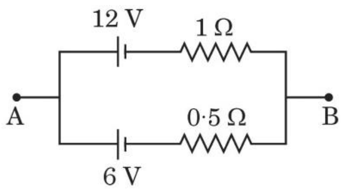
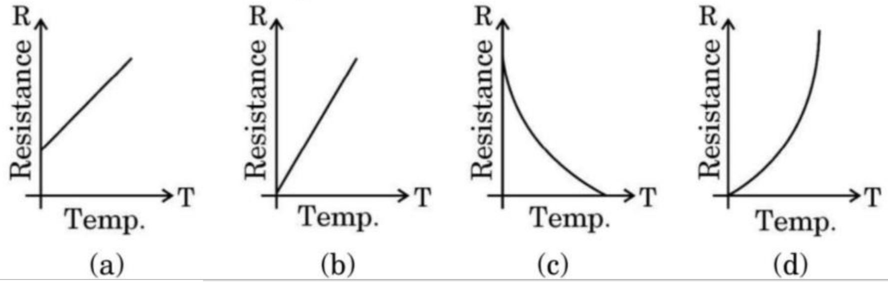
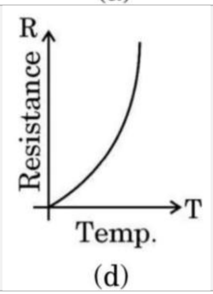
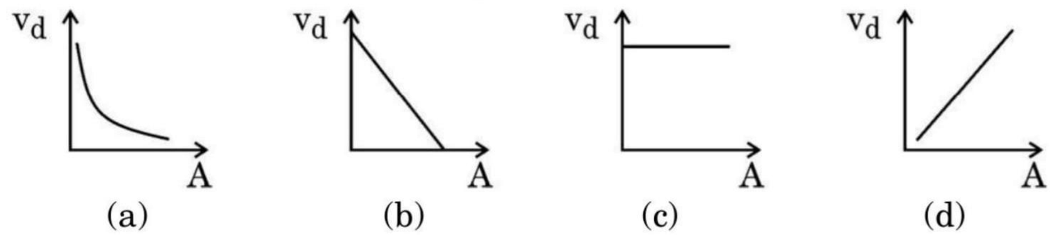
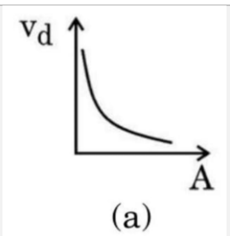
ELECTROSTATICS

1.	A thin plastic rod is bent into a circular ring of radius R. It is uniformly charged with charge density λ. The magnitude of the electric field at its centre is: (A) $\frac{\lambda}{2\varepsilon_0 R}$ (B) Zero (C) $\frac{\lambda}{4\pi\varepsilon_0 R}$ (D) $\frac{\lambda}{4\varepsilon_0 R}$
Ans.	(B) Zero
2.	Ten capacitors, each of capacitance 1 μF, are connected in parallel to a source of 100 V. The total energy stored in the system is equal to: (A) 10^{-2} J (B) 10^{-3} J (C) 0.5×10^{-3} J (D) 5.0×10^{-2} J
Ans.	(D) 5.0×10^{-2} J
3.	Two charged particles P and Q, having the same charge but different masses m_P and m_Q, start from rest and travel equal distances in a uniform electric field E in time t_P and t_Q respectively. Neglecting the effect of gravity, the ratio $\left(\frac{t_p}{t_q}\right)$ is: (A) $\frac{m_p}{m_q}$ (B) $\frac{m_q}{m_p}$ (C) $\sqrt{\frac{m_p}{m_q}}$ (D) $\sqrt{\frac{m_q}{m_p}}$
Ans.	(C) $\sqrt{\frac{m_p}{m_q}}$
4.	Consider a group of charges q_1, q_2, q_3… such that $\sum q \neq 0$. Then equipotentials at a large distance, due to this group are approximately : (A) Plane (B) Spherical surface (C) Paraboloidal surface (D) Ellipsoidal surface
Ans.	(B) Spherical surface
5.	A proton is taken from point P_1 to point P_2, both located in an electric field. The potentials at points P_1 and P_2 are -5 V and +5 V respectively. Assuming that kinetic energies of the proton at points P_1 and P_2 are zero, the work done on the proton is: (A) -1.6×10^{-18} J (B) 1.6×10^{-18} J (C) Zero (D) $0{\cdot}8 \times 10^{-18}$ J
Ans.	(B) 1.6×10^{-18} J
6.	Two charges +q each are kept '2a' distance apart. A third charge -2q is placed midway between them. The potential energy of the system is- (A) $\frac{q^2}{8\pi\varepsilon_0 a}$ (B) $-\frac{6q^2}{8\pi\varepsilon_0 a}$ (C) $-\frac{7q^2}{8\pi\varepsilon_0 a}$ (D) $\frac{9q^2}{8\pi\varepsilon_0 a}$
Ans.	(C) $-\frac{7q^2}{8\pi\varepsilon_0 a}$
7.	Two identical small conducting balls B_1 and B_2 are given -7 pC and +4 pC charges respectively. They are brought in contact with a third identical ball B_3 and then separated. If the final charge on each ball is -2 pC, the initial charge on B_3 was (A) -2 pC (B) -3 pC (C) -5 pC (D) -15 pC
Ans.	(B) -3 pC
8.	A point charge situated at a distance 'r' from a short electric dipole on its axis, experiences a force F. If the distance of the charge is '2r', the force on the charge will be: (A) $\frac{F}{16}$ (B) $\frac{F}{8}$ (C) $\frac{F}{4}$ (D) $\frac{F}{2}$
Ans.	(B) $\frac{F}{8}$
9.	In the process of charging of a capacitor, the current produced between the plates of the capacitor is: (a) $\mu_0 \frac{d\phi_E}{dt}$ (b) $\frac{1}{\mu_0}\frac{d\phi_E}{dt}$ (c) $\varepsilon_0 \frac{d\phi_E}{dt}$ (d) $\frac{1}{\varepsilon_0}\frac{d\phi_E}{dt}$ where symbols have their usual meanings.
Ans.	(c) $\varepsilon_0 \frac{d\phi_E}{dt}$

