Pre-Board Examination : 2025-26

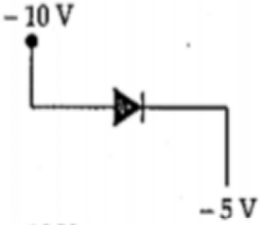
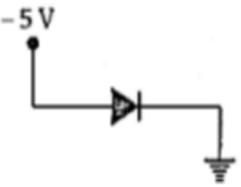
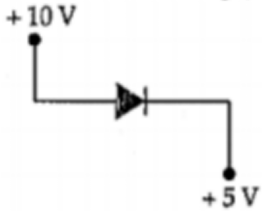
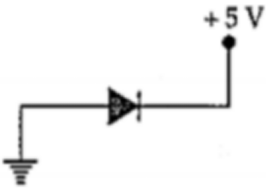
Sub : Physics

(The figures in the margin indicate full marks for the questions)

Time – 3 hours Full marks-70

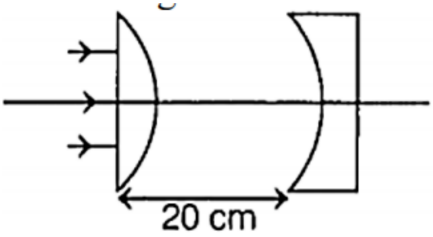
Section A (Each question carries 1 mark)	
1	C and Si both have the same lattice structure, having 4 bonding electrons in each. However, C is an insulator whereas Si is an intrinsic semiconductor. This is because (i) In case of C the valence band is not completely filled at absolute zero temperature. (ii) In case of C the conduction band is partly filled even at absolute zero temperature. (iii) The four bonding electrons in the case of C lie in the second orbit, whereas in the case of Si they lie in the third. (iv) The four bonding electrons in the case of C lie in the third orbit, whereas for Si they lie in the fourth orbit. (A) Option (ii) (B) Option (i) (C) Option (iv) (D) Option (iii)

2	The cations and anions are arranged in alternate form in (A) ionic crystal (B) semiconductor crystal (C) covalent crystal (D) metallic crystal
3	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) $\frac{1}{x}$ (D) $\frac{1}{x^1/2}$
4	The energy band gap is maximum in: (A) Metals (B) Insulators (C) Superconductors (D) Semiconductors
5	The number of valence electrons in a good conductor is generally (A) three or less than three (B) four (C) six or more than six (D) five

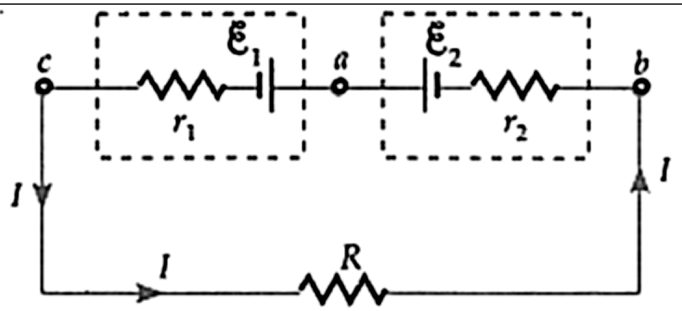
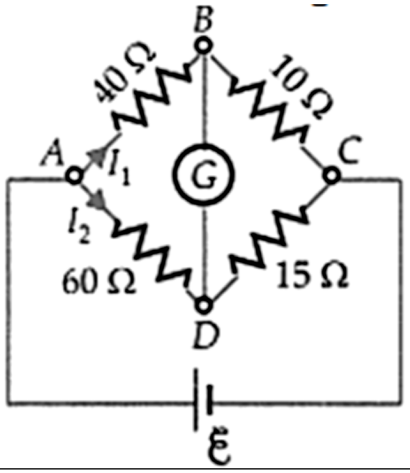
6	A long strength wire of radius a carries a steady current I. The current is uniformly distributed across its area of cross-section. The ratio of magnitude of magnetic field B_1 at $\frac{a}{2}$ and B_2 at distance 2a is (A) $\frac{1}{2}$ (B) 1 (C) 2 (D) 4
7	A ray of monochromatic light propagating in air is incident on the surface of water. Which of the following will be the same for the reflected and refracted ray? (A) Energy carried (B) Speed (C) Frequency (D) Wavelength
8	Which of the following p-n junction is forward biased? (A)  (B)  (C)  (D) 

