هدية مجانية

Guiding Exams

of The Ministry of Education 2025

PHYSICS

By A Group Of Supervisors



EL-MOASSER

3rd SEC.

Exam 1

Answered

Questions signed by ✱ are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

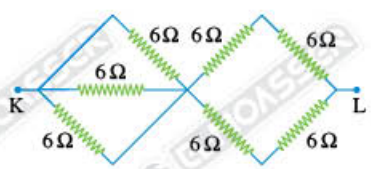
1 A number of resistors are connected together in parallel with a battery of negligible internal resistance. When one of the resistors is disconnected, the potential difference across the remaining resistors .....

(a) increases (b) decreases (c) remains constant (d) becomes zero

2 The ratio between the electrical conductivity of a copper wire of length (ℓ) and another wire of the same material of length (2ℓ) at the same temperature equals .....

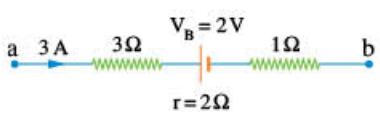
(a) 1 (b) 2 (c) 0.5 (d) 4

3 In the opposite figure, the value of the equivalent resistance between the two points K and L equals .....



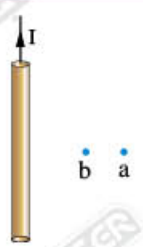
(a) 8 Ω (b) 9 Ω
(c) 12 Ω (d) 18 Ω

4 ✱ The opposite figure shows a part of a closed electric circuit, so the magnitude of potential difference between points a and b equals .....



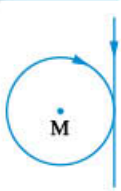
(a) 14 V (b) 16 V (c) 20 V (d) 22 V

5 A long straight wire carries an electric current of intensity (I) as shown in the figure. If the ratio between the magnetic flux density at point (a) to the magnetic flux density at point (b) equals $\frac{3}{4}$, then the ratio between the distance of point (a) from the wire and the distance of point (b) from the wire respectively equals .....



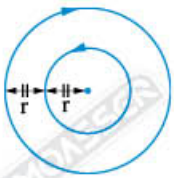
(a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{16}{9}$ (d) $\frac{5}{4}$

6 The figure shows a long straight wire touching a metal ring which is insulated from it; both are in the plane of the page and carry electric currents of equal intensities, so the net magnetic flux density at the center of the ring (M) is .....



(a) perpendicular into the plane of the page (b) perpendicular out of the plane of the page
(c) in the plane of the page to the right (d) equal to zero

7 The figure shows two concentric circular rings in the same plane, carrying equal electric currents. If the magnetic flux density resulting from the current in the outer ring at the center is B, then the net magnetic flux density resulting from both currents at their common center is .....



(a) zero (b) B (c) 2 B (d) 3 B

8 Two straight parallel wires are separated by a certain distance, and each carries an electric current so that the mutual magnetic force between them equals F. If the current intensity in each wire is doubled and the perpendicular distance between them is reduced to one-third, then the mutual magnetic force between the two wires will be .....

(a) 12 F (b) $\frac{4}{3}$ F (c) 7 F (d) F

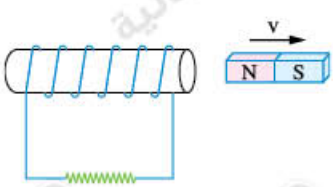
9 In a sensitive galvanometer, the main reason for its uniform scale is that the angle of deflection of its pointer from the zero position is proportional ..... through its coils.

(a) directly to the square of the current intensity
(b) directly to the current intensity
(c) inversely to the square of the current intensity
(d) inversely to the current intensity

10 When the value of the shunt resistor (R_s) in an ammeter is increased, the sensitivity of the ammeter .....

(a) decreases (b) increases (c) does not change (d) becomes zero

11 An experiment was conducted twice. In the first trial, a magnet moved a certain distance at a uniform speed (v) away from a stationary solenoid, as shown in the figure. And in the second trial, the magnet moved from the same starting position for the same distance at a uniform speed (2v) in the same direction, with keeping all other conditions constant, then .....



	The direction of the induced current in the coil	The average value of the induced current in the coil
(a)	reverses	increases
(b)	does not change	increases
(c)	does not change	decreases
(d)	reverses	decreases

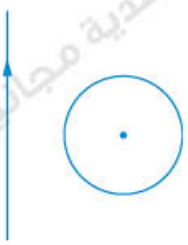
12 A long vertical wire carries an electric current (I), and a horizontal metal rod (ab) moves vertically upward as shown in the figure. The mathematical relationship between the electric potentials at the two points a and b is .....



(a) $V_b > V_a$ (b) $V_a > V_b$

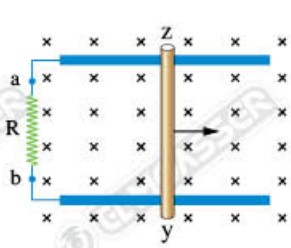
(c) $V_a = V_b = 0$ (d) $V_a = V_b \neq 0$

13 ✻ In the shown figure, while the intensity of the electric current passing through the wire increases uniformly from zero to 2 A during a time t, an induced current is generated in the metal ring with an average value of (I) in a certain direction. So when the current intensity in the wire decreases uniformly from 2 A to zero during a time 2t, what is the average value of the induced current in the ring during that period? And what happens to its direction?



	The average value of induced current in the ring	The direction of induced current in the ring
(a)	$\frac{1}{2}$ I	Remains the same
(b)	2 I	Remains the same
(c)	$\frac{1}{2}$ I	Reverses
(d)	2 I	Reverses

14 In the opposite figure, if the metal wire yz moves perpendicularly to a uniform magnetic field in the direction shown, then the direction of the induced current is through .....



	Resistor (R)	Wire (yz)
(a)	from a to b	from y to z
(b)	from b to a	from y to z
(c)	from a to b	from z to y
(d)	from b to a	from z to y

15 Which of the following procedures leads to reducing the eddy currents generated in the metal core of a coil carrying an alternating current?

(a) Using a solid metal core.

(b) Increasing the frequency of the current passing through the coil.

(c) Using a core made of a metal with low electrical resistivity.

(d) Using a core made of a metal with low electrical conductivity.

16 An ideal step-up transformer has an output power of 1000 W. If the ratio between the number of turns of its two coils is 3 : 8 and the resulting voltage across its secondary coil is 220 V, then the value of the current passing through its primary coil is approximately .....

(a) 12.12 A (b) 1.7 A (c) 0.58 A (d) 0.082 A

17 In an electric transformer, when using a core made of a metal with high electrical conductivity, ...

(a) the efficiency of the transformer decreases

(b) the efficiency of the transformer increases

(c) the transformer becomes a step-up transformer

(d) the transformer becomes a step-down transformer

18 In a hot-wire ammeter, when replacing the platinum-iridium wire with another wire made of a metal with a lower thermal expansion coefficient and passing the same current value through it, the deflection angle of the pointer .....

(a) increases (b) decreases (c) does not change (d) becomes zero

19 ✳ An AC circuit consists of an ohmic resistance of 100 Ω, an inductor with inductive reactance of 125 Ω, and a capacitor with capacitance (C) microfarads, all connected in series to a source with an effective voltage of 220 V and frequency $\frac{280}{11}$ Hz. If the effective value of the current passing through the circuit is at its maximum, then the capacitance of the capacitor (C) equals .....

(a) 5 μF (b) 500 μF (c) 50 μF (d) 0.5 μF

20 In a resonance circuit, if the capacitance of the capacitor is doubled and the self-induction coefficient of the coil is reduced to $\frac{1}{8}$ its initial value, the frequency that achieves the resonance state .....

(a) doubles

(b) decreases to half

(c) increases to 4 times its initial value

(d) decreases to $\frac{1}{4}$ its initial value

21 All of the following are from the properties of the photon **except that** .....

(a) it can be accelerated in a vacuum

(b) its energy is equal to the product of its frequency and Planck's constant

(c) it has no rest mass

(d) it has a particle nature

22 ✳ When a beam of photons, each with a momentum (X), falls at a rate of (Y) photons/second perpendicularly onto a reflecting surface, the force acting on the surface equals .....

(a) XY (b) 4 XY

(c) 2 XY (d) 0.5 XY

23 A photon of energy (E) falls on a metal surface with a surface work function ($\frac{E}{4}$), so the number of electrons that this photon can release equals .....

(a) 1 (b) 2

(c) 3 (d) 4

24 ✳ A group of hydrogen atoms were excited such that the electron in each of them becomes in the fifth energy level. The electron can transition between any two of these levels, so the number of spectral series that can be emitted from the atom is .....

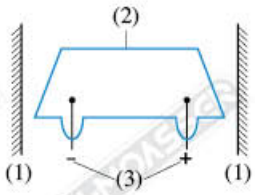
(a) 4 (b) 6

(c) 8 (d) 10

25 When increasing the filament current in a Coolidge tube, then .....

	The rate of electrons emitted from the cathode	The intensity of the resulting X-rays
(a)	increases	increases
(b)	decreases	decreases
(c)	increases	decreases
(d)	decreases	increases

26 The schematic diagram shows a helium-neon (He-Ne) laser device. Which of the following choices correctly describes the role of components (1, 2, 3)?



	Component (1)	Component (2)	Component (3)
(a)	Photons production	Creating high potential difference	Reflecting photons
(b)	Reflecting photons	Contains the active medium	Creating high potential difference
(c)	Pumping excitation energy to atoms	Exciting neon atoms	Amplifying the number of photons
(d)	Photons production	Source of used energy	Exciting neon atoms

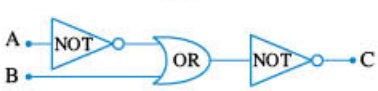
27 Laser is used in holographic imaging (holography) because of .....

(a) the coherence of its photons
(b) its spectral purity
(c) the parallelism of its beam
(d) its high speed

28 Which substance atoms reach the state of population inversion in a (helium-neon) laser as one of the stages of laser production?

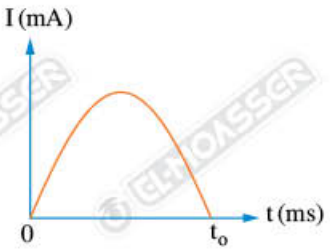
(a) Helium
(b) Neon
(c) Both helium and neon
(d) Neither of them

29 The opposite figure represents a group of logic gates connected together. The output (C) is high (1) when the input on (A) and (B) is .....



	Input (A)	Input (B)
(a)	0	0
(b)	1	0
(c)	0	1
(d)	1	1

30 A diode is connected to an AC source with a frequency of 100 Hz and a switch. The switch is closed at (t = 0), and the opposite graph represents the variation of the current (I) during the period from (t = 0) to (t = t_o). If the effective value of the current was 2 mA, then the average value of the current passing in the circuit during the period from (t = 5 ms) to (t = 10 ms) equals .....



(a) $2\sqrt{2}$ mA (b) 2 mA (c) 1.8 mA (d) 0 mA

31 If the base current in a transistor is 3 mA and the current gain is 100, then .....

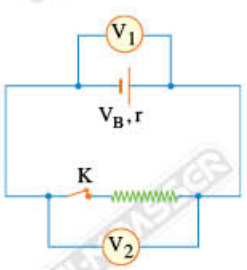
	Current transfer ratio (α_e)	Collector current intensity (I_C)
(a)	0.99	300 mA
(b)	0.99	297 mA
(c)	0.95	303 mA
(d)	0.95	300 mA

32 A pure silicon crystal was doped with aluminum atoms at a concentration of 10^{13} cm^{-3}. If you know that the concentration of free electrons in the doped crystal is 10^{11} cm^{-3}, then the concentration of free electrons in the pure silicon crystal equals .....

(a) 10^{11} cm^{-3} (b) 10^{12} cm^{-3} (c) 10^{13} cm^{-3} (d) 10^{14} cm^{-3}

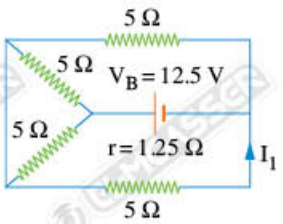
Second Choose the correct answer 33 : 44 — 2 Marks

33 In the electric circuit shown in the figure, when opening the switch (K), which of the following choices is correct regarding the readings of the two voltmeters V_1 and V_2?



	Reading of voltmeter (V_1)	Reading of voltmeter (V_2)
(a)	0	0
(b)	0	V_B
(c)	V_B	0
(d)	V_B	V_B

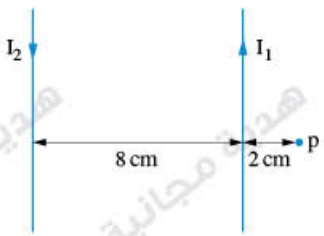
34 In the opposite electric circuit, the current intensity (I_1) equals .....



(a) 1 A (b) 2 A

(c) 5 A (d) 2.5 A

35 In the opposite figure, if point (p) is a neutral point, then the ratio $(\frac{I_1}{I_2})$ equals .....



(a) $\frac{4}{1}$ (b) $\frac{1}{4}$

(c) $\frac{5}{1}$ (d) $\frac{1}{5}$

36 A solenoid is connected to a DC source of negligible internal resistance. If 25% of the number of turns of the coil is cut off and the remainder is stretched to its original length and reconnected to the same source, the ratio between the magnetic flux density at the midpoint of the solenoid's axis in the first case and the flux density at the same point in the second case $\left(\frac{B_1}{B_2}\right)$ equals .....

(a) $\frac{1}{4}$ (b) $\frac{3}{4}$

(c) $\frac{1}{2}$ (d) $\frac{1}{1}$

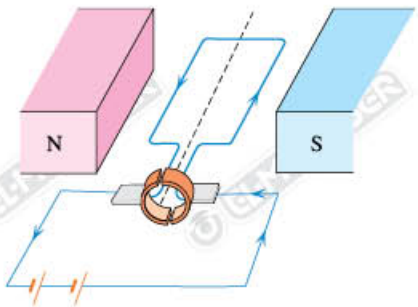
37 A circular coil of radius 4 cm and number turns 100 turns carries a current of 2 A. The magnetic flux density at the center of the circular coil = ...

(Given that: $\pi = 3.14$, $\mu = 4\pi \times 10^{-7}$ Wb/A.m)

(a) 3.14×10^{-3} T (b) 1.57×10^{-3} T

(c) 6.28×10^{-3} T (d) 9.14×10^{-3} T

38 The opposite figure represents an electric motor. When the coil passes through the perpendicular position relative to the magnetic field, then .....

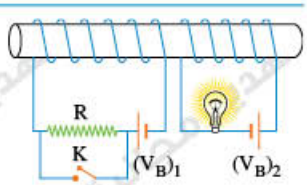


	The magnetic torque	The magnetic force acting on the two sides that are parallel to the axis of rotation
(a)	becomes zero	remains maximum value
(b)	becomes maximum value	remains maximum value
(c)	becomes zero	becomes zero
(d)	becomes maximum value	becomes zero

39 ✳ A solenoid has a number of turns (N), a cross-sectional area (A), a length (ℓ), and a self-induction coefficient of 0.2 H. If a part of one-quarter of the solenoid's turns is cut off, the self-induction coefficient for the remainder of the solenoid becomes .....

(a) 0.05 H (b) 0.15 H (c) 0.25 H (d) 0.11 H

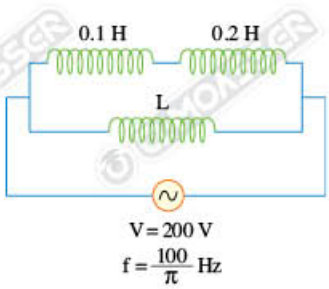
40 ✳ In the opposite figure, the brightness of the lamp at the instant of closing the switch (K) .....



(a) becomes zero (b) decreases but does not become zero

(c) increases (d) does not change

41 ✳ Three coils with negligible ohmic resistance are connected together as shown in the opposite figure. If the effective value of the electric current passing through the circuit is 5 A and neglecting the mutual induction between these coils, then the self-induction coefficient of the coil (L) = ...



(a) 1 H (b) 0.3 H (c) 0.4 H (d) 0.6 H

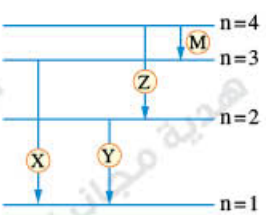
42 In an AC, RL circuit, the self-inductance of the coil is $\frac{2}{5\pi}$ H, the value of ohmic resistance is 30 Ω, and the effective voltage of the AC source is 200 V and its frequency is 50 Hz. Then the values of both the impedance (Z) and the current (I) passing through the circuit are .....

	Impedance (Z)	Current (I)
(a)	11.4 Ω	17.4 A
(b)	30.7 Ω	6.5 A
(c)	40.4 Ω	5 A
(d)	50 Ω	4 A

43 ✳ A free electron moves such that its associated de-Broglie wavelength is (λ_1). If the kinetic energy of this electron increases to double, then the de-Broglie wavelength associated with this electron relative to (λ_1) becomes .....

(a) $\frac{1}{\sqrt{2}}$ (b) $\sqrt{2}$ (c) $\frac{1}{2}$ (d) 2

44 The opposite figure shows four transitions of an electron in a hydrogen atom between energy levels. Which of the following statements is correct regarding these transitions?



(a) Transition (M) gives a spectral line with the shortest wavelength among these transitions.

(b) Transition (Z) gives a spectral line in the ultraviolet region.

(c) Transition (Y) gives a spectral line in the infrared region.

(d) Transition (X) gives a spectral line with the highest frequency among these transitions.

Third **Answer the following questions 45 & 46** — 2 Marks

45 Two solenoids (x) and (y) are coaxial. Their number of turns are 100 turns and 200 turns respectively. If when increasing the current intensity in coil (x) from zero to 10 A during 0.1 s, an induced emf was generated in coil (y) with an average value of 0.02 V.

Calculate:

(1) The mutual induction coefficient between the two coils.

(2) The change in magnetic flux that cuts through coil (y) during that period.

.....

.....

46 An ohmmeter has a resistance of 1500 Ω whose galvanometer pointer deflects to the end of its scale when a current of 200 mA passes through it where at this point, the deflection angle of the pointer from the zero position equals 80°. **Calculate:**

(1) The deflection angle of the galvanometer pointer from the zero position when an external resistance of 4500 Ω is connected between the terminals of the ohmmeter.

(2) The current intensity that when passing through the galvanometer causes its pointer to deflect from the zero position by an angle of 60°.

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Exam 2

Answered

Questions signed by ✱ are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

1 Which of the following changes leads to a decrease in the electrical resistance of a metal wire?

(a) Lowering the temperature of the wire.
(b) Increasing the length of the wire.
(c) Coating the wire with an insulating layer.
(d) Reducing the cross-sectional area of the wire.

2 When the length of a metal wire is doubled, its material's electrical conductivity.....

(a) remains constant
(b) decreases to half
(c) decreases to a quarter
(d) increases to 4 times its original value

3 The figures show four identical electrical resistors connected together in different ways,

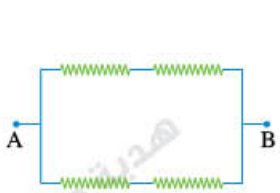


Figure (1)

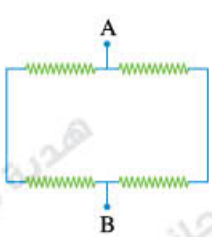


Figure (2)

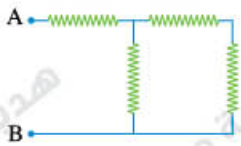


Figure (3)

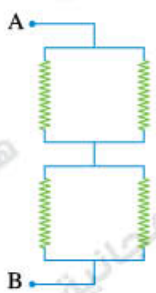
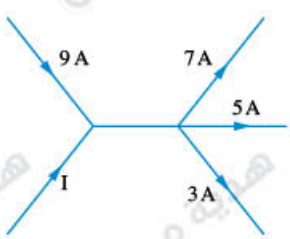


Figure (4)

Which of these figures have the same equivalent resistance for the group of resistors between points A and B?

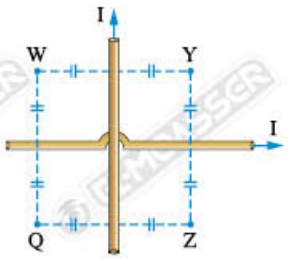
(a) Figures (1), (2), (3)
(b) Figures (2), (3), (4)
(c) Figures (1), (2), (4)
(d) Figures (1), (3), (4)

4 The figure shows a part of a closed electric circuit.
What is the current intensity (I)?



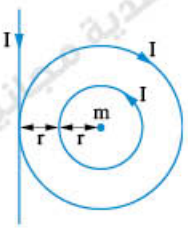
(a) 3 A
(b) 6 A
(c) 12 A
(d) 15 A

5 Two straight, insulated wires are perpendicular to each other and placed in the plane of the page. Each carries an electric current of intensity (I) as shown in the figure. At which of the indicated points is the net magnetic flux density generated by the currents of the two wires greater and directed perpendicularly out of the page?



(a) Point (W) (b) Point (Y) (c) Point (Z) (d) Point (Q)

6 The figure shows two circular loops and an insulated straight wire, all in the same plane. Each carries an electric current of intensity (I). What is the direction of the total magnetic field generated by all of them at point (m)?



(a) Perpendicular into the plane of the page

(b) Perpendicular out of the plane of the page

(c) In the plane of the page and upwards

(d) In the plane of the page and downwards

7 A straight wire of length (ℓ) was wound in the form of a circular coil of one turn, and an electric current was passed through it so that the magnetic flux density generated at the center of the coil was (B). So, when the wire was rewound again in the form of a circular coil of 3 turns and the same electric current was passed through it, the magnetic flux density at the center becomes .....

(a) 3 B (b) 6 B (c) 9 B (d) 12 B

8 Two long straight parallel wires (P) and (Q) are separated by a perpendicular distance (d), and each carries an electric current of intensity (I). If you know that the magnitude of the magnetic force acting on the unit length of wire (P) is (F), then when the perpendicular distance between the two wires is reduced to its quarter and the intensity of the current in each of them is doubled, the magnetic force acting on the unit length of wire (P) becomes .....

(a) $\frac{F}{10}$ (b) $\frac{F}{8}$ (c) 8 F (d) 16 F

9 You have an old sensitive galvanometer in the lab with a full-scale reading of 200 μA. When a DC current of 50 μA is passed through its coil, its pointer indicates 60 μA. Which of the following is likely to have happened to the galvanometer as a result of repeated use?

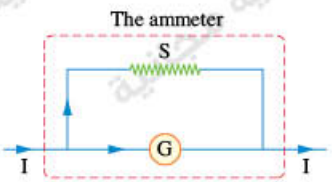
(a) Decrease in the magnetic permeability of the iron cylinder.

(b) Weakening of the torsion constant of the spiral springs.

(c) Increase in friction with the agate base.

(d) Weakening of the magnetic field strength of the magnet.

10 The figure shows a galvanometer connected to a shunt resistor with resistance (S) to convert it into an ammeter that measures a maximum current (I). The value of the shunt resistor that should be connected instead of (S) to make the sensitivity of the device as low as possible is .....



(a) $\frac{1}{4}$ S (b) $\frac{1}{2}$ S (c) 2 S (d) 4 S

11 Which of the following procedures does **not** result in the generation of an induced electromotive force in a coil placed perpendicularly within a magnetic field?

(a) Changing the surface area of the coil exposed to the magnetic field.

(b) Leaving the coil stationary within a varying magnetic field.

(c) Leaving the coil stationary within a uniform magnetic field.

(d) Changing the angle between the plane of the coil and the magnetic field.

12 ✳ Which of the following procedures leads to a decrease in the induced electromotive force between the ends of a metallic wire while it moves with a uniform velocity (v) perpendicularly to a uniform magnetic field for a distance (d) during a time (t)?

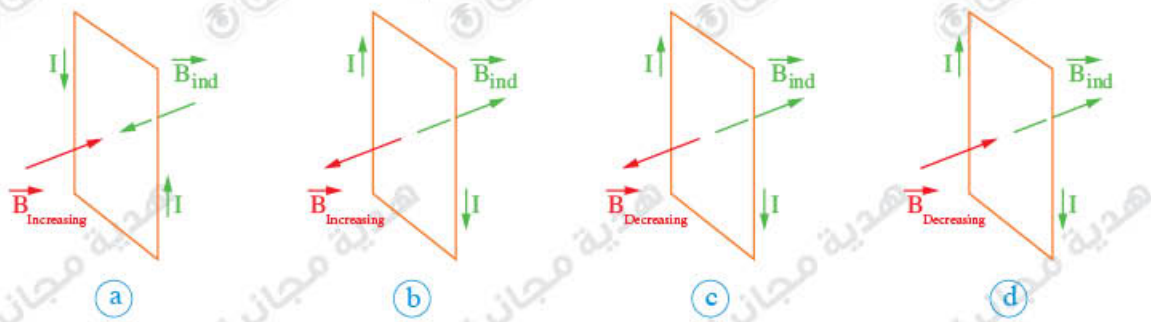
(a) Increasing the speed of the wire's motion.

(b) Increasing the time of the wire's motion to cover the same distance (d).

(c) Decreasing the time of the wire's motion to cover the same distance (d).

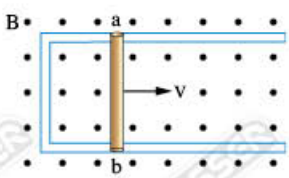
(d) Increasing the acting magnetic flux density.

13 The following figures show the generation of an induced current (I) in a coil, which results in an induced magnetic flux density (B_{ind}) due to the increase or decrease of the external magnetic flux density (B) acting on the coil. Which of these figures does **not** represent the correct directions of these three quantities based on Lenz's law?



(a) (b) (c) (d)

14 A metallic wire (ab) moves with a uniform velocity (v) perpendicularly to the direction of a uniform magnetic field (B) as shown in the figure. The direction of the induced current through the wire is ....., where the electric potential at point (a) is ..... the electric potential at point (b).



(a) from a to b, higher than
(b) from a to b, lower than
(c) from b to a, higher than
(d) from b to a, lower than

15 In which of the following cases are eddy currents formed in a piece of metal?

(a) Passing a high-intensity direct current through a coil wrapped around the metal piece.
(b) Moving the metal piece perpendicularly to a uniform magnetic field.
(c) Placing the metal piece stationary within a uniform magnetic field.
(d) Passing a low-intensity direct current through a coil wrapped around the metal piece.

16 In an ideal electric transformer, if you know that the ratio between:

$$\frac{\text{The output voltage across the secondary coil terminals } (V_S)}{\text{The voltage across the primary coil terminals } (V_p)} = \frac{10}{3}$$

Then the ratio between:

$$\frac{\text{The current value in the secondary coil } (I_S)}{\text{The current value in the primary coil } (I_p)}$$

is equal to .....

(a) $\frac{10}{3}$ (b) $\frac{3}{10}$ (c) $\frac{20}{3}$ (d) $\frac{3}{20}$

17 You have four step-down, non-ideal electric transformers made of the same wire. The ratio between the number of turns in each coil $\frac{N_p}{N_s}$ is constant. Each primary coil of the transformers is connected to an AC source with the same voltage (V_p = 220 V) but with different frequencies, as shown in the four figures below:

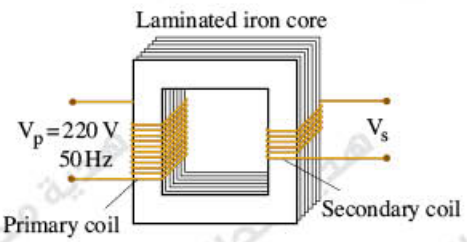


Figure (1)

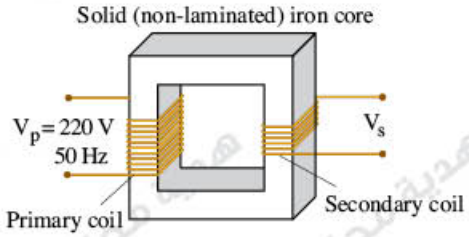


Figure (2)

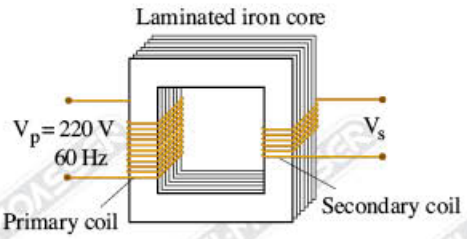


Figure (3)

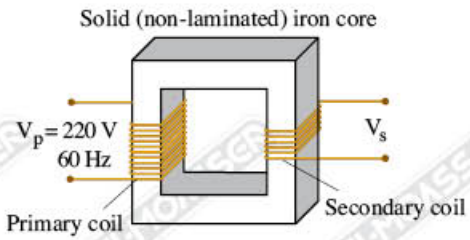


Figure (4)

By analyzing the shown data, which of the previous figures represents the most efficient transformer?

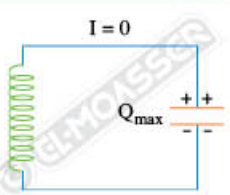
(a) Figure (1) (b) Figure (2) (c) Figure (3) (d) Figure (4)

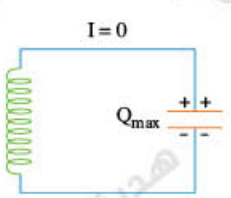
18 The principle of operation of the hot-wire ammeter is based on the .....

(a) luminous effect of electric current (b) magnetic effect of electric current

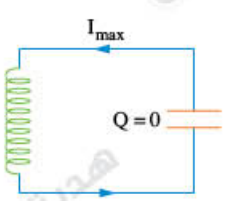
(c) chemical effect of electric current (d) thermal effect of electric current

19 The figure shows an oscillating circuit at a specific instant (t = 0). Which figure correctly represents the state of the circuit at the instant ($t = \frac{3T}{4}$)? (Where: T is the periodic time of the current)

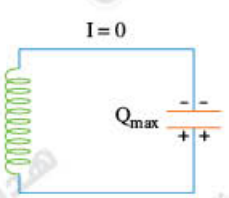




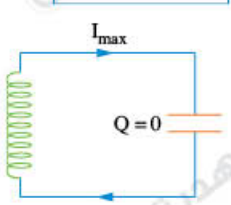
(a)



(b)



(c)



(d)

20 A resonant circuit receives a radio wave with a frequency (f). To receive a radio wave with a frequency (3f), while keeping the self-inductance of the coil constant, the capacitance of the capacitor must be .....

(a) decreased to its one-third
(b) decreased to its one-ninth
(c) increased to its 3 times
(d) increased to its 9 times

21 Which of the following is **not** a property of a photon?

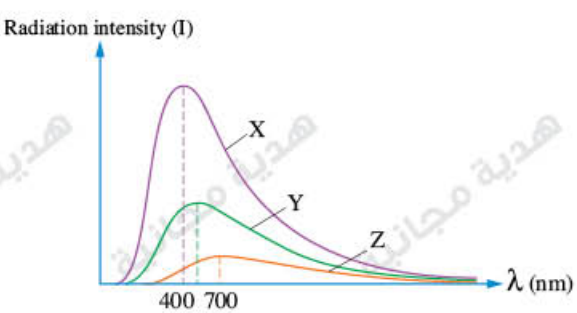
(a) It has a wave nature.
(b) It has a particle nature.
(c) Its energy is directly proportional to its wavelength.
(d) Its energy is directly proportional to its frequency.

22 Two photons (X) and (Y) have wavelengths of 3000 Å and 6000 Å, respectively. So, the ratio between

$$\frac{\text{The linear momentum of photon (X)}}{\text{The linear momentum of photon (Y)}} = \text{.....}$$

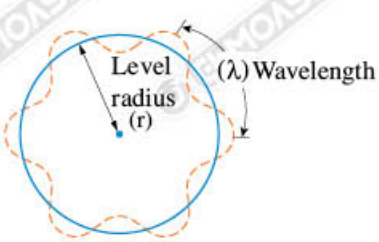
(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 2 (d) 4

23 The opposite graph represents the relation between the intensity of electromagnetic radiation (I) emitted from three identical hot blackbodies and the wavelength (λ) of the radiation. Which of the following choices correctly represents the order of the temperatures of the bodies (X), (Y), and (Z)?



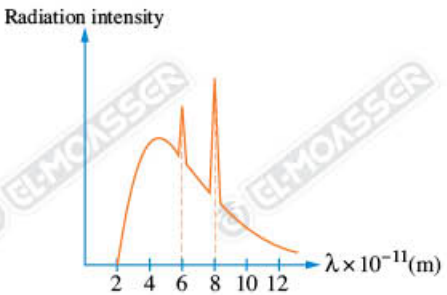
(a) $T_X > T_Y > T_Z$ (b) $T_Z > T_Y > T_X$
(c) $T_X > T_Z > T_Y$ (d) $T_Z > T_X > T_Y$

24 The figure illustrates the standing wave associated with the motion of an electron in one of the energy levels of a hydrogen atom according to the Bohr model. Which of the following choices correctly expresses the relationship between the wavelength (λ) and the radius of the level (r)?



(a) $\pi r = 12 \lambda$ (b) $\pi r = 6 \lambda$
(c) $\pi r = 4 \lambda$ (d) $\pi r = 3 \lambda$

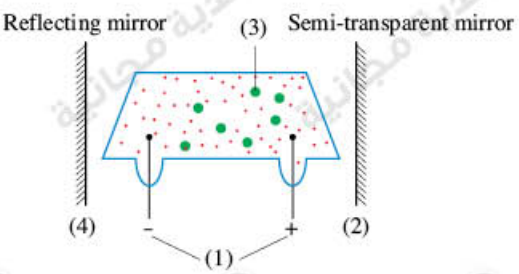
25 The opposite graph represents the spectrum of X-rays emitted from a Coolidge tube. So, the two wavelengths of the characteristic linear spectrum of these X-rays are .....



(a) 0.02 nm, 0.1 nm (b) 0.02 nm, 0.6 nm

(c) 0.04 nm , 0.1 nm (d) 0.06 nm, 0.08 nm

26 The figure shows a schematic diagram of a helium-neon laser device. Which of the illustrated components is responsible for the excitation of helium atoms?



(a) Component (1) (b) Component (2)

(c) Component (3) (d) Component (4)

27 If the phase difference between two laser waves reflected from an object is 4π and the wavelength of the laser is λ, then the path difference between the two waves is equal to .....

(a) $\frac{\lambda}{2}$ (b) $\frac{\lambda}{4}$ (c) 2λ (d) 4λ

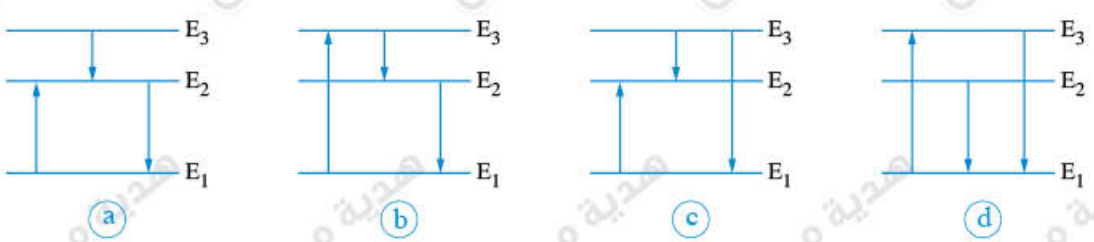
28 Below are three transitions that occur for neon atoms in a (helium-neon) laser:

(I) A transition resulting from the collision of unexcited neon atoms with excited helium atoms.

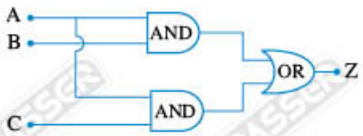
(II) A transition that produces laser photons by stimulated emission.

(III) A transition that produces photons by spontaneous emission.

Which of the following schematic diagrams correctly represents these three transitions between the energy levels?

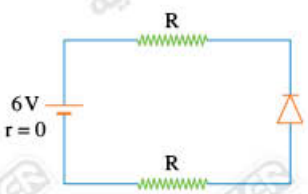


29 A group of logic gates are connected together as shown in the figure. Which of the following choices holds true for this combination?



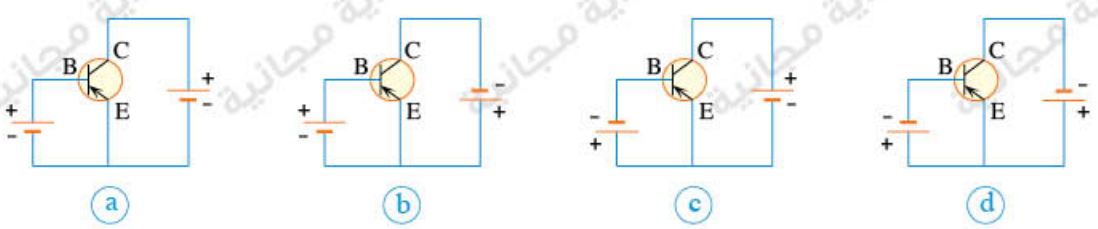
	A	B	C	Z
(a)	0	1	1	1
(b)	1	0	1	0
(c)	1	1	0	0
(d)	0	1	1	0

30 In the opposite electric circuit, if the resistance of the diode in the forward-bias state is R, and in the reverse-bias state is infinite, then the potential difference across the terminals of the diode is equal to .....