10.	The magnitude of the electric field due to a point charge object at a distance of 4.0 m is 9 N/C. From the same charged object the electric field of magnitude, 16 N/C will be at a distance of (a) 1 m (b) 2 m (c) 3 m (d) 6 m
Ans.	(c) 3 m
11.	A point P lies at a distance x from the mid point of an electric dipole on its axis. The electric potential at point P is proportional to (A) $\frac{1}{x^2}$ (B) $\frac{1}{x^3}$ (C) $\frac{1}{x^4}$ (D) $\frac{1}{x^{1/2}}$
Ans.	(A) $\frac{1}{x^2}$
12.	An electron experiences a force $(1.6 \times 10^{-16}\ N)\ \hat{i}$ in an electric field $\vec{E}$. The electric field $\vec{E}$ is : (a) $(1.0 \times 10^{3}\ \frac{N}{C})\ \hat{i}$ (b) $-(1.0 \times 10^{3}\ \frac{N}{C})\ \hat{i}$ (c) $(1.0 \times 10^{-3}\ \frac{N}{C})\ \hat{i}$ (d) $-(1.0 \times 10^{-3}\ \frac{N}{C})\ \hat{i}$
Ans.	(b) $-(1.0 \times 10^{3}\ \frac{N}{C})\ \hat{i}$
13.	Which one of the following is ***not*** a scalar quantity? (a) Electric field (b) Voltage (c) Resistivity (d) Power
Ans.	(a) Electric field
14.	Two charges q_1 and q_2 are placed at the centres of two spherical conducting shells of radius r_1 and r_2 respectively. The shells are arranged such that their centres are d [> $(r_1 + r_2)$] distance apart. The force on q_2 due to q_1 is : (a) $\frac{1}{4\pi \varepsilon_0} \frac{q_1 q_2}{d^2}$ (b) $\frac{1}{4\pi \varepsilon_0} \frac{q_1 q_2}{(d - r_1)^2}$ (c) Zero (d) $\frac{1}{4\pi \varepsilon_0} \frac{q_1 q_2}{[d - (r_1 + r_2)]^2}$
Ans.	(c) Zero
15.	An electric dipole of length 2 cm is placed at an angle of 30° with an electric field 2×10^5 N/C. If the dipole experiences a torque of 8×10^{-3} Nm, the magnitude of either charge of the dipole, is (A) 4 μC (B) 7 μC (C) 8 mC (D) 2 mC
Ans.	(A) 4 μC
16.	Two long parallel wires kept 2 m apart carry 3A current each, in the same direction. The force per unit length on one wire due to the other is (A) 4.5×10^{-5} Nm^{-1}, attractive (B) 4.5×10^{-7} N/m, repulsive (C) 9×10^{-7} N/m, repulsive (D) 9×10^{-5} N/m, attractive
Ans.	No option is correct. **[Award one mark to each student]** ***According to Marking scheme***
17.	The capacitors, each of 4 μF are to be connected in such a way that the effective capacitance of the combination is 6 μF. This can be achieved by connecting (A) All three in parallel (B) All three in series (C) Two of them connected in series and the combination in parallel to the third. (D) Two of them connected in parallel and the combination in series to the third.
Ans.	(C) Two of them connected in series and the combination in parallel to the third.

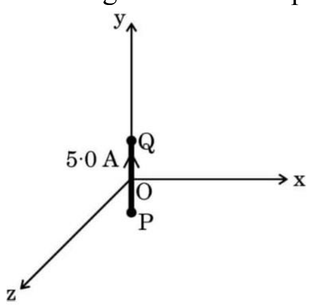
CURRENT ELECTRICITY

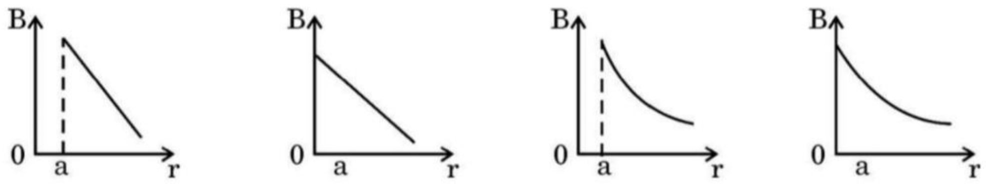
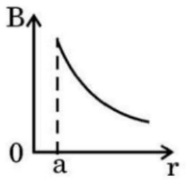
1.	Consider the circuit shown in the figure. The potential difference between points A and B is:  (A) 6 V (B) 8 V (C) 9 V (D) 12 V
Ans.	(B) 8 V

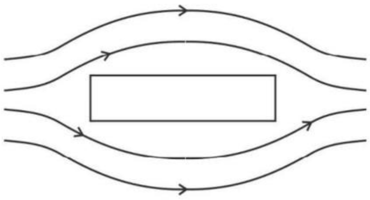
2.	Electrons drift with speed V_d in a conductor with potential difference V across its ends. If V is reduced to $\left(\frac{V}{2}\right)$, their drift speed will become: (A) $\frac{V_d}{2}$ (B) V_d (C) 2 V_d (D) 4 V_d
Ans.	(A) $\frac{V_d}{2}$
3.	A battery supplies 0.9 A current through a 2 Ω resistor and 0.3 A current through a 7 Ω resistor when connected one by one. The internal resistance of the battery is: (A) 2 Ω (B) 1.2 Ω (C) 1 Ω (D) 0.5 Ω
Ans.	(D) 0.5 Ω
4.	For a metallic conductor, the correct representation of variation of resistance R with temperature T is : 
Ans.	
5.	The potential difference across a cell in an open circuit is 8 V. It falls to 4 V when a current of 4 A is drawn from it. The internal resistance of the cell is: (a) 4 Ω (b) 3Ω (c) 2Ω (d) 1Ω
Ans.	(d) 1Ω
6.	A steady current flows through a metallic wire whose area of cross-section (A) increases continuously from one end of the wire to the other. The magnitude of drift velocity (V_d) of the free electrons as a function of 'A' can be shown by: 
Ans.	
7.	A current of 0.8 A flows in a conductor of 40Ω for 1 minute. The heat produced in the conductor will be (a) 1445 J (b) 1536 J (c) 1569 J (d) 1640 J
Ans.	(b) 1536 J
8.	A cell of emf E is connected across an external resistance R. When current 'I' is drawn from the cell, the potential difference across the electrodes of the cell drops to V. The internal resistance 'r' of the cell is (A) $\left(\frac{E-V}{E}\right)R$ (B) $\left(\frac{E-V}{R}\right)$ (C) $\frac{(E-V)R}{I}$ (D) $\left(\frac{E-V}{V}\right)R$
Ans.	(D) $\left(\frac{E-V}{V}\right)R$
9.	The current density due to drift of electrons in a conductor is given by : (symbols have their usual meanings)

	(a) ne AV_d (b) $\frac{nAVd}{e}$ (c) $\frac{nVd}{eA}$ (d) ne Vd
Ans.	(d) ne Vd

MOVING CHARGES AND MAGNETISM

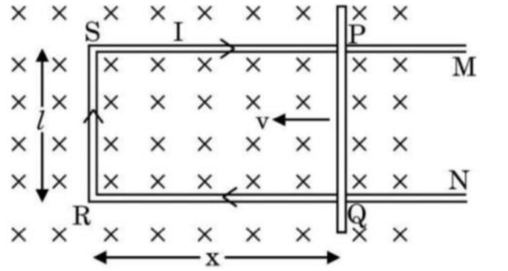
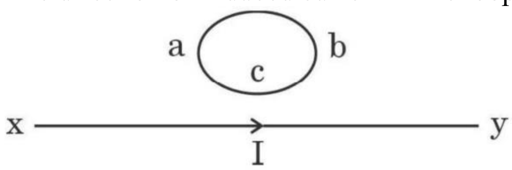
1.	A loop carrying a current I clockwise is placed in x-y plane, in a uniform magnetic field directed along z-axis. The tendency of the loop will be to: (A) move along x-axis (B) move along y-axis (C) shrink (D) expand
Ans.	(C) shrink
2.	A 10 cm long wire lies along y-axis. It carries a current of 1.0 A in positive y-direction. A magnetic field $\vec{B} = (5\ mT)\ \hat{j}$ - $(8\ mT)\ \hat{K}$ exists in the region. The force on the wire is: (A) (0·8 mN) î (B) - (0·8 mN) î (C) (80 mN) î (D) - (80 mN) î
Ans.	(B) - (0·8 mN) î
3.	A galvanometer of resistance G Ω is converted into an ammeter of range 0 to I A. If the current through the galvanometer is 0.1% of I A, the resistance of the ammeter is: (A) $\frac{G}{999}\ \Omega$ (B) $\frac{G}{1000}\ \Omega$ (C) $\frac{G}{1001}\ \Omega$ (D) $\frac{G}{100.1}\ \Omega$
Ans.	(B) $\frac{G}{1000}\ \Omega$
4.	A wire of length 4.4 m is bent round in the shape of a circular loop and carries a current of 1.0 A. The magnetic moment of the loop will be: (A) 0.7 Am^2 (B) 1.54 Am^2 (C) 2.10 Am^2 (D) 3.5 Am^2
Ans.	(B) 1.54 Am^2
5.	A circular coil of radius 10 cm is placed in a magnetic field B = (1·0 ^i + 0·5 ^j) mT such that the outward unit vector normal to the surface of the coil is (0·6 ^i + 0·8 ^j). The magnetic flux linked with the coil is : (A) 0.314 μWb (B) 3.14 μWb (C) 31.4 μWb (D) 1.256 μWb
Ans.	(C) 31.4 μWb
6.	A 2.0 cm segment of wire, carrying 5.0 A current in positive y-direction lies along y-axis, as shown in the figure. The magnetic field at a point (3 m, 4 m, 0) due to this segment (part of a circuit) is :  (A) (0·12 nT) $\hat{j}$ (B) – (0·10 nT) $\hat{j}$ (C) – (0·24 nT) $\hat{k}$ (D) (0·24 nT) $\hat{k}$
Ans.	(C) – (0.24 nT) ^k
7.	A circular loop of wire, carrying a current 'I' is lying in xy-plane with its centre coinciding with the origin. It is subjected to a uniform magnetic field pointing along + z-axis. The loop will : (A) move along x-axis (B) move along -y-axis (C) move along z-axis (D) remain stationary
Ans.	(D) remain stationary
8.	A current carrying circular loop of magnetic moment M is suspended in a vertical plane in an external magnetic field B such that its plane is normal to B. The work done in rotating this loop by 45^0 about an axis perpendicular to B is closest to : (A) -0.3 MB (B) 0.3 MB (C) -1.7 MB (D) 1.7 MB
Ans.	(B) 0.3 MB
9.	A straight wire is kept horizontally along east-west direction. If a steady current flows in wire from east to west, the magnetic field at a point above the wire will point towards (A) East (B) West (C) North (D) South
Ans.	(C) North
10.	The magnetic susceptibility for a diamagnetic material is (A) small and negative (B) small and positive (C) large and negative (D) large and positive