(a) 0 V (b) 2 V (c) 4 V (d) 6 V

31 Which of the following schematic diagrams shows the correct connection method for a pnp transistor when used as a closed switch?



32 A p-type semiconductor crystal has a concentration of acceptor impurity atoms of 10^{20} m^{-3}. If you know that the concentration of free electrons in the pure (intrinsic) crystal is 2.5×10^{19} m^{-3}, then the concentration of free electrons in the doped p-type crystal is equal to .....

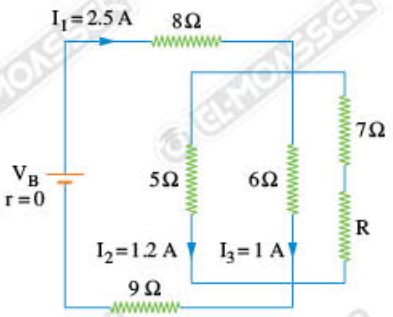
(a) 6.23×10^{20} m^{-3} (b) 6.25×10^{18} m^{-3}

(c) 6.23×10^{17} m^{-3} (d) 6.25×10^{16} m^{-3}

Second Choose the correct answer 33 : 44

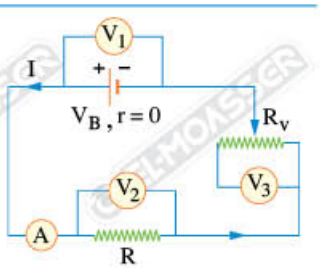
2 Marks

33 The opposite figure shows a closed electric circuit. What are the values of the electromotive force of the battery (V_B) and the resistance of (R)?



	Electromotive force of the battery (V_B)	Resistance (R)
(a)	48.5 V	13 Ω
(b)	42.5 V	13 Ω
(c)	48.5 V	20 Ω
(d)	42.5 V	20 Ω

34 In the closed electrical circuit shown in the figure, when the value taken from the variable resistor (R_v) is decreased, then .....



	Ammeter reading (A)	Voltmeter reading (V_1)	Voltmeter reading (V_2)	Voltmeter reading (V_3)
(a)	increases	remains constant	increases	decreases
(b)	increases	decreases	increases	decreases
(c)	decreases	remains constant	decreases	increases
(d)	decreases	increases	decreases	increases

35 An electron moves vertically upward to enter a region of a uniform horizontal magnetic field that directs to south, so the direction of the magnetic force acting on the moving electron at the instant it enters the field is .....

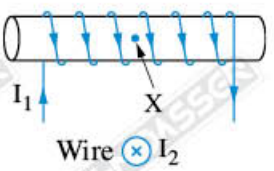
(a) horizontal towards the east

(b) horizontal towards the west

(c) horizontal towards the north

(d) vertical downwards

36 The figure shows a long solenoid with its axis in the plane of the page, carrying a current of intensity (I_1) so that it generates a magnetic field with flux density at point (X) equal to (B_1) and also a long straight wire perpendicular to the plane of the page, carrying an electric current of intensity (I_2) directed into the page, generating a magnetic field with flux density at point (X) equal to (B_2). So, the net magnetic flux density resulting from the two currents at point (X) is calculated from the relationship ..... and its direction is .....



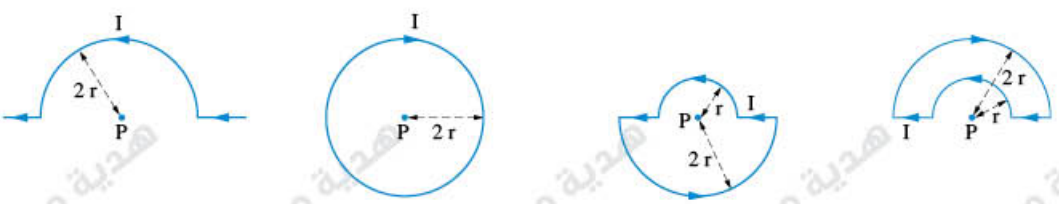
(a) ($B_1 + B_2$), in the plane of the page to the right

(b) ($B_1 + B_2$), in the plane of the page to the left

(c) ($B_1 - B_2$), in the plane of the page to the right

(d) ($B_1 - B_2$), in the plane of the page to the left

37 A group of wires are shaped as shown in the following figures, and a current of intensity (I) flows through each of them.



(A) **(B)** **(C)** **(D)**

Which choice expresses the correct order of the magnetic flux density at point (P) resulting from the flow of the electric current (I)?

(a) $B_B > B_A > B_C = B_D$

(b) $B_C > B_B > B_A = B_D$

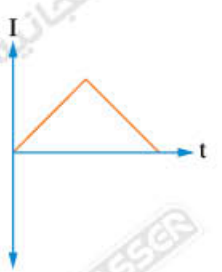
(c) $B_C > B_D > B_B > B_A$

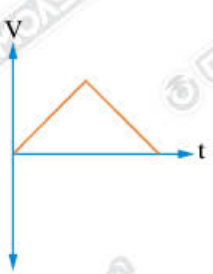
(d) $B_B > B_A > B_C > B_D$

38 Which of the following choices correctly expresses the role of each of the back induced emf, the split metallic cylinder, and inertia during the rotation of a DC motor coil?

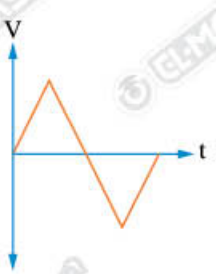
	Back induced emf	Split metallic cylinder	Inertia
a	Uniformity of motor rotation speed after a period of starting its rotation	Maintaining motor rotation in one direction	Continuation of motor rotation despite the coil reaching the position perpendicular to the magnetic flux lines
b	Continuation of motor rotation despite the coil reaching the position perpendicular to the magnetic flux lines	Maintaining motor rotation in one direction	Uniformity of motor rotation speed after a period of starting its rotation
c	Uniformity of motor rotation speed after a period of starting its rotation	Continuation of motor rotation despite the coil reaching the position perpendicular to the magnetic flux lines	Maintaining motor rotation in one direction
d	Maintaining motor rotation in one direction	Continuation of motor rotation despite the coil reaching the position perpendicular to the magnetic flux lines	Uniformity of motor rotation speed after a period of starting its rotation

39 An electric current passes through an induction coil of negligible ohmic resistance whose intensity (I) changes with time (t) as shown in the opposite graph. Which of the following graphs correctly represents the change in the induced potential difference (V) between the terminals of the coil with time (t)?

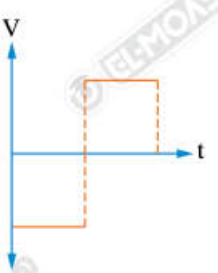




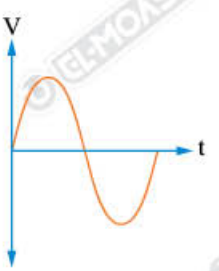
a



b

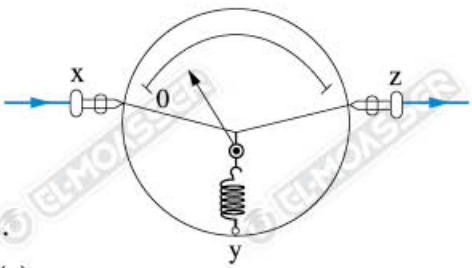


c



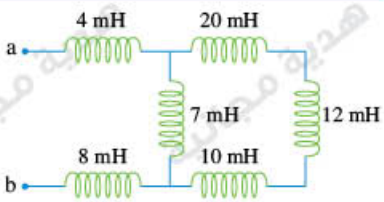
d

40 In the opposite figure of a hot-wire ammeter, which of the following procedures increases the measurement range of the ammeter?



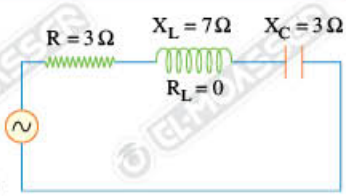
(a) Replacing the silk thread with a copper wire.
(b) Replacing the spiral spring with a more elastic one.
(c) Connecting a small resistance at positions (x) and (z).
(d) Connecting a small resistance at positions (x) and (y).

41 The figure shows a part of an electric circuit consisting of a group of inductors. The equivalent self-inductance between points (a) and (b) is equal to .....



(a) 18 mH (b) 15 mH
(c) 14 mH (d) 13 mH

42 Using the data provided in the LRC circuit shown in the figure, then .....



	The total impedance of the circuit (Z)	The phase angle (θ) between the total voltage and the circuit current
(a)	5 Ω	53.13°
(b)	13 Ω	53.13°
(c)	5 Ω	– 53.13°
(d)	13 Ω	– 53.13°

43 In an electron microscope, the ratio between the speed of an electron under the influence of a potential difference of 800 V and its speed under the influence of a potential difference of 200 V is equal to .....

(a) 0.25 (b) 0.5 (c) 2 (d) 4

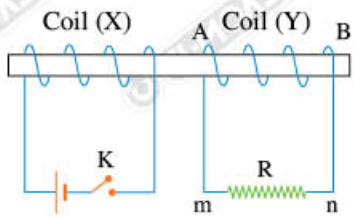
44 The frequency of the photon emitted from a hydrogen atom when an electron drops from energy level (N) to energy level (L) is equal to:

(Given that: $h = 6.625 \times 10^{-34}$ J.s, $e = 1.6 \times 10^{-19}$ C)

(a) 6.16×10^{14} Hz (b) 3.83×10^{33} Hz (c) 8.22×10^{14} Hz (d) 5.14×10^{33} Hz

Third **Answer the following questions 45 & 46** — 2 Marks

45 Two adjacent coils, (X) and (Y), are wound around an iron core as shown in the opposite figure. So, at the moment of closing the switch (K) in the circuit of coil (X):



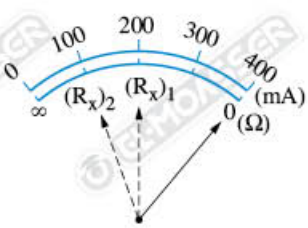
(1) What is the type of magnetic pole formed at terminal (A) of coil (Y)?

(2) What is the direction of the induced current from coil (Y) as it passes through resistor (R)?

.....

.....

46 The figure illustrates the scale of a galvanometer that has been converted into an ohmmeter. Use the data shown on the scale **to find** the ratio between the two resistance values $\left(\frac{(R_X)_1}{(R_X)_2}\right)$.



.....

.....

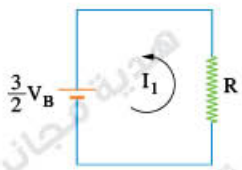
Exam 3

Answered

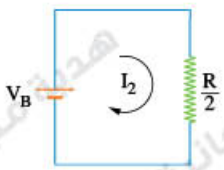
Questions signed by ✻ are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

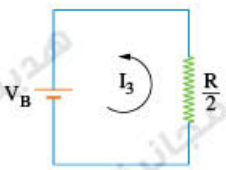
1 The following figures represent four electric circuits in which the electric sources have negligible internal resistance:



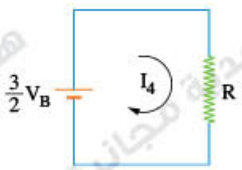
Circuit (1)



Circuit (2)



Circuit (3)



Circuit (4)

Which of these circuits carries the electric current of the highest intensity, and its conventional direction correctly is represented in that circuit?

(a) Circuit (1) (b) Circuit (2) (c) Circuit (3) (d) Circuit (4)

2 The following figures show conductors of the same material, equal cross-sectional areas, and different lengths. The potential difference across each of them is shown in the figures:

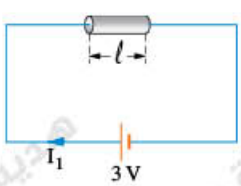


Figure (1)

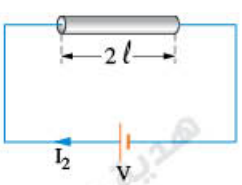


Figure (2)

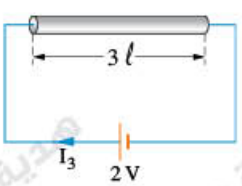
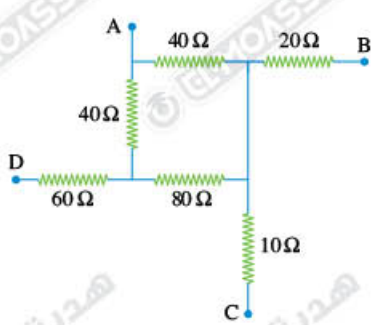


Figure (3)

So, the correct relationship for the intensities of the currents passing through the conductors is .....

(a) $I_1 > I_2 > I_3$ (b) $I_3 > I_2 > I_1$ (c) $I_1 > I_3 > I_2$ (d) $I_1 = I_2 = I_3$

3 Several resistors are connected together as shown in the opposite figure. To which two points in the figure should the terminals of a battery be connected to obtain the smallest equivalent resistance?



(a) B, C (b) A, B

(c) C, D (d) A, D

4 ✳ Each of the following figures shows a part of a closed electric circuit:

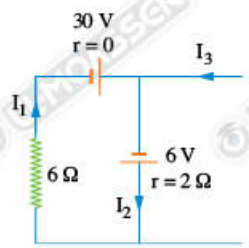


Figure (A)

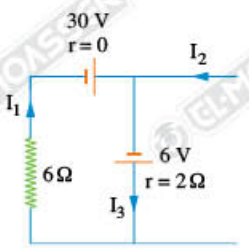


Figure (B)

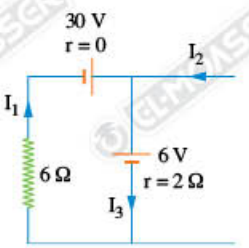


Figure (C)

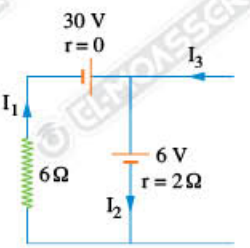


Figure (D)

In which of the previous figures is the equation $(4I_1 + I_2 = 12)$ fulfilled?

(a) Figure A (b) Figure B (c) Figure C (d) Figure D

5 A long straight wire (ab) is connected three times in an electric circuit with a battery and a resistor as in the following figures:

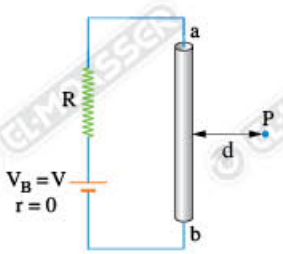


Figure (1)

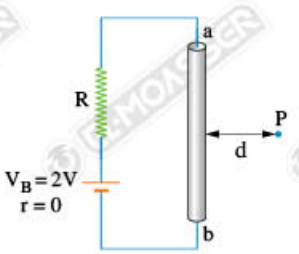


Figure (2)

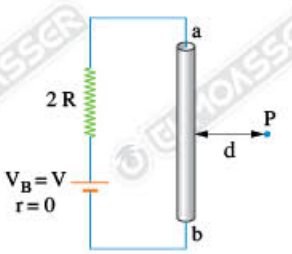


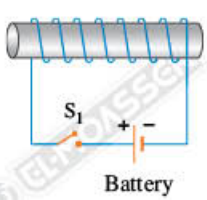
Figure (3)

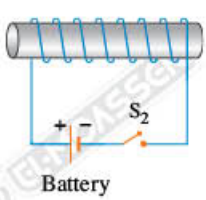
So, the relationship between the magnitudes of the magnetic flux density arising from the passage of the electric current in wire ab at point (P) in the three figures is .....

(a) $B_2 > B_1 > B_3$ (b) $B_2 > B_3 > B_1$

(c) $B_1 > B_2 > B_3$ (d) $B_1 = B_2 = B_3$

6 Two solenoids with soft iron cores are each connected to a battery and a switch as shown in the opposite figure. So, after closing both switches (S_1) and (S_2), the two solenoids will .....





(a) repel, because both of the facing poles are north

(b) repel, because both of the facing poles are south

(c) attract, because one of the facing poles is north and the other is south

(d) neither attract nor repel

7 A long straight wire, a circular metallic ring, and a solenoid with 8 turns carry electric currents as shown in the following figures:

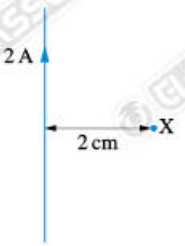


Figure (1)

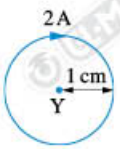


Figure (2)

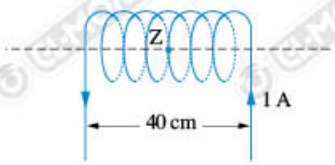
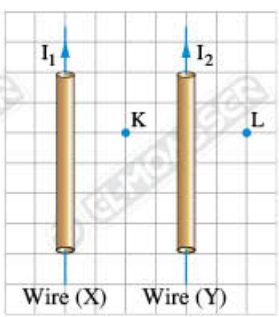


Figure (3)

So, the order of the magnitudes of magnetic flux density at points (X), (Y), and (Z) is .....

(a) $B_X < B_Y < B_Z$ (b) $B_Y < B_X < B_Z$ (c) $B_Z < B_X < B_Y$ (d) $B_X < B_Z < B_Y$

8 Two long, straight parallel wires carry currents as shown in the figure. If the direction of the current passing through wire (X) is reversed, then the magnitudes of the net magnetic flux density at points L and K, respectively, will .....



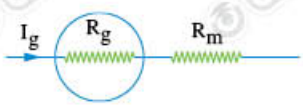
(a) decrease, increase (b) increase, decrease

(c) not change, not change (d) decrease, decrease

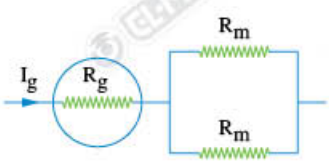
9 In a moving-coil galvanometer, every 5 divisions on its scale indicate a current of 1 mA, and every 20 divisions in it indicate a potential difference of 1 V. So, the resistance of the galvanometer equals .....

(a) 250 Ω (b) 500 Ω (c) 40 Ω (d) 25 Ω

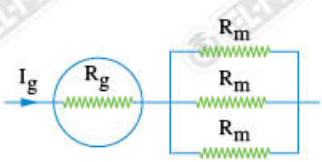
10 Three identical galvanometers, each with resistance R_g, were connected to three different multiplier resistors to convert them into three voltmeters (A, B, and C) as shown in the following figures:



Voltmeter (A)



Voltmeter (B)

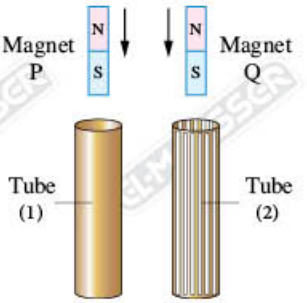


Voltmeter (C)

The order of the maximum readings on the scales of the devices is .....

(a) $V_B > V_A > V_C$ (b) $V_C < V_B < V_A$ (c) $V_A < V_C < V_B$ (d) $V_C > V_B > V_A$

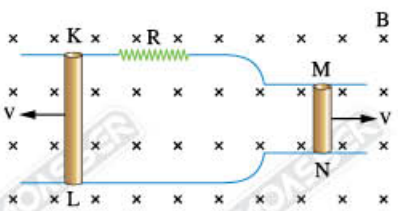
11 Two identical magnets, P and Q, are suspended vertically at the same height above two tubes, (1) and (2) respectively. Both tubes are made of copper, but tube (2) is divided into insulated longitudinal strips as shown in the figure. If the two magnets are dropped at the same instant to pass through the tubes without touching them, induced currents I_1 and I_2 are generated respectively. So, which magnet exits completely from its tube first, and why?



(a) Q, because $I_1 > I_2$ (b) Q, because $I_1 < I_2$

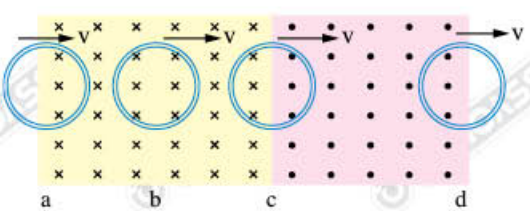
(c) P, because $I_1 > I_2$ (d) P, because $I_1 < I_2$

12 Two copper conductors, KL and MN, have negligible resistance and the same cross-sectional area. The length of conductor MN is (ℓ) and the length of conductor KL is (2ℓ). The conductors move on a metal frame of negligible resistance at a uniform speed (v) perpendicular to a uniform magnetic field (B) as shown in the opposite figure. The intensity of the induced current passing through the resistor (R) equals .....



(a) $\frac{3B\ell v}{R}$ (b) $\frac{B\ell v}{R}$ (c) $\frac{2B\ell v}{R}$ (d) $\frac{4B\ell v}{R}$

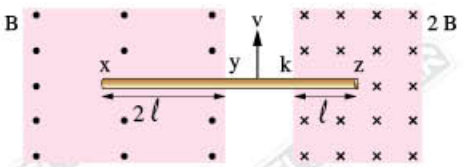
13 A metal ring moves at a uniform speed (v) through two adjacent regions of uniform magnetic fields in the direction shown in the following figure:



So, an induced current is generated in the ring in a clockwise direction at the instant it passes through position .....

(a) a (b) b (c) c (d) d

14 A metal conductor (xz) has part (xy) located in a uniform magnetic field of flux density B, and part (kz) in a uniform magnetic field of flux density 2B. The conductor moves at a uniform speed (v) in the direction shown in the figure. So, the induced electromotive force between the ends of the conductor (xz) equals .....

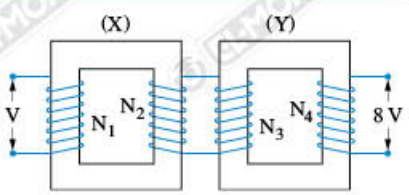


(a) $3\,B\ell v$ (b) $2\,B\ell v$ (c) $B\ell v$ (d) zero

15 If the number of magnetic flux lines penetrating a metal piece perpendicularly is changed, induced currents are generated in it called eddy currents where the plane of the eddy currents is ..... the direction of the affecting magnetic field.

(a) in the same direction as (b) perpendicular to
(c) at an angle of 180° with (d) at an angle of 45° with

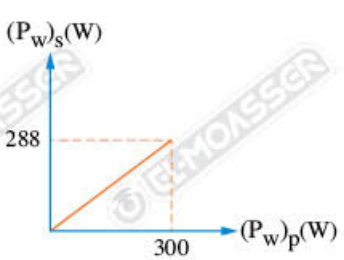
16 The figure shows two ideal electric transformers, (X) and (Y). If the output voltage of transformer (Y) is 8 times the input voltage of transformer (X), the ratio of the number of turns in each transformer could be .....



(Given that the number of turns on the figure does not represent the actual values in the transformers).

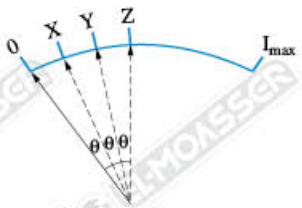
(a) $N_2 = 2\,N_1$, $N_4 = 4\,N_3$ (b) $N_2 = 2\,N_1$, $N_4 = 3\,N_3$
(c) $N_1 = 3\,N_2$, $N_3 = 2\,N_4$ (d) $N_1 = 2\,N_2$, $N_3 = 4\,N_4$

17 The opposite graph represents the relation between the power of the secondary coil $(P_w)_s$ and the power of the primary coil $(P_w)_p$ for an electric transformer. Assuming the efficiency of the transformer remains constant, it is equal to .....



(a) 99% (b) 96%
(c) 95% (d) 98%

18 The opposite figure shows the scale of a hot-wire ammeter and several current values, where:

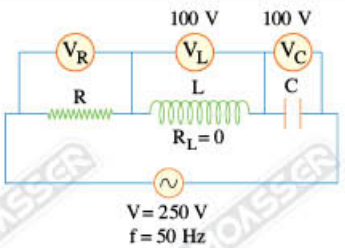


- (ΔI_1) represents the change in current value that causes the pointer to deflect from zero to position X.
- (ΔI_2) represents the change in current value that causes the pointer to deflect from position X to position Y.
- (ΔI_3) represents the change in current value that causes the pointer to deflect from position Y to position Z.

If the shown angles are equal, the correct order of these current changes is .....

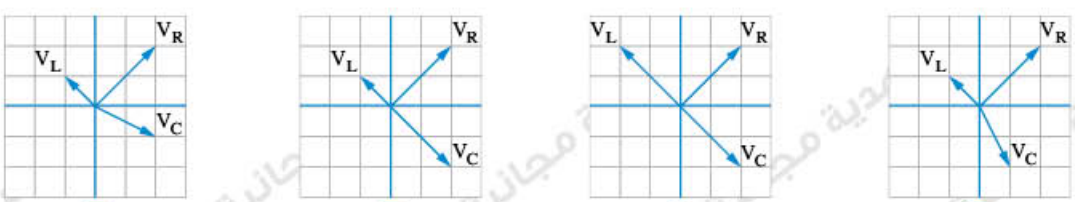
(a) $\Delta I_1 > \Delta I_2 > \Delta I_3$ (b) $\Delta I_1 = \Delta I_2 = \Delta I_3$ (c) $\Delta I_1 < \Delta I_2 < \Delta I_3$ (d) $\Delta I_1 < \Delta I_2 > \Delta I_3$

19 The opposite figure represents an AC, RLC circuit, so the reading of the voltmeter (V_R) is .....



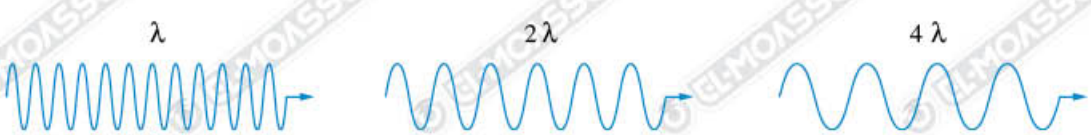
(a) 250 V (b) 100 V
(c) 50 V (d) 0

20 Which of the following phasor diagrams correctly represents the resonance state in an LCR circuit?



(a) (b) (c) (d)

21 The figure shows three photons (a), (b), and (c), with their corresponding wavelengths written on each of them:



Photon (a) **Photon (b)** **Photon (c)**

If the energy of photon (c) is 3 eV, then the energy of photon (a) is greater than the energy of photon (b) by an amount of .....

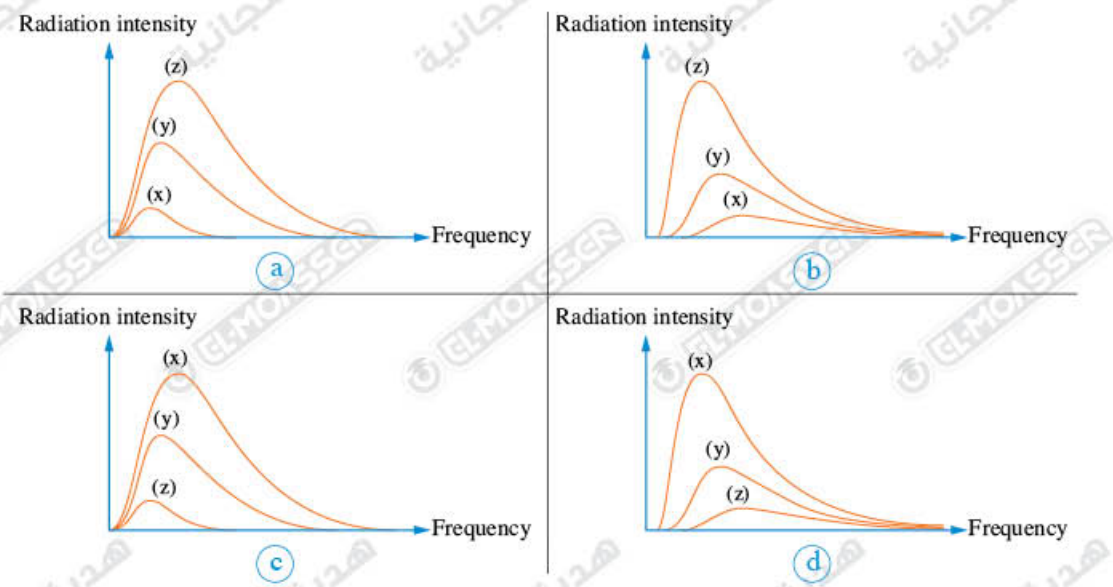
(a) 6 eV (b) 4 eV (c) 8 eV (d) 9 eV

22 Photons of electromagnetic radiation with a wavelength of 6620 Å fall perpendicularly onto a perfectly reflecting surface. If the force exerted by the photons is 10^{-7} N, then the number of photons falling each second on the surface is .....

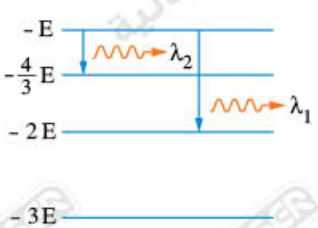
(Given that: $h = 6.625 \times 10^{-34}$ J.s)

(a) 5×10^{19} (b) 5×10^{16} (c) 2.5×10^{19} (d) 2.5×10^{16}

23 Which of the following graphs represents the relation between the radiation intensity and the frequency for a blackbody at three different constant temperatures **x**, y, z ?
(Given that: **x** > y > z)



24 The opposite figure shows two possible electron transitions between energy levels in a hypothetical atom with the shown energy values. The ratio between the wavelengths of the two photons emitted as a result of these transitions $\left(\frac{\lambda_1}{\lambda_2}\right)$ is equal to .....



(a) $\frac{1}{3}$ (b) $\frac{3}{4}$ (c) $\frac{2}{3}$ (d) $\frac{4}{3}$

25 ✳ Figure (1) graphically represents the relation between radiation intensity (I) and wavelength (λ) for the X-rays produced from a Coolidge tube when using a molybdenum target. Figure (2) represents two possible electron transitions between energy levels of the target atom that result in the characteristic spectrum shown in figure (1):

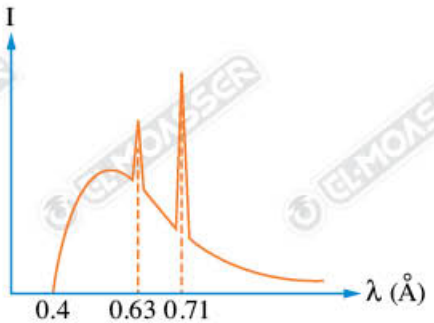


Figure (1)

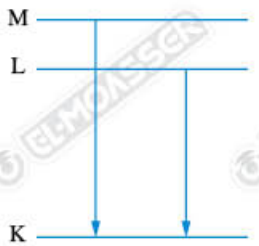


Figure (2)

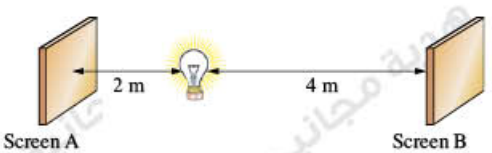
What is the wavelength of the photon emitted when an electron returns from level (M) to level (L) in one of the target material atoms?

(a) 5.6 Å (b) 1.34 Å (c) 4.26 Å (d) 0.33 Å

26 In a helium-neon laser, when the semi-transparent mirror that has a reflectivity of 95% is replaced by another mirror of reflectivity 98%, the intensity of the resulting laser beam ..... and the energy of a single photon of the resulting laser beam ....., respectively.

(a) changes, remains constant
(b) remains constant, remains constant
(c) remains constant, changes
(d) changes, changes

27 Two identical screens, A and B, are placed such that a light source is at a distance of 2 m from screen A and 4 m from screen B, as shown in the opposite figure. The ratio between the light intensities on the two screens $\left(\frac{I_B}{I_A}\right)$ = ...

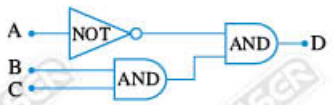


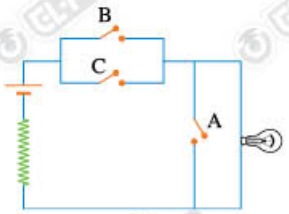
(a) $\frac{1}{1}$ (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) $\frac{4}{1}$

28 The monochromaticity of laser beams is attributed to the fact that .....

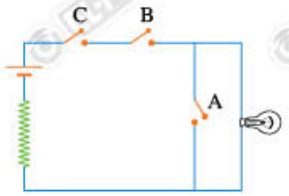
(a) all atoms of the active medium are excited to a single unstable energy level
(b) all atoms of the active medium are in the ground state
(c) all photons emitted by stimulated emission have the same energy
(d) all photons emitted by stimulated emission are amplified when passing between the two reflecting mirrors

29 Which of the following simple electric circuits represents the operation of the opposite set of logic gates?

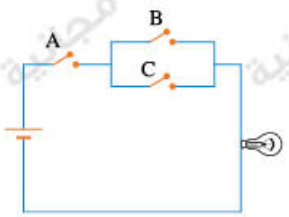




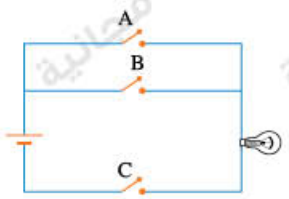
(a)



(b)

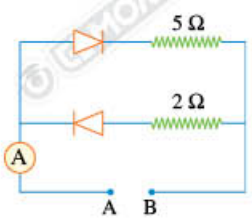


(c)



(d)

30 In the shown electrical circuit, if a battery of an electromotive force 2 V and negligible internal resistance is connected such that its positive terminal is at point (A), and given that the resistance of each diode is negligible in forward bias and infinite in reverse bias, then the ammeter reading is .....



(a) 0.4 A (b) 2 A (c) 1.4 A (d) zero

31 In the npn transistor circuit shown in figure (1), the relation between the output voltage (V_{CE}) and the collector current (I_C) is plotted graphically, as shown in figure (2):

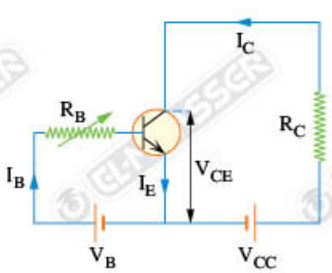


Figure (1)

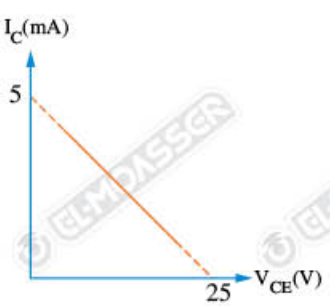


Figure (2)

Therefore, the resistance (R_C) equals ..... and the electromotive force of the battery (V_{CC}) equals .....

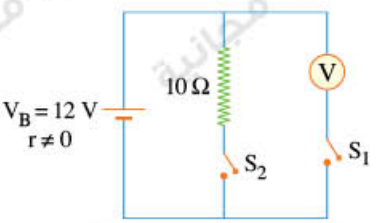
(a) 5 kΩ , 25 V (b) 5 kΩ , 5 V (c) 25 kΩ , 25 V (d) 25 kΩ , 5 V

32 Two identical pure semiconductor crystals, A and B, have temperatures T_1 and T_2, respectively. If the ambient temperature is T_o, where $(T_1 > T_o > T_2)$, then upon reaching thermal equilibrium for each crystal with the surroundings, the electrical conductivity of crystal A ..... and the electrical resistivity of crystal B .....

(a) decreases, decreases
(b) increases, increases
(c) increases, decreases
(d) decreases, increases

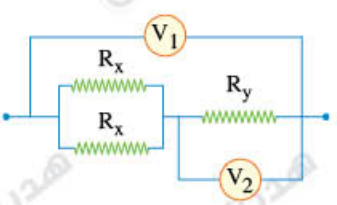
Second Choose the correct answer 33 : 44 — 2 Marks

33 In the electric circuit shown in the figure, the voltmeter reading is 12 V when .....



(a) switch (S_1) is closed and switch (S_2) is open
(b) switch (S_1) is closed and switch (S_2) is closed
(c) switch (S_1) is open and switch (S_2) is open
(d) switch (S_1) is open and switch (S_2) is closed

34 The figure represents a part of an electric circuit. If the ratio between the readings of the two voltmeters is $\left(\frac{V_1}{V_2} = \frac{5}{2}\right)$, then the ratio between the values of the two resistors $\left(\frac{R_x}{R_y}\right)$ = ...



(a) $\frac{3}{1}$
(b) $\frac{1}{3}$
(c) $\frac{5}{2}$
(d) $\frac{2}{5}$

35 Each of the following figures shows a straight wire carrying an electric current and placed within a uniform magnetic field:

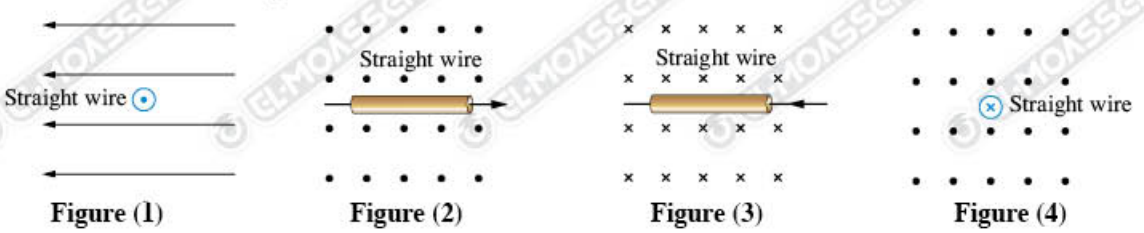


Figure (1) **Figure (2)** **Figure (3)** **Figure (4)**

In which of these figures is the wire **not** affected by a magnetic force?