Ans.	(A) small and negative
11.	A galvanometer of resistance 100 Ω is converted into an ammeter of range (0-1 A) using a resistance of 0.1 Ω. The ammeter will show full scale deflection for a current of about (A) 0.1 mA (B) 1 mA (C) 10 mA (D) 0.1 mA
Ans.	(B) 1 mA
12.	A circular loop A of radius R carries a current I. Another circular loop B of radius $r = \frac{R}{20}$ is placed concentrically in the plane of A. The magnetic flux linked with loop B is proportional to (A) R (B) $\sqrt{R}$ (C) $R^{3/2}$ (D) R^2
Ans.	(B) $\sqrt{R}$
13.	A particle of mass m and charge q describes a circular path of radius R in a magnetic field. If it mass and charge were 2m and $\frac{q}{2}$ respectively, the radius of its path would be (A) $\frac{R}{4}$ (B) $\frac{R}{2}$ (C) 2R (D) 4R
Ans.	(D) 4R
14.	Which of the following pairs is that of paramagnetic materials ?
Ans.	(A) Copper and Aluminium (B) Sodium and Calcium (C) Lead and Iron (D) Nickel and Cobalt
15.	A galvanometer of resistance 50 Ω is converted into a voltmeter of range (0-2 V) using a resistor of 1.0 k Ω. If it is to be converted into a voltmeter of range (0-10 V), the resistance required will be (A) 4.8 k Ω (B) 5.0 k Ω (C) 5.2 k Ω (D) 5.4 k Ω
Ans.	(C) 5.2 k Ω
16.	A diamagnetic substance is brought near the north or south pole of a bar magnet. It will be : (a) repelled by both the poles. (b) attracted by both the poles. (c) repelled by the north pole and attracted by the south pole. (d) attracted by the north pole and repelled by the south pole.
Ans.	(a) repelled by both the poles.
17.	Beams of electrons and protons move parallel to each other in the same direction. They (a) attract each other. (b) repel each other. (c) neither attract nor repel. (d) force of attraction or repulsion depends upon speed of beams.
Ans.	(b) repel each other.
18.	A long straight wire of radius 'a' carries a steady current 'I'. The current is uniformly distributed across its area of cross-section. The ratio of magnitude of magnetic field B_1 at a/2 and B_2 at distance 2a is (a) 1/2 (b) 1 (d) 4
Ans.	(b) 1
19.	Which of the following graphs correctly represents the variation of the magnitude of the magnetic field outside a straight infinite current carrying wire of radius 'a', as a function of distance 'r' from the centre of the wire ?  (a) (b) (c) (d)
Ans.	 (c)
20.	A particle of mass m and charge q moving with a uniform velocity $\vec{v} = v_{0x}\hat{i} + v_{0y}\hat{j}$ enters a region with a magnetic field $\vec{B} = B_0\hat{j}$. After some time, an electric field $\vec{E} = E_0\hat{j}$ is also switched on in the region. The resulting path described by the particle will be :

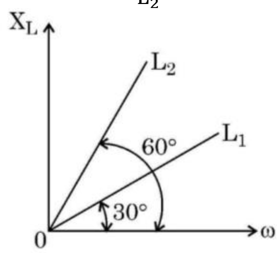
	(a) a circle in x-z plane (b) a parabola in x-y plane (c) a helix with constant pitch (d) a helix with increasing pitch
Ans.	(d) a helix with increasing pitch
21.	An electron enters a uniform magnetic field with speed v. It describes a semicircular path and comes out of the field. The final speed of the electron is : (a) Zero (b) v (c) v/2 (d) 2v
Ans.	(b) v
22.	The magnetic field lines near a substance are as shown in the figure. The substance is :  (a) Copper (b) Iron (c) Sodium (d) Aluminium
Ans.	(a) Copper
23.	Which of the following has its permeability less than that of free space? (A) Copper (B) Aluminium (C) Copper chloride (D) Nickel
Ans.	(A) Copper
24.	A square shaped coil of side 10 cm, having 100 turns is placed perpendicular to a magnetic field which is increasing at 1 T/s. The induced emf in the coil is (A) 0.1 V (B) 0.5 V (C) 0.75 V (D) 1.0 V
Ans.	(D) 1.0 V

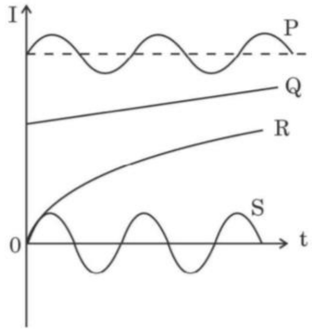
ELECTROMAGNETIC INDUCTION

1.	Which of the following quantity/quantities remains same in primary and secondary coils of an ideal transformer ? Current, Voltage, Power, Magnetic flux (A) Current only (B) Voltage only (C) Power only (D) Magnetic flux and Power both
Ans.	(D) Magnetic flux and Power both
2.	The current in a coil of 15 mH increases uniformly from zero to 4 A in 0.004 s. The emf induced in the coil will be : (A) 22.5 V (B) 17.5 V (C) 15.0 V (D) 12.5 V
Ans.	(C) 15.0 V
3.	Consider a solenoid of length *l* and area of cross-section A with fixed number of turns. The self-inductance of the solenoid will increase if: (A) both l and A are increased (B) l is decreased and A is increased (C) l is increased and A is decreased (D) both l and A are decreased
Ans.	(B) l is decreased and A is increased
4.	A coil of N turns is placed in a magnetic field B such that B is perpendicular to the plane of the coil. B changes with time as $B = B_0 \cos\left(\frac{2\pi}{T}t\right)$ where T is time period. The magnitude of emf induced in the coil will be maximum at (A) $t = \frac{nT}{8}$ (B) $t = \frac{nT}{4}$ (C) $t = \frac{nT}{2}$ (D) t = nT Here, $n = 1, 2, 3, 4, ...$
Ans.	(B) $t = \frac{nT}{4}$
5.	Two coils are placed near each other. When the current in one coil is changed at the rate of 5 A/s, an emf of 2 mV is induced in the other. The mutual inductance of the two coils is (A) 0.4 mH (B) 2.5 mH (C) 10 mH (D) 2.5 H
Ans.	(A) 0.4 mH
6.	A circular coil of radius 8.0 cm and 40 turns is rotated about its vertical 25 diameter with an angular speed of $\frac{25}{\pi}$ rad s-1 in a uniform horizontal π magnetic field of magnitude 3.0×10^{-2} T. The maximum emf induced in the coil is : (a) 0.12 V (b) 0.15 V (c) 0.19 V (d) 0.22 V
Ans.	(c) 0.19 V
7.	Figure shows a rectangular conductor PSRQ in which movable arm PQ has a resistance 'r' and resistance of PSRQ is negligible. The magnitude of emf induced when PQ is moved with a velocity V does ***not*** depend on:

	
	(a) magnetic field ($\vec{B}$) (b) velocity ($\vec{v}$)
	(c) resistance (r) (d) length of PQ
Ans.	(c) resistance (r)
8.	The direction of induced current in the loop abc is :
	
	(a) along abc if I decreases (b) along acb if I increases
	(c) along abc if I is constant (d) along abc if I increases
Ans.	(d) along abc if I increases

ALTERNATING CURRENT

1.	The reactance of a capacitor of capacitance C connected to an ac source of frequency $\boldsymbol{\omega}$ is 'X'. If the capacitance of the capacitor is doubled and the frequency of the source is tripled, the reactance will become:
	(a) $\frac{X}{6}$ (b) 6X (c) $\frac{2}{3}X$ (d) $\frac{3}{2}X$
Ans.	(a) $\frac{X}{6}$
2.	A resistor and an ideal inductor are connected in series to a $100\sqrt{2}$ V, 50 Hz ac source. When a voltmeter is connected across the resistor or the inductor, it shows the same reading. The reading of the voltmeter is :
	(A) $100\sqrt{2}$ V (B) 100 V (C) $50\sqrt{2}$ V (D) 50 V
Ans.	(B) 100 V
3.	Figure shows the variation of inductive reactance X_L of two ideal inductors L_1 and L_2, with angular frequency ω. The value of $\frac{L_1}{L_2}$ is
	
	(A) $\sqrt{3}$ (B) $\frac{1}{\sqrt{3}}$
	(C) 3 (D) $\frac{1}{3}$
Ans.	(D) $\frac{1}{3}$
4.	An inductor, a capacitor and a resistor are connected in series across an ac source of voltage. If the frequency of the source is decreased gradually, the reactance of: (a) both the inductor and the capacitor decreases. (b) inductor decreases and the capacitor increases. (c) both the inductor and the capacitor increases. (d) inductor increases and the capacitor decreases.
Ans.	(b) inductor decreases and the capacitor increases.
5.	The figure shows variation of current (I) with time (t) in four devices P, Q, R and S. The device in which an alternating current flows is :

	 (a) P (b) Q (c) R (d) S
Ans.	(d) S
6.	An ac voltage $v = v_o \sin \omega t$ is applied to a series combination of a resistor R and an element X. The instantaneous current in the circuit is $I = I_0 \sin (\omega t + \frac{\pi}{4})$. Then, which of the following is correct ? (a) X is a capacitor and $X_C = \sqrt{2}$ R (b) X is an inductor and X_L = R (c) X is an inductor and $X_L = \sqrt{2}$ R (d) X is a capacitor and X_c = R
Ans.	(d) X is a capacitor and X_c = R
7.	Which of the following statements about a series LCR circuit connected to an ac source is correct? (A) If the frequency of the source is increased, the impedance of the circuit first decreases and then increases. (B) If the net reactance ($X_L - X_C$) of circuit becomes equal to its resistance, then the current leads the voltage by 45°. (C) At resonance, the voltage drop across the inductor is more than that across the capacitor. (D) At resonance, the voltage drop across the capacitor is more than that across the inductor.
Ans.	(A) If the frequency of the source is increased, the impedance of the circuit first decreases and then increases.

ELECTROMAGNETIC WAVES

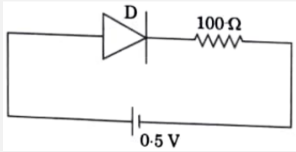
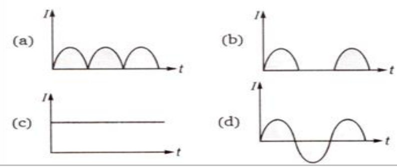
1.	In the four regions, I, II, III and IV, the electric fields are described as: Region I : $E_x = E_0 \sin (kz-\omega t)$ Region II : $E_x = E_0$ Region III : $E_x = E_0 \sin kz$ Region IV : $E_x = E_0 \cos kz$ The displacement current will exist in the region: (A) I (B) IV (C) II (D) III
Ans.	(A) I
2.	Electromagnetic waves with wavelength 10 nm are called : (A) Infrared waves (B) Ultraviolet rays (C) Gamma rays (D) X-rays
Ans.	(B) Ultraviolet rays
3.	Which one of the following has the highest frequency ? (A) Infrared rays (B) Gamma rays (C) Radio waves (D) Microwaves
Ans.	(B) Gamma rays
4.	The phase difference between electric field E and magnetic field B in an electromagnetic wave propagating along z-axis is- (A) Zero (B) π (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$
Ans.	(A) Zero
5.	The electromagnetic waves used to purify water are (A) Infrared rays (B) Ultraviolet rays (C) X-rays (D) Gamma rays
Ans.	(B) Ultraviolet rays
6.	E and B represent the electric and the magnetic field of an electromagnetic wave respectively. The direction of propagation of the wave is along (a) B (b) E (c) $E \times B$ (d) $B \times E$
Ans.	(c) $E \times B$
7.	The electromagnetic radiations used to kill germs in water purifiers are called: (a) Infrared waves (b) X-rays (c) Gamma rays (d) Ultraviolet rays
Ans.	(d) Ultraviolet rays
8.	The electromagnetic waves used in radar systems are : (a) Infrared waves (b) Ultraviolet rays (c) Microwaves (d) X-rays
Ans.	(c) Microwaves