(a) Figure (1)
(b) Figure (2)
(c) Figure (3)
(d) Figure (4)

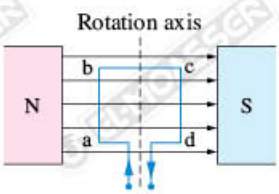
36 The figure shows two insulated solenoids with negligible resistance. They have the same number of turns and are each wound around a metal core of the same material. The length of each is much larger than its diameter. Each is connected to an electric source with negligible internal resistance and an external resistor.



If the magnetic flux densities at the centers of both solenoids are equal, then the ratio between the electromotive forces of the two sources $\frac{(V_B)_1}{(V_B)_2}$ = ...

(a) $\frac{2}{3}$ (b) $\frac{1}{12}$ (c) $\frac{1}{4}$ (d) $\frac{1}{2}$

37 An electric motor rotates at a uniform speed. During the rotation of the motor's coil from the position shown in the diagram until it completes a quarter turn, which of the following values decreases gradually?



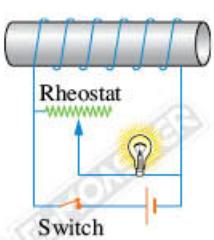
(a) The magnetic torque acting on the coil.

(b) The magnetic dipole moment of the coil.

(c) The magnetic force causing the rotation.

(d) The force acting on side (bc).

38 In the electric circuit shown in the figure, the inductor has a large self-inductance. If the rheostat is adjusted so that the lamp is lit, what happens to the brightness of the lamp at the moment the switch is opened?



(a) Increases and then vanishes.

(b) Does not change.

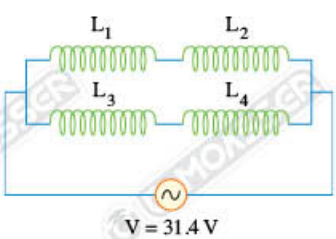
(c) Decreases and then remains constant.

(d) Increases and then remains constant.

39 An AC generator has a coil with 500 turns, and the area of each turn is 0.02 m^2. It rotates at a rate of 6000 revolutions per minute in a uniform magnetic field of flux density 0.25 T. So, the maximum induced electromotive force in the coil and the instantaneous value of the induced emf in it when it makes an angle of 60° with the magnetic field lines are .....

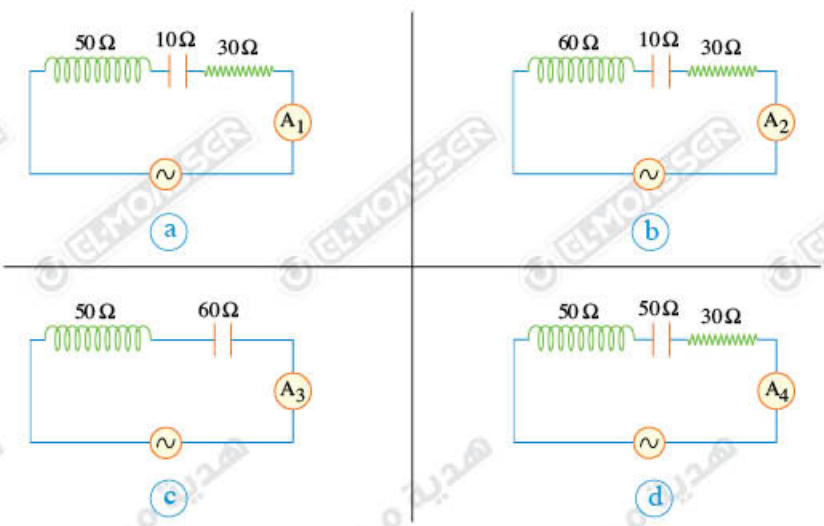
	Maximum induced emf	Instantaneous induced emf
(a)	(500 π) V	(250 π) V
(b)	(100 π) V	(350 π) V
(c)	(250 π) V	(400 π) V
(d)	(400 π) V	(150 π) V

40 Four inductors of negligible ohmic resistance, each having a self-inductance of 50 mH, are connected together as shown in the opposite circuit. If the effective value of the current through the circuit is 10 A, and ignoring the mutual induction between the coils, the frequency of this current is approximately .....



(a) 60 Hz (b) 10 Hz (c) 20 Hz (d) 50 Hz

41 In the following AC circuits, if the AC sources have the same electromotive force and the hot-wire ammeters have the same ohmic resistance, in which circuit does the hot-wire ammeter show the lowest reading?



42 ✳ A potential difference (V) was used in an electron microscope to see a virus with dimensions of 20 nm. To be able to see another virus with dimensions of 15 nm, the used potential difference must .....

(a) increase to $\frac{9}{7}$ V
(b) decrease to $\frac{7}{9}$ V
(c) increase to $\frac{16}{9}$ V
(d) decrease to $\frac{9}{16}$ V

43 Figure (1) shows the energy level diagram for an atom of a certain element. Figure (2) shows the wavelengths of the line spectrum for this element resulting from electron transitions from higher energy levels to lower energy levels:

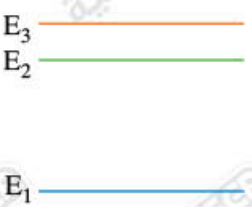


Figure (1)

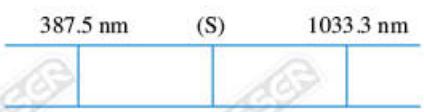
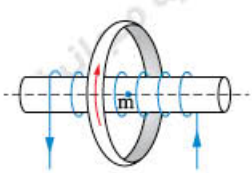


Figure (2)

The wavelength of the spectral line (S) is equal to .....

(a) 620 nm
(b) 775 nm
(c) 516.7 nm
(d) 710.4 nm

44 An electric current of intensity 0.5 A passes through a solenoid consisting of 20 turns per 1 cm of its length. Another wire is wound around it in the form of a single circular loop with a radius of 1 cm, centered at point (m) which is located at the midpoint of the solenoid's length and on its axis, as shown in the opposite figure. What is the intensity of the electric current passing through the circular loop so that its magnetic flux density equals the magnetic flux density produced by the solenoid at point (m)?



(a) 10 A
(b) 20 A
(c) 30 A
(d) 40 A

Third **Answer the following questions 45 & 46** — 2 Marks

45 A solenoid (x) has a length of 88 cm, a diameter of 40 mm, and a number of turns of 400 turns wound at equal distances on an iron core and it carries an electric current of intensity 5 A. Another solenoid (y) has a number of turns 200 turns wound around solenoid (x). If the electric current passing through solenoid (x) vanishes within 0.002 s, **calculate:**

(Given that: the magnetic permeability of iron = 2×10^{-3} Wb/A.m)

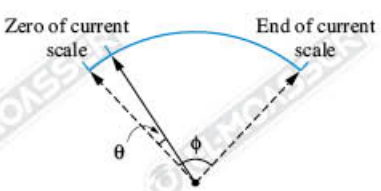
1. The average induced electromotive force in solenoid (y) during that period.

2. The mutual induction coefficient between the two solenoids.

.....

.....

46 The figure shows the scale of an ohmmeter with a resistance of 30 kΩ. If the maximum deflection angle of its pointer from the zero of the current scale is ($\phi = 60°$), **find** the value of the unknown resistance that when connected to the terminals of the ohmmeter, it causes its pointer to deflect from the zero of the current scale by an angle ($\theta = 10°$).



.....

.....

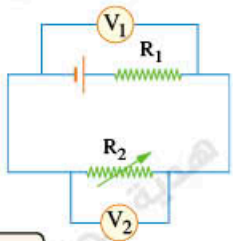
Exam 4

Answered

Questions signed by * are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

1 In the opposite electric circuit, what happens to the readings of the two voltmeters (V_1) and (V_2) when the value of the variable resistance (R_2) increases?



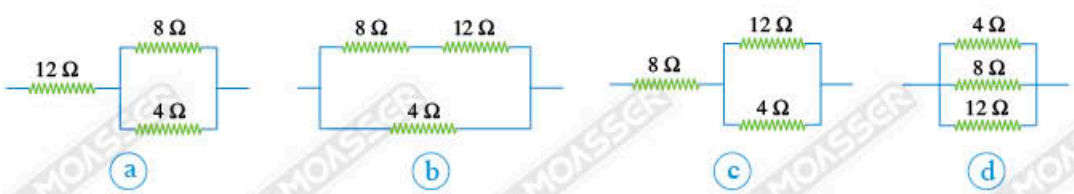
	Voltmeter reading (V_1)	Voltmeter reading (V_2)
(a)	Decreases	Increases
(b)	Increases	Decreases
(c)	Increases	Increases
(d)	Decreases	Decreases

2 A solid copper rod of length 5 m and cross-sectional diameter 4 cm. If you know that the electric resistivity of copper is 1.72×10^{-8} Ω.m, then the resistance of the rod equals ..... .

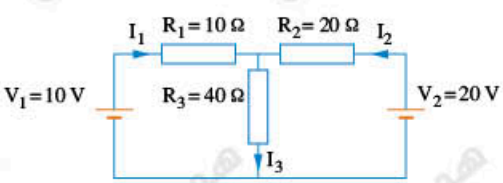
(a) 6.84×10^{-5} Ω (b) 6.84×10^{-7} Ω

(c) 1.72×10^{-6} Ω (d) 6.35×10^{-6} Ω

3 You have three different resistors (4 Ω, 8 Ω, 12 Ω). Which of the following connection methods makes their equivalent resistance equal to 11 Ω?



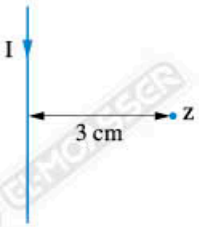
4 In the opposite electric circuit, the electric current intensity passing through the resistance (R_3) is ..... .



(a) 0.14 A (b) 0.29 A

(c) 0.42 A (d) 0. 56 A

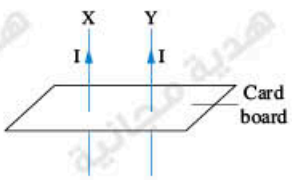
5 The opposite figure shows a long wire whose resistance is 2 Ω and the potential difference across its terminals is 4 V. The magnitude and direction of the magnetic flux density at point (Z) respectively are .....

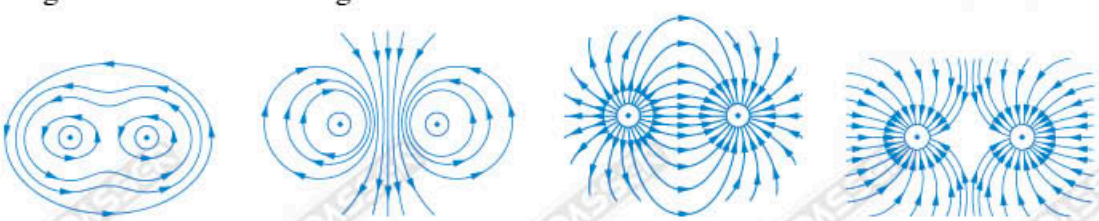


(Given that: $\mu = 4\pi \times 10^{-7}$ Wb/A.m)

(a) 1.3×10^{-5} T, out of the page
(b) 1.3×10^{-5} T , into the page
(c) 5.3×10^{-5} T , out of the page
(d) 5.3×10^{-5} T, into the page

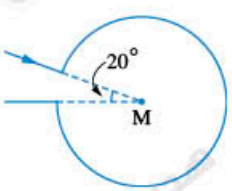
6 Two long straight parallel wires carry two electric currents in the same direction and have the same intensity (I) as shown in the figure. Which of the following figures represents the magnetic field lines arising from the currents of the two wires?





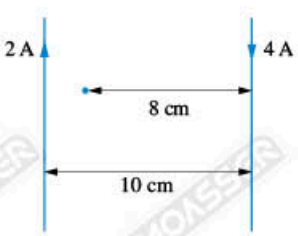
(a) (b) (c) (d)

7 The figure shows an electric current of intensity 2 A passing in a wire shaped as an arc of a circle of radius 0.02 m. The direction and the magnitude of the magnetic flux density at the center of the circle (M) respectively are ..... . **(Given that :** $\mu = 4\pi \times 10^{-7}$ Wb/A.m)



(a) into the page, 2.5×10^{-3} T
(b) out of the page, 7×10^{-6} T
(c) into the page, 5.9×10^{-5} T
(d) out of the page, 3.5×10^{-4} T

8 Two long parallel wires, each carrying an electric current as shown in the figure. The resultant magnetic flux density at a point between them and at a distance of 10 cm from the wire carrying a current of 4 A equals ..... .



(Given that: $\mu = 4\pi \times 10^{-7}$ Wb/A.m)

(a) 3×10^{-7} T
(b) 3×10^{-5} T
(c) 1×10^{-7} T
(d) 1×10^{-5} T

9 A moving-coil galvanometer has a scale divided into ten divisions where the indication of each division is 5 μA. The current intensity required to pass through the galvanometer so that its pointer deflects to the middle of the scale equals ..... .

(a) 10 μA
(b) 15 μA
(c) 25 μA
(d) 50 μA

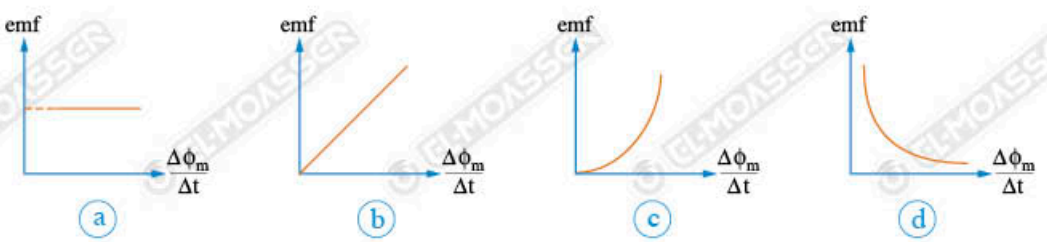
10 A galvanometer has a resistance of 50 Ω. The value of the shunt resistance required to reduce the sensitivity of the device to one-fifth its value equals ..... .

(a) 10 Ω (b) 12.5 Ω (c) 25 Ω (d) 50 Ω

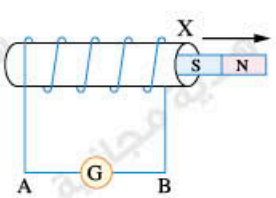
11 Which of the following increases the induced electromotive force in a coil (in a closed circuit) when moving a bar magnet towards it?

(a) Decreasing the relative speed between the magnet and the coil
(b) Increasing the relative speed between the magnet and the coil
(c) Decreasing the number of turns of the coil
(d) Decreasing the magnetic permeability coefficient of the coil's core

12 The graph that represents the relation between the induced electromotive force (emf) in a coil and the rate of change of the magnetic flux $\left(\frac{\Delta\phi_m}{\Delta t}\right)$ intersecting the coil is ..... .

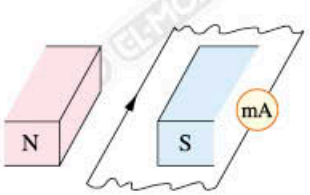


13 In the figure, while pulling the magnet out of the solenoid, the direction of the induced current through the galvanometer passes from ..... and the magnetic pole formed at end (X) of the coil is ..... .



(a) point (B) to point (A), north
(b) point (B) to point (A), south
(c) point (A) to point (B), north
(d) point (A) to point (B), south

14 From the opposite figure, in which direction was the wire moved so that the direction of the induced current is as shown?



(a) Upwards
(b) Downwards
(c) Towards the north pole of the magnet
(d) Towards the south pole of the magnet

15 When a metal core is placed inside a double-wound solenoid and a changeable electric current is passed through the coil, then ..... .

(a) the temperature of the core rises due to the generation of eddy currents in it

(b) the temperature of the core decreases due to the generation of eddy currents in it

(c) the temperature of the core does not change despite the generation of eddy currents in it

(d) the temperature of the core does not change due to the non-generation of eddy currents in it

16 An ideal electric transformer, the electrical power in one of its coils is 600 W, the potential difference across its primary coil equals 180 V, and the value of the current passing through its secondary coil equals 4 A. Then ..... .

	The type of transformer	The potential difference across the secondary coil
(a)	step-down	100 V
(b)	step-up	100 V
(c)	step-up	150 V
(d)	step-down	150 V

17 A step-down electric transformer with an efficiency of 70% is used to operate an electric lamp with a potential difference of 22 V using an AC source with a potential difference of 220 V. If the number of turns of the secondary coil is 350 turns, then the number of turns of the primary coil equals ..... .

(a) 240 turns (b) 500 turns (c) 2450 turns (d) 3500 turns

18 The wire of the hot-wire ammeter is fixed on a metallic plate having the same coefficient of thermal expansion in order to ..... .

(a) increase the amount of thermal expansion of the wire

(b) decrease the efficiency of the device in measurement

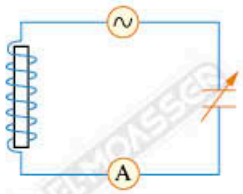
(c) eliminate the zero error

(d) return the pointer quickly to zero when the current is disconnected

19 A resonance circuit consists of a capacitor of capacitance (C) mF and an inductor of self-inductance (L) mH. This circuit receives a wave of frequency 600 kHz. If another inductor of self-inductance (2 L) mH and another capacitor of capacitance (2C) mF are used, the frequency of the wave that can be received equals ..... .

(a) 600 kHz (b) 400 kHz (c) 300 kHz (d) 200 kHz

20 The figure represents an AC circuit in a state of resonance. When pulling the iron core out from inside the coil, the reading of the hot-wire ammeter (A) ..... .



(a) increases (b) decreases
(c) remains constant (d) becomes zero

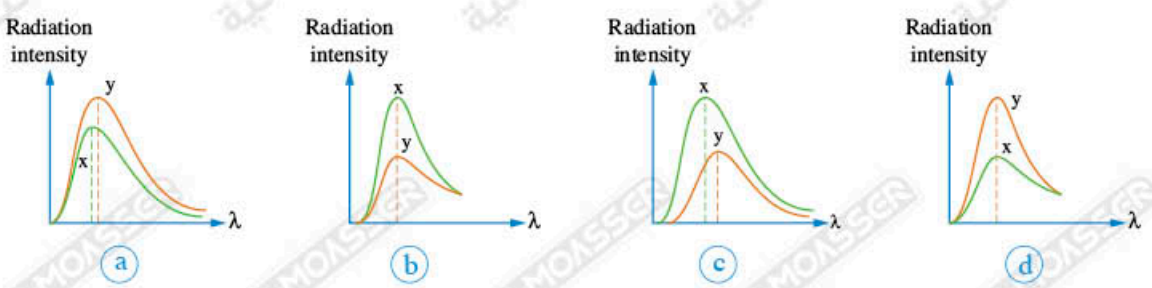
21 The ratio between the speed of a blue light photon in a vacuum to the speed of a red-light photon in a vacuum ..... .

(a) is greater than one (b) is less than one
(c) equals one (d) cannot be determined

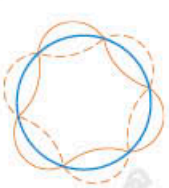
22 When a gamma-ray photon collides with a free electron, both are scattered. Which of the following choices is correct?

	The momentum of the scattered photon	The associated wavelength with the scattered electron
(a)	Decreased	Decreased
(b)	Decreased	Increased
(c)	Increased	Decreased
(d)	Increased	Increased

23 Which of the following graphs illustrates the radiation curves emitted from two identical blackbodies (x) and (y), given that the temperature of body (x) is greater than the temperature of body (y)?

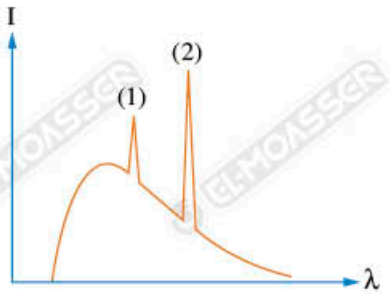


24 The opposite figure represents a standing wave of wavelength (λ) associated with an electron orbiting the nucleus of a hydrogen atom in a certain orbit. The radius (r) of the orbit in which the electron rotates, according to Bohr's model, is calculated from the relation ..... .



(a) $r = \frac{3\lambda}{2\pi}$ (b) $r = \frac{\lambda}{2\pi}$ (c) $r = \frac{2\lambda}{\pi}$ (d) $r = \frac{\lambda}{\pi}$

25 The opposite graph represents the relation between the radiation intensity (I) of an X-ray spectrum and its wavelength (λ). The common property between the characteristic X-rays (1) and (2) is that their photons have the same ..... .



(a) energy (b) rate of emission
(c) frequency (d) speed in space

26 In a (helium-neon) laser, the amplification process occurs under the effect of ..... .
(a) electrical discharge of the gas inside the tube
(b) decrease in the ratio of helium to neon in the active medium
(c) successive reflections inside the resonant cavity
(d) decrease of gas pressure inside the tube

27 A three-dimensional image (holography) can be formed using a laser because laser photons are ..... .
(a) parallel (b) having spectral purity
(c) having high intensity (d) coherent

28 The following figures represent energy levels in an atom.

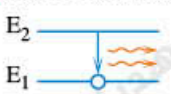


Figure (1)



Figure (2)

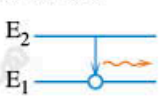


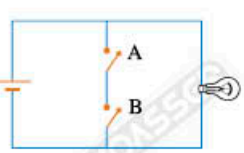
Figure (3)

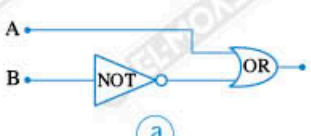


Figure (4)

Which of them represents a state of stimulated emission?
(a) Figure (1) (b) Figure (2) (c) Figure (3) (d) Figure (4)

29 The opposite figure represents an electric circuit.
Which of the following sets of logic gates represents the operation of this circuit?





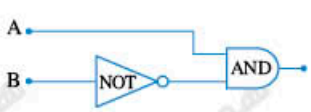
(a)



(b)

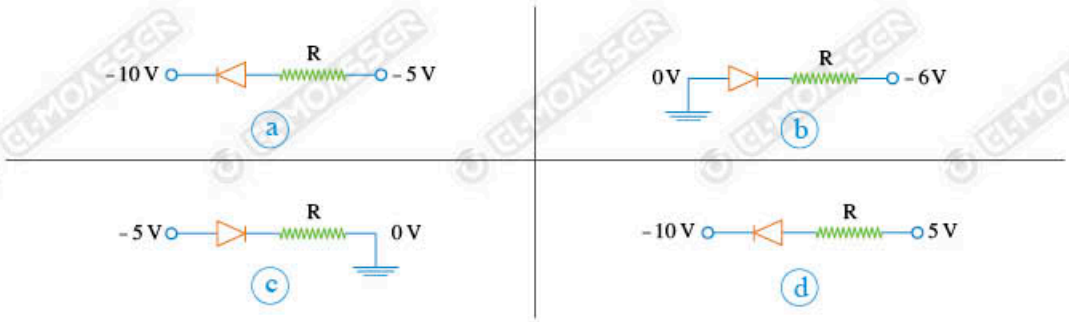


(c)



(d)

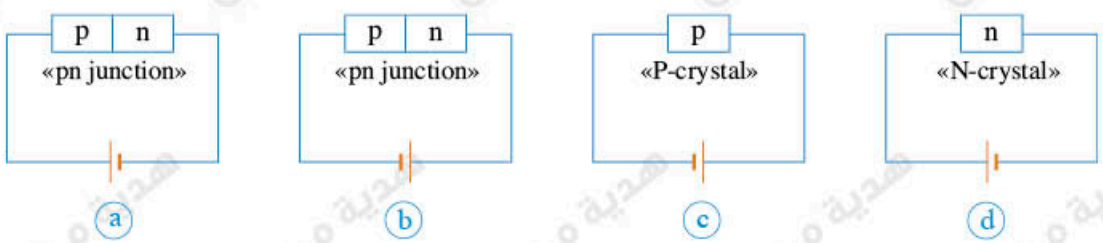
30 Which of the following figures shows the reverse biasing of a p-n junction (diode)?



31 In (npn) transistor circuit, the emitter was common and the base voltage was positive and large. Which of the following is considered correct?

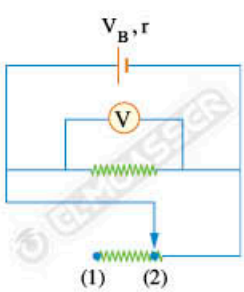
(a) The output voltage is high, and the transistor works as a closed switch (on)
(b) The output voltage is high, and the transistor works as an open switch (off)
(c) The output voltage is low, and the transistor works as a closed switch (on)
(d) The output voltage is low, and the transistor works as an open switch (off)

32 Which of the following figures represents a semiconductor having the highest resistance to the flow of electric current?



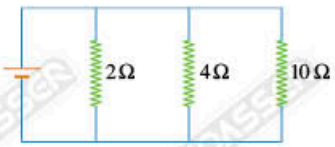
Second Choose the correct answer 33 : 44 — 2 Marks

33 In the electric circuit shown in the figure, what happens to both the value of the resistance taken from the rheostat and the reading of the voltmeter (V) when moving the slider from point (2) to point (1)?



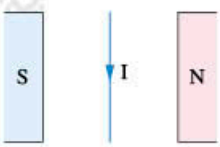
	The value of resistance taken from the rheostat	The voltmeter reading (V)
(a)	Decreases	Decreases
(b)	Increases	Decreases
(c)	Decreases	Increases
(d)	Increases	Increases

34 In the opposite electric circuit, if the current intensity passing through the 10 Ω resistance equals 2 A, then the current intensities passing through the 2 Ω and 4 Ω resistances respectively are ....., ...



	The current intensity in resistance (4 Ω)	The current intensity in resistance (2 Ω)
(a)	5 A	10 A
(b)	10 A	5 A
(c)	4 A	8 A
(d)	8 A	4 A

35 The figure shows a straight copper wire in the plane of the page carrying a direct electric current and placed between the poles of a magnet. The direction of the wire's motion will be ..... .



(a) in the plane of the page upwards
(b) in the plane of the page downwards
(c) perpendicular to the plane of the page outwards
(d) perpendicular to the plane of the page inwards

36 A solenoid of length 0.5 m, number of turns 400 turns, and cross-sectional area 0.001 m^2 carries an electric current of intensity 2 A. If you know that the magnetic permeability of air is $4\pi \times 10^{-7}$ T.m/A, then the magnetic flux density at a point at the midpoint of the coil's length on its axis equals ..... .

(a) 1×10^{-3} T (b) 2×10^{-3} T (c) 1 T (d) 2 T

37 A straight wire was wound in the form of a circular coil of 4 turns and carried an electric current of intensity (I). The magnetic flux density at its center was (B_1). Then, the same wire was rewound in the form of a circular turn and carried the same current intensity (I), and the magnetic flux density at its center became (B_2). Then the ratio of $\left(\frac{B_1}{B_2}\right)$ equals ..... .

(a) $\frac{1}{4}$ (b) $\frac{4}{1}$ (c) $\frac{16}{1}$ (d) $\frac{1}{16}$

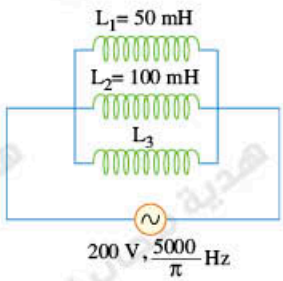
38 The splitted cylinder into two insulated halves in the electric motor act to ..... .

(a) convert the direct current into an alternating current
(b) convert the alternating current into a direct current
(c) reverse the direction of current in the coil every half cycle
(d) produce a unidirectional current

39 A solenoid of length (ℓ) and self-inductance (L) is divided into two identical coils. If the turns are uniformly separated in each coil to restore the original length (ℓ), while keeping the face area of the coil constant, what is the self-inductance of either of the coils?

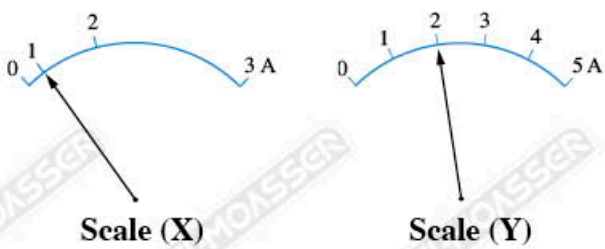
(a) 0.25 L (b) 0.5 L (c) 2 L (d) 4 L

40 In the opposite electric circuit, if the coils have negligible ohmic resistance and the value of the current passing through the circuit is 2 A, then the self-induction coefficient (L_3) equals ..... .



(a) 0.2 mH (b) 5 mH
(c) 10.4 mH (d) 14.29 mH

41 The opposite diagram shows two scales (X) and (Y) for two devices used to measure the value of electric current for both types. The reason for the pointer stopping in both devices is due to:



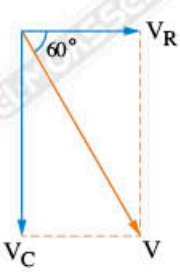
Scale (X) **Scale (Y)**

- **Reason (1):** The torsional torque in the two spiral springs equals the magnetic torque acting on the coil.
- **Reason (2):** The rate of losing heat equals the rate of producing heat.

Which of the previous reasons is correct for scales (X) and (Y)?

	Scale (X)	Scale (Y)
(a)	Reason (1)	Reason (1)
(b)	Reason (1)	Reason (2)
(c)	Reason (2)	Reason (1)
(d)	Reason (2)	Reason (2)

42 ✱ An AC circuit consists of an AC source, an ohmic resistance, and a capacitor connected together in series, and its impedance is (Z). The opposite figure represents the phasor vectors for the potential differences in the circuit. Which of the following relations is correct?



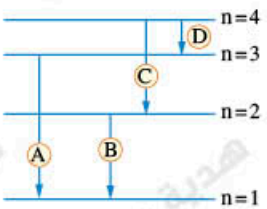
(a) $\frac{Z}{R} = \frac{2}{1}$ (b) $\frac{Z}{R} = \frac{1}{2}$

(c) $\frac{V_C}{V_R} = \frac{1}{\sqrt{2}}$ (d) $\frac{V_C}{V_R} = \frac{\sqrt{2}}{1}$

43 The electron microscope is characterized by a high resolving power, and this is due to the possibility of giving the electrons a ..... kinetic energy and a ..... associated wavelength.

(a) high, short (b) high, long (c) low, short (d) low, long

44 The figure represents several possible transitions for an electron of a hydrogen atom. Which of these transitions emits a photon with the shortest wavelength?



(a) Transition A (b) Transition B

(c) Transition C (d) Transition D

Third **Answer the following questions 45 & 46** — 2 Marks

45 Two adjacent coils (X) and (Y). The number of turns of coil (Y) is 500 turns. If an electric current of 10 A passes through coil (X), it produces a magnetic flux of 4.2×10^{-4} Wb in coil (Y). **Calculate:**

(1) The average induced electromotive force in coil (Y) when the current in coil (X) vanishes during 0.2 s.

(2) The mutual induction coefficient between the two coils.

.....

.....

46 An ohmmeter contains a battery of 8 V, a resistance, and a milli-ammeter connected together such that its pointer deflects to the maximum current scale when an electric current of 4 mA passes through it. **Find** the value of the unknown resistance that is connected across the ohmmeter terminals to make its pointer deflect to the quarter of the current scale.

.....

.....

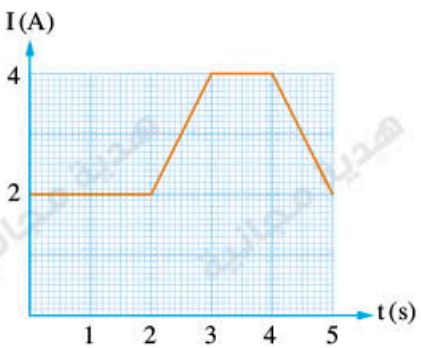
Exam 5

Answered

Questions signed by * are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

1 The opposite graph represents the relation between the electric current intensity (I) passing through a conductor and the time (t). The quantity of electric charge passing through a cross-section of the conductor during the five seconds shown in the graph is ..... .

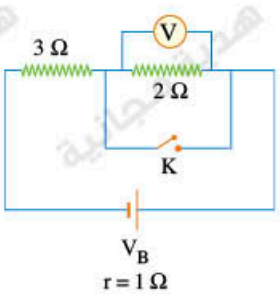


(a) 2 C (b) 4 C
(c) 14 C (d) 20 C

2 An electric current of intensity 5 A passes through a conductor of length 40 m and cross-sectional area 6.67×10^{-7} m^2 and the potential difference across its terminals is 30 V. The electric resistivity of the conductor's material equals ..... .

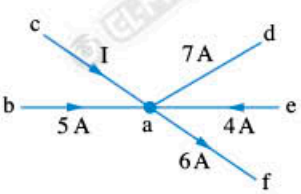
(a) 2.5×10^{-6} Ω.m (b) 4.4×10^{-6} Ω.m
(c) 10^{-7} Ω.m (d) 2.8×10^{-9} Ω.m

3 The opposite figure represents an electric circuit. If the voltmeter reading is 4 V when the switch (K) is opened, then the potential difference across the 3 Ω resistance when the switch (K) is closed equals ..... .



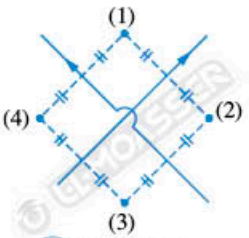
(a) 4 V (b) 6 V
(c) 8 V (d) 9 V

4 The opposite figure represents electric currents passing through several branches in an electric circuit. The current intensity (I) and the direction of the current (7 A) respectively are ..... .



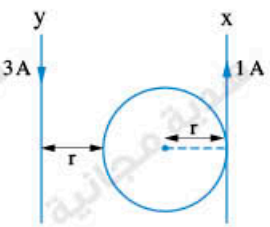
(a) 4 A, from a to d (b) 4 A, from d to a
(c) 13 A, from a to d (d) 13 A, from d to a

5 Two insulated straight wires are perpendicular to each other in the same plane, each carries an electric current. Each of the four indicated points is at the same distance from the two wires.
The point at which the resultant magnetic flux density is maximum and directed outwards from the page is ..... .



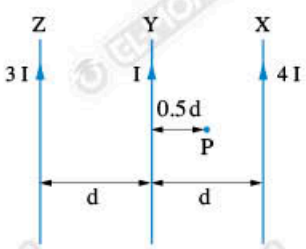
(a) point (1) (b) point (2) (c) point (3) (d) point (4)

6 Two long, parallel straight wires (x) and (y), each carries an electric current. A circular ring is placed in the same plane of the two wires such that wire (x) is tangent to it and isolated from it, as shown in the figure. If the radius of the circular ring (r) is 10 cm and an electric current of intensity $\frac{1}{\pi}$ A passes through it in the clockwise direction, then the resultant magnetic flux density at the center of the ring equals ..... .
(Given that: $\mu = 4\pi \times 10^{-7}$ T.m/A)



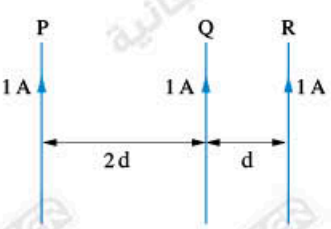
(a) 1.5×10^{-6} T (b) 3×10^{-6} T (c) 4.5×10^{-6} T (d) 6×10^{-6} T

7 Three long, parallel straight wires (X, Y, Z) each carries an electric current as shown in the opposite figure. If the magnetic flux density at point (P) due to the flow of current in wire (Y) is B, then the resultant of the magnetic flux density at point (P) equals ..... .



(a) B (b) 2 B (c) 4 B (d) 8 B

8 Three straight and parallel wires (P, Q, R) are in the plane of the page. Each carries an electric current of intensity (1 A) in the directions shown in the figure. The direction of the magnetic force acting on each of the three wires with respect to the plane of the page is ..... .



	Wire (P)	Wire (Q)	Wire (R)
(a)	to the right	to the right	to the left
(b)	to the left	to the right	to the right
(c)	to the right	to the left	to the left
(d)	to the left	to the left	to the right

9 When using a magnet with plane poles in the moving-coil galvanometer, the magnetic flux that cuts the coil during its rotation ..... .