9.	Which one of the following electromagnetic radiation has the least wavelength ? (A) Gamma rays (B) Microwaves (C) Visible light (D) X-rays
Ans.	(A) Gamma rays

RAY OPTICS AND WAVE OPTICS

1.	**The focal lengths of the objective and the eyepiece of a compound microscope are 1 cm and 2 cm respectively. If the tube length of the microscope is 10 cm, the magnification obtained by the microscope for most suitable viewing by relaxed eye is:** (A) 250 (B) 200 (C) 150 (D) 125	**7.**	**A Young's double-slit experiment set up is kept in a medium of refractive index (4/3). Which maximum in this case will coincide with the 6^{th} maximum obtained if the medium is replaced by air?** (A) 4^{th} (B) 6^{th} (C) 8^{th} (D) 10^{th}
2.	**For a concave mirror of focal length 'f', the minimum distance between the object and its real image is:** (A) zero (B) f (C) 2f (D) 4f	**8.**	**A ray of monochromatic light propagating in air, is incident on the surface of water. Which of the following will be the same for the reflected and refracted rays?** (A) Energy carried (B) speed (C) Frequency (D) wavelength
3.	**A beam of light travels from air into a medium. Its speed and wavelength in the medium are 1.5×10^8 m/s and 230 nm respectively. The wavelength of light in air will be** (A) 230 nm (B) 345 nm (C) 460 nm (D) 690 nm	**9.**	**In the wave picture of light, the intensity I of light is related to the amplitude A of the wave as:** (A) $I \propto \sqrt{A}$ (B) $I \propto A$ (C) $I \propto A^2$ (D) $I \propto 1/A^2$
4.	**In a single-slit diffraction experiment, the width of the slit is halved. The width of the central maximum, in the diffraction pattern, will become:** (A) half (B) twice (C) four times (D) one-fourth	**10.**	**In a Young's slit experiment, the fringe width is found to be β. If the entire apparatus is immersed in a liquid of refractive index μ, the new fringe width will be:** (A) β (B) $\mu\beta$ (C) β/μ (D) β/μ^2
5.	**According to Huygen's principle, the amplitude of secondary wavelets is** (A) equal in both the forward and the backward directions. (B) Maximum in the forward direction and zero in the backward direction. (C) Large in the forward direction and small in the backward direction. (D) Small in the forward direction and large in the backward direction.	**11.**	**In a Young's double-slit experiment, the screen is moved away from the plane of the slits. What will be its effect on the following?** **(i) Angular separation of the fringes.** **(ii) Fringe-width.** (A) Both (i) and (ii) remain constant (B) (i) remains constant, but (ii) decreases (C) (i) remains constant, but (ii) increases (D) Both (i) and (ii) increase.
6.	**A plane wavefront is incident on a concave mirror of radius of curvature R. The radius of the refracted wavefront will be:** (A) 2R (B) R (C) R/2 (D) R/4		

SEMICONDUCTOR

1.	**Ge is doped with As. Due to doping,** (A) the structure of Ge lattice is distorted. (B) the number of conduction electrons increases. (C) the number of holes increases. (D) the number of conduction electrons decreases.	8.	**An n-type semiconducting Si is obtained by doping intrinsic Si with:** (A) Al (B) B (C) P (D) In
2.	**When a p-n junction diode is subjected to reverse biasing:** (A) the barrier height decreases and the depletion region widens. (B) the barrier height increases and the depletion region widens. (C) the barrier height decreases and the depletion region shrinks. (D) the barrier height increases and the depletion region shrinks.	9.	**The threshold voltage for a p-n junction diode used in the circuit is 0.7 V. The type of biasing and current in the circuit are:**  (A) Forward biasing, 0 A (B) Reverse biasing, 0 A (C) Forward biasing, 5 mA (D) Reverse biasing, 2 mA
3.	**When an intrinsic semiconductor is doped with a small amount of trivalent impurity, then:** (A) its resistance increases. (B) it becomes a p-type semiconductor. (C) there will be more free electrons than holes in the semiconductor. (D) dopant atoms become donor atoms.	10.	**Si is doped with a pentavalent element. The energy required to set the additional electron free is about:** (A) 0·01 eV (B) 0·05 eV (C) 0·72 eV (D) 1·1 eV
4.	**In the energy-band diagram of n-type Si, the gap between the bottom of the conduction band E_C and the donor energy level E_D is of the order of:** (A) 10 eV (B) 1 eV (C) 0.1 eV (D) 0.01 eV	11.	**In an extrinsic semiconductor, the number density of holes is 4×10^{20} m^{-3}. If the number of density of intrinsic carriers is 4×10^{20} m^{-3}, the number density of electrons in it is** (A) 1.8×10^{9} m^{-3} (B) 2.4×10^{10} m^{-3} (C) 3.6×10^{9} m^{-3} (D) 3.2×10^{10} m^{-3}
5.	**A pure Si crystal having 5×10^{28} atoms m^{-3} is doped with 1 ppm concentration of antimony. If the concentration of holes in the doped crystal is found to be 4.5×10^{9} m^{-3}, the concentration (in m^{-3}) of intrinsic charge carriers in Si crystal is about** (A) 1.2×10^{15} (B) 1.5×10^{16} (C) 3.0×10^{15} (D) 2.0×10^{16}	12.	**At a certain temperature in an intrinsic semiconductor, the electrons and holes concentration is 1.5×10^{16} m^{-3}. When it is doped with a trivalent dopant, hole concentration increases to 4.5×10^{22} m^{-3}. In the doped semiconductor, the concentration of electrons (n_e) will be:** (A) 3×10^{6} m^{-3} (B) 5×10^{7} m^{-3} (C) 5×10^{9} m^{-3} (D) 6.75×10^{38} m^{-3}
6.	**If a p-n junction diode is reverse biased,** (A) the potential barrier is lowered. (B) the potential barrier remains unaffected. (C) the potential barrier is raised (D) the current is mainly due to majority carriers.	13.	**The formation of depletion region in a p-n junction diode is due to** (A) movement of dopant atoms (B) diffusion of both electrons and holes (C) drift of electrons only (D) drift of holes only
7.	**During the formation of a p-n junction:** (A) diffusion currents keep increasing (B) drift current remains constant (C) both the diffusion current and drift current remain constant. (D) diffusion current remains almost constant but drift current increases till both currents become equal.	14.	**An ac source of voltage is connected in series with a p-n junction diode and a load resistor. The correct option for output voltage across load resistance will be:** 

MODERN PHYSICS

(DUAL NATURE OF RADIATION AND MATTER, ATOMS AND NUCLEI)

1. The transition of electron that gives rise to the formation of the second spectral line of the Balmer series in the spectrum of hydrogen atom corresponds to:

(A) $n_f = 2$ and $n_i = 3$
(B) $n_f = 3$ and $n_i = 4$
(C) $n_f = 2$ and $n_i = 4$
(D) $n_f = 2$ and $n_i = \infty$

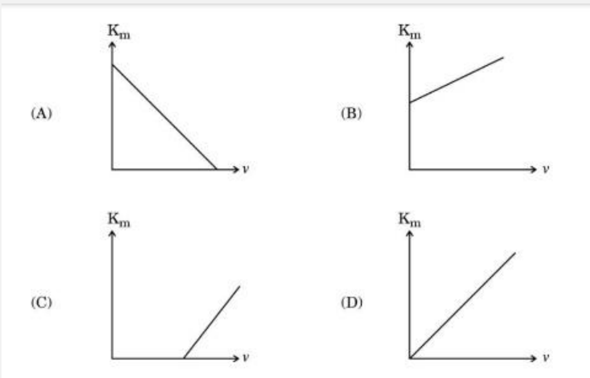
2. A proton and an alpha particle having equal velocities approach a target nucleus. They come momentarily to rest and then reverse their directions. The ratio of the distance of closest approach of the proton to that of the alpha particle will be:

(A) $\frac{1}{2}$ (B) 2
(C) $\frac{1}{4}$ (D) 4

3. An alpha particle approaches a gold nucleus in Geiger-Marsden experiment with kinetic energy K. It momentarily stops at a distance d from the nucleus and reverses its direction. Then d is proportional to:

(A) $\frac{1}{\sqrt{K}}$ (B) $\sqrt{K}$
(C) $\frac{1}{K}$ (D) K

4. Which one of the following is the correct graph between the maximum kinetic energy (Km) of the emitted photoelectrons and the frequency of incident radiation (v) for a given photosensitive surface?



5. An electron makes a transition from n = 2 level to n = 1 level in the Bohr model of a hydrogen atom. Its period of revolution:

(A) increases by 87.5%
(B) decreases by 87.5%
(C) increases by 43.75%
(D) decreases by 43.75%

6. Two beams, A and B whose photon energies are 3·3 eV and 11·3 eV respectively, illuminate a metallic surface (work function 2·3 eV) successively. The ratio of maximum speed of electrons emitted due to beam A to that due to beam B is:

(A) 3 (B) 9
(C) $\frac{1}{3}$ (D) $\frac{1}{9}$

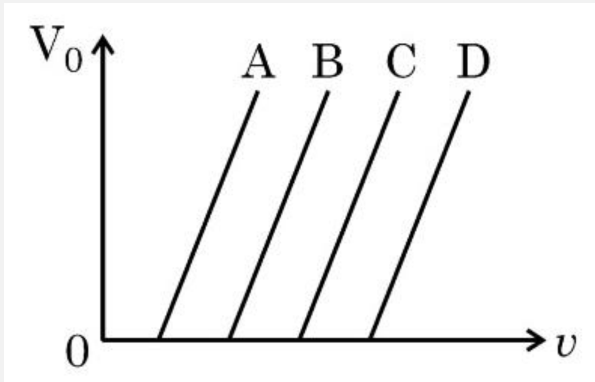
7. Energy levels A, B and C of an atom correspond to increasing values of energy i.e. $E_A < E_B < E_C$. Let 1, 2 and 3 be the wavelengths of radiation corresponding to the transitions C to B, B to A and C to A, respectively. The correct relation between λ_1 λ_2 and λ_3 is:

(A) $\lambda_1^2 + \lambda_2^2 = \lambda_3^2$ (B) $\frac{1}{\lambda 1} + \frac{1}{\lambda 2} = \frac{1}{\lambda 3}$
(C) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (D) $\lambda_1 + \lambda_2 = \lambda_3$

8. The work function for a photosensitive surface is 3·315 eV. The cut-off wavelength for photoemission of electrons from this surface is:

(A) 150 nm (B) 200 nm
(C) 375 nm (D) 500 nm

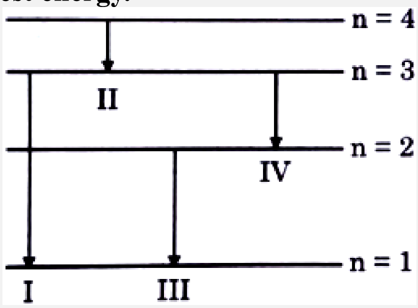
9. The variation of the stopping potential (V_0) with the frequency (v) of the incident radiation for four metals A, B, C and D is shown in the figure. For the same frequency of incident radiation producing photoelectrons in all metals, the kinetic energy of photoelectrons will be maximum for metal