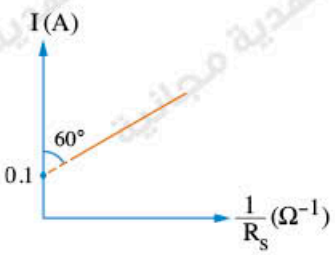
(a) is variable

(b) its lines always make an angle of 45° with the plane of the coil

(c) its lines are always perpendicular to the plane of the coil

(d) its lines are always parallel to the plane of the coil

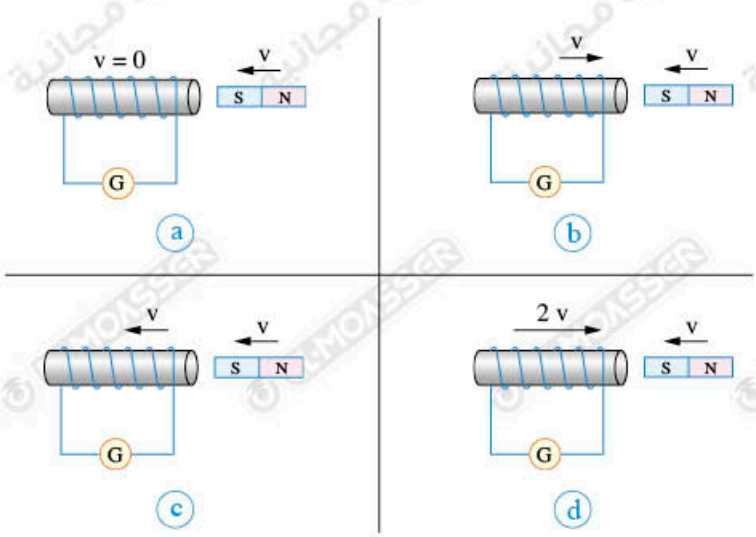
10 The opposite graph represents the relation between the maximum current intensity (I) measured by an ammeter and the reciprocal of the shunt resistance $\left(\frac{1}{R_s}\right)$ connected in parallel with the galvanometer coil. The resistance of the galvanometer equals ..... .



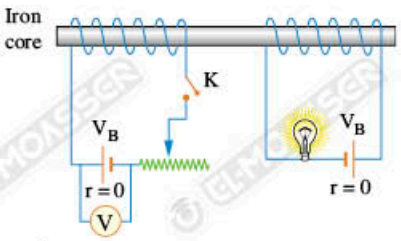
(Where both quantities are represented on the axes with the same scale)

(a) 1.73 Ω (b) 17.3 Ω (c) 0.577 Ω (d) 5.77 Ω

11 A magnet, a solenoid, and a galvanometer were used to perform Faraday's electromagnetic induction experiments. The experiment was carried out four times, moving the magnet and the coil at different speeds as shown in the four figures. Then the galvanometer pointer will have the maximum deflection in figure ..... .



12 Two adjacent coils are wound on an iron core as shown in the figure. At the moment of closing switch K .....



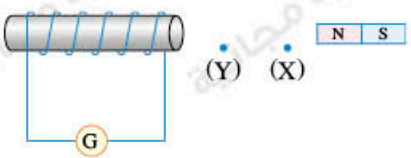
(a) The bulb's brightness increases, and the voltmeter reading remains constant.

(b) The bulb's brightness decreases, and the voltmeter reading increases.

(c) The bulb's brightness decreases, and the voltmeter reading decreases.

(d) The bulb's brightness decreases, and the voltmeter reading remains constant.

13 In the opposite figure, when the magnet moves towards a solenoid at speed (v) from point (X) to point (Y), the galvanometer pointer deflects two divisions to the right of the zero point of the scale. If the experiment was repeated where the south pole is facing the coil and is moved at speed (2v) from point (X) to point (Y), then the galvanometer pointer deflects ..... of the zero point of the scale.



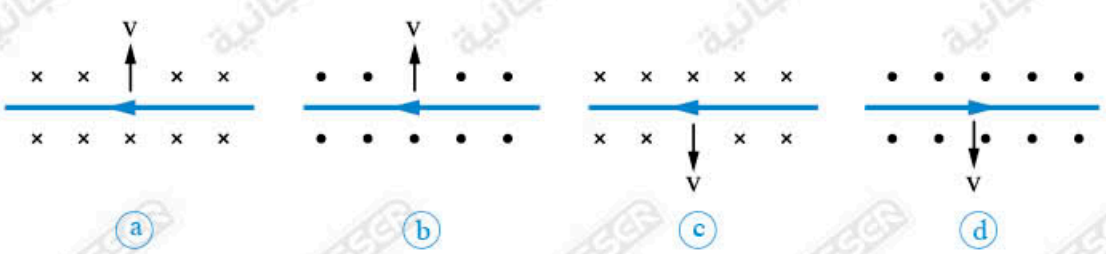
(a) two divisions to the right

(b) two divisions to the left

(c) four divisions to the right

(d) four divisions to the left

14 The following figures show four straight wires; each connected to a closed circuit and moving at speed (v) in a uniform magnetic field. In which of these figures is the direction of the induced current in the wire correct?



15 Eddy currents in the metallic core of an electric motor can be reduced by ..... .

(a) decreasing the resistance of the metallic core

(b) dividing the metallic core into insulated disks

(c) increasing the rotation speed of the motor's coil

(d) using an alternating current source instead of a direct current source

16 An electric transformer raises the voltage from 120 V to 10^3 V and decreases the current from 10^3 A to 110 A. The electrical power lost through it is ..... .

(a) 5×10^3 W (b) 5×10^4 W (c) 10^3 W (d) 10^4 W

17 The efficiency of a transformer is 80% , it means that ..... .

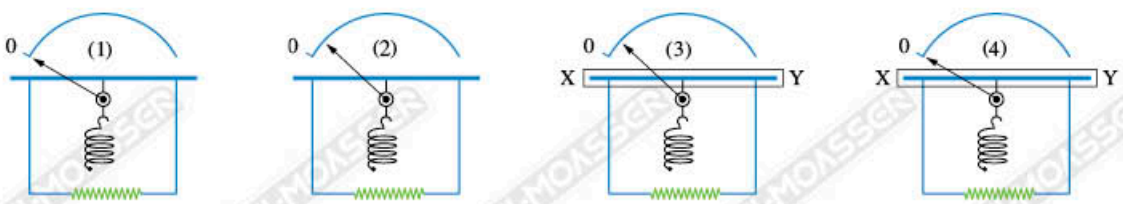
(a) the power lost in the transformer is 80%

(b) the electric power in its primary coil is 20% of the electric power in its secondary coil

(c) the power lost in the transformer is 20%

(d) the electric power in its secondary coil is 20% of the electric power in its primary coil

18 In a country characterized by very hot weather, a student wanted to use a hot-wire ammeter located in a non-air-conditioned school laboratory.

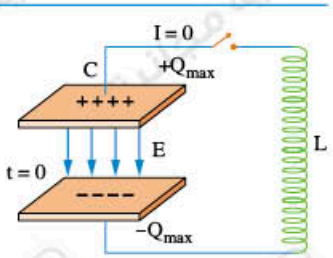


Which two figures correctly show the position of the hot-wire ammeter's pointer at the laboratory's room temperature?

(Given that: (XY) is a strip of material that has the same thermal expansion coefficient as the platinum-iridium wire)

(a) 2, 4 (b) 1, 3 (c) 2, 3 (d) 1, 4

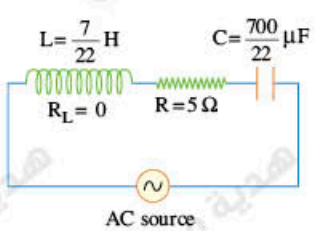
19 In the circuit shown in the figure, during a quarter of a cycle of the current, starting from the moment of closing the switch, an electromotive force (emf) is induced in the coil ..... .



(a) in the backward direction (b) of constant magnitude

(c) that increases with time (d) in the forward direction

20 In the opposite electric circuit, at what frequency of the source will the potential difference across the inductor (V_L) equal the potential difference across the capacitor (V_C) ?



(a) 90 Hz (b) 60 Hz

(c) 50 Hz (d) 70 Hz

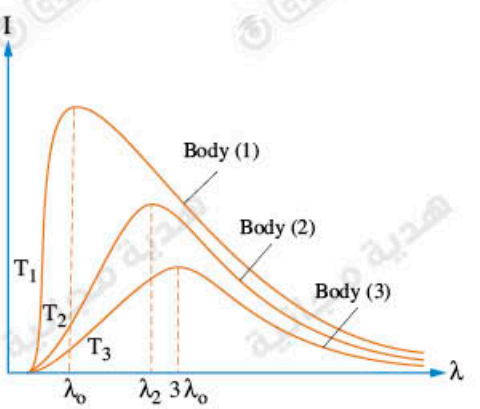
21 In the Compton phenomenon, when a gamma ray photon collides with a free electron moving at speed (v), then :

	The momentum of the scattered photon	The momentum of the electron after collision
(a)	Increases	Decreases
(b)	Decreases	Remains constant
(c)	Decreases	Increases
(d)	Decreases	Decreases

22 Photon (x) has a frequency of 9.375×10^{14} Hz and photon (y) has a frequency of 1.25×10^{15} Hz. The ratio of $\left(\frac{P_{Lx}}{P_{Ly}}\right)$ equals ..... .

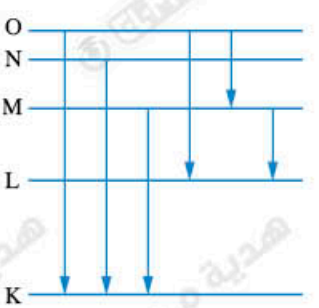
(a) $\frac{9}{2}$ (b) $\frac{2}{9}$ (c) $\frac{3}{4}$ (d) $\frac{4}{3}$

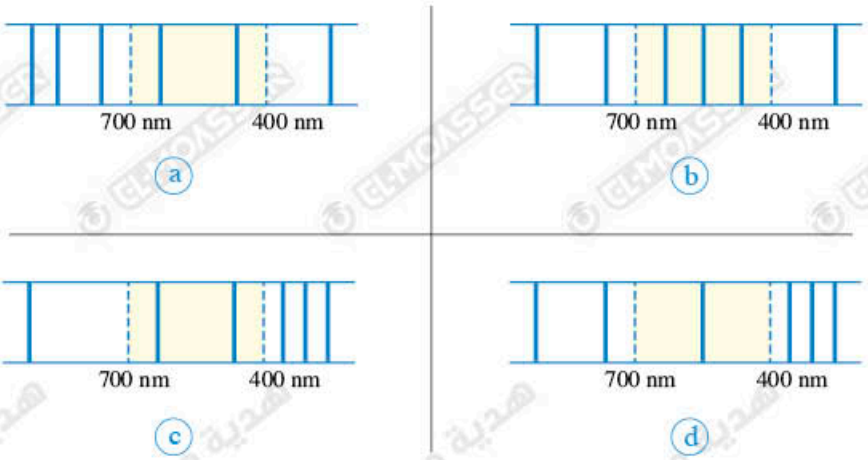
23 The figure represents the relation between the radiation intensity (I) emitted from three identical hot bodies and the wavelength (λ) of the radiation (Planck's distribution). If $T_2 = \frac{9\,T_3}{7}$ and the wavelength associated with the maximum radiation intensity emitted from bodies (1) and (3) is λ_o , $3\,\lambda_o$ respectively, then the wavelength associated with the maximum radiation intensity emitted from body (2) equals ..... .



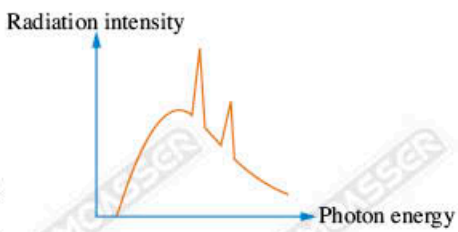
(a) $\lambda_2 = \frac{9\,\lambda_o}{7}$ (b) $\lambda_2 = \frac{7\,\lambda_o}{3}$ (c) $\lambda_2 = \frac{12\,\lambda_o}{5}$ (d) $\lambda_2 = \frac{11\,\lambda_o}{4}$

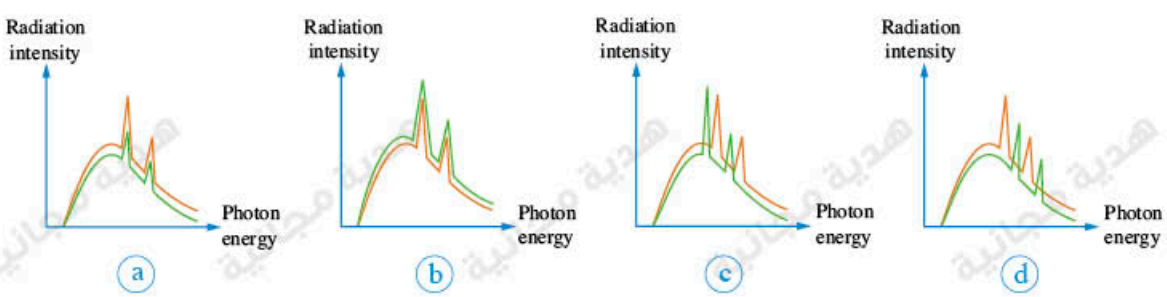
24 The diagram shows six possible transitions for an electron between energy levels of a hydrogen atom. Each transition between two energy levels emits a photon of a certain energy and frequency. Which of the following line spectra corresponds to the transitions shown in the diagram, given that the direction of increasing the spectral frequency is from left to right?





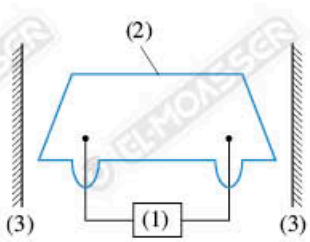
25 The opposite graph shows the relation between the radiation intensity (I) of X-rays and the energy of photons produced from a Coolidge tube. If the target material is replaced by another with a lower atomic number while keeping the potential difference between the cathode and anode constant, which of the following graphs could represent the resulting spectrum?





26 The opposite diagram represents a (helium-neon) laser device. Which of the components shown in the figure is responsible for the amplification process?

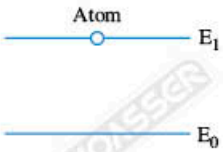
(a) Component (1)
(b) Component (3)
(c) Components (1), (2)
(d) Components (1), (3)



27 The appropriate energy source in a ruby laser is ..... .

(a) electrical (b) chemical (c) optical (d) thermal

28 The opposite figure shows an excited atom in energy level E_1. Which of the following statements correctly describes the stimulated emission from this atom?



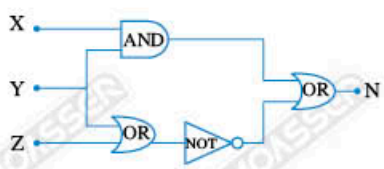
(a) The atom transitions spontaneously from energy level E_1 to energy level E_0, emitting a photon of energy $(E_1 - E_0)$.

(b) A photon of energy $(E_1 - E_0)$ falls on the excited atom, forcing it to emit a photon of energy greater than $(E_1 - E_0)$ and the atom absorbs the incident photon.

(c) A photon of energy $(E_1 - E_0)$ falls on the excited atom, forcing it to emit a photon of energy equal to $(E_1 - E_0)$ in phase with the incident photon.

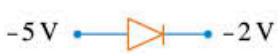
(d) A photon of energy $(E_1 - E_0)$ falls on the excited atom, forcing it to emit a photon of energy less than $(E_1 - E_0)$ in phase with the incident photon.

29 In the logic gates circuit shown in the figure, which of the following choices gives an output (N) equal to (0)?



	X	Y	Z
(a)	0	1	0
(b)	1	1	0
(c)	1	1	1
(d)	0	0	0

30 The diode shown in the figure acts as ..... .



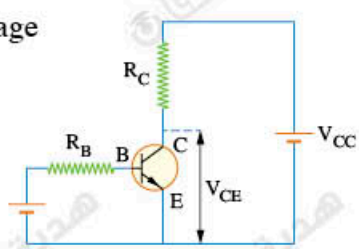
(a) a switch in the (on) position

(b) a DC source

(c) an amplifier

(d) a switch in the (off) position

31 ✱ The figure represents a npn transistor circuit. If ($R_C = 5000\ \Omega$, $R_B = 2000\ \Omega$) and the current gain ($\beta_e = 60$), and the signal voltage at the base was 12 mV, then the potential difference across the collector resistance equals ..... .



(a) 0.667 V

(b) 1 V

(c) 1.5 V

(d) 1.8 V

32 The resistivity of a pure germanium crystal can be increased by ..... .

(a) adding pentavalent impurity atoms

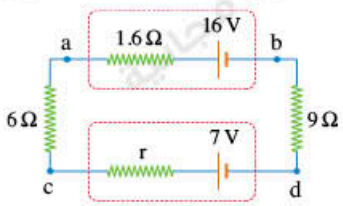
(b) decreasing its temperature

(c) applying high-frequency radiation on it

(d) adding trivalent impurity atoms

Second Choose the correct answer 33 : 44 — 2 Marks

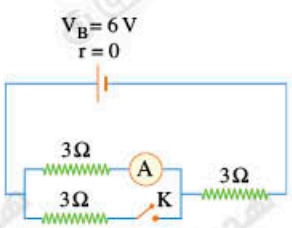
33 In the electric circuit shown in the opposite figure, if the potential difference between points (a) and (b) equals 15.2 V, then the value of both the internal resistance (r) and the potential difference between points (c) and (d) respectively are ..... .



(a) 1.4 Ω, 7.7 V (b) 1.4 Ω, 7.8 V

(c) 0.7 Ω, 7.7 V (d) 2.8 Ω, 8.4 V

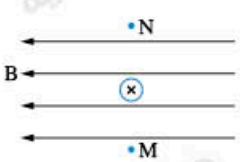
34 In the electric circuit shown in the opposite figure, the ratio between the ammeter readings before and after closing switch (K) respectively is ..... .



(a) $\frac{3}{2}$ (b) $\frac{2}{3}$

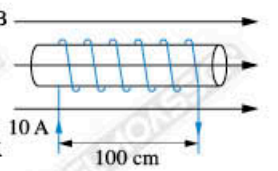
(c) $\frac{4}{3}$ (d) $\frac{3}{4}$

35 In the opposite figure, a long straight wire carries an electric current of intensity 25 A whose direction is perpendicular into the page. The wire is placed in a uniform magnetic field of flux density 3×10^{-3} T in the direction shown in the figure. The magnitude and the direction of the magnetic force acting on a unit length of the wire are ..... .



	The magnitude	The direction
(a)	0.075 N/m	towards N
(b)	0.15 N/m	towards M
(c)	0.075 N/m	towards M
(d)	0.15 N/m	towards N

36 A solenoid of length 100 cm and number of turns is 100 turns carries an electric current of intensity 10 A. If an external uniform magnetic field of flux density (B = 0.04 T) is applied parallel to its axis and its direction is as shown in the opposite figure, the resultant magnetic flux density at the midpoint of the coil's length on its axis is ..... .



(Given that: the magnetic permeability of the core = 0.002Wb/A.m)

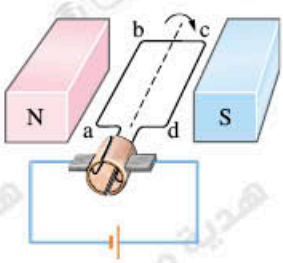
(a) 2.04 T (b) 1.96 T (c) 2.0004 T (d) zero

37 A circular coil of 50 turns carrying a current of intensity 1.4 A has its axis aligned with the Earth meridian lines, whose density is 5×10^{-5} T at the center of the coil. If the coil is flipped, the total magnetic flux density at the center of the circular coil becomes twice what it was initially, so the radius of the coil equals ..... .

(Given that: The magnetic field arising from the passage of current in the circular coil at its center is greater than the Earth meridian field at the center of the coil, the magnetic permeability of the coil's core = 12.56×10^{-7} Wb/A.m)

(a) 2.93 m (b) 8.8 m (c) 0.88 m (d) 0.293 m

38 You have a DC electric motor consisting of a single coil that started its motion from the position parallel to the magnetic flux lines as shown in the figure. After this coil rotates by an angle of 60° with the direction of clockwise rotation from the shown position, then:



(a) the magnetic torque remains constant.

(b) the magnetic force acting on side (bc) becomes half its maximum value.

(c) the magnetic torque becomes $\frac{\sqrt{3}}{2}$ of its maximum value.

(d) the magnitude of the magnetic force acting on side (ab) remains constant.

39 A uniformly wound solenoid with 60 turns and a self-induction coefficient of 0.2 H. If 8 turns are cut off from it, then the self-induction coefficient of the coil becomes ..... .

(a) 3.55 mH (b) 26.67 mH

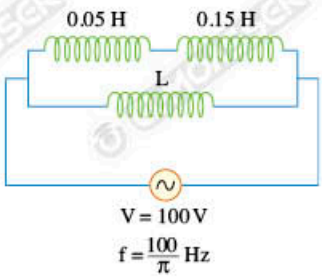
(c) 1502.22 mH (d) 173.33 mH

40 Among the processes in which alternating current is NOT suitable for use directly is ..... .

(a) electrolysis (b) heating

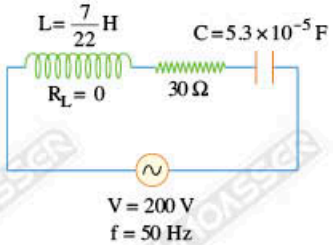
(c) operating an air conditioner (d) lighting lamps

41 Three inductors of negligible ohmic resistance are connected together to an AC source having an effective voltage of 100 V and frequency $\frac{100}{\pi}$ Hz as shown in the opposite figure. If the maximum value of the electric current passing in the circuit equals $5\sqrt{2}$ A, and by ignoring the mutual induction between these coils, then the self-induction coefficient (L) equals ..... .



(a) 0.5 H (b) 0.1 H
(c) 0.2H (d) 0.4 H

42 The opposite figure shows an RLC AC circuit. The effective value of the source voltage in it is 200 V and its frequency is 50 Hz. Using the data shown on the figure, the effective value of the current passing through the circuit approximately equals ..... .

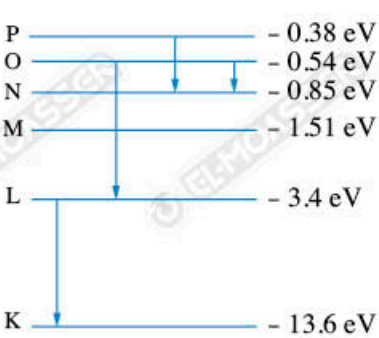


(a) 8 A (b) 2 A (c) 4 A (d) 6 A

43 In an electron microscope, when increasing the potential difference between the cathode and anode from 20 kV to 80 kV, the associated wavelength of the electron beam's motion ..... .

(a) quadruples (b) decreases to its quarter
(c) halves (d) doubles

44 The opposite figure shows some possible transitions for an electron between the energy levels of a hydrogen atom. Which of these transitions results in the emission of a photon with a wavelength of 4343.3 Å ?
(Given that: $e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^{8}$ m/s , $h = 6.625 \times 10^{-34}$ J.s)



(a) Transition from (O) to (N) (b) Transition from (P) to (N)
(c) Transition from (L) to (K) (d) Transition from (O) to (L)

Third **Answer the following questions 45 & 46** — 2 Marks

45 Two adjacent coils (A) and (B), their number of turns are 100 turns and 200 turns respectively. If an electric current of intensity 2 A passes through coil (A), it produces a magnetic flux in coil (A) of 3×10^{-4} Wb, and in coil (B) of 1.5×10^{-4} Wb. **Find :**

(1) The mutual inductance coefficient between the two coils.

(2) The average induced emf in coil (B) during the vanishing of the current in coil (A) within 0.1 s.

.....

.....

46 A milli-ammeter whose coil resistance is 50 Ω has its pointer reach the end of its scale if a current of intensity 1 mA passes through it. It is desired to modify it into an ohmmeter by using an electric cell of an electromotive force of 2 V and negligible internal resistance. **Calculate:**

(1) The value of the standard resistance required to be used.

(2) The resistance that is connected between the ohmmeter terminals to make the milli-ammeter pointer deflect to $\frac{1}{6}$ of its scale.

.....

.....

Exam 6

Answered

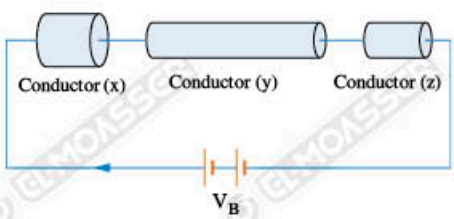
Questions signed by ✱ are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

1 Two wires (x) , (y) made of the same material, the ratio between their lengths is $\frac{\ell_x}{\ell_y} = \frac{4}{3}$ and the ratio between their cross-sectional diameters is $\frac{D_x}{D_y} = \frac{2}{3}$. If the two wires are connected in an electric circuit, and the potential difference across wire (x) equals the potential difference across wire (y), then the ratio between the current intensity passing through wire (x) and the current intensity passing through wire (y) equals .....

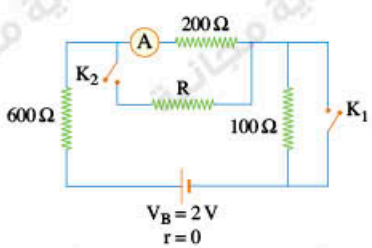
(a) $\frac{16}{27}$ (b) $\frac{8}{9}$ (c) $\frac{1}{2}$ (d) $\frac{1}{3}$

2 ✱ The figure shows an electric circuit containing a battery of negligible internal resistance and three conductors (x), (y), (z) made of the same material. The relation between their lengths was ($2\ell_x = 2\ell_z = \ell_y$) and the relation between their cross-sectional diameters was ($D_x = 2D_y = 2D_z$). Then, the ratio between the potential differences across these conductors ($V_x : V_y : V_z$) respectively is .....



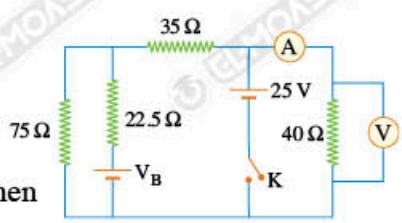
(a) 1:2:1 (b) 1:4:2 (c) 1:8:4 (d) 4:8:1

3 ✱ The figure shows an electric circuit. If the reading of the ammeter (A) does not change when both switches (K_1) and (K_2) are closed together, then the value of the resistance R equals .....



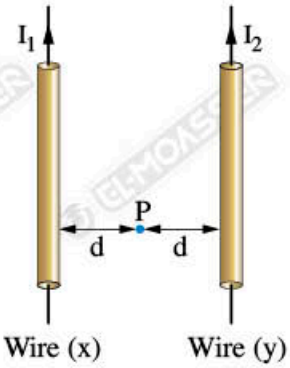
(a) 800 Ω (b) 900 Ω
(c) 1200 Ω (d) 1000 Ω

4 In the electric circuit shown in the figure, if the internal resistances of the batteries are negligible and the reading of the voltmeter (V) equals 15 V, then the value of the electromotive force (V_B) and the reading of the ammeter when closing the switch (K) respectively are .....



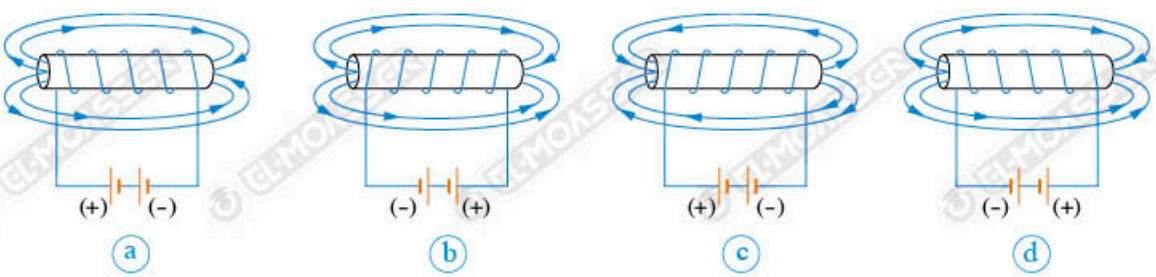
(a) 40 V , 0.25 A (b) 15 V , 0.375A
(c) 45 V , 0.625 A (d) 25 V , 0.75 A

5 The figure shows two long, parallel metallic wires (x), (y) carrying electric currents (I_1), (I_2) respectively. If the total magnetic flux density at point (P) equals B, and the magnetic flux density arising from the current of wire (x) is greater than the magnetic flux density arising from the current of wire (y), and when reversing the direction of the current passing through wire (y), the total magnetic flux density at the same point became 3 B, then the ratio of $\frac{I_1}{I_2}$ equals .....



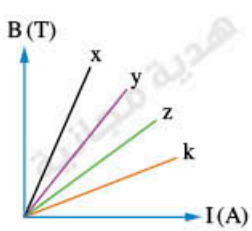
(a) $\frac{3}{1}$ (b) $\frac{2}{1}$ (c) $\frac{3}{2}$ (d) $\frac{1}{1}$

6 Which of the following figures correctly describes the direction of the magnetic field arising from the passage of an electric current in a solenoid ?



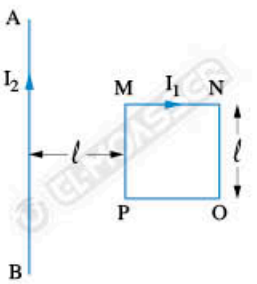
(a) (b) (c) (d)

7 Four solenoids (x), (y), (z), (k), each carry an electric current. The opposite graph represents the relation between the magnetic flux density (B) at the midpoint of each coil's length on its axis and the intensity of the electric current (I) passing through the coil. If the following choices show the specifications of the four coils, which of them belongs to coil (x) ?



	The number of turns	The length of the solenoid
(a)	N	ℓ
(b)	N	2ℓ
(c)	2 N	ℓ
(d)	2 N	3ℓ

8 A square-shaped coil (MNOP) free to move consists of one turn and carries an electric current of intensity I_1. A fixed long straight wire (AB) carrying a current of intensity I_2 is placed near it in the same plane as shown in the opposite figure. If the magnitude of the resultant magnetic forces acting on the wire (AB) equals F, then by studying the following statements:



(I) The magnitude of the mutual magnetic force between the wire AB and side MP equals 2F.

(II) The magnitude of the mutual magnetic force between the wire AB and side NO equals F.

(III) The coil rotates in the counterclockwise direction.

(IV) The coil moves closer to the straight wire.

Which statements of the previous are correct ?

(a) (I), (II), (IV) only (b) (I), (II) only

(c) (II), (IV) only (d) (I), (II), (III), (IV)

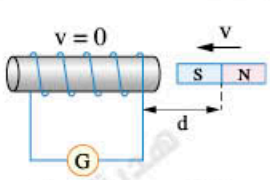
9 ✻ Two galvanometers (A), (B). Galvanometer (A) requires the flow of a current of intensity 50 mA in its coil for its pointer to deflect to the end of its scale which is divided into 15 divisions, while galvanometer (B) requires the flow of a current of intensity 80 mA in its coil for its pointer to deflect to the end of its scale divided which is into 20 divisions. If the angle between every two successive divisions is the same for both galvanometers, then the ratio of galvanometer (A) sensitivity to the galvanometer (B) sensitivity equals .....

(a) $\frac{5}{6}$ (b) $\frac{6}{5}$ (c) $\frac{1}{1}$ (d) $\frac{4}{3}$

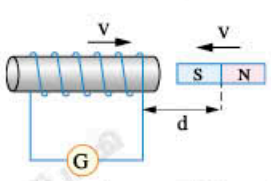
10 A moving coil galvanometer whose coil resistance is R_g measures a maximum potential difference V_g. When connecting the coil of the galvanometer to a resistance R in series, it converts into a voltmeter of range V_1 and when connecting the coil of the same galvanometer to a resistance 2R in series, it converts into a voltmeter of range V_2, then:

(a) $V_2 = V_1 - 2V_g$ (b) $V_2 = 2V_1 - V_g$ (c) $V_2 = 2V_1 + V_g$ (d) $V_2 = 2V_1$

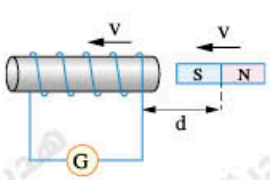
11 The following figures show four experiments (A), (B), (C), (D) to study the electromagnetic induction experiment, in each of them either the magnet, the coil, or both move at a uniform speed.



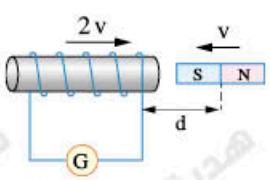
Experiment (A)



Experiment (B)



Experiment (C)



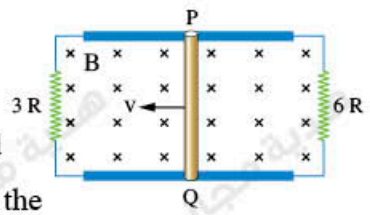
Experiment (D)

Which of the following represents the relation between the galvanometer pointer's deflection angles in the four experiments ?

(a) $\theta_C > \theta_D > \theta_B > \theta_A$ (b) $\theta_C > \theta_A = \theta_D > \theta_B$

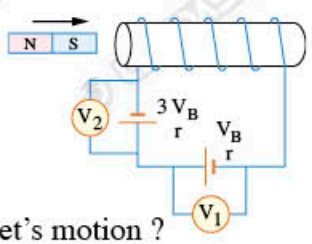
(c) $\theta_D > \theta_B > \theta_A > \theta_C$ (d) $\theta_D > \theta_C > \theta_A > \theta_B$

12 ✳ The figure shows the motion of a metal conductor (PQ) of length (ℓ) and resistance R at a speed (v) on two metallic rails of negligible resistance in a uniform magnetic field of flux density (B) perpendicular to the page and directed inwards. So, an induced current of intensity (I) passes through the conductor (PQ). Then the acting force (F) on the wire which is required to make it move at a uniform speed (v) equals .....



(a) $\frac{B^2 \ell v}{R}$ (b) $\frac{B \ell^2 v}{3R}$ (c) $\frac{B^2 \ell^2 v}{2R}$ (d) $\frac{B^2 \ell^2 v}{3R}$

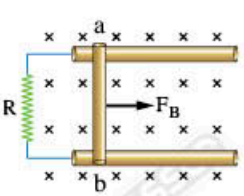
13 ✳ The figure shows a magnet moving in the direction indicated by the arrow towards a solenoid connected to two batteries. An average induced electromotive force of magnitude (V_B) was generated in the coil. What happens to the readings of the two voltmeters (V_1), (V_2) respectively immediately upon the magnet's motion ?



(a) Increases, Increases (b) Increases, Decreases

(c) Decreases, Increases (d) Decreases, Decreases

14 A metal conductor (ab) moves at uniform speed on two metallic rails perpendicularly to a uniform magnetic field. An induced current passes through the conductor and a magnetic force (F_B) is produced whose direction is as shown in the figure. Then the direction of the induced current in the closed loop is .....



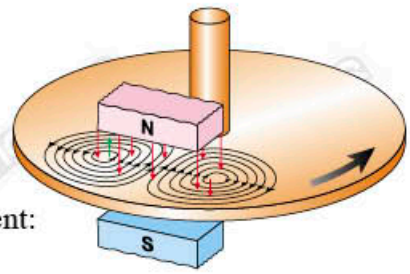
(a) in the clockwise because the potential at point (a) is higher than the potential at point (b)

(b) in the clockwise because the potential at point (a) is lower than the potential at point (b)

(c) in the counterclockwise because the potential at point (a) is higher than the potential at point (b)

(d) in the counterclockwise because the potential at point (a) is lower than the potential at point (b)

15 A solid metal disk rotates at a constant angular velocity (ω) neglecting the friction forces. When applying a magnetic field to the disk during its rotation as shown in the opposite figure, a slowing down of the disk's rotation was observed. Below are three statements related to this experiment:



(1) As the disk's rotation slows down, its temperature rises.

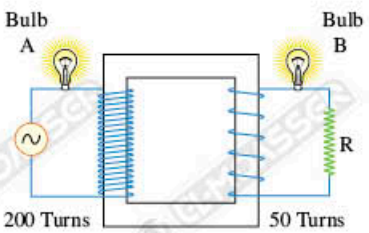
(2) The disk's rotation slows down due to the generation of eddy currents in it.

(3) The disk's rotation slows down at a greater rate if the disk is made of an insulating material.

Which statements of the previous are correct?

(a) Statement (1) only
(b) Statement (2) only
(c) Statements (2), (3)
(d) Statements (1), (2)

16 The figure represents an ideal electrical transformer. When replacing the AC source with a battery whose electromotive force equals the effective value of the AC source's voltage, then the brightness of the two bulbs A, B respectively .....