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

10. The radius (r_n) of n^{th} orbit in Bohr model of hydrogen atom varies with n as

(a) $r_n \alpha n$ (b) $r_n \alpha \frac{1}{n}$
(c) $r_n \alpha n^2$ (d) $r_n \alpha \frac{1}{n^2}$

11.	**In Balmer series of Hydrogen atom, as the wavelength of spectral decreases, they appear** (A) equally spaced and equally intense. (B) further apart and stronger in intensity. (C) closer together and stronger in intensity. (D) closer together and weaker in intensity.	18.	**The energy of an electron in the ground state of hydrogen atom is -13.6 eV. The kinetic and potential energy of the electron in the first excited state will be** (A) -13.6 eV, 27.2 eV (B) -6.8 eV, 13.6 eV (C) 3.4 eV, -6.8 eV (D) 6.8 eV, -3.4 eV
12.	**The radius of the nth orbit in Bohr Model of hydroegn atom is proportional to:** (A) $\frac{1}{n^2}$ (B) $\frac{1}{n}$ (C) n^2 (D) n	19.	**The potential energy between to nucleons inside a nucleus is minimum at a distance of about** (A) 0.6 fm (B) 1.6 fm (C) 2.0 fm (D) 2.8 fm
13.	**The quantum nature of light explains the observations on Photoelectric effect as-** re is a minimum frequency of incident radiation ow which no electrons are emitted. maximum kinetic energy of photoelectrons depend ly on the frequency of incident radiation. en the metal surface is illuminated, electrons are cted from the surface after sometime. e photoelectric current is independent of the intensity incident radiation.	20.	**The diagram shows four energy level of an electron in Bohr model of hydrogen atom. Identity the transition in which the emitted photon will have the highest energy.**  (A) I (B) II (C) III (D) IV
14.	**The mass density of a nucleus of mass number A is:** (A) proportional to $A^{1/3}$ (B) proportional to $A^{2/3}$ (C) proportional to A^3 (D) independent of A	21.	**A hydrogen atom makes a transition from n = 5 to n = 1 orbit. The wavelength of photon emitted is λ. The wavelength of photon emitted when it makes a transition from n = 5 to n = 2 orbit is** (A) $\frac{8}{7}\lambda$ (B) $\frac{16}{7}\lambda$ (C) $\frac{24}{7}\lambda$ (D) $\frac{32}{7}\lambda$
15.	**The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for helium nucleus. This implies that helium nucleus is** (A) radioactive (B) unstable (C) easily fissionable (D) more stable nucleus than its neighbours	22.	**A graph is plotted between the stopping potential (on y-axis) and the frequency of incident radiation (on x-axis) for a metal. The product of the slope of the straight line obtained and the magnitude of charge on an electron is equal to:** (A) h (B) $\frac{h}{c}$ (C) $\frac{2h}{c}$ (D) $\frac{h}{2c}$
16.	**Light of frequency 6.4×10^{14} Hz is incident on a metal of work function 2.14 eV. The maximum kinetic energy of the emitted electrons is about:** (A) 0.25 eV (B) 0.51 eV (C) 1.02 eV (D) 0.10 eV	23.	**The ratio of maximum frequency and minimum frequency of light emitted in Balmer series pf hydrogen spectrum, in Bohr's model is:** (A) $\frac{11}{9}$ (B) $\frac{9}{5}$ (C) $\frac{11}{7}$ (D) $\frac{16}{7}$
17.	**Photons of energy 3.2 eV are incident on a photosensitive surface. If the stopping potential for the emitted electrons is 1.5 V, the work function for the surface is:** (A) 1.5 eV (B) 1.7 eV (C) 3.2 eV (D) 4.7 eV	24.	**A proton and an alpha particle have the same kinetic energy. The ratio of de Broglie wavelengths associated with the proton to that with the alpha particle is:** (A) 1 (B) 2 (C) $2\sqrt{2}$ (D) ½

25. **The potential energy of an electron in the second excited state in hydrogen atom is:**

(A) -3.4 eV (B) -3.02 eV

(C) -1.51 eV (D) -6.8 eV

26. **The energy of a photon of wavelength λ is**

(A) hc λ (B) hc/ λ

(C) λ/hc (D) λh/c

27. **Hydrogen atom initially in the ground state, absorbs a photon which excites it to n = 5 level. The wavelength of the photon is:**

(A) 975 nm (B) 740 nm

(C) 523 nm (D) 95 nm

28. **The waves associated with a moving electron and a moving proton have the same wavelength λ. It implies that they have the same:**

(A) momentum (B) angular momentum

(C) speed (D) energy

29. **The difference in mass of ^{7}X nucleus and total mass of its constituent nucleons is 21.00 u. The binding energy per nucleon for this nucleus is equal to the energy equivalent of:**

(A) 3 u (B) 3.5 u

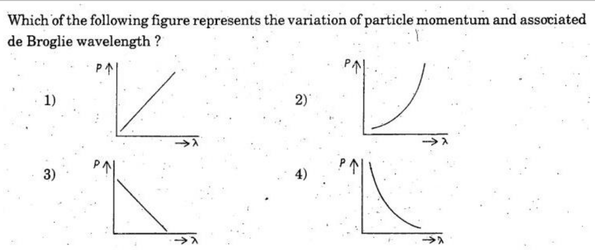
(C) 7 u (D) 21 u

30. **The ratio of the nuclear densities of two nuclei having mass number 64 and 125 is**

(A) $\frac{64}{125}$ (B) $\frac{4}{5}$

(C) $\frac{5}{4}$ (D) 1

31.



32. **Which one of the following metals does not exhibit emission of electrons from its surface when irradiated by visible light?**

(A) Rubidium (B) Sodium

(C) Cadmium (D) Caesium