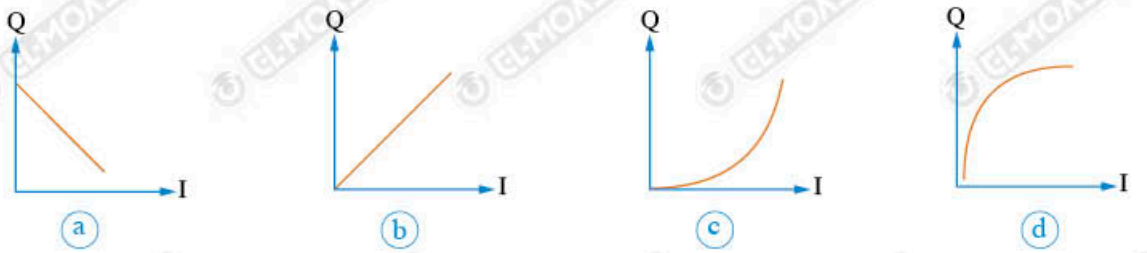


(a) increases, vanishes
(b) does not change, increases
(c) vanishes, vanishes
(d) does not change, vanishes

17 ✻ An electric transformer has an efficiency of 90% and the ratio between the number of its coils turns $\left(\frac{N_P}{N_S} = \frac{2}{9}\right)$. It operates on an AC source with a maximum voltage of 157.13 V. An electric device operating as an ohmic resistance (R) was connected across the terminals of the secondary coil, so a current of effective value (I) passed in the secondary coil, and a power of 3000 W was drawn from the primary coil. Then the type of the electric transformer and the resistance of the device connected to its secondary coil respectively are .....

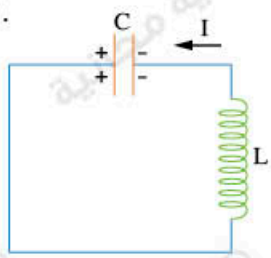
(a) step-up, 75 Ω
(b) step-up, 150 Ω
(c) step-down, 75 Ω
(d) step-down, 150 Ω

18 In the hot-wire ammeter, which of the following graphs illustrates the relation between the quantity of heat (Q) generated in the (platinum-iridium) wire during a certain time and the value of the current (I) passing through it?



(a) (b) (c) (d)

19 The figure shows an oscillating electric circuit at the moment $\left(t = \frac{T}{8}\right)$. If the direction of the current (I) passing in the circuit and the accumulated charge (Q) on the capacitor plates are as shown in the figure, what happens to the value of the current (I) passing through the circuit and the quantity of charge (Q) on the capacitor plates during the period from $\left(t = \frac{T}{8}\right)$ to $\left(t = \frac{T}{4}\right)$? (Given that: (T) is the periodic time of the current)



	The value of the current (I) in the circuit	The quantity of charge (Q) on the capacitor plates
(a)	Increases to a maximum value	Increases to a maximum value
(b)	Increases to a maximum value	Decreases to zero
(c)	Decreases to zero	Increases to a maximum value
(d)	Decreases to zero	Decreases to zero

20 In an RLC circuit where its components are connected in series, if the potential difference across each component is ($V_R = V_L = V_C = V_{source}$), then when removing the inductor from the circuit, the potential difference across the resistance R becomes .....

(a) $\sqrt{2}\, V_{source}$ (b) $\frac{V_{source}}{\sqrt{2}}$ (c) V_{source} (d) $\frac{V_{source}}{2}$

21 An X-ray photon of wavelength 1.4×10^{-10} m collided with a free electron, so the kinetic energy of the electron increased after the collision by an amount of 3.98×10^{-17}J. Then the wavelength of the X-ray photon after the collision equals .....

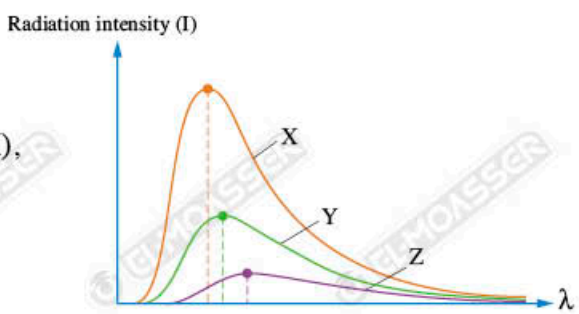
(Given that: $h = 6.625 \times 10^{-34}$ J.s , $c = 3 \times 10^{-8}$ m/s)

(a) 1.48 Å (b) 1.46 Å (c) 1.43 Å (d) 1.44 Å

22 A photon (x) has energy E, momentum P, and the wavelength of its radiation λ. Then the energy and the momentum of another photon (y) from electromagnetic radiation whose wavelength is shorter than λ are .....

	The energy of photon (y)	The momentum of photon (y)
(a)	Less than E	Less than P
(b)	Less than E	Greater than P
(c)	Greater than E	Less than P
(d)	Greater than E	Greater than P

23 The graph represents the relation between the intensity of electromagnetic radiation (I) and the wavelength (λ) for three glowing bodies (X), (Y), (Z). Which of the following statements is correct?



(a) The temperature of body (X) is the highest among the three bodies

(b) The temperature of body (Y) is the highest among the three bodies

(c) The temperature of body (Z) is the highest among the three bodies

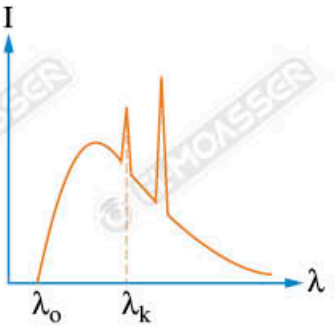
(d) The three bodies have the same temperature

24 ✳ According to Bohr's model for the hydrogen atom, if the ratio between the diameter of the second orbit to the diameter of the third orbit equals $\frac{4}{9}$ and the velocity of the electron orbiting in the second orbit of the hydrogen atom is v_2, and the velocity of the electron orbiting in the third orbit of the hydrogen atom is v_3. Which of the following relations is correct regarding the electron's velocities in the two orbits?

(a) $v_2 = \frac{2}{3} v_3$ (b) $v_2 = \frac{4}{9} v_3$

(c) $v_2 = \frac{3}{2} v_3$ (d) $v_2 = \frac{9}{4} v_3$

25 The graph shows the relation between the radiation intensity (I) of X-rays emitted from a Coolidge tube and its wavelength (λ). When the potential difference is increased between the filament and the target, the difference between the values of λ_o , λ_K ..... .



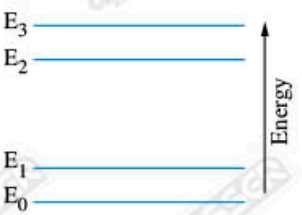
(a) increases

(b) decreases

(c) does not change

(d) becomes zero

26 The diagram shows four energy levels for the atoms of the active medium in a laser. If the level (E_2) is the only metastable energy level in this atom, then the choice that can represent the lifetime for the atoms in the energy levels (E_1), (E_2), (E_3) is ..... .



	Level (E_1)	Level (E_2)	Level (E_3)
(a)	10^{-8} s	10^{-6} s	10^{-8} s
(b)	10^{-3} s	10^{-3} s	10^{-8} s
(c)	10^{-2} s	10^{-3} s	10^{-8} s
(d)	10^{-8} s	10^{-3} s	10^{-9} s

27 Which of the following reasons makes the radiation intensity of the light emitted from a laser source of power 5 mW greater than the radiation intensity of the light emitted from a lamp of power 5 W at a certain point far away from both sources by a large distance (d)?

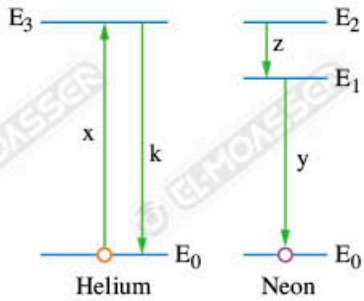
(a) The dispersion of the lamp's light is limited

(b) The dispersion of the laser's light is limited

(c) The laser light is monochromatic

(d) The lamp's light is monochromatic

28 The opposite figure shows some transitions x, y, z and k in a helium – neon laser. The correct sequence of these transitions is .....



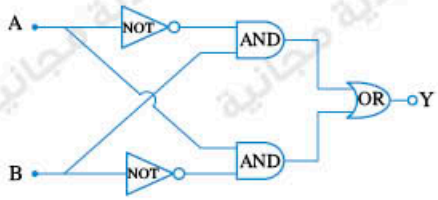
(a) k ⟶ y ⟶ z ⟶ x

(b) x ⟶ y ⟶ z ⟶ k

(c) x ⟶ k ⟶ z ⟶ y

(d) z ⟶ y ⟶ x ⟶ k

29 Which of the following choices is equivalent to the set of logic gates present in the opposite figure?

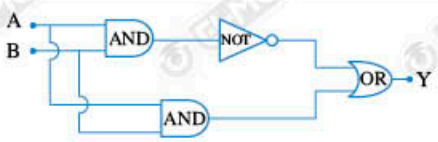




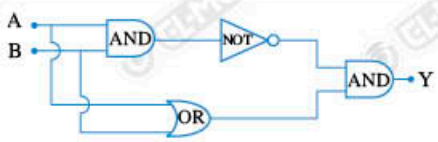
(a)



(b)

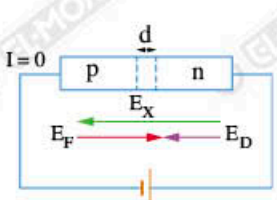


(c)

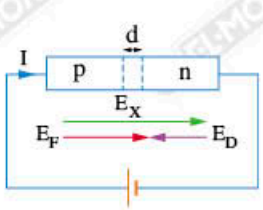


(d)

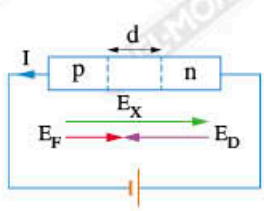
30 A p-n junction (diode) is connected to an external DC source in a closed circuit. Which of the following choices correctly shows the direction of the conventional current (I), the thickness of the depletion region (d), and the directions and intensities of the electric field arising from the battery (E_X), the internal electric field (E_D), and the resultant net electric field (E_F) affecting the p-n junction? (Assume that: the junction's resistance in the reverse bias is infinity)



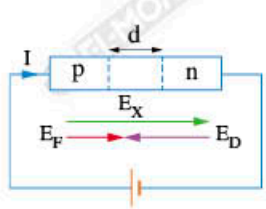
(a)



(b)

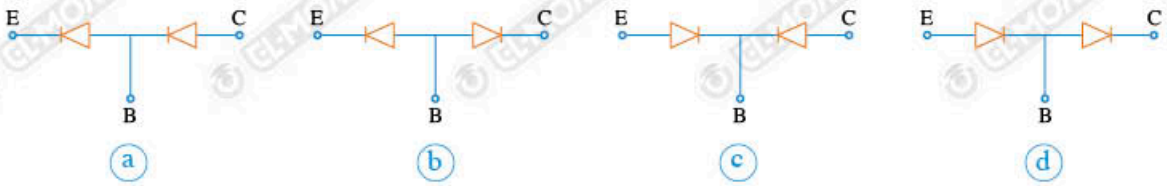


(c)



(d)

31 An npn transistor can be considered equivalent to two diodes connected together. Which of the following figures is the correct equivalent shape for the npn transistor?

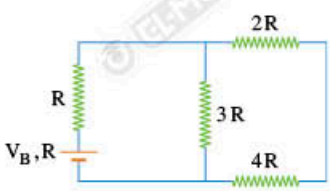


32 Two identical pure germanium crystals (A), (B) were doped with pentavalent impurity atoms at concentrations of 10^{20} cm^{-3} and 3×10^{20} cm^{-3} respectively. If the concentration of holes in crystal (A) equals 9×10^{12} cm^{-3} at a certain temperature, then the concentration of holes in crystal (B) at the same temperature equals .....

(a) 11×10^{12} cm^{-3} (b) 9×10^{12} cm^{-3} (c) 7×10^{12} cm^{-3} (d) 3×10^{12} cm^{-3}

Second Choose the correct answer 33 : 44 — 2 Marks

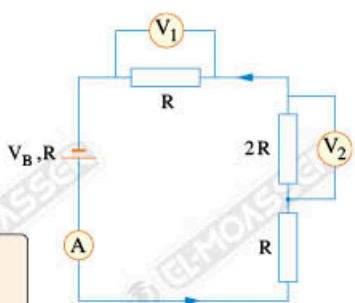
33 In the opposite electric circuit, a group of different electric resistors is connected together with a battery having internal resistance R. Which of the following relations is correct regarding the potential differences across the external resistors?



(a) $V_{3R} = 3\ V_R = 3\ V_{2R} = 1.5\ V_{4R}$ (b) $V_{3R} = 3\ V_R = 1.5\ V_{2R} = 0.75\ V_{4R}$

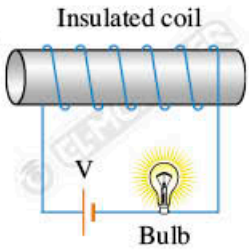
(c) $V_{3R} = 2\ V_R = V_{2R} = V_{4R}$ (d) $V_{3R} = 2V_R = 3\ V_{2R} = 1.5\ V_{4R}$

34 The opposite figure represents an electric circuit consists of a group of resistors connected together with a battery of internal resistance R. When adding an electric resistance of value (2R) in parallel with the resistance (2R), then .....



	Voltmeter reading (V_1)	Voltmeter reading (V_2)	Ammeter reading (A)
(a)	Remains constant	Decreases	Remains constant
(b)	Decreases	Increases	Decreases
(c)	Increases	Decreases	Increases
(d)	Decreases	Increases	Increases

35 An inductor of negligible ohmic resistance is connected in series with an electric bulb of ohmic resistance R and a battery of electromotive force V and negligible internal resistance. The current passing in the circuit was (I) and the power consumed in the bulb was P_w. When connecting an AC source of effective voltage V instead of the battery, the current passing in the circuit was 0.75 I. Then the power consumed in the bulb and the phase angle between the total voltage and the current in this case respectively are .....



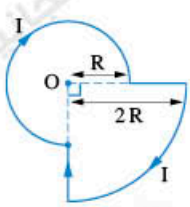
(a) $\frac{9\,P_w}{16}$, 41.41° (b) $\frac{9\,P_w}{16}$, 36.89° (c) $\frac{3\,P_w}{4}$, 48.6° (d) $\frac{3\,P_w}{4}$, 41.41°

36 ✳ A copper wire with a resistance per unit length of 0.01 Ω/m, is wound into a solenoid of length 20 cm consisting of 400 turns, each with a radius of 1 cm. If the terminals of the solenoid are connected to a battery of negligible internal resistance and an electric current passes through it, producing a magnetic field of flux density 0.01 T at the midpoint of the solenoid along its axis, then the electromotive force (emf) of the battery equals .....

(Given that: $\mu = 4\,\pi \times 10^{-7}$ Wb/A.m)

(a) 1 V (b) 4 V (c) $\frac{1}{16\,\pi}$ V (d) $\frac{1}{80\,\pi}$ V

37 A metal wire of length (ℓ) is shaped as shown in the opposite figure and an electric current of intensity (I) passes through it. Then the total magnetic flux density and its direction at the center (O) respectively are .....



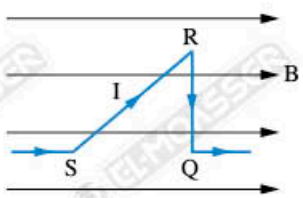
(a) $\frac{7\,\mu I}{16\,R}$, Perpendicular to the page inwards

(b) $\frac{5\,\mu I}{16\,R}$, Perpendicular to the page inwards

(c) $\frac{7\,\mu I}{16\,R}$, Perpendicular to the page outwards

(d) $\frac{5\,\mu I}{16\,R}$, Perpendicular to the page outwards

38 A straight wire of length (ℓ) carrying an electric current of intensity (I) was reshaped to form the opposite figure and then placed in a uniform magnetic field of flux density (B). If you know that the length of the part (QR) equals 0.3 ℓ and it is affected by a magnetic force of magnitude 0.3 BIℓ, while the length of the part (SR) equals 0.6 ℓ and the angle enclosed between the two parts is 60°.Then the magnitude and the direction of the magnetic force acting on the part (SR) respectively are .....



(a) 0.6 BIℓ, into the page
(b) 0.3 BIℓ, into the page
(c) 0.52BIℓ , out of the page
(d) 0.3 BIℓ, out of the page

39 Four inductors of negligible ohmic resistance **x**, y, z & k have self-inductance coefficients of 2μ H, 4μ H, 2 μH, 1 μH respectively. If the following procedures are performed on them:

(I) Increasing the current value in coil (**x**) from 1 A to 2 A during 0.5 s.

(II) Decreasing the current value in coil (y) from 3 A to zero during 2 s.

(III) Passing a current of constant intensity equal to 4 A in coil (z).

(IV) Increasing the current value in coil (k) from zero to 4 A during 0.25 s.

Then the correct order of the coils according to the induced potential difference across each of them is .....

(a) y > z > x > k
(b) k > y > x > z
(c) k > x > z > y
(d) z > x > y > k

40 In the electric motor, the number of coils is increased and the split cylinder is divided longitudinally into a number of insulated segments equal to twice the number of coils ..... .

(a) to make the coil rotate in one direction
(b) to maintain a roughly constant torque at the maximum value
(c) to make the coil continue rotating
(d) to make the coil rotate at an increasing speed

41 When connecting a group of identical inductors of zero ohmic resistance together in series with an AC source of frequency $\frac{100}{\pi}$ Hz, the total inductive reactance was 240 Ω and when connecting them together in parallel with the same source, the total inductive reactance was 15 Ω. Then the number of coils and the self-inductance coefficient of one coil respectively are .....

(a) 16 coils, 75 mH
(b) 4 coils, 150 mH
(c) 4 coils, 300 mH
(d) 16 coils, 150 mH

42 An AC source of frequency $\frac{100}{\pi}$ Hz and its effective voltage of 20 V is connected in series with an ohmic resistance of 3 Ω and a capacitor of capacitance 1250 μF. Then the maximum value of the electric charge on the capacitor plates is ..... .

(a) 0.020 C (b) 0.025 C (c) 0.028 C (d) 0.035 C

43 In the electron microscope, the electron beam was accelerated using a potential difference between the cathode and anode of 14 kV, so the wavelength associated with the electron beam's motion was λ. When using another potential difference of 224 kV, the wavelength associated with the electron beam's motion .....

(a) decreases to $\frac{1}{16}\lambda$ (b) decreases by $\frac{1}{4}\lambda$

(c) decreases by $\frac{3}{4}\lambda$ (d) decreases to $\frac{1}{2}\lambda$

44 When an electron of a hydrogen atom transitions from the third energy level to the second energy level, it emits a photon of wavelength λ. If the electron transitions from the fourth energy level to the third energy level, then the wavelength of the emitted photon will be .....

(a) $\frac{25}{16}\lambda$ (b) $\frac{16}{9}\lambda$ (c) $\frac{27}{20}\lambda$ (d) $\frac{20}{7}\lambda$

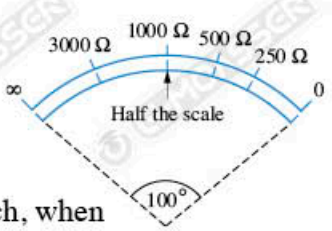
Third Answer the following questions 45 & 46 — 2 Marks

45 A long solenoid has a diameter of 0.1 m and its number of turns per unit length is 2000 turns/m. A circular coil consisting of 100 turns, diameter 0.02 m, and the resistance of its wire 10 π^2 Ω was placed at its center such that its axis coincides with the axis of the solenoid. If the intensity of the current passing through the solenoid is decreased at a constant rate from 4 A to zero during a time interval of 0.5 s, **calculate** the total induced charge in the circular coil that flows through a cross-section of its wire during this period. (Given that: magnetic permeability $\mu = 4\pi \times 10^{-7}$ Wb/A.m)

.....

.....

46 The opposite figure represents an ohmmeter scale diagram, and the angle between the pointer's positions at readings (0) and (∞) equals 100°. Using the data on the figure:



(1) Explain why the ohmmeter's scale is non-uniform.

(2) Calculate the value of the unknown (external) resistance which, when connected across the ohmmeter terminals, makes the galvanometer pointer deflect by an angle of 15° from the infinity position.

.....

.....

Exam 7

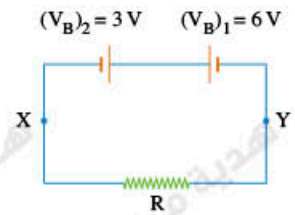
Answered

Questions signed by ✻ are answered in detail.

First Choose the correct answer 1 : 32

1 Mark

1 In the opposite electric circuit, which of the following choices expresses the relationship between the electric potentials of points (X) and (Y)?



(a) The electric potential of point (X) is greater than the electric potential of point (Y)

(b) The electric potential of point (X) is less than the electric potential of point (Y)

(c) The electric potential of point (X) equals the electric potential of point (Y)

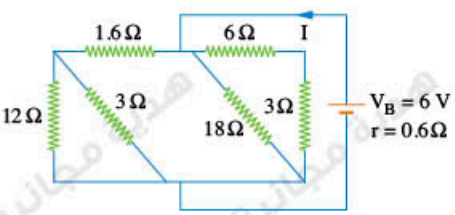
(d) The electric potential of point (X) and the electric potential of point (Y) are zero

2 A wire has length ℓ and electric resistance R as shown in the figure. If it is stretched uniformly until its length becomes three times its original length, then the electric resistance of the wire becomes .....



(a) 3R (b) 6R (c) 9R (d) 12R

3 In the electric circuit shown in the figure, the current intensity (I) equals .....

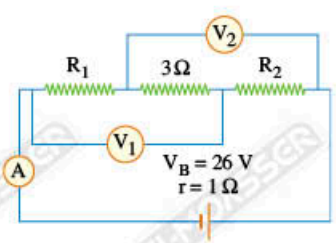


(a) 1 A (b) 1.5 A

(c) 2 A (d) 2.4 A

4 In the electric circuit, if the reading of voltmeter $V_1 = 14$ V and the reading of voltmeter $V_2 = 16$ V, which of the following choices is correct?

(Given: The ohmic resistance of the voltmeters is infinite and the ammeter resistance is negligible)

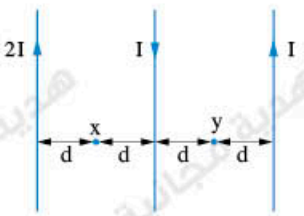


	Ammeter reading (A)	Value of resistance (R_1)	Value of resistance (R_2)
(a)	1 A	8 Ω	10 Ω
(b)	1 A	3 Ω	5 Ω
(c)	2 A	4 Ω	5 Ω
(d)	2 A	8 Ω	10 Ω

5 A long straight wire carries an electric current (I). If you know that the magnetic flux density at a point whose perpendicular distance from the wire's axis is (d) equals (B), then the magnetic flux density at another point whose perpendicular distance from the wire's axis is $\left(\frac{4d}{3}\right)$ is ..... .

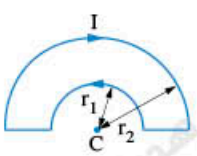
(a) less than (B) by 75%
(b) less than (B) by 25%
(c) greater than (B) by 75%
(d) greater than (B) by 25%

6 Three very long parallel wires are placed in the plane of the page, and each carries an electric current whose intensity and direction are as shown in the figure. The direction of the resultant magnetic field at points x and y is .....



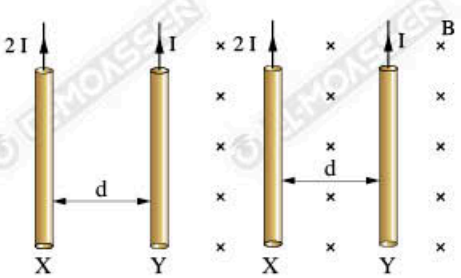
	At point (x)	At point (y)
(a)	Perpendicular to the page inwards	Perpendicular to the page inwards
(b)	Perpendicular to the page inwards	Perpendicular to the page outwards
(c)	Perpendicular to the page outwards	Perpendicular to the page outwards
(d)	Perpendicular to the page outwards	Perpendicular to the page inwards

7 In the shown figure, a wire of uniform cross-section is bent into two semi-circular rings having a common center (C) with radii (r_1) and (r_2), and each carries an electric current of intensity (I). The resultant magnetic flux density (B) at point (C) is calculated from the relation ..... .



(a) $B = \frac{\mu I}{2}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$
(b) $B = \frac{\mu I}{2}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$
(c) $B = \frac{\mu I}{4}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$
(d) $B = \frac{\mu I}{4}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$

8 ✱ Figure (1) shows two parallel straight wires (X) and (Y) carrying electric currents 2I and I respectively, so the mutual magnetic force between the two wires equals F. So, when the two wires are placed in an external magnetic field of flux density (B) as shown in Figure (2), the resultant magnetic force acting on wire (X) becomes zero. Then the resultant magnetic force acting on wire (Y) becomes .....



(a) 0.5 F
(b) F
(c) 1.5 F
(d) 2 F

9 When an electric current of intensity 250 μA passes through a moving-coil galvanometer, the angle of deflection of its pointer from the zero position was 15°. The sensitivity of the galvanometer equals ..... .

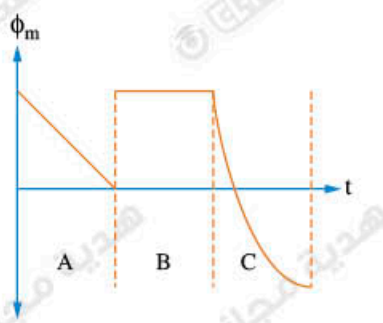
(a) 0.06 deg/μA (b) 0.12 deg/μA

(c) 0.18 deg/μA (d) 0.24 deg/μA

10 A galvanometer with a coil resistance of 100 Ω has its scale divided into N divisions. If a current of intensity I passed through it, its pointer deflected to the end of its scale and when a resistance of 20 Ω was connected in parallel with the galvanometer coil to convert it into an ammeter, where the same current intensity I passed through the ammeter, its pointer deflected for only two divisions. Then the number of divisions of the galvanometer's scale (N) equals ..... .

(a) 2 (b) 6 (c) 12 (d) 24

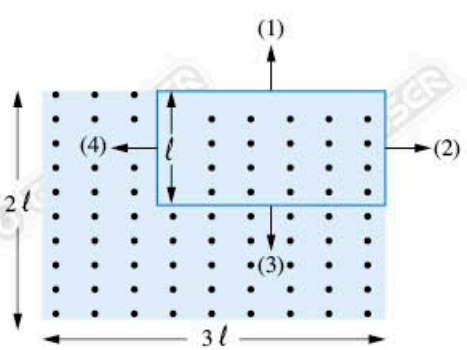
11 A metallic ring is penetrated by a changing magnetic flux. The opposite graph represents the relationship between the magnitude of the magnetic flux (ϕ_m) penetrating the ring and the time (t). The time interval during which an induced current, whose value gradually decreases, passes through the ring is interval ..... .



(a) A (b) B

(c) C (d) A, B

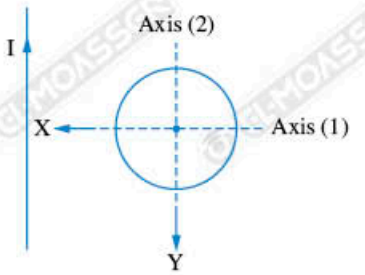
12 A metallic frame of width ℓ and length 2ℓ is placed perpendicularly to a uniform magnetic field bounded by the region shown in the figure, so the direction in which, if the frame is moved a distance ℓ during time t, the largest average induced electromotive force gets generated, is .....



(a) direction (1) (b) direction (2)

(c) direction (3) (d) direction (4)

13 A metallic ring and a long straight wire are placed in the same plane where an electric current of intensity I passes through the wire as shown in the opposite figure. How the ring can be moved so that no induced electromotive force is generated in it?



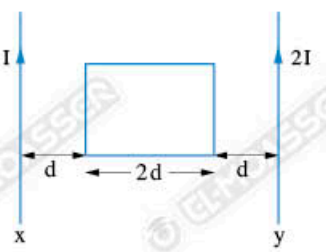
(a) Rotated about axis (1)

(b) Rotated about axis (2)

(c) Moved in its plane in direction (X)

(d) Moved in its plane in direction (Y)

14 In the shown figure, a metallic frame and two long straight wires (x) and (y) are all in the same plane, where both wires carry electric currents, so the direction of the current induced in the metallic frame, if the current vanishes during time t in .....



	Wire (x)	Wire (y)
(a)	Clockwise	Clockwise
(b)	Counterclockwise	Counterclockwise
(c)	Clockwise	Counterclockwise
(d)	Counterclockwise	Clockwise

15 A metal piece is placed in an alternating magnetic field. Which of the following correctly describes the relationship between the value of the induced eddy currents in that piece and the frequency of the magnetic field (assuming other factors remain constant)?

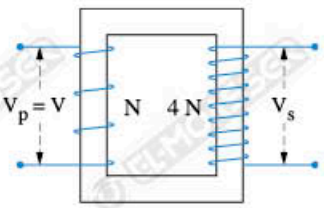
(a) With increasing frequency, the value of eddy currents decreases.

(b) With increasing frequency, the value of eddy currents remains constant.

(c) With increasing frequency, the value of eddy currents increases.

(d) There is no direct relationship between the frequency and the value of eddy currents.

16 The figure shows an ideal transformer, the potential difference across its primary coil is V, and when the circuit of its secondary coil is closed, a current of value I passes in the primary coil. If the number of turns of the primary coil is N and the number of turns of the secondary coil is 4N, then the value of both the potential difference across the secondary coil V_s and the current passing through it I_s is .....



	V_s	I_s
(a)	4 V	0.25 I
(b)	4 V	I
(c)	0.25 V	4 I
(d)	V	0.25 I

17 Two electrical transformers (X) and (Y) are identical, but transformer (X) uses an iron core made of thin insulated laminations, while transformer (Y) uses a solid iron core. Which of the following options best describes the efficiency of the two transformers?

(a) Transformer (Y) will be more efficient because the solid iron core provides a better magnetic path

(b) Transformer (X) will be more efficient because the laminated iron core reduces eddy currents

(c) The efficiency of both transformers will be identical due to the identical coils

(d) Transformer (Y) will be more efficient because the solid iron core reduces eddy currents

18 In the hot-wire ammeter, the quantity of heat generated in the Platinum-Iridium wire during a certain time as a result of an alternating electric current passing through it is directly proportional to .....

(a) The reciprocal of the square of the effective value of the potential difference across it

(b) The effective value of the current passing through it

(c) The maximum value of the current passing through it

(d) The square of the effective value of the potential difference across it

19 The current oscillates in an oscillating circuit with a frequency of 1 MHz. If the capacitance of the capacitor is 10 nF, the self-induction coefficient of the used coil is .....

(a) 2.53 μH (b) 25.3 μH (c) 253 μH (d) 2.53 mH

20 A radio device contains a wireless receiving circuit with an inductor and a variable capacitor to tune into different radio stations. If the self-inductance of the coil used in the tuning circuit is 1 mH, and the required frequency range is from 540 kHz to 1600 kHz, then the approximate range of the required capacitance must be .....

(a) from 10 pF to 87 pF (b) from 100 pF to 870 pF

(c) from 1 nF to 8.7 nF (d) from 10 nF to 87 nF

21 Which of the following is the main reason for the increase in the wavelength of the photon after its collision with a free electron in Compton effect?

(a) The transfer of part of the electron energy to the photon.

(b) The transfer of part of the photon energy to the electron.

(c) The decrease in the electron's mass after collision.

(d) The decrease in the photon's speed after collision.

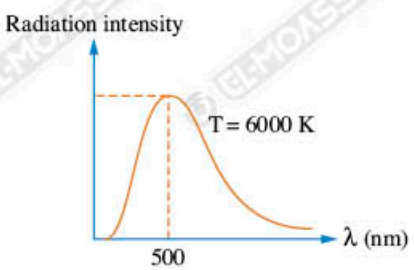
22 Two photons (A) and (B). If the wavelength of photon (A) is half the wavelength of photon (B), and the energy of photon (B) equals 3×10^{-19} J, then the equivalent mass of photon (A) equals .....

(Given that: $c = 3 \times 10^{8}$ m/s)

(a) 6.67×10^{-36} kg (b) 3.33×10^{-36} kg

(c) 2×10^{-27} kg (d) 1×10^{-27} kg

23 ✳ The opposite graph represents the relationship between solar radiation intensity and its emission wavelengths. If there is a metallic surface (x) of which the wavelength associated with the maximum radiation intensity emitted from it is 1 μm, then the temperature of this surface equals ..... .



(a) 300 K (b) 600 K (c) 3000 K (d) 6000 K

24 In the Bohr model of the hydrogen atom, the electron revolves around the nucleus in specific orbits. In the electron transition from a higher energy orbit to a lower energy orbit, it emits a photon (quantum of energy). What describes the relationship between the energy of this photon and its wavelength?

(a) The energy of the emitted photon is directly proportional to the square of its wavelength

(b) The energy of the emitted photon is not related to its wavelength

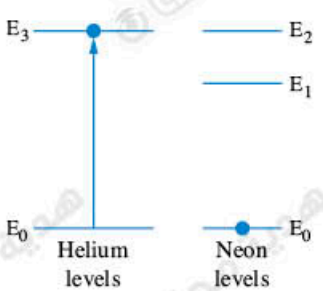
(c) As the energy of the emitted photon increases, its wavelength increases

(d) As the energy of the emitted photon increases, its wavelength decreases

25 An X-ray machine produces photons with a maximum energy of 20 keV. Under other conditions, the machine was set to produce photons with a maximum energy of 80 keV. What is the ratio between the shortest wavelength of photons in the second case compared to the shortest wavelength of photons in the first case?

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 2 (d) 4

26 Here is an energy level diagram for a (He-Ne) laser. Which of the following is true regarding the laser production process?



(a) Population inversion for Neon atoms occurs at energy level (E_1)

(b) A laser photon is emitted from the Neon atom and its energy equals ($E_2 - E_0$)

(c) Helium atoms excited to level (E_3) collide with Neon atoms in level (E_0)

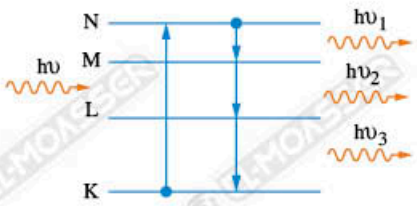
(d) Excited Helium atoms collide elastically with Neon atoms

27 In holography, if the phase difference between two laser waves after reflection from an object's surface equals π radians, and the wavelength of the used laser was 532 nm, what is the path difference between these two waves?

(a) 266 nm (b) 532 nm

(c) 1064 nm (d) 1596 nm

28 A hydrogen atom electron in energy level K absorbed a photon of energy E and frequency υ and transitioned to level N. After a certain time period, the electron dropped to level K passing through levels L and M as shown in the opposite figure, such that when the electron transitions:



- From level N to level M, a photon of frequency υ_1 is emitted
- From level M to level L, a photon of frequency υ_2 is emitted
- From level L to level K, a photon of frequency υ_3 is emitted

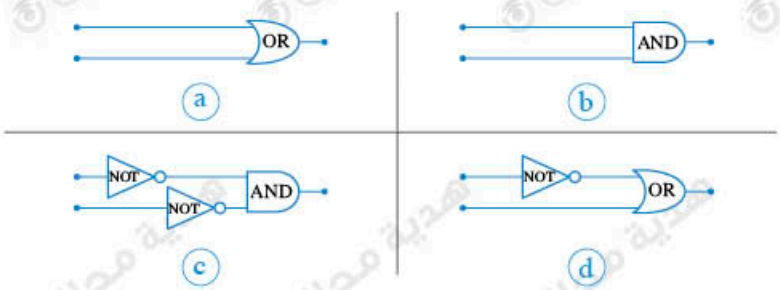
So, which of the following relationships correctly describes the relationship between the absorbed photon's frequency and the emitted photons' frequencies?

(a) $\upsilon > (\upsilon_1 + \upsilon_2 + \upsilon_3)$ (b) $\upsilon = \upsilon_1 + \upsilon_2 + \upsilon_3$

(c) $\upsilon < (\upsilon_1 + \upsilon_2 + \upsilon_3)$ (d) $\upsilon = \upsilon_2 + \upsilon_3 - \upsilon_1$

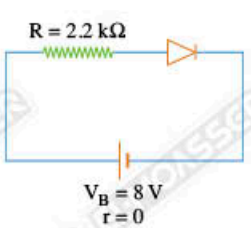
29 The figure shows a set of logic gates where the output is (0) when the input is as shown. Then part (G) could be .....





30 If a diode, a battery, and a resistor are connected in series as shown in the figure, then the potential difference across the resistor (R) equals .....

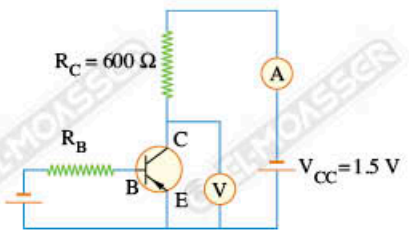
(Given: The resistance of the diode in forward bias is 0.211 kΩ, and in reverse bias is infinite)



(a) 8 V (b) 7.3 V

(c) 0.7 V (d) 0 V

31 In the opposite transistor circuit, if the ammeter reading is 1.5 mA, the voltmeter reading is .....



(a) 0 (b) 0.5 V
(c) 0.6 V (d) 0.7 V

32 In a pure silicon crystal, the holes concentration is 3.2×10^{9} cm^{-3}. When impurities from an element were added to it, the free electron concentration in it became 1.6×10^{13} cm^{-3}. The valence of the impurity atoms and the type of crystal after doping are ....., ...

(a) trivalent, p-type (b) trivalent, n-type
(c) pentavalent, p-type (d) pentavalent, n-type

Second Choose the correct answer 33 : 44 — 2 Marks

33 ✳ Figure (1) graphically represents the relationship between the electric current intensity (I) passing through the circuit shown in figure (2) and the value of the resistance taken from the rheostat (R_v). The electromotive force (V_B) of the battery equals .....

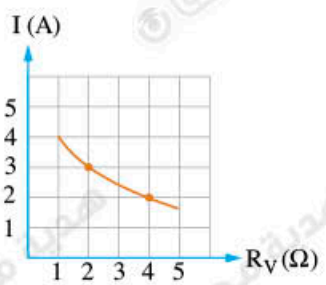


Figure (1)

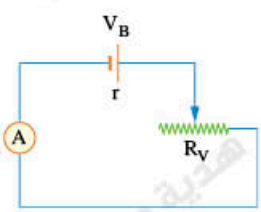
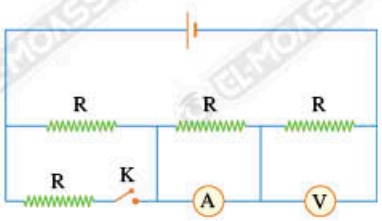


Figure (2)

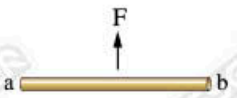
(a) 3 volts (b) 6 volts
(c) 12 volts (d) 24 volts

34 In the opposite electric circuit, if the voltmeter resistance is infinite and the ammeter resistance is negligible, what happens to both the ammeter reading and the voltmeter reading, respectively, upon closing the switch (K)?



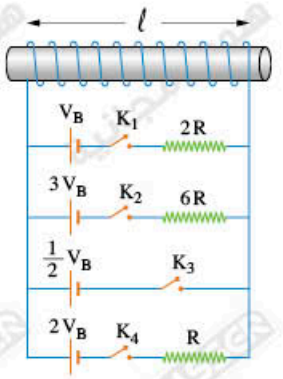
(a) Increases, Increases (b) Decreases, Decreases
(c) Decreases, Increases (d) Increases, Decreases

35 A metallic wire (ab) of length 1 m is in the plane of the page. A current of 2 A passes through it from end (a) to end (b). The magnitude and direction of the magnetic flux density required to be applied so that the wire get affected by a magnetic force of 0.2 N upwards in the plane of the page as shown in the figure, are ..... , ...



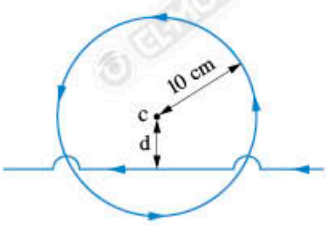
(a) 0.2 T, perpendicularly out of the page
(b) 0.2 T, perpendicularly into the page
(c) 0.1 T, perpendicularly out of the page
(d) 0.1 T, perpendicularly into the page

36 A solenoid of resistance (R) is embedded into an electrical circuit as shown in the opposite figure. The magnetic flux density at the midpoint of the coil's length on its axis is maximum after closing switch ..... only.



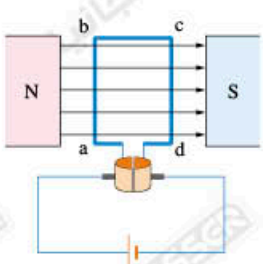
(a) K_1
(b) K_2
(c) K_3
(d) K_4

37 In the opposite figure, an insulated circular ring carries an electric current of intensity (I), and an insulated long straight wire carries an electric current of intensity (I), both in the same plane. If the resultant magnetic flux density at the center of the ring (c) is zero, then the distance (d) equals .....



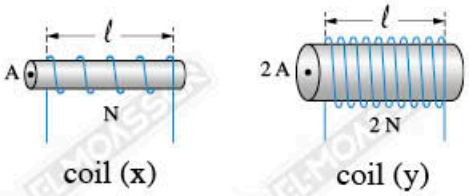
(a) 3.14 cm
(b) 6.28 cm
(c) 3.18 cm
(d) 5 cm

38 The figure represents a simple electric motor where the plane of its coil is parallel to the direction of the magnetic flux lines. Starting from the shown coil position, which of the following choices is correct?



	Reason for its start of rotation	Reason for its continuation of rotation after a quarter cycle
(a)	Torque	Inertia
(b)	Inertia	Torque
(c)	Inertia	Inertia
(d)	Torque	Torque

39 In the opposite figure, two coils (x) and (y) have the same length and are wound around an iron core. The number of turns and cross-sectional area of coil (y) is twice the number of turns and cross-sectional area of coil (x). The ratio between their self-inductance coefficients $\left(\frac{L_x}{L_y}\right)$ equals .....

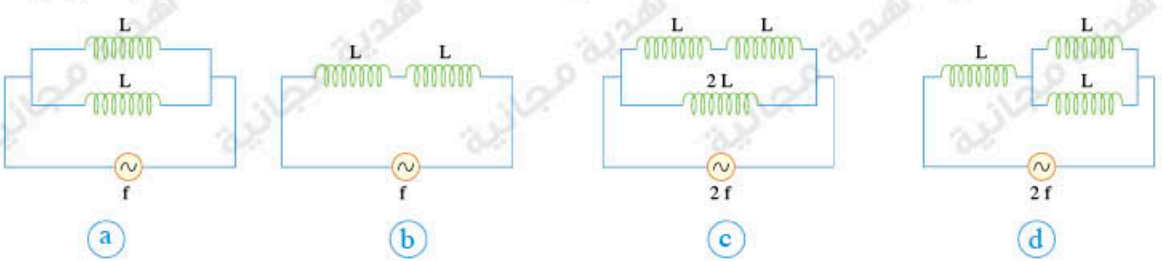


(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{8}$ (d) $\frac{1}{16}$

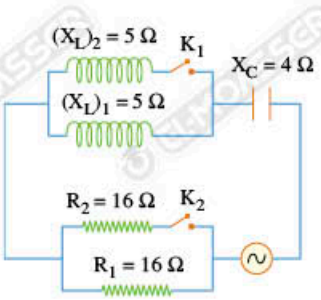
40 The following figures represent four electrical circuits, each with a resistance R, and the electrical sources in each have negligible internal resistance. The circuit in which the consumed power is the greatest is .....



41 In each of the following electrical circuits, an AC source is connected to a number of inductors. If the frequency of the source and the value of the self-inductance coefficient are as shown in the following figures, and the mutual inductance between the coils is negligible, in which of these circuits is the equivalent inductive reactance greatest?



42 In the shown alternating current circuit, if the resistance of the coils and the source is negligible, and the impedance of the circuit in the case of opening and closing both switches is Z_1 and Z_2 respectively, then the ratio $\left(\frac{Z_1}{Z_2}\right)$ approximately equals .....



(a) $\sqrt{2}$ (b) $\frac{\sqrt{2}}{2}$

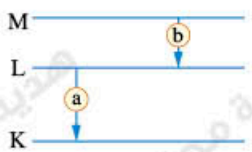
(c) 2 (d) $2\sqrt{2}$

43 If the wavelength associated with the motion of electrons in an electron microscope which is required to form an image of an object is 0.04 nm, then the potential difference required to be applied between the anode and cathode is .....

(Given that: $h = 6.625 \times 10^{-34}$ J.s, $e = 1.6 \times 10^{-19}$C, $m_e = 9.1 \times 10^{-31}$ kg)

(a) 942 V (b) 1884 V (c) 7536 V (d) 471 V

44 The figure represents two possible transitions for an electron in the hydrogen atom resulting in two photons with momenta $(P_L)_a$ and $(P_L)_b$, so the ratio $\frac{(P_L)_a}{(P_L)_b}$ is .....



(a) $\frac{4}{3}$ (b) $\frac{30}{7}$ (c) $\frac{54}{11}$ (d) $\frac{27}{5}$

Third **Answer the following questions 45 & 46** — 2 Marks

45 Two overlapping solenoids have the same length, the number of turns of each is 200, and the cross-sectional area of each is 4 cm^2. They are wound on an iron core with a magnetic permeability of 2×10^{-3} T.m/A. If the current intensity in one of them changes at a rate of 5 A/s, an induced electromotive force of 2 V is generated in the second one.

Calculate the length of one solenoid.

.....

.....

.....

46 The figure represents equal divisions on the scale of an ohmmeter that has been precisely calibrated and adjusted. When an unknown resistance (R_x) is connected across the ohmmeter terminals, its value can be calculated in terms of the current intensity passing through the device (I_x) from the relation $R_x = \left(\frac{7}{5I_x} - 2000\right)\ \Omega$. **Calculate:**



(1) The electromotive force of the battery used inside the ohmmeter device.

(2) The value of the unknown resistance (R_k) on the scale.

.....

.....

.....

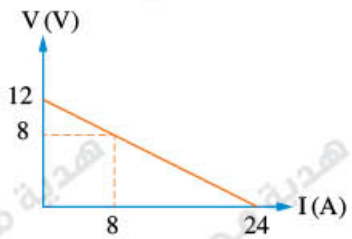
Exam 8

Answered

Questions signed by * are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

1 The graph represents the relationship between the potential difference (V) across a battery in an electric circuit and the intensity of the current (I) passing through it. The value of the internal resistance of the battery = ...

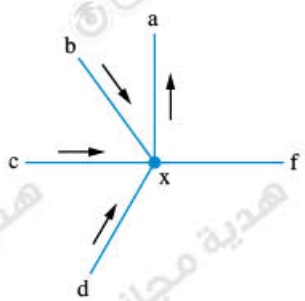


(a) 0.25 Ω (b) 0.5 Ω
(c) 1 Ω (d) 1.5 Ω

2 A copper wire of length 30 m, cross-sectional area 2×10^{-6} m^2, and resistivity 1.79×10^{-8} Ω.m. If the potential difference across its ends is 3 volts, then the electric current intensity passing through the wire = ...

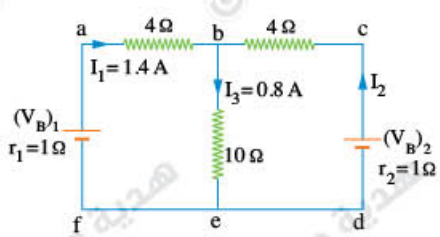
(a) 0.805 A (b) 1.240 A (c) 11.17 A (d) 0.089 A

3 In the figure, point (x) is the junction of several wires, each carrying an electric current, and the shown directions represent the direction of free electrons motion. The current intensities in the wires xa, xc, xd respectively are 6 A, 3 A, 15 A.
If 2.5×10^{19} electrons/second pass through a cross-section of wire xb, then the number of free electrons passing through a cross-section of wire xf and their direction of motion are .....
(Given: $e = 1.6 \times 10^{-19}$ C)



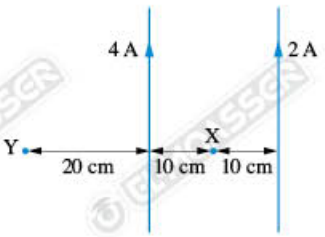
(a) 1×10^{20} electrons/second, from x to f
(b) 1×10^{20} electrons/second, from f to x
(c) 1.6×10^{19} electrons/second, from x to f
(d) 1.6×10^{19} electrons/second, from f to x

4 From the circuit shown in the figure,
the value of $(V_B)_2$ = ...



(a) 5 V (b) 8 V
(c) 12 V (d) 15 V

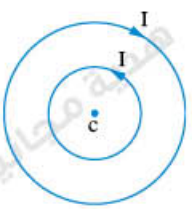
5 The opposite figure shows two straight parallel wires, each carrying an electric current. The ratio of $\frac{\text{the magnetic flux density at point (Y)}}{\text{the magnetic flux density at point (X)}}$ = ...



(a) $\frac{5}{4}$ (b) $\frac{4}{5}$

(c) $\frac{1}{4}$ (d) $\frac{3}{4}$

6 In the opposite figure, there are two coplanar concentric circular rings, each carrying an electric current of the same intensity (I). The magnetic flux density at the common center of the rings (c) .....



(a) equals zero

(b) has direction perpendicular to the plane of the rings, outwards.

(c) has direction perpendicular to the plane of the rings, inwards.

(d) has direction in the plane of the rings, downwards.

7 A straight wire was wound into a circular coil of 3 turns, and an electric current was passed through it. The magnetic flux density at its center was B_1. Then it was rewound into a circular coil of 10 turns and the same current intensity was passed through it. The magnetic flux density at its center was B_2. The ratio $\left(\frac{B_1}{B_2}\right)$ equals .....

(a) $\frac{3}{10}$ (b) $\frac{9}{100}$ (c) $\frac{10}{3}$ (d) $\frac{6}{20}$

8 A magnetic needle was placed horizontally between two long, vertical, parallel straight wires (x) and (y) at a distance of 6 cm from wire (y). When electric currents of intensities 2 A and 5 A respectively were passed through the two wires, the needle did not deflect from its direction. The distance between the two wires equals .....

(a) 8.4 cm (b) 2.4 cm (c) 6.6 cm (d) 3.6 cm

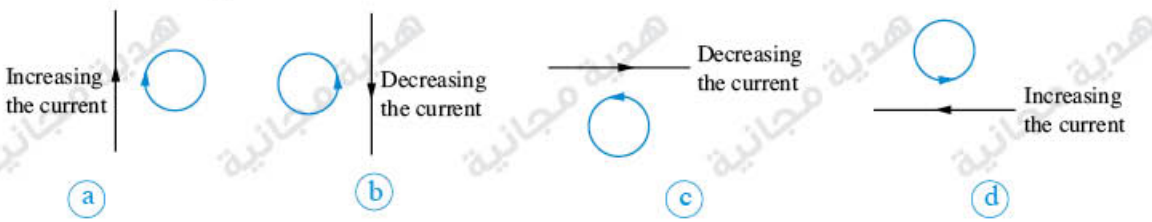
9 A straight wire was shaped into a single-turn circular coil and an electric current was passed through it. It was placed parallel to a uniform magnetic field, thus experiencing a magnetic torque (τ). If the wire was reshaped to form a circular coil of 3 turns, carrying the same current, and placed parallel to the same magnetic field, the magnetic torque acting on the coil becomes .....

(a) $3\,\tau$ (b) $\frac{\tau}{3}$ (c) $9\,\tau$ (d) $\frac{\tau}{9}$

10 What is the value of the shunt resistance that reduces the sensitivity of a galvanometer of resistance (R) to one-third?

(a) R (b) $\frac{R}{2}$ (c) $\frac{R}{3}$ (d) $\frac{R}{4}$

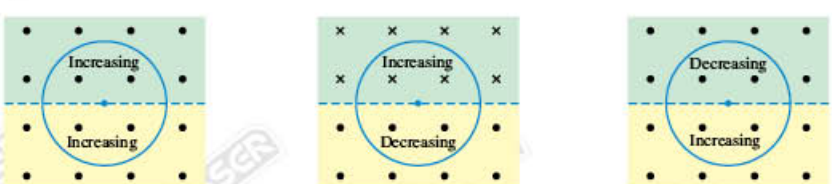
11 Which of the following choices represents the correct direction of the induced current in the metal ring due to the change in the intensity of the current passing through the wire shown in each figure?



12 A circular coil with a cross-sectional area of 0.045 m^2 and 150 turns is connected in a closed circuit with a total resistance of 0.9 Ω. If the plane of the coil is perpendicular to a uniform magnetic field of flux density 8×10^{-5} T, what is the amount of electric charge passing through the coil's wire when it rotates a quarter cycle about an axis in its plane during time (t)?

(a) 6×10^{-4} C (b) 7×10^{-4} C (c) 8×10^{-4} C (d) 9×10^{-4} C

13 Three metal rings (a), (b), and (c) were placed inside two magnetic field regions whose flux densities change increasingly or decreasingly at the same rate as shown in the following figures :



Ring (a) Ring (b) Ring (c)

Which ring does **not** have an induced electric current?

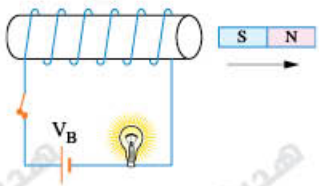
(a) Ring (a). (b) Ring (b).

(c) Ring (c). (d) The three rings.

14 A coil of 150 turns and area 48 cm^2 is placed perpendicularly to a uniform magnetic field of flux density 0.7 T. If the direction of the magnetic field is reversed within a time period of 0.15 s, the average induced electromotive force in the coil during that period equals .....

(a) 6.72 V (b) 0.1512 V (c) 3.36 V (d) 0 V

15 In the opposite figure, while moving the magnet in the indicated direction, an induced electromotive force less than (V_B) is generated in the coil. Then the illumination intensity of the lamp .....



(a) increases (b) decreases (c) becomes zero (d) remains the same

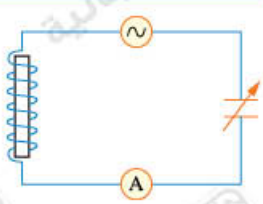
16 The unit (Henry.m^{-1}) is the measuring unit of .....

(a) magnetic permeability of the medium (μ)
(b) magnetic dipole moment (m_d)
(c) magnetic flux density (B)
(d) magnetic flux (ϕ_m)

17 If the time taken by the alternating current in a dynamo to reach from zero to the effective value for the first time is 9 ms, then the time required for the current to reach from zero to half the maximum value for the first time during the same cycle is .....

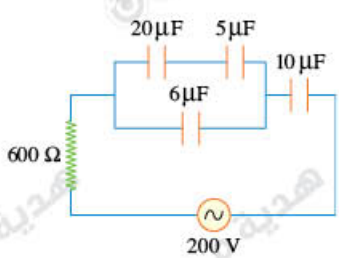
(a) 12 ms (b) 8 ms (c) 4 ms (d) 6 ms

18 The figure represents an RLC circuit in a state of resonance. When the iron core is removed from the coil, the reading of the hot-wire ammeter .....



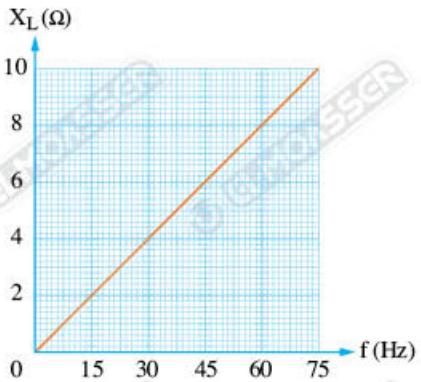
(a) increases (b) decreases
(c) remains constant (d) becomes zero

19 In the opposite figure, an alternating current (RC) circuit has a current of 0.2 A passing through it. The frequency of the source equals .....



(a) 33.8 Hz (b) 34.8 Hz
(c) 28.8 Hz (d) 39.8 Hz

20 The opposite graph represents the relationship between the inductive reactance (X_L) of a coil and the frequency (f) of the current passing through it.
So, the self-inductance of the coil equals .....



(a) 0.133 H
(b) 0.838 H
(c) 1.195 H
(d) 0.021 H

21 If an electron is accelerated so that its kinetic energy increases to nine times its original value, then the wavelength associated with the electron's motion ..... its original value.

(a) increases to 9 times
(b) increases to 3 times
(c) decreases to $\frac{1}{3}$
(d) decreases to $\frac{1}{9}$

22 A laser emits light with a wavelength of 200 nm. How many emitted laser photons have a total energy of 1 Joule?
(Given that: $c = 3 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ J.s)

(a) 8.32×10^{18}
(b) 1.01×10^{18}
(c) 1.36×10^{18}
(d) 9.95×10^{19}

23 In Compton effect, when a gamma-ray photon of wavelength (λ) falls on a free electron, the photon loses $\frac{1}{4}$ of its energy. The wavelength of the scattered photon will be .....

(a) λ
(b) $\frac{4}{3}\lambda$
(c) $\frac{3}{2}\lambda$
(d) 2λ

24 Which of the following transitions of a hydrogen atom electron produces a spectral line with the longest wavelength in the Balmer series?

(a) From level (3) to level (2).
(b) From level (3) to level (1).
(c) From level (7) to level (3).
(d) From level (7) to level (2).

25 The ratio of the longest wavelength in the Lyman series to the longest wavelength in the Balmer series in the hydrogen atom is .....

(a) $\frac{5}{27}$
(b) $\frac{3}{23}$
(c) $\frac{7}{27}$
(d) $\frac{9}{31}$

26 The schematic diagrams (1), (2), (3), and (4) represent the steps to obtain laser photons.



(1) (2) (3) (4)

So, the correct sequence of steps to obtain laser photons is .....

(a) 3 → 4 → 1 → 2 (b) 4 → 2 → 3 → 1

(c) 4 → 1 → 3 → 2 (d) 2 → 1 → 4 → 3

27 When producing a hologram using a laser beam of wavelength (λ), the path difference between two waves reflected from the object's surface was (1.5 λ), so the phase difference between them equals .....

(a) 2 π (b) 3 π (c) 4 π (d) 0.5 π

28 Laser is used in holography (3D imaging) because of .....

(a) the parallelism of its beams (b) the coherence of its photons

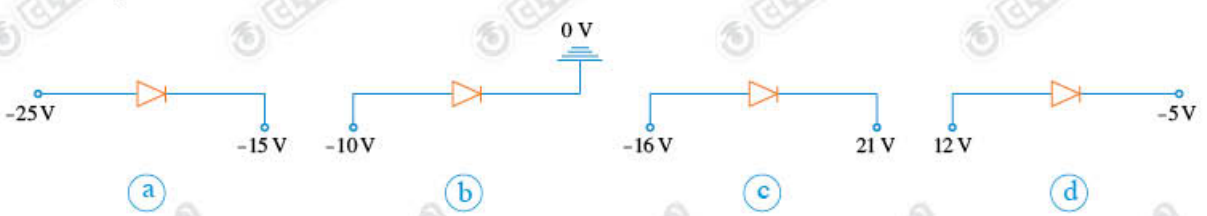
(c) its high intensity (d) its spectral purity

29 In an electrical circuit, a transistor was connected in a common-emitter configuration where $\beta_e = 27$, $R_C = 3\ k\Omega$, $V_{CC} = 7\ V$, $V_{CE} = 0.4\ V$, then the emitter current I_E = ...

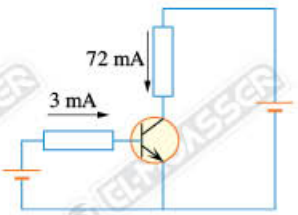
(a) 2.281 mA (b) 2.2 mA (c) 0.091 mA (d) 0.081 mA

30 The following figures show parts of closed electric circuits, each containing a semiconductor diode. In which of these figures does the diode allow electric current to pass through it?

(Assuming the resistance of the diode in forward bias is negligible and in reverse bias is infinite)



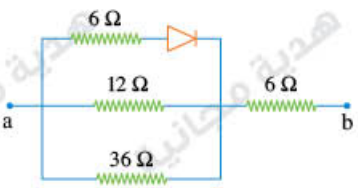
31 The figure shows a transistor circuit acting as a switch. By analyzing the figure and its data, determine whether the switch is closed (ON) or open (OFF) and what is the value of the current transfer ratio ratio (α_e)?



(a) 0.04, off (b) 0.96, off

(c) 0.04, on (d) 0.96, on

32 The figure shows a part of an electric circuit. If you know that the electric potential at point (a) is V_a and at point (b) is V_b, and V_b is greater than V_a, then the relation that determines the current intensity (I) passing through the 12 Ω resistance in terms of V_b and V_a is .....

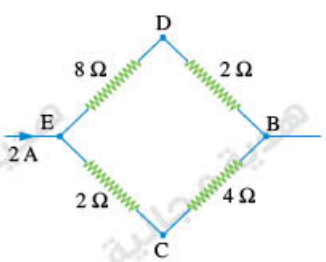


(Where: the resistance of the diode in case of forward connection is negligible and in case of reverse connection is infinity)

(a) $I = \frac{5\,(V_b - V_a)}{48}$ (b) $I = \frac{V_b - V_a}{32}$ (c) $I = \frac{V_b - V_a}{20}$ (d) $I = \frac{V_b - V_a}{15}$

Second Choose the correct answer 33 : 44 — 2 Marks

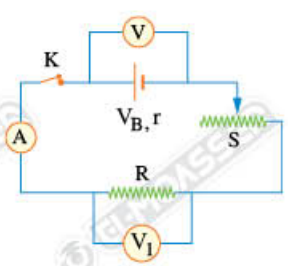
33 From the opposite figure, the potential difference between points C and D equals .....



(a) 6 V (b) 7.5 V

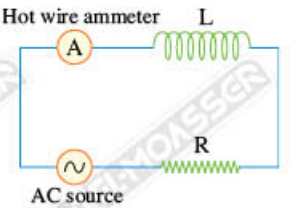
(c) 1.25 V (d) 3.5 V

34 In the shown electric circuit, what happens to the readings of the devices (A), (V), and (V_1) upon increasing the value of the variable resistance (S)?



	Ammeter Reading (A)	Voltmeter Reading (V)	Voltmeter Reading (V_1)
(a)	increases	increases	decreases
(b)	decreases	increases	decreases
(c)	remains constant	increases	decreases
(d)	decreases	remains constant	increases

35 In the opposite electric circuit, when a capacitor is connected in series in the circuit, the reading of the hot-wire ammeter did not change. What is the relationship between the capacitive reactance of the capacitor (X_C) and the inductive reactance of the coil (X_L)?



(a) $X_C = 2\,X_L$ (b) $X_C = 0.5\,X_L$

(c) $X_C = X_L$ (d) $X_C = \sqrt{2}\,X_L$

36 ✳ If the ohmmeter pointer deflects to $\frac{1}{4}$ of the current scale when a 6000 Ω resistance is connected across its terminals, what will its deflection be when a 3000 Ω resistance is connected across its terminals?

(a) $\frac{1}{2}$ of the current scale (b) $\frac{2}{7}$ of the current scale

(c) $\frac{1}{8}$ of the current scale (d) $\frac{2}{5}$ of the current scale

37 Two parallel straight wires carry electric currents, so the mutual magnetic force between them equals (F). If the current intensity in one of the wires is doubled and the perpendicular distance between them is reduced to half, the mutual magnetic force between the wires will be .....

(a) 2 F (b) 4 F (c) 8 F (d) F

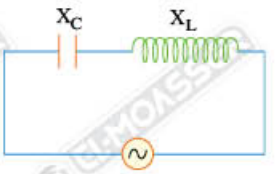
38 ✳ Two parallel straight wires each carries an electric current, and the neutral point was exactly midway between them. When the current passing through one of them is doubled, the neutral point is displaced by 3 cm towards one of the wires, so the distance between the wires = ...

(a) 6 cm (b) 9 cm (c) 12 cm (d) 18 cm

39 An AC dynamo whose instantaneous induced electromotive force is calculated from the relation V = 200 sin(18000 t). If its coil starts rotating from the perpendicular position, the time taken to reach (–100 V) for the first time is .....

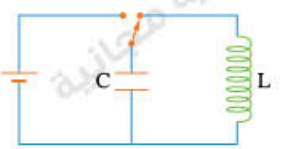
(a) $\frac{1}{600}$ s (b) $\frac{5}{600}$ s (c) $\frac{1}{100}$ s (d) $\frac{7}{600}$ s

40 In the opposite electric circuit, an AC source with variable frequency is used. At frequency (f), the inductive reactance (X_L) was twice the capacitive reactance (X_C). If the source frequency is reduced to ($\frac{f}{2}$), the ratio between the inductive reactance and the capacitive reactance $\left(\frac{X_L}{X_C}\right)$ becomes .....



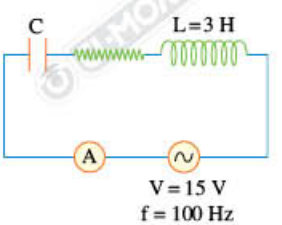
(a) 1 (b) 0.5 (c) 4 (d) 2

41 The figure shows an oscillating circuit containing an inductor and a capacitor of capacitance 300 μF. What is the self-inductance (L) of the coil required to obtain a current with a frequency of 60 Hz?



(a) 20.1 mH (b) 22.3 mH (c) 23.4 mH (d) 26.4 mH

42 In the opposite RLC circuit, if the reading of the hot-wire ammeter is 5 A and the ohmic resistance of the circuit = 3 Ω, then the capacitance of the capacitor (C) equals .....



(a) 8.44×10^{-7} F (b) 1.32×10^{-3} F (c) 6.21×10^{-9} F (d) 3.33×10^{-5} F

43 A high-energy photon with a wavelength of 1.2×10^{-12} m collided with a free electron, and the frequency of the scattered photon was 1.5×10^{20} Hz. The kinetic energy gained by the electron as a result of the collision is .....

(Given: $c = 3 \times 10^8$ m/s, $h = 6.625 \times 10^{-34}$ J.s)

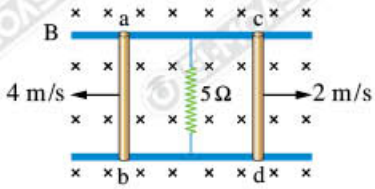
(a) 2.955×10^{-19} J (b) 8.752×10^{-16} J (c) 1.257×10^{-17} J (d) 6.625×10^{-14} J

44 In the Bohr model, if the energy of the third level in a hydrogen atom is E, then the energy of the fourth level is .....

(a) $\frac{9}{16}$ E (b) $\frac{3}{2}$ E (c) $\frac{2}{3}$ E (d) $\frac{16}{18}$ E

Third **Answer the following questions 45 & 46** — 2 Marks

45 Two parallel rails with negligible resistance are separated by 10 cm and connected by a 5 Ω resistance. Two metal wires ab and cd with resistances 10 Ω and 15 Ω respectively, slide at constant speeds of 4 m/s and 2 m/s respectively through a uniform magnetic field of flux density 0.01 T perpendicular to the plane of the rails, as shown in the figure. **Calculate** the current passing through the 5 Ω resistance.



.....

.....

.....

46 In the shown electric circuit, if a voltmeter of resistance (R) is connected in parallel with the 63 Ω resistance, the voltmeter reading will be 6.516 V. **Calculate** the resistance of the voltmeter (R).



.....

.....

.....

Exam 9

Answered

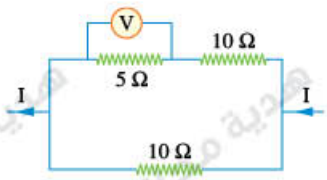
Questions signed by * are answered in detail.

First Choose the correct answer 1 : 32

1 Mark

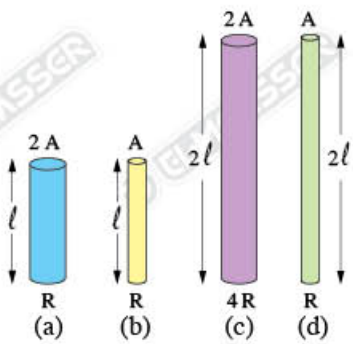
1 In the opposite figure, if the voltmeter reading is 20 V, then the total current intensity (I) equals .....

(a) 5 A
(b) 10 A
(c) 15 A
(d) 20 A



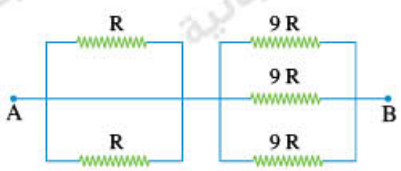
2 The opposite figure shows four wires made of different materials, their lengths, cross-sectional areas and resistances are as shown. The order of the electrical conductivities for these wires' materials is .....

(a) $\sigma_a > \sigma_b > \sigma_c > \sigma_d$
(b) $\sigma_d > \sigma_b > \sigma_a > \sigma_c$
(c) $\sigma_d > \sigma_c > \sigma_b > \sigma_a$
(d) $\sigma_b > \sigma_d > \sigma_a > \sigma_c$



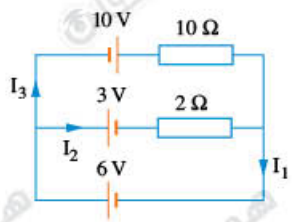
3 In the opposite figure, the equivalent resistance between points A and B equals .....

(a) 9 R
(b) 8 R
(c) 3.5 R
(d) 3 R

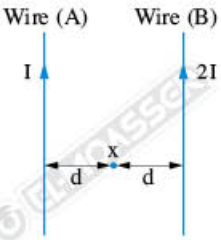


4 From the opposite figure, the ratio $\left(\frac{I_1}{I_2}\right)$ is .....

(a) $\frac{16}{15}$
(b) $\frac{15}{31}$
(c) $\frac{31}{15}$
(d) $\frac{1}{1}$



5 In the figure, there are two long parallel wires (A) and (B) each carrying an electric current. If wire (B) is moved away a distance (d) to the right, the resultant magnetic flux density at point (x) will ..... .



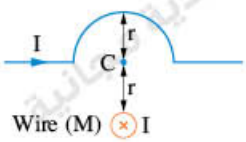
(a) decrease but not reach zero

(b) increase

(c) remain unaffected

(d) become zero

6 In the opposite figure, a straight insulated wire (M) is perpendicular to the plane of the page and carries an electric current (I), creating a magnetic field with flux density (B_1) at point (C). Another wire, part of which is bent into a semi-circle, carries the same current intensity (I) and creates a magnetic field with flux density (B_2) at point (C). The magnitude of the resultant magnetic flux density (B_t) at point (C) is calculated from the relation .....



(a) $B_t = \sqrt{B_1^2 + B_2^2}$ (b) $B_t = B_1 + B_2$ (c) $B_t = B_1 - B_2$ (d) $B_t = \sqrt{B_1^2 - B_2^2}$

7 Using the data shown in figures (1) and (2),

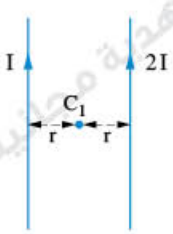


Figure (1)
Two long parallel straight wires

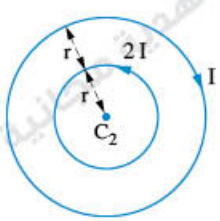


Figure (2)
Two concentric metal rings in one plane

what is the relationship between the resultant magnetic flux densities at points C_1 and C_2?

(a) $B_{C_1} = B_{C_2} = 0$

(b) $B_{C_1} > B_{C_2}$

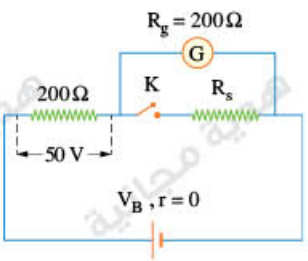
(c) $B_{C_1} = B_{C_2} \neq 0$

(d) $B_{C_1} < B_{C_2}$

8 A straight wire of length 100 cm carries an electric current of 10 A. Its direction is the same as the direction of a uniform magnetic field with a flux density of 0.05 T. The magnitude of the magnetic force acting on the wire equals ..... .

(a) 50 N (b) 25 N (c) 5 N (d) zero

9 In the opposite figure, the galvanometer pointer deflects to the end of its scale when switch (K) is open. If switch (K) is closed, the sensitivity of the galvanometer (G) decreases to one-fifth. The values of (V_B) and (R_s) respectively are ..... .



(a) 100 V, 40 Ω (b) 60 V, 100 Ω

(c) 100 V, 50 Ω (d) 60 V, 40 Ω

10 When the shunt resistor in an ammeter is replaced by another shunt with a lower resistance, the sensitivity of the ammeter ..... .

(a) decreases (b) increases (c) is unaffected (d) becomes zero

11 In figure (1), a solenoid made of aluminum wire is moved a distance (d) at a constant velocity (v) towards a strong magnet, inducing an electromotive force of magnitude (emf) across its terminals,

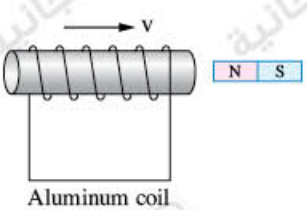


Figure (1)

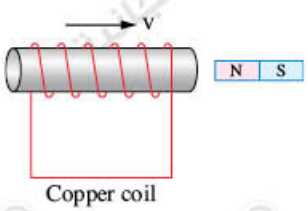


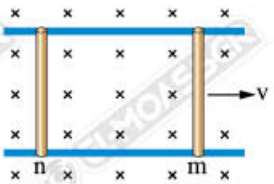
Figure (2)

if the experiment is repeated exactly as in the first case, but the coil is replaced with an identical copper coil as shown in figure (2), the magnitude of the induced electromotive force across the copper coil's terminals will be ..... .

(a) greater than (emf) (b) less than (emf)

(c) equal to (emf) (d) equal to zero

12 ✳ Two metal rods (m) and (n) can slide on two smooth metal rails within a region of a strong uniform magnetic field perpendicular to the plane containing the rods and rails, as shown in the opposite figure. If rod (m) moves at a constant velocity (v) to the right, then rod (n) ..... .



(a) moves in the same direction as rod (m)

(b) moves in the opposite direction to rod (m)

(c) moves perpendicular to the direction of rod (m)

(d) does not move

13 In figure (1), as the magnet approaches a solenoid, the galvanometer pointer deflects by an angle (θ) in a certain direction. In figure (2), the experiment is repeated using two identical magnets, similar to the one in figure (1),

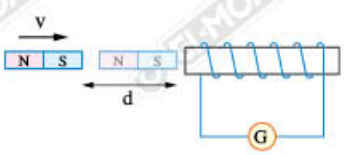


Figure (1)

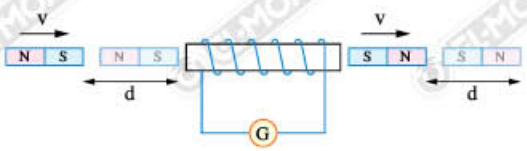


Figure (2)

which of the following choices is correct?

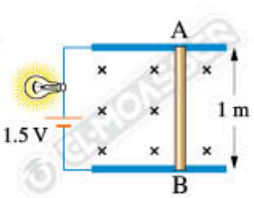
(a) The galvanometer pointer deflects by an angle (2θ) in the opposite direction.

(b) The galvanometer pointer deflects by an angle (2θ) in the same direction.

(c) The galvanometer pointer does not deflect.

(d) The galvanometer pointer deflects by an angle (θ) in the same direction.

14 In the illustrated circuit, if the resistance of all components is negligible except for the lamp, and the lamp lights up with a certain intensity. Then, the wire (AB) starts moving at a constant velocity of 6 m/s to the right, perpendicular to a uniform magnetic field with a flux density of 0.6 T. The brightness of the lamp will ..... .



(a) decrease

(b) increase

(c) remain unaffected

(d) become zero

15 ✻ An insulated wire wound around a piece of soft iron is connected once to an AC source and another time to a DC source, as shown in figures (1) and (2). What happens to the iron piece in each figure?

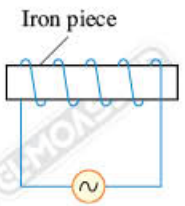


Figure (1)

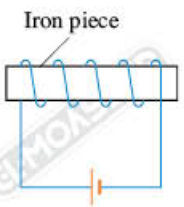


Figure (2)

(a) The iron piece heats up in figure (1) only.

(b) The iron piece heats up in figure (2) only.

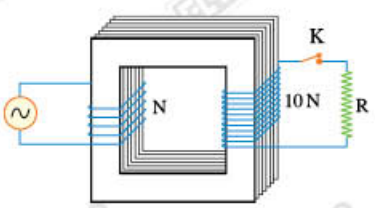
(c) The iron piece heats up in both cases.

(d) The iron piece does not heat up in either case.

16 In an ideal electrical transformer, the relationship between the voltages of the primary and secondary coils is $V_s = 5V_p$. The ratio of the secondary coil current to the primary coil current $\left(\frac{I_s}{I_p}\right)$ equals ..... .

(a) $\frac{1}{5}$ (b) $\frac{5}{1}$ (c) $\frac{1}{2}$ (d) $\frac{2}{1}$

17 ✻ The figure shows an ideal electrical transformer. If the primary coil current is 1 A when switch (K) is closed, the primary coil current after opening switch (K) will ..... .



(a) remain 1 A (b) become 10 A (c) become 5 A (d) approach zero

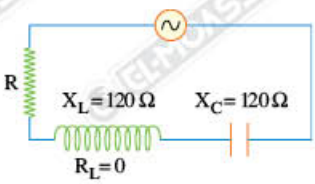
18 When an alternating current with an effective value (I) passes through a hot-wire ammeter, the electrical power consumed in the platinum-iridium wire equals (P_w), so the effective value of the current that causes the consumed power in the same hot-wire ammeter to be ($2\ P_w$) equals ..... .

(a) I (b) $\sqrt{2}$ I (c) 0.5 I (d) 2 I

19 An AC circuit contains an inductor of negligible resistance and a capacitor where ($X_L = 2\ X_C$). When the current frequency is doubled, the ratio between the total impedance in the circuit before and after increasing the frequency equals .....

(a) $\frac{1}{1}$ (b) $\frac{1}{4}$ (c) $\frac{2}{7}$ (d) $\frac{2}{5}$

20 In the opposite AC circuit, when a resistor (R) is connected in parallel with the existing ohmic resistor, the value of the current passing through the circuit ..... .



(a) decreases to half

(b) increases to double

(c) increases to four times

(d) remains the same

21 The characteristic shared by X-rays emitted from a coolidge tube and the light emitted from (Helium-Neon) laser is ..... .

(a) the coherence of their photons

(b) the speed in a vacuum

(c) the range of wavelengths

(d) retaining constant intensity with increasing distance from the source

22 The opposite figure represents two photons (A) and (B) and their wavelength values. What is the ratio between their momenta $\left(\frac{P_A}{P_B}\right)$?



(a) $\frac{1}{4}$ (b) $\frac{4}{1}$

(c) $\frac{1}{2}$ (d) $\frac{1}{1}$

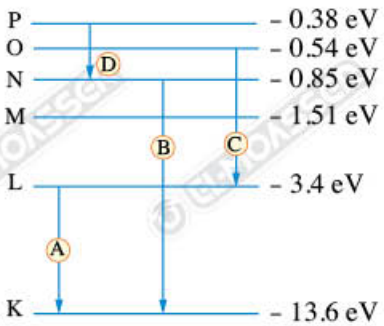
23 If the wavelength corresponding to the maximum radiation intensity from the sun is 500 nm and the surface temperature of the sun is 6000 K, and the human body temperature is 37°C, then the wavelength corresponding to the maximum radiation intensity emitted by the human body equals ..... .

(a) 967.7419 nm (b) 9677.419 Å

(c) 967.7419 Å (d) 9677.419 nm

24 The opposite diagram shows some possible electron transitions between energy levels in a hydrogen atom. Which of these transitions results in the emission of a photon with a wavelength of 4343 Å?

(Given: $h = 6.625 \times 10^{-34}$ J.s,
$c = 3 \times 10^{8}$ m/s, $e = 1.6 \times 10^{-19}$C)



(a) Transition (B)
(b) Transition (D)
(c) Transition (C)
(d) Transition (A)

25 If the shortest wavelength emitted from a Coolidge tube is 0.561 Å, then the applied potential difference between the anode and cathode is .....

(Given: $h = 6.626 \times 10^{-34}$ J.s, $c = 3 \times 10^{8}$ m/s, $e = 1.6 \times 10^{-19}$C)

(a) 2.21×10^{4} V
(b) 3.03×10^{4} V
(c) 1.04×10^{4} V
(d) 2.52×10^{4} V

26 In a (Helium-Neon) laser device, the energy of the laser photon emitted from the neon atom is ..... the energy transferred to an unexcited neon atom when it collides with an excited helium atom.

(a) greater than
(b) less than
(c) equal to
(d) there is not enough information to answer

27 In three-dimensional holography of an object using a laser of wavelength (λ), if the path difference between two waves reflected from the object is ($\frac{2}{3}\lambda$), the phase difference between these two waves equals ..... .

(a) $\frac{3}{4}\pi$
(b) π
(c) $\frac{4}{3}\pi$
(d) $\frac{3}{2}\pi$

28 The ratio between the lifetime in a normal excited state to the lifetime in a metastable excited state ..... .

(a) is greater than one
(b) is equal to one
(c) is less than one
(d) cannot be determined

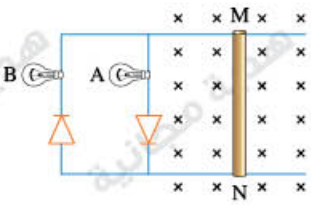
29 In the opposite logic circuit, if the output value is (Y=1) and the input value is (A = 0), then the values of input (B) and input (C) are ..... .



(a) B = 0, C = 1 (b) B = 0, C = 0

(c) B = 1, C = 1 (d) B = 1, C = 0

30 ✱ In the opposite figure, a straight wire (MN) moves in a uniform magnetic field perpendicular to the plane of the page. For lamp (A) to light up, wire MN must move ..... .



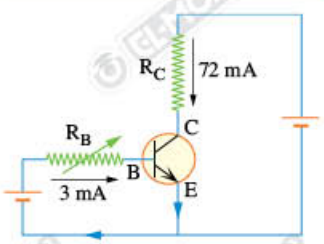
(a) in the plane of the page to the right

(b) in the plane of the page to the left

(c) perpendicular to the plane of the page inwards

(d) perpendicular to the plane of the page outwards

31 In the opposite transistor circuit, what is the usage of the transistor? And what is the current transfer ratio (α_e)?



	The transistor usage	current transfer ratio (α_e)
(a)	Open switch	0.04
(b)	Open switch	0.96
(c)	Closed switch	0.04
(d)	Closed switch	0.96

32 As the temperature of pure silicon approaches absolute zero (Zero Kelvin), its electrical resistivity ..... .

(a) becomes zero

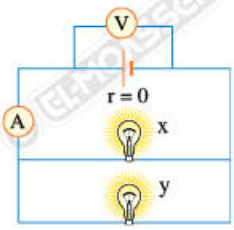
(b) increases significantly

(c) remains unchanged

(d) decreases significantly

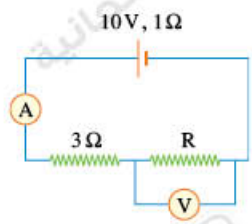
Second Choose the correct answer 33 : 44 — 2 Marks

33 In the illustrated electric circuit, lamps (x) and (y) are identical and connected in parallel. If another identical lamp is connected in parallel with them, then the reading of the ammeter (A) ..... and the reading of the voltmeter (V) ..... .



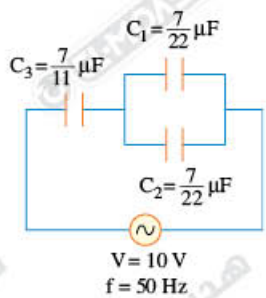
(a) decreases, increases
(b) increases, decreases
(c) increases, is unaffected
(d) decreases, is unaffected

34 In the electric circuit shown in the figure, if the ammeter reading is 1 A, the voltmeter reading equals .....



(a) 3 V
(b) 6 V
(c) 7 V
(d) 9 V

35 In the opposite electric circuit, the value of the total current passing through it is .....

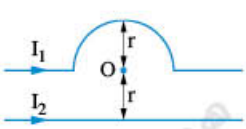


(a) 0.1 A
(b) 0.01 A
(c) 0.001 A
(d) 0.0001 A

36 A solenoid of length (ℓ) and number of turns (N) is connected across a battery of negligible internal resistance, so that the magnetic flux density at the midpoint of its axis equals (B_1). If the solenoid is cut in half and one of the halves is connected to the same battery, creating a magnetic field with flux density (B_2) at the midpoint of its axis, so the ratio $\left(\frac{B_1}{B_2}\right)$ equals .....

(a) $\frac{1}{2}$
(b) $\frac{1}{1}$
(c) $\frac{2}{1}$
(d) $\frac{3}{1}$

37 In the opposite figure, if the resultant magnetic flux density at point (O) is zero, then the ratio of the two currents $\left(\frac{I_1}{I_2}\right)$ is .....



(a) $\frac{1}{\pi}$
(b) $\frac{\pi}{1}$
(c) $\frac{\pi}{2}$
(d) $\frac{2}{\pi}$

38 A moving-coil galvanometer has a scale consisting of 15 divisions. If you know that every 5 divisions indicate 5 mA and every 2 divisions indicate 10 mV, then the value of the resistance that must be connected in series with the galvanometer coil so that the indication of a single division becomes 1 V is ..... .

(a) 995 Ω (b) 99.5 Ω (c) 9.95 Ω (d) 9950 Ω

39 The opposite figures show two identical solenoids. If coil (x) is wound around a soft iron core and coil (y) is hollow, when switches K_1 and K_2 are closed, the ratio of the time it takes the ammeter pointer in figure (1) to reach its steady value to the time it takes the ammeter pointer in figure (2) to reach its steady value is ..... .

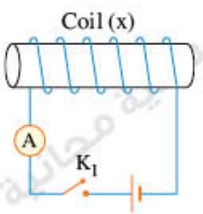


Figure (1)

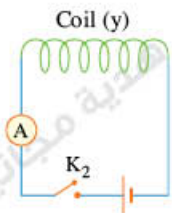


Figure (2)

(a) greater than one (b) equal to one

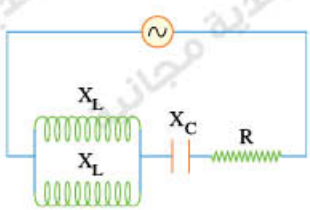
(c) less than one (d) cannot be determined

40 Alternating current is **not** suitable directly for ..... .

(a) lighting lamps (b) operating household appliances

(c) charging batteries (d) operating electrical transformers

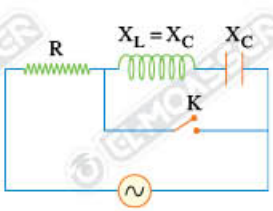
41 In the opposite figure, the circuit is in a state of resonance if ..... .



(a) $X_L = X_C$ (b) $X_L = 0.5\ X_C$

(c) $X_L = 2\ X_C$ (d) $X_C = 2\ X_L$

42 In the opposite AC circuit, after closing switch (K), the phase angle between the total voltage and the current ..... .



(a) increases

(b) decreases

(c) increases then decreases

(d) remains the same

43 The principle of operation of the electron microscope depends on ..... .

(a) the wave nature of electrons (b) the wave nature of photons

(c) the particle nature of electrons (d) the particle nature of photons

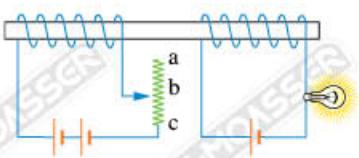
44 An electron revolves around the nucleus of a hydrogen atom and is associated with a standing wave of wavelength πr according to Bohr's model. This electron is moving in energy level ..... .

(a) L (b) M (c) K (d) N

Third Answer the following questions 45 & 46 — 2 Marks

45 The figure represents two adjacent coils.

What happens to the brightness of the lamp while the rheostat slider is moved from position (b) to position (a), **with explanation.**



.....

.....

46 The opposite table shows the values of some different resistors (R_x) that can be connected across the terminals of an ohmmeter, and the intensity of the current (I) flowing in its circuit when they are connected. **Calculate** the value of the resistance (R_1) across the ohmmeter terminals.

R_x (Ω)	I (μA)
0	200
600	160
R_1	75

.....

.....

Exam 10

Answered

Questions signed by ✻ are answered in detail.

First Choose the correct answer 1 : 32 — 1 Mark

1 If the total work done to transfer a charge of 2 C inside and outside a battery is 12 J, this means that .....

(a) the current intensity passing through the battery equals 6 A

(b) the electric power produced by the battery equals 6 W

(c) the internal resistance of the battery equals 6 Ω

(d) the electromotive force of the battery equals 6 V

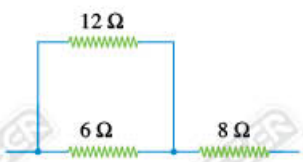
2 A uniform cross-section silver wire has length (ℓ), cross-sectional area (A), and resistivity of 1.5×10^{-8} Ω.m. If its length is doubled and its cross-sectional area is reduced to one-third at the same temperature, its resistivity becomes.....

(a) 1.5×10^{-8} Ω.m (b) 3×10^{-8} Ω.m (c) 5×10^{-8} Ω.m (d) 2×10^{-8} Ω.m

3 You have two electrical resistors. If the value of the first resistor is 3 times the value of the second, and when connected in parallel, their equivalent resistance is 3 ohms, then their equivalent resistance when connected in series equals .....

(a) 12 ohms (b) 16 ohms (c) 8 ohms (d) 4 ohms

4 The figure shows a part of a closed electric circuit. If the current passing through the 12 Ω resistor is 1.5 A, then the current passing through the 8 Ω resistor equals .....



(a) 2.25 A (b) 3 A

(c) 4.5 A (d) 6 A

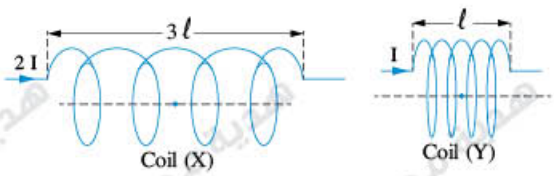
5 A long straight wire carries a current of 4 A. If the magnetic flux density at a point away from it is 2×10^{-5} T, then the perpendicular distance of that point from the wire's axis equals ..... (Given that: $\mu = 4\pi \times 10^{-7}$ Wb/A.m)

(a) 0.04 m (b) 0.4 m (c) 20 cm (d) 0.2 cm

6 Two long parallel wires (x) and (y) are separated by a perpendicular distance of 0.5 m. Both wires carry an electric current in the same direction, where the current in wire (x) is I and the current in wire (y) is 3I. The neutral point is located at a distance of .....

(a) 0.125 m from wire (x)
(b) 0.125 m from wire (y)
(c) 0.17 m from wire (y)
(d) 0.17 m from wire (x)

7 Two solenoids (x) and (y) have the same number of turns. The length and the current passing through each of them are shown in the opposite figure. The ratio between



$$\frac{\text{The magnetic flux density at the midpoint of the axis of coil (x)}}{\text{The magnetic flux density at the midpoint of the axis of coil (y)}} = \text{.....}$$

(a) $\frac{1}{6}$
(b) $\frac{6}{1}$
(c) $\frac{3}{2}$
(d) $\frac{2}{3}$

8 If the mutual magnetic force between two long parallel wires carrying currents, acting on a unit length of each, is 10^{-4} N/m, then when the perpendicular distance between them is doubled, the magnetic force per unit length on either wire becomes .....

(a) 40×10^{-5} N/m
(b) 20×10^{-5} N/m
(c) 5×10^{-5} N/m
(d) 2.5×10^{-5} N/m

9 When connecting a moving-coil galvanometer to a suitable DC source, which of the following choices represents the change in both the magnetic torque acting on the coil and the torsion of the spring coils from the moment the pointer deflects until it stabilizes at a specific reading?

	The magnetic torque acting on the coil	The torsion of the spring coils
(a)	Increases	Increases
(b)	Increases	Remains constant
(c)	Remains constant	Increases
(d)	Remains constant	Remains constant

10 A galvanometer has a coil resistance of 30 ohms. What is the value of the shunt resistance needed to decrease its sensitivity to one-third?

(a) 10 ohms
(b) 15 ohms
(c) 20 ohms
(d) 30 ohms

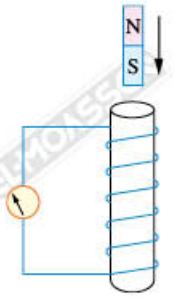
11 In Faraday's electromagnetic induction experiment shown in the figure, some of the following procedures can be performed :

(I) Using a coil with fewer turns.

(II) Increasing the speed of the magnet towards the coil.

(III) Using a coil with a larger cross-sectional area.

Which of these procedures leads to an increase in the induced electromotive force in the coil during the magnet's movement?



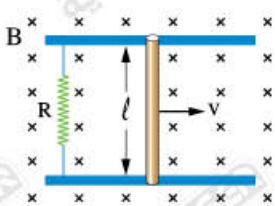
(a) (I) and (II) only

(b) (II) and (III) only

(c) (I) and (III) only

(d) (I), (II), and (III)

12 The figure shows a straight metal wire of length (ℓ) moving with velocity (v) perpendicular to a uniform magnetic field of flux density (B). Which of the following procedures leads to an increase in the induced electromotive force generated across the wire?



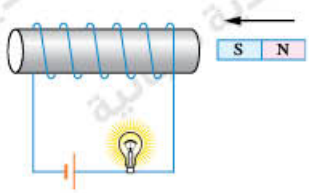
(a) Using another wire of the same length but less thick.

(b) Moving the wire with the same velocity (v) in the opposite direction.

(c) Connecting a resistor of value $\left(\frac{R}{2}\right)$ instead of the resistor (R).

(d) Moving the wire in the same direction with a velocity (2v).

13 In the shown figure, while moving the magnet towards the coil, the brightness of the electric lamp .....



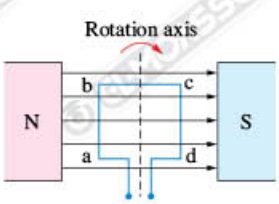
(a) increases

(b) decreases

(c) vanishes

(d) remains constant

14 In the shown figure, during the rotation of the coil (abcd) a quarter of a turn clockwise about the axis of rotation, and considering the coil circuit is closed, the induced current flows in the coil in direction .....



(a) b ⟶ a ⟶ d ⟶ c

(b) b ⟶ c ⟶ d ⟶ a

(c) a ⟶ b ⟶ c ⟶ d, then reverses

(d) d ⟶ c ⟶ b ⟶ a, then reverses

15 Which of the following procedures **does not lead** to a reduction in eddy currents in a metal core on which a coil carrying alternating current is wound?

(a) Making the metal core in the form of mutually insulated laminations.

(b) Making the metal core from a material with high electrical conductivity.

(c) Using a low-frequency current.

(d) Making the metal core from a material with high electrical resistivity.

16 An ideal step-down transformer has 5000 turns in its primary coil and 250 turns in its secondary coil. If the potential difference across its primary coil is 240 V, then the induced electromotive force across its secondary coil equals .....

(a) 12 V (b) 24 V (c) 6 V (d) 36 V

17 Which of the following **is not** a characteristic of a step-up transformer with an efficiency of 90%?

(a) The potential difference across its secondary coil is greater than the potential difference across its primary coil

(b) The current intensity passing through its secondary coil is less than the current intensity passing through its primary coil

(c) The electric power in its primary circuit is greater than the electric power in its secondary circuit

(d) The frequency of the current passing through its primary coil is less than the frequency of the current passing through its secondary coil

18 If the reading of a hot-wire ammeter when connected to an alternating current source is $4\sqrt{2}$ A, then the maximum value of the alternating current through this source equals .....

(a) 4 A (b) $4\sqrt{2}$ A (c) 8 A (d) $8\sqrt{2}$ A

19 The oscillations of the alternating current passing through the oscillating circuit are damped because of ..... .

(a) the ohmic resistance of the circuit

(b) the inductive reactance of the coil

(c) the capacitive reactance of the capacitor

(d) the total impedance of the circuit

20 A resonant circuit receives an electromagnetic wave of frequency (f). When each of the capacitance of the capacitor and the self-inductance of the coil is increased to four times its original value, the frequency of the electromagnetic wave that can be received in this case equals .....

(a) $\frac{f}{4}$ (b) $\frac{f}{8}$ (c) $\frac{f}{16}$ (d) $\frac{f}{2}$

21 According to Einstein's explanation of the photoelectric effect, if a photon of energy (4E) falls on a metal surface with a work function of (E), it may liberate .....

(a) one electron with a maximum kinetic energy of (3E)

(b) two electrons, each having a maximum kinetic energy of (E)

(c) three electrons, each having a maximum kinetic energy of $\left(\frac{E}{3}\right)$

(d) four electrons, none of which possessing any kinetic energy

22 Which of the following photons has the greatest energy?

(Given that: $c = 3 \times 10^{8}$ m/s, $h = 6.625 \times 10^{-34}$ J.s)

(a) A photon with a wavelength of 4×10^{-7} m

(b) A photon with a frequency of 10^{15} Hz

(c) A photon with a momentum of 3.3125×10^{-27} kg.m/s

(d) A photon with an equivalent mass of 2.208×10^{-35} kg

23 A body has a temperature of (T) kelvin, and the wavelength corresponding to its maximum emitted radiation intensity equals (λ). When the body's temperature is increased by (3T) kelvin, the wavelength corresponding to its maximum emitted radiation intensity becomes .....

(a) $\frac{\lambda}{3}$ (b) $\frac{\lambda}{4}$ (c) 3λ (d) 4λ

24 According to Bohr's model of the hydrogen atom, if the length of the standing wave associated with the electron's motion in a particular orbit of radius (r) equals ($\frac{1}{2}\pi r$), then the energy level in which the electron revolves is .....

(a) $n = 1$ (b) $n = 2$ (c) $n = 3$ (d) $n = 4$

25 In a Coolidge tube, and under the same conditions, the characteristic X-ray spectrum will have the shortest wavelength when the target material is .....

(a) Copper, atomic number (Z = 29)

(b) Molybdenum, atomic number (Z = 42)

(c) Rhodium, atomic number (Z = 45)

(d) Tungsten, atomic number (Z = 74)

26 The figure shows an excited atom whose lifetime has not yet ended, being passed by a photon (a), causing stimulated emission. Which of the following choices is correct?



	Energy of photon (a)	Number of the emerged photons
(a)	$E_2 - E_1$	One photon
(b)	$E_2 - E_1$	Two photons
(c)	$E_2 + E_1$	One photon
(d)	$E_2 + E_1$	Two photons

27 A helium-neon laser beam was used in holographic imaging of an object. If the path difference between two reflected waves from the object equals (3λ), where (λ) is the wavelength of the laser photons, then the phase difference between them equals .....

(a) $1.5\ \pi$ (b) $3\ \pi$

(c) $4.5\ \pi$ (d) $6\ \pi$

28 In a (Helium-Neon) laser, which of the following choices represents the cause of excitation of both helium and neon atoms during laser production?

	Excitation of helium	Excitation of neon
(a)	High DC voltage	High DC voltage
(b)	High DC voltage	Collisions with excited helium atoms
(c)	Collisions with excited neon atoms	High DC voltage
(d)	Collisions with excited neon atoms	Collisions with excited helium atoms

29 What is the equivalent binary number for the decimal number (57)?

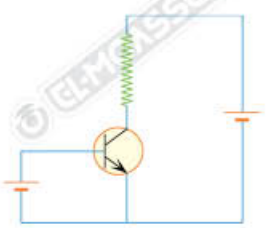
(a) $(111001)_2$ (b) $(110110)_2$ (c) $(101011)_2$ (d) $(111011)_2$

30 The figure shows a diode connected to a DC source in a closed circuit. Which of the following choices describes the characteristics of the junction in the opposite circuit upon closing the switch (K)?



	Thickness of the depletion region	Resistance of the junction
(a)	Decreases	Decreases
(b)	Decreases	Increases
(c)	Increases	Decreases
(d)	Increases	Increases

31 The figure shows a transistor circuit. Which of the following choices describes the operation of the transistor in this circuit?



(a) Amplifier for both electrical power and electric current intensity

(b) Amplifier for electrical power but not for electric current intensity

(c) Amplifier for electric current intensity but not for electrical power

(d) Does not amplify either electrical power or electric current intensity

32 When the temperature of a copper coil and a pure silicon crystal is raised, the electrical resistivity ..... .

(a) increases for copper and decreases for silicon

(b) decreases for copper and increases for silicon

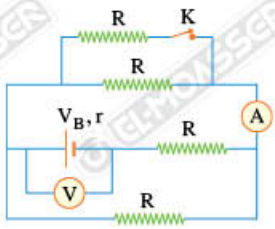
(c) increases for both

(d) decreases for both

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Second Choose the correct answer 33 : 44 — 2 Marks

33 In the electric circuit shown in the figure, what happens to the reading of both the ammeter and the voltmeter when the switch (K) is opened?



	Ammeter reading	Voltmeter reading
(a)	Decreases	Increases
(b)	Increases	Decreases
(c)	Decreases	Decreases
(d)	Increases	Increases

34 ✳ A capacitor of capacitance 20 μF, an inductor of self-inductance 0.2 H, and an ohmic resistance of 100 Ω are all connected in series to an alternating current source of electromotive force 200 V and frequency 50 Hz. The electrical power consumed in the circuit is approximately ..... (Given that: $\pi = 3.14$)

(a) 200 W (b) 144 W (c) 288 W (d) 207 W

35 When a variable capacitor is connected to an alternating current source of frequency (f), its capacitive reactance is 1000 Ω. If the value of both the capacitance of the capacitor and the frequency of the current are doubled, the capacitive reactance of the capacitor becomes .....

(a) 2000 Ω (b) 500 Ω (c) 4000 Ω (d) 250 Ω

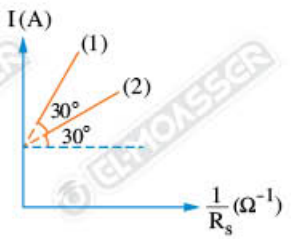
36 A solenoid of length (ℓ), cross-sectional area of a turn (A), and number of turns (N) carries an electric current of intensity (I). If its turns are moved away from each other until its length becomes (3ℓ) while keeping the rest of the factors constant, then the magnetic flux density at the midpoint of its length and on its axis decreases to ..... of its original value.

(a) $\frac{1}{3}$ (b) $\frac{1}{6}$ (c) $\frac{1}{12}$ (d) $\frac{1}{16}$

37 A voltmeter has a resistance of 800 Ω and the maximum potential difference it can measure is 4 V. The value of the multiplier resistance that must be connected to it to increase the maximum measured potential difference to 10 times its original value equals .....

(a) 8 kilohms (b) 4 kilohms (c) 3.2 kilohms (d) 7.2 kilohms

38 ✱ Two galvanometers each is connected to a changeable shunt resistance. The opposite graph represents the relationship between the maximum measurement range of the two ammeters (I) and the reciprocal of the value of the shunt resistance ($\frac{1}{R_s}$) connected to the galvanometer in each of them. The ratio between the resistances of the two galvanometers $\left(\frac{(R_g)_1}{(R_g)_2}\right)$ equals .....

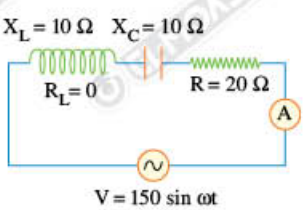


(a) $\frac{1}{2}$ (b) $\frac{2}{1}$ (c) $\frac{1}{3}$ (d) $\frac{3}{1}$

39 An inductor with a self-inductance of 0.3 H is connected to a battery of negligible internal resistance and of electromotive force 60 V, and a switch. The rate of growth of the current at the moment of closing the circuit equals .....

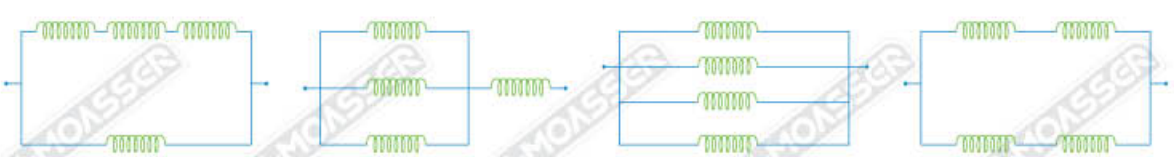
(a) 240 $A.s^{-1}$ (b) 200 $A.s^{-1}$ (c) 1580 $A.s^{-1}$ (d) 60 $A.s^{-1}$

40 In the opposite figure, an alternating current circuit has a potential difference across the electric source given by the relation V = 150 sin(ωt). If you know that the ohmic resistance of the hot-wire ammeter is 10 Ω, then its reading equals .....



(a) 5 A (b) 3 A (c) 3.54 A (d) 2.12 A

41 Four identical inductors were connected together with an alternating current source, and the inductive reactance of each of them was 4 Ω. In which of the following connection methods is their equivalent inductive reactance 4 Ω?



42 An alternating current source is connected to an ohmic resistance of 8 Ω, an inductor with an inductive reactance of 14 Ω and negligible ohmic resistance, and a capacitor with a capacitive reactance of 8 Ω, all in series. The total impedance of the circuit equals .....

(a) 14 Ω (b) 30 Ω (c) 10 Ω (d) 46 Ω

43 In the electron microscope, if the minimum potential difference that can be used to examine a virus of dimensions (X) is (V), then the minimum potential difference that can be used to examine a virus of dimensions $\left(\frac{X}{4}\right)$ is .....

(a) 2 V (b) 4 V (c) 8 V (d) 16 V

44 In the atomic spectrum of hydrogen, the ratio between the shortest wavelength of the line spectrum in the Brackett series and the shortest wavelength of the line spectrum in the Paschen series equals .....

(a) $\frac{4}{3}$ (b) $\frac{16}{9}$ (c) $\frac{3}{2}$ (d) $\frac{9}{4}$

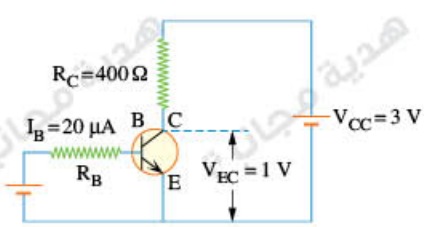
Third Answer the following questions 45 & 46 — 2 Marks

45 An alternating current dynamo produces an electromotive force with an effective value of $314\sqrt{2}$ V. **Find** the average electromotive force during $\frac{1}{6}$ of a cycle, if the dynamo starts rotating from the position perpendicular to the magnetic field. (Given that: $\pi = 3.14$)

.....

.....

46 Using the data shown in the opposite circuit, **find** the value of the emitter current (I_E).



.....

.....

.....

Answers of Physics Guiding Exams

Answers of Exam 1

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	c	a	a	c	b	a	b	a	b	b	b	b

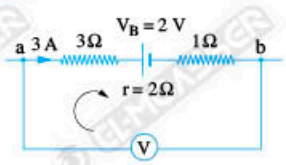
Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	c	a	d	a	a	b	c	a	a	c	a	a

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	a	b	a	b	b	d	a	b	d	a	d	d

Question no.	37	38	39	40	41	42	43	44
Answer	a	c	b	c	d	d	a	d

Detailed Answers for the Questions Signed by ✱

4 (c)



- To find the potential difference between points a and b, we assume a voltmeter is connected between these two points.
- By applying Kirchhoff's second law on the path shown:

$\Sigma V_B = \Sigma IR$

$V_{ab} - 2 = 3 \times (3 + 2 + 1)$

$V_{ab} = 18 + 2 = 20$ V

∴ The value of the potential difference between points a and b equals 20 V.

13 (c)

- While the current intensity in the wire increases uniformly from 0 to 2 A during time (t), the magnetic flux penetrating the ring increases so that an induced current is generated, creating a magnetic field opposite to the wire's field. Hence, the induced current in the loop is counter-clockwise.
- While the current intensity in the wire decreases uniformly from 2 A to 0 during time (2t), the magnetic flux penetrating the loop decreases so that an induced current is generated, creating a field in the same direction as the wire's field. Hence, the induced current in the loop is clockwise.

∴ The direction of the induced current in the loop reverses.

$\because I_{induced} = \frac{emf}{R} = \frac{-N}{R} \times \frac{\Delta\phi_m}{\Delta t}$

∵ The values of N, R, $\Delta\phi_m$ are constant.

$\therefore I_{induced} \propto \frac{1}{\Delta t}$

$\therefore \frac{I_1}{I_2} = \frac{t_2}{t_1}$, $\frac{I}{I_2} = \frac{2t}{t}$, $I_2 = \frac{1}{2} I$

19 (c)

$\because X_L = 2\pi fL$

$\therefore L = \frac{X_L}{2\pi f} = \frac{125}{2 \times \frac{22}{7} \times \frac{280}{11}} = \frac{25}{32}$ H

$\because$ The effective current passing through the circuit is maximum.

$\therefore$ The circuit is in resonance.

$$\therefore f^2 = \frac{1}{4\pi^2 LC}$$

$$\therefore C = \frac{1}{4\pi^2 f^2 L} = \frac{1}{4 \times \left(\frac{22}{7}\right)^2 \times \left(\frac{280}{11}\right)^2 \times \frac{25}{32}} = 5 \times 10^{-5}\ F = \mathbf{50\ \mu F}$$

22 (c)

- The force exerted by a single photon on a reflective surface:

$$F = \frac{\Delta P_L}{\Delta t}$$

- When a photon with momentum (P_L) falls perpendicularly on a reflective surface, it rebounds with momentum ($-P_L$), and the magnitude of the change in momentum is:

$$\Delta P_L = 2\,P_L = 2\,X$$

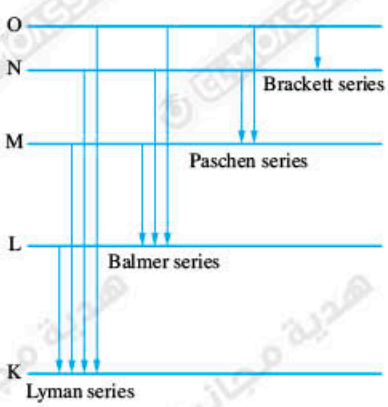
$$F = \frac{2\,X}{\Delta t}$$

- The force exerted by a beam of photons on the reflective surface:

$$F = \frac{2\,X}{\Delta t} \times N = \mathbf{2\,XY}$$

24 (a)

Based on the opposite figure, the number of spectral series that can be emitted from the atom is 4.



39 (b)

$$\because L = \frac{\mu A N^2}{\ell}$$

- The values of μ and A are constant.

$$\therefore L \propto \frac{N^2}{\ell}$$

$$\therefore \frac{L_1}{L_2} = \frac{N_1^2\,\ell_2}{N_2^2\,\ell_1} \quad , \quad \frac{0.2}{L_2} = \frac{N^2 \times \frac{3}{4}\,\ell}{\left(\frac{3}{4}N\right)^2 \times \ell} = \frac{4}{3}$$

$$\therefore L_2 = \mathbf{0.15\ H}$$

40 (c)

- **The intensity of the lamp's light increases momentarily,**

Because at the moment the switch (K) is closed, the total resistance of the circuit which is connected to battery $(V_B)_1$ decreases. Therefore, the current intensity increases according to the relationship $\left(I = \frac{V}{R}\right)$.

Consequently, the resulting magnetic flux from this coil, which cuts through the turns of the coil which is connected to the lamp, increases. This generates a back induced electromotive force in the coil which is connected to the lamp that increases the total emf in that circuit.

41 (d)

$\grave{X}_L = \frac{V}{I} = \frac{200}{5} = 40\ \Omega$

$\grave{X}_L = 2\pi f \grave{L}$

$40 = 2\pi \times \frac{100}{\pi} \grave{L}$, $\grave{L} = 0.2$ H

$\grave{L} = \frac{(0.1 + 0.2)\, L}{0.1 + 0.2 + L} = 0.2$

$L = \mathbf{0.6\ H}$

43 (a)

$\because \lambda = \frac{h}{m_e v}$, $KE = \frac{1}{2} m_e v^2$

$\therefore v = \sqrt{\frac{2\,KE}{m_e}}$

$\therefore \lambda = \frac{h}{m_e \sqrt{\frac{2\,KE}{m_e}}} = \frac{h}{\sqrt{2 m_e KE}}$, $\lambda \propto \frac{1}{\sqrt{KE}}$

$\therefore \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{(KE)_2}{(KE)_1}} = \sqrt{\frac{2\,(KE)_1}{(KE)_1}} = \sqrt{2}$

$\therefore \lambda_2 = \mathbf{\frac{1}{\sqrt{2}} \lambda_1}$

$\therefore$ The correct choice is (a).

Answers of Essay Questions

45 **(1)** $(emf)_y = M \frac{\Delta I_x}{\Delta t}$, $0.02 = M \times \frac{(10 - 0)}{0.1}$

$M = \mathbf{2 \times 10^{-4}\ H}$

(2) $(emf)_y = N_y \frac{(\Delta\phi_m)_y}{\Delta t}$, $0.02 = \frac{200 \times (\Delta\phi_m)_y}{0.1}$

$(\Delta\phi_m)_y = \mathbf{10^{-5}\ Wb}$

• Another solution:

$N_y (\Delta\phi_m)_y = M \Delta I_x$

$200 \times (\Delta\phi_m)_y = 2 \times 10^{-4} \times 10$

$(\Delta\phi_m)_y = \mathbf{10^{-5}\ Wb}$

46 **(1)** $\because$ The galvanometer scale is uniform.

$\therefore$ The angle of deflection is directly proportional to the intensity of the current passing through the galvanometer.

$$\frac{\theta_g}{\theta} = \frac{I_g}{I} = \frac{R_{(ohmmeter)} + R_x}{R_{(ohmmeter)}}$$

$$\frac{80}{\theta} = \frac{1500 + 4500}{1500} = 4 \quad , \quad \theta = 20°$$

(2) $\frac{\theta_g}{\theta} = \frac{I_g}{I}$

$$\frac{80}{60} = \frac{200}{I} \quad , \quad I = 150 \text{ mA}$$

Answers of Exam 2

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	a	a	c	b	a	b	c	d	b	a	c	b

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	c	b	b	b	a	d	d	b	c	c	a	d

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	d	a	c	b	d	d	d	b	a	a	b	a

Question no.	37	38	39	40	41	42	43	44
Answer	b	a	c	c	a	a	c	a

Detailed Answers for the Questions Signed by ❋

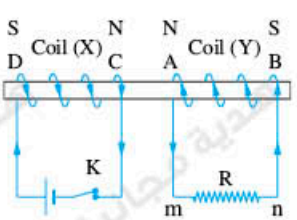
12 (b)

- The induced electromotive force in a wire is determined by the relationship:
  $emf = B\ell v$
- When the values of both B and ℓ are constant.
  $\therefore emf \propto v$
  $\therefore$ Choice (a) is wrong.
- When the values of both v and ℓ are constant.
  $\therefore emf \propto B$
  $\therefore$ Choice (d) is wrong.
  $\because v = \frac{d}{t}$ $\quad \therefore emf = B\ell\frac{d}{t}$
- When the values of B, ℓ, and d are constant.
  $\therefore emf \propto \frac{1}{t}$
  $\therefore$ Choice (b) is correct and choice (c) is wrong.

Answers of Essay Questions

45 **(1)** At the moment of closing the switch (K):

The current grows in coil (X), causing the resulting magnetic flux initiated from it which cuts through coil (Y) to increase gradually. As a result, a back electromotive force is induced in coil (Y), which generates an inverse induced current. Therefore, the magnetic pole formed at end (A) is similar to the pole formed at end (C), i.e., a north pole, as shown in the figure.



(2) By applying the clockwise direction rule, we find that the induced current flowing through the resistor (R) moves from m to n.

46

$\because \frac{I_g}{I} = \frac{\grave{R} + R_x}{\grave{R}}$

$\therefore \frac{400}{200} = \frac{\grave{R} + (R_x)_1}{\grave{R}}$, $(R_x)_1 = \grave{R}$

$\therefore \frac{400}{100} = \frac{\grave{R} + (R_x)_2}{\grave{R}}$, $(R_x)_2 = 3\,\grave{R}$

$\therefore \frac{(R_x)_1}{(R_x)_2} = \frac{\grave{R}}{3\,\grave{R}} = \frac{1}{3}$

Answers of Exam 3

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	b	c	a	c	a	c	d	a	a	b	a	a

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	c	d	b	a	b	a	a	c	a	a	c	a

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	a	a	c	c	b	a	a	a	a	a	d	a

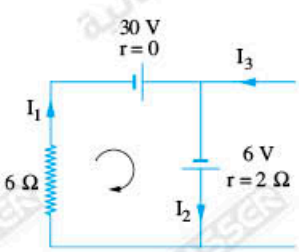
Question no.	37	38	39	40	41	42	43	44
Answer	a	a	a	b	b	c	a	b

Detailed Answers for the Questions Signed by ❋

4 (c)

• In figure (A):

Applying Kirchhoff's second law (loop rule) on the indicated loop:



$\Sigma V_B = \Sigma IR$

$30 + 6 = 6 I_1 + 2 I_2$

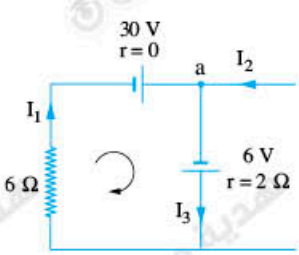
$6 I_1 + 2 I_2 = 36$

$3 I_1 + I_2 = 18$

∴ Choice (a) is wrong.

• In figure (B):

Applying Kirchhoff's first law (junction rule) at point (a):



$\Sigma I_{in} = \Sigma I_{out}$

$I_1 + I_2 = I_3$ (1)

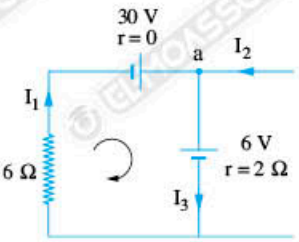
Applying Kirchhoff's second law on the indicated loop:

$30 + 6 = 6 I_1 + 2 I_3$, $3 I_1 + I_3 = 18$ (2)

Substituting equation (1) into equation (2):

$3I_1 + I_1 + I_2 = 18$, $4I_1 + I_2 = 18$

∴ Choice (b) is wrong.



• In figure (C):

Applying Kirchhoff's first law at point (a):

$I_1 + I_2 = I_3$ (1)

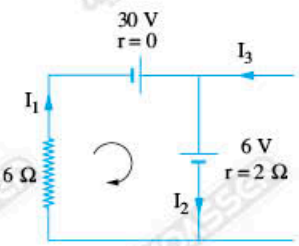
Applying Kirchhoff's second law on the indicated loop:

$30 - 6 = 6I_1 + 2I_3$, $3I_1 + I_3 = 12$ (2)

Substituting equation (1) into equation (2):

$3I_1 + I_1 + I_2 = 12$, $4I_1 + I_2 = 12$

∴ Choice (c) is correct.



• In figure (D):

Applying Kirchhoff's second law on the indicated path:

$30 - 6 = 6I_1 + 2I_2$

$3I_1 + I_2 = 12$

∴ Choice (d) is wrong.

25 (a)

$\Delta E = \frac{hc}{\lambda}$

$E_M - E_K = \frac{hc}{0.63 \times 10^{-10}}$ (1)

$E_L - E_K = \frac{hc}{0.71 \times 10^{-10}}$ (2)

By subtracting equation (2) from equation (1):

$E_M - E_L = \frac{hc}{\lambda_{ML}} = \frac{hc}{0.63 \times 10^{-10}} - \frac{hc}{0.71 \times 10^{-10}}$

$\lambda_{ML} = 5.6 \times 10^{-10}\ m = 5.6\ Å$

42 (c)

$\because eV = \frac{1}{2} m_e v^2$, $v = \frac{h}{m_e \lambda}$

$\therefore eV = \frac{1}{2} m_e \frac{h^2}{m_e^2 \lambda^2} = \frac{h^2}{2 m_e \lambda^2}$, $\lambda^2 = \frac{h^2}{2 m_e eV}$

$\therefore \lambda = \frac{h}{\sqrt{2 m_e eV}}$, $\lambda \propto \frac{1}{\sqrt{V}}$

$\therefore \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{V_2}{V_1}}$, $\frac{20}{15} = \sqrt{\frac{V_2}{V}}$

$\therefore V_2 = \frac{16}{9}\ V$

∴ The correct choice is (c).

Answers of Essay Questions

45 **(1)** $\because (emf)_y = -N_y \frac{(\Delta\phi_m)_x}{\Delta t} = -N_y \frac{\Delta B_x A_x}{\Delta t}$ ①

$\because B_x = \frac{\mu N_x I_x}{\ell_x} = \frac{2 \times 10^{-3} \times 400 \times 5}{88 \times 10^{-2}} = \frac{50}{11}$ T

$\therefore (emf)_y = -200 \times \frac{\left(0 - \frac{50}{11}\right) \times \frac{22}{7} \times \left(\frac{40 \times 10^{-3}}{2}\right)^2}{0.002} = 571.43$ V

(2) $\because (emf)_y = -M \frac{\Delta I_x}{\Delta t}$ ②

$\therefore 571.43 = -M \times \frac{(0-5)}{0.002}$, $M = 0.23$ H

46 $\because \theta \propto I$

$\therefore \frac{I}{I_g} = \frac{\theta}{\phi} = \frac{10}{60} = \frac{1}{6}$

$\because \frac{I}{I_g} = \frac{\grave{R}}{\grave{R} + R_x}$

$\therefore \frac{1}{6} = \frac{30}{30 + R_x}$, $R_x = 150$ kΩ

Answers of Exam 4

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	c	a	c	b	a	a	c	b	c	b	b	b

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	c	a	d	d	c	c	c	b	c	a	c	a

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	d	c	d	a	c	c	c	b	d	a	d	b

Question no.	37	38	39	40	41	42	43	44
Answer	c	c	a	d	c	a	a	a

Detailed Answers for the Questions Signed by ❋

42 (a)

$\because \tan\theta = \frac{-V_C}{V_R}$

$\therefore \frac{-V_C}{V_R} = \frac{-IX_C}{IR} = \tan(-60) = -\sqrt{3}$, $X_C = \sqrt{3}\,R$

$\therefore Z = \sqrt{R^2 + X_C^2} = \sqrt{R^2 + 3R^2} = \sqrt{4R^2} = 2R$

$\therefore \frac{Z}{R} = \frac{2R}{R} = \frac{2}{1}$

Answers of Essay Questions

45 **(1)** $\because (emf)_Y = -N_Y \frac{(\Delta\phi_m)_Y}{\Delta t}$

$\therefore (emf)_Y = -500 \times \frac{0-(4.2\times10^{-4})}{0.2} = 1.05$ V

(2) $\because (emf)_Y = -M \frac{\Delta I_X}{\Delta t}$

$\therefore 1.05 = -M \times \frac{(0-10)}{0.2}$, $M = 0.021$ H

46 $\grave{R} = \frac{V_B}{I_g} = \frac{8}{4\times10^{-3}} = 2000\ \Omega$

$\frac{1}{4} I_g = \frac{V_B}{\grave{R}+R_x}$, $\frac{1}{4} \times 4\times10^{-3} = \frac{8}{2000+R_x}$

$2000 + R_x = 8000$, $R_x = 6000\ \Omega$

Answers of Exam 5

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	c	c	d	a	d	b	b	a	a	d	d	a

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	d	a	b	d	c	a	a	c	c	c	b	c

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	c	b	c	c	a	d	d	b	a	a	a	a

Question no.	37	38	39	40	41	42	43	44
Answer	d	d	d	a	c	c	c	d

Detailed Answers for the Questions Signed by ❋

31 (d) $I_B = \frac{V_{Base}}{R_B} = \frac{12\times10^{-3}}{2000} = 6\times10^{-6}$ A

$\beta_e = \frac{I_C}{I_B}$, $60 = \frac{I_C}{6\times10^{-6}}$, $I_C = 3.6\times10^{-4}$ A

$V_C = I_C R_C = 3.6\times10^{-4} \times 5000 = 1.8$ V

Answers of Essay Questions

45 **(1)** $M = \frac{N_B (\Delta\phi_m)_B}{\Delta I_A} = \frac{200\times1.5\times10^{-4}}{2} = 0.015$ H

(2) $(emf)_B = -N_B \frac{(\Delta\phi_m)_B}{\Delta t} = -200 \times \frac{0-(1.5\times10^{-4})}{0.1} = 0.3$ V

Another solution:

$(emf)_B = -M \frac{\Delta I_A}{\Delta t} = -0.015 \times \frac{0-2}{0.1} = 0.3$ V

46 (1) $I_g = \frac{V_B}{\grave{R}} = \frac{V_B}{R_g + R_{standard}}$, $1 \times 10^{-3} = \frac{2}{50 + R_{standard}}$

$R_{calibrated} = 1950\ \Omega$

(2) $\frac{I_g}{I} = \frac{\grave{R} + R_x}{\grave{R}} = \frac{R_g + R_{standard} + R_x}{R_g + R_{standard}}$, $\frac{I_g}{\frac{I_g}{6}} = \frac{50 + 1950 + R_x}{50 + 1950}$

$6 \times 2000 = 2000 + R_x$, $R_x = 10000\ \Omega = 10\ k\Omega$

Answers of Exam 6

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	d	c	c	c	b	d	c	a	b	b	c	d

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	c	b	d	a	a	c	b	b	d	d	a	c

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	a	d	b	c	d	b	b	d	d	c	a	a

Question no.	37	38	39	40	41	42	43	44
Answer	a	b	b	b	c	c	c	d

Detailed Answers for the Questions Signed by ❋

2 (c)

$\because V = IR$

$\because$ The three conductors are connected in series.

$\therefore$ The current through them is equal.

$\therefore V \propto R$ (1)

$\because R = \frac{\rho_e \ell}{A} = \frac{\rho_e \ell}{\pi r^2} = \frac{\rho_e \ell}{\pi \left(\frac{D}{2}\right)^2} = \frac{4 \rho_e \ell}{\pi D^2}$

$\because$ The three conductors are made of the same material.

$\therefore R \propto \frac{\ell}{D^2}$ (2)

From (1) & (2) :

$\therefore V \propto \frac{\ell}{D^2}$

$\therefore V_x : V_y : V_z = \frac{\ell_x}{D_x^2} : \frac{\ell_y}{D_y^2} : \frac{\ell_z}{D_z^2} = \frac{\ell_x}{D_x^2} : \frac{2\ell_x}{\left(\frac{D_x}{2}\right)^2} : \frac{\ell_x}{\left(\frac{D_x}{2}\right)^2} = 1 : \frac{2}{\frac{1}{4}} : \frac{1}{\frac{1}{4}} = 1 : 8 : 4$

3 (c)

• When the two switches (K_1) , (K_2) are open:

$I = \frac{V_B}{\grave{R}}$

$= \frac{2}{600 + 200 + 100} = 2.22 \times 10^{-3}$ A

∴ The ammeter reading $= 2.22 \times 10^{-3}$ A

• When the two switches (K_1) & (K_2) are closed together:

∵ The two resistors 200 Ω, R are connected in parallel.

∴ The voltage across each of them is equal.

∵ The ammeter reading doesn't change.

∴ $V_R = 2.22 \times 10^{-3} \times 200 = 0.444$ V

∴ $V_{600\ \Omega} = V_B - V_R = 2 - 0.444 = 1.556$ V

∴ $I_{Total} = \frac{V_{600\ \Omega}}{600} = \frac{1.556}{600} = 2.59 \times 10^{-3}$ A

∴ $I_R = I_{Total} - I_{Ammeter} = (2.59 \times 10^{-3}) - (2.22 \times 10^{-3})$

$= 0.37 \times 10^{-3}$ A

∴ $R = \frac{V_R}{I_R} = \frac{0.444}{0.37 \times 10^{-3}} =$ **1200 Ω**

9 (b)

∵ Current intensity (I) = The number of divisions indicated by the pointer deflection × the indication of each one division

• In galvanometer (A):

$50 = 15 \times I_A$, $I_A = \frac{50}{15} = \frac{10}{3}$ mA

• In galvanometer (B):

$80 = 20 \times I_B$, $I_B = \frac{80}{20} = 4$ mA

∵ Sensitivity of galvanometer $= \frac{\theta}{I}$

∵ The angle between each two successive divisions of the galvanometer is the same for both galvanometers.

∴ Sensitivity of galvanometer $\propto \frac{1}{I}$

∴ $\frac{\text{Sensitivity of galvanometer (A)}}{\text{Sensitivity of galvanometer (B)}} = \frac{I_B}{I_A} = \frac{4}{\frac{10}{3}} =$ **$\frac{6}{5}$**

12 (d)

• For the wire (PQ) to move with a uniform velocity (v), the resultant forces acting on it must be zero; which means, it is pulled with a force equal to the magnetic force acting on it.

∴ $F = F_B = BI\ell = B \times \frac{emf}{\grave{R}} \times \ell$

∵ $emf = B\ell v$, $\grave{R} = R + \frac{6R \times 3R}{6R + 3R} = 3R$

∴ $F = B \times \frac{B\ell v}{3R} \times \ell =$ **$\frac{B^2\ell^2 v}{3R}$**

13 (c)

- When the magnet moves towards the coil, the magnetic flux cutting the coil increases, so a reverse induced electromotive force (emf) is generated in the coil and this makes the face of the coil facing the magnet a south pole. Consequently, the direction of the induced emf is the same as the direction of the battery (V_B) and opposite to the direction of the battery ($3V_B$) which leads to a decrease in the total potential difference in the circuit and therefore a decrease in the total current flowing in the circuit.

$\because V_1 = V_B + Ir \quad , \quad V_2 = 3V_B - Ir$

$\therefore$ The voltmeter reading (V_1) decreases and the voltmeter reading (V_2) increases.

17 (a)

$\because \frac{N_p}{N_s} < 1$

$\therefore$ The electric transformer is a step-up.

$(V_p)_{eff} = \frac{(V_p)_{max}}{\sqrt{2}} = \frac{157.13}{\sqrt{2}} = 111.11 \text{ V}$

$I_p = \frac{(P_W)_p}{(V_p)_{eff}} = \frac{3000}{111.11} = 27 \text{ A}$

$\frac{N_p}{N_s} = \frac{I_s}{I_p} \quad , \quad \frac{2}{9} = \frac{I_s}{27} \quad , \quad I_s = 6 \text{ A}$

$\eta(P_w)_p = I_s V_s$

$\frac{90}{100} \times 3000 = 6 V_s \quad , \quad V_s = 450 \text{ V}$

$R = \frac{V_s}{I_s} = \frac{450}{6} = 75 \ \Omega$

24 (c)

$\because n\lambda_n = 2\pi r_n \quad , \quad \lambda_n = \frac{h}{m_e v_n}$

$\therefore \frac{nh}{m_e v_n} = 2\pi r_n \quad , \quad v_n = \frac{nh}{2\pi r_n m_e}$

$\therefore v_n \propto \frac{n}{r_n} \qquad \because \frac{r_2}{r_3} = \frac{D_2}{D_3} = \frac{4}{9}$

$\therefore \frac{v_3}{v_2} = \frac{n_3}{n_2} \times \frac{r_2}{r_3} = \frac{3}{2} \times \frac{4}{9} = \frac{2}{3}$

$\therefore v_2 = \frac{3}{2} v_3$

36 (a)

$\ell_{Wire} = 2\pi r_{Coil} N = 2 \times \frac{22}{7} \times 1 \times 10^{-2} \times 400 = 25.14 \text{ m}$

$R_{Wire} = 0.01 \times 25.14 = 0.2514 \ \Omega$

$\because B = \frac{\mu N I}{\ell_{Solenoid}}$

$\therefore I = \frac{B\ell_{Solenoid}}{\mu N} = \frac{0.01 \times 20 \times 10^{-2}}{4\pi \times 10^{-7} \times 400} \simeq 4 \text{ A}$

$\therefore V_B = IR_{Wire} = 4 \times 0.2514 \simeq 1 \text{ V}$

Answers of Essay Questions

45

$$\because M = \frac{N_{Circular}\,\Delta(\phi_m)_{Circular}}{\Delta I_{Solenoid}}$$

$$= \frac{N_{Circular}\,\Delta B_{Solenoid}\,A_{Circular}}{\Delta I_{Solenoid}}$$

$$= \frac{N_{Circular} \times \mu n_{Solenoid} \times \Delta I_{Solenoid} \times A_{Circular}}{\Delta I_{Solenoid}}$$

$$= \mu n_{Solenoid}\, N_{Circular}\, A_{Circular}$$

$$\therefore M = 4\pi \times 10^{-7} \times 2000 \times 100 \times \pi \left(\frac{0.02}{2}\right)^2$$

$$= 7.9 \times 10^{-5}\ H$$

$$\because emf_{Circular} = \frac{-M\Delta I_{Solenoid}}{\Delta t}$$

$$\because emf_{Circular} = I_{Circular}\, R_{Circular}$$

$$= \frac{Q_{Circular}}{\Delta t} R_{Circular}$$

$$\therefore -M\Delta I_{Solenoid} = Q_{Circular}\, R_{Circular}$$

$$\therefore Q_{Circular} = \frac{-M\Delta I_{Solenoid}}{R_{Circular}}$$

$$\therefore Q_{Circular} = \frac{-7.9 \times 10^{-5} \times (0-4)}{10\,\pi^2} = 3.2 \times 10^{-6}\ C$$

46 (1) Because the current intensity is inversely proportional to the total resistance of the circuit $(\grave{R} + R_x)$

$$\because \theta \propto I \quad , \quad I \propto \frac{1}{\grave{R} + R_x}$$

$$\therefore \theta \propto \frac{1}{\grave{R} + R_x} \quad , \quad \frac{\theta_1}{\theta_2} = \frac{\grave{R} + R_x}{\grave{R}}$$

- When the pointer of the galvanometer deflects to the mid of the scale:

$$\therefore \frac{100}{50} = \frac{\grave{R} + 1000}{\grave{R}} \quad , \quad 2\grave{R} = \grave{R} + 1000$$

$$\therefore \grave{R} = 1000\ \Omega$$

- When the pointer of the galvanometer deflects by angle of 15° from the position of infinity:

$$\therefore \frac{100}{15} = \frac{1000 + R_x}{1000} \quad , \quad 10^5 = (15 \times 10^3) + 15\,R_x$$

$$\therefore R_x = 5666.67\ \Omega$$

Answers of Exam 7

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	a	c	c	c	b	b	c	c	a	c	c	a

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	d	c	c	a	b	d	a	a	b	a	c	d

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	a	c	a	b	c	b	c	d	c	a	d	d

Question no.	37	38	39	40	41	42	43	44
Answer	c	a	c	d	d	c	a	d

Detailed Answers for the Questions Signed by ❋

8 (c)

In figure (1):

$\because F = \frac{\mu I_1 I_2 \ell}{2\pi d}$

$\therefore F = \frac{\mu \times I \times 2I \times \ell}{2\pi d} = \frac{\mu I^2 \ell}{\pi d}$

In figure (2):

$\because F = B_t I \ell$

• When the net magnetic forces acting on wire (X) vanishes:

$\therefore (B_t)_X = 0 \quad , \quad B_{outer} = B_Y = B$

$\therefore B = \frac{\mu I}{2\pi d}$

• The net magnetic forces acting on wire (Y):

$(B_t)_Y = B_X + B = \frac{\mu \times 2I}{2\pi d} + \frac{\mu I}{2\pi d} = \frac{3}{2}\left(\frac{\mu I}{\pi d}\right)$

$\because F_Y = (B_t)_Y I_Y \ell$

$\therefore F_Y = \frac{3}{2}\left(\frac{\mu I}{\pi d}\right) \times I \times \ell = \frac{3}{2}\left(\frac{\mu I^2 \ell}{\pi d}\right) = 1.5\,F$

23 (c)

$\because \lambda_{max} \propto \frac{1}{T}$

$\therefore \frac{(\lambda_{max})_1}{(\lambda_{max})_2} = \frac{T_2}{T_1} \quad , \quad \frac{500 \times 10^{-9}}{1 \times 10^{-6}} = \frac{T_2}{6000}$

$\therefore T_2 = 3000\ K$

33 ⓒ

$V_B = I\,(R_v + r)$

• From the graph:

- When $R_v = 2\ \Omega$

$I = 3\ A$

$\therefore V_B = 3 \times (2 + r)$ ①

- When $R_v = 4\ \Omega$

$I = 2\ A$

$\therefore V_B = 2 \times (4 + r)$ ②

• By equating equations (1), (2):

$\therefore 3 \times (2 + r) = 2 \times (4 + r)$, $r = 2\ \Omega$

• By substituting in equation (1):

$\therefore V_B = 3 \times (2 + 2) = \mathbf{12\ V}$

Answers of Essay Questions

45

$\because (emf)_2 = M \dfrac{\Delta I_1}{\Delta t}$

$\therefore 2 = M \times 25$, $M = 0.08\ H$

$\because M = \dfrac{\mu N_1 N_2 A}{\ell}$

$\therefore 0.08 = \dfrac{2 \times 10^{-3} \times 200 \times 200 \times 4 \times 10^{-4}}{\ell}$

$\therefore \ell = \mathbf{0.4\ m}$

46 **(1)**

$\because V_B = I_x\,(\tilde{R} + R_x)$, $\therefore R_x = \dfrac{V_B}{I_x} - \tilde{R}$ ①

• By comparing equation (1) with by the given equation in the question :

$R_x = \dfrac{7}{5\,I_x} - 2000$

$R_x = \dfrac{V_B}{I_x} - \tilde{R}$

$\therefore V_B = \dfrac{7}{5}\ V = \mathbf{1.4\ V}$

(2) By comparing the two equations :

$\tilde{R} = 2000\ \Omega$

$\therefore I_g = \dfrac{V_B}{\tilde{R}} = \dfrac{1.4}{2000} = 7 \times 10^{-4}\ A$

$\because I_k = \frac{5}{7} I_g$

$\therefore R_k = \frac{1.4}{\frac{5}{7} \times 7 \times 10^{-4}} - 2000 = 800\ \Omega$

Answers of Exam 8

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	b	c	a	a	a	b	b	a	b	b	d	a

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	c	a	b	a	d	b	d	d	c	b	b	a

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	a	c	b	b	a	d	d	c	d	b	a	d

Question no.	37	38	39	40	41	42	43	44
Answer	b	d	d	b	c	a	d	a

Detailed Answers for the Questions Signed by ❋

36 (d)

$\because \frac{I_g}{I} = \frac{\grave{R} + R_x}{\grave{R}}$

• When connecting resistance 6000 Ω to the ohmmeter :

$\frac{I_g}{\frac{1}{4} I_g} = \frac{\grave{R} + 6000}{\grave{R}}$, $4\grave{R} = \grave{R} + 6000$

$\grave{R} = 2000\ \Omega$

• When connecting resistance 3000 Ω to the ohmmeter :

$\frac{I_g}{I_2} = \frac{2000 + 3000}{2000} = \frac{5}{2}$, $I_2 = \frac{2}{5} I_g$

$\therefore$ The ohmmeter's pointer deflects to $\frac{2}{5}$ of the current scale

38 (d)

• Before increasing the current in one of the two wires:

$\because$ The neutral point is midway between the two wires.

$\therefore I_1 = I_2 = I$

• The distance between the two wires (d):

$d = 2\, d_1$

• Where (d_1) is the distance between any of the wires and the neutral point.

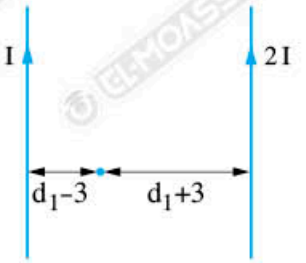
• When doubling the current passing through one of the wires, the neutral point becomes closer to the wire of the less current.

$$\therefore \frac{\mu I}{2\pi (d_1 - 3)} = \frac{\mu \times 2I}{2\pi (d_1 + 3)}$$

$$\therefore d_1 - 3 = \frac{d_1 + 3}{2}$$

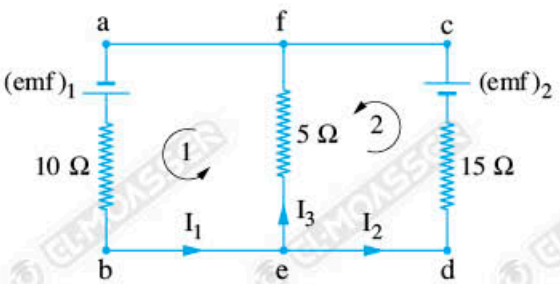
$$\therefore 2d_1 - 6 = d_1 + 3 \quad , \quad d_1 = 9 \text{ cm}$$

$$\therefore d = 2d_1 = 2 \times 9 = \mathbf{18 \text{ cm}}$$



Answers of Essay Questions

45 Redraw the electric circuit as in the opposite figure:



$$(emf)_1 = B\ell v_{ab} = 0.01 \times 10 \times 10^{-2} \times 4$$

$$= 4 \times 10^{-3} \text{ V}$$

$$(emf)_2 = B\ell v_{cd} = 0.01 \times 10 \times 10^{-2} \times 2$$

$$= 2 \times 10^{-3} \text{ V}$$

• By applying Kirchhoff's first law at point (e:)

$$\Sigma I_{in} = \Sigma I_{out}$$

$$I_1 = I_2 + I_3 \quad , \quad I_1 - I_2 - I_3 = 0 \qquad (1)$$

• By applying Kirchhoff's second law on path (1):

$$\Sigma V_B = \Sigma IR$$

$$4 \times 10^{-3} = 10 I_1 + 5 I_3 \quad , \quad 10 I_1 + 0 I_2 + 5 I_3 = 4 \times 10^{-3} \qquad (2)$$

• By applying Kirchhoff's second law on path (2):

$$2 \times 10^{-3} = 15 I_2 - 5 I_3 \quad , \quad 0 I_1 + 15 I_2 - 5 I_3 = 2 \times 10^{-3} \qquad (3)$$

• By solving equations (1),(2),(3) using the calculator:

$$I_1 = 3.27 \times 10^{-4} \text{ A}$$

$$I_2 = 1.82 \times 10^{-4} \text{ A}$$

$$I_3 = 1.45 \times 10^{-4} \text{ A}$$

$\therefore$ The current passing through the resistance 5 Ω is 1.45×10^{-4} A

46

$V_{12\,\Omega} = 7.8 - 6.516 = 1.284$ V

$I_t = \frac{1.284}{12} = 0.107$ A

• The equivalent resistance $\grave{R}$ of the voltmeter and the resistance 63 Ω:

$\grave{R} = \frac{V_{voltmeter}}{I_t} = \frac{6.516}{0.107} = 60.9\ \Omega$

$60.9 = \frac{63\,R}{63 + R}$, $R = 1827\ \Omega$

Answers of Exam 9

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	b	b	d	c	d	a	d	d	c	a	c	a

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	b	b	a	a	d	b	c	b	b	a	d	c

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	a	b	c	c	c	a	d	b	c	b	c	a

Question no.	37	38	39	40	41	42	43	44
Answer	d	a	a	c	c	d	a	a

Detailed Answers for the Questions Signed by ✱

12 (a)

• When the rod (m) moves with a uniform velocity (v) rightwards, induced emf gets induced at its ends which causes the flow of induced electric current, its direction is counter clockwise according to Fleming's right-hand rule.

• When the induced current passes in the rod (n), it gets affected by a magnetic force its direction is to the right of the page according to Fleming's left-hand rule, so it moves in the same direction of motion of rod (m)

15 (a)

- In figure (1):

• The AC current passing in the coil produces variable magnetic flux which leads to generating eddy currents in the iron piece and that leads to the rise of its temperature.

- In figure (2):

• The DC current passing in the coil produces a magnetic field of constant intensity and direction which leads to magnetizing the iron piece.

∴ The correct choice is (a)

17 (d)

- When opening the switch (K) in the secondary coil circuit, the back induced emf in the primary coil by self-induction becomes almost equal to the emf of the AC source which makes the current if the primary coil be close to zero.

30 (a)

- The light bulb (A) lights up when connected diode is forward biased i.e. the current passing in the circuit is in the counter clockwise direction , and this is achieved by moving the wire (MN) to the right in the plane of the page.

Answers of Essay Questions

45

- The bulb brightness increases due to the increase of the total emf in the bulb circuit, which is due to generating forward induced emf in the secondary coil as a result of the reduction of the flux which is produced from the primary coil due to the decrease of its current during moving the rheostat slider from position (b) to position (a).

46

$\because \frac{I_g}{I} = \frac{\grave{R} + R_x}{\grave{R}}$

- When connecting the resistance (600 Ω) between the terminals of the ohmmeter:

$\therefore \frac{200}{160} = \frac{\grave{R} + 600}{\grave{R}}$, $1.25\,\grave{R} = \grave{R} + 600$

$\therefore \grave{R} = 2400\ \Omega$

- When connecting the resistance (R_1) between the terminals of the ohmmeter:

$\therefore \frac{200}{75} = \frac{2400 + R_1}{2400}$, $R_1 = 4000\ \Omega$

Answers of Exam 10

Question no.	1	2	3	4	5	6	7	8	9	10	11	12
Answer	d	a	b	c	a	a	d	c	c	b	b	d

Question no.	13	14	15	16	17	18	19	20	21	22	23	24
Answer	a	b	b	a	d	c	a	a	a	d	b	d

Question no.	25	26	27	28	29	30	31	32	33	34	35	36
Answer	d	b	d	b	a	a	a	a	a	d	d	a

Question no.	37	38	39	40	41	42	43	44
Answer	d	d	b	c	d	c	d	b

Detailed Answers for the Questions Signed by ❋

34 (d)

$X_L = 2\pi fL = 2 \times 3.14 \times 50 \times 0.2 = 62.8\ \Omega$

$X_C = \frac{1}{2\pi fC} = \frac{1}{2 \times 3.14 \times 50 \times 20 \times 10^{-6}} = 159.24\ \Omega$

$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{(100)^2 + (62.8 - 159.24)^2} = 138.93\ \Omega$

$I = \frac{V}{Z} = \frac{200}{138.93} = 1.44\ A$

$P_w = I^2R = (1.44)^2 \times 100 \simeq 207\ W$

38 (d)

$\because I = I_g + \frac{V_g}{R_s}$, $\therefore$ slope $= \frac{\Delta I}{\Delta(\frac{1}{R_s})} = V_g = I_g R_g$

$\because$ The cut part of the x-axis is equal.

$\therefore (I_g)_1 = (I_g)_2$, $R_g \propto$ slope

$\therefore \frac{(R_g)_1}{(R_g)_2} = \frac{(\text{slope})_1}{(\text{slope})_2} = \frac{\tan\theta_1}{\tan\theta_2} = \frac{\tan 60}{\tan 30} = \frac{3}{1}$

Answers of Essay Questions

45

$\because (\text{emf})_{\text{eff}} = \frac{(\text{emf})_{\max}}{\sqrt{2}}$

$\therefore 314\sqrt{2} = \frac{(\text{emf})_{\max}}{\sqrt{2}}$, $(\text{emf})_{\max} = 628\ V$

$\because 628 = NBA(2\pi f)$, $NBAf = \frac{628}{2 \times 3.14} = 100$

$\because \text{emf}_{\text{avg}} = -NBA\frac{(\cos\theta_2 - \cos\theta_1)}{\Delta t}$

$\therefore \text{emf}_{\text{avg}} = -NBA\frac{(\cos 60 - \cos 0)}{\frac{1}{6f}} = 3\,NBAf$

$\therefore \text{emf}_{\text{avg}} = 3 \times 100 = 300\ V$

46

$\because V_{CC} = V_{CE} + I_C R_C$

$\therefore 3 = 1 + (I_C \times 400)$, $I_C = 5 \times 10^{-3}\ A$

$\because I_E = I_C + I_B = (5 \times 10^{-3}) + (20 \times 10^{-6})$

$= 5.02 \times 10^{-3}\ A$