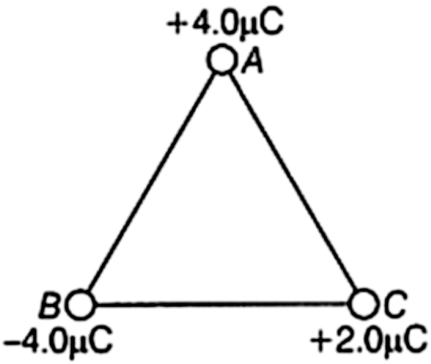
9	A beam of light travels from air into a medium. Its speed and wavelength in the medium are 1.5×10^8 m/s and 230 nm, respectively. The wavelength of light in air will be (A) 230 nm (B) 345 nm (C) 460 nm (D) 690 nm
10	The dimension of electrical resistance is: (A) $[ML^2T^{-3}A^1]$ (B) $[ML^2T^{-3}A^{-2}]$ (C) $[ML^3T^{-3}A^{-2}]$ (D) $[ML^2T^{-3}A^{-1}]$
11	Which of the following is not the property of an equipotential surface? (A) They do not cross each other. (B) The work done in carrying a charge from one point to another on an equipotential surface is zero. (C) For a uniform electric field, they are concentric spheres. (D) They can be imaginary spheres.
12	An electric dipole placed in an electric field of intensity 2×10^5 N/C at an angle of 30° experiences a torque equal to 4 Nm. The charge on the dipole of dipole length 2 cm is (A) 7 μC (B) 8 mC (C) 2 Mc (D) 5 mC
13	**(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.**

	(b) If both Assertion and Reason are true but Reason is not the correct of Assertion. **(c) If Assertion is true but Reason is false.** **(d) If both Assertion and Reason are false.** **Assertion:** If a proton and electron are moving with same velocity, then wavelength of de-Broglie wave associated with electron is longer than that associated with proton. **Reason:** The wavelength of de-Broglie wave associated with a moving particle is inversely proportional to its mass.
14	**Assertion:** The photoelectrons produced by a monochromatic light beam incident on a metal surface, have a spread in their kinetic energies. **Reason:** The work function of the metal varies as a function of depth from the surface
15	**Assertion:** Diamagnetic substances exhibit magnetism. **Reason:** Diamagnetic materials do not have

	permanent magnetic dipole moment.
16	**Assertion:** Work done in moving a change around a closed path in an electric field is always zero. **Reason:** Electrostatic force is a conservative force.
Section B (Each question carries 2 marks)	
17	MHz travels in free space along the x-direction. At a particular point in space and time, E = 6.3 V/m. What is B at this point?
18	In the given figure the radius of curvature of curved face in the plano-convex and the plano-concave lens is 15 cm each. The refractive index of the material of the lenses is 1.5. Find the final position of the image formed 
19	(i) What is meant by ionisation energy? Write its value for hydrogen atom. **OR**

	(ii) Define the term mass defect. How is it related to stability of the nucleus?
20	Draw energy band diagram for an n-type and p-type semiconductor at T > OK.
21	A series C-R circuit with R = 200 Ω and C = (50/π)μF is connected across an AC source of peak voltage ε_0 = 100 V and frequency v = 50 Hz. Calculate (i) impedance of the circuit Z, (ii) phase angle ϕ and
Section C (Each question carries 3 marks)	
22	In Figure, ε1 and ε2 are respectively 2.0 V and 4.0 V and the resistances r_1, r_2 and R are respectively 1.0 Ω ,2.0 Ω and 5.0 Ω. Calculate the current in the circuit. Also, calculate: (i) potential difference between the points b and a, (ii) potential difference between a and c.

	
23	Define critical angle of a given pair of media and total internal reflection. Obtain the relation between the critical angle and refractive index of the medium.
24	Calculate the ratio of the heat produced in the four arms of the Wheatstone bridge shown in Figure. 
25	Prove that the density of a nucleus is independent of its mass number.
26	What is Wheatstone bridge? Deduce the condition

	for which Wheatstone bridge is balanced
27	State the significance of negative value of electrostatic potential energy of a system of charges. Three charges are placed at the corners of an equilateral triangle ABC of side 2.0 m as shown in figure. Calculate the electric potential energy of the system of three charges 
28	The coil of an AC generator consists of 100 turns of wire each of area 0.5 m^2. The resistance of the wire is 100 Ω. The coil is rotating in a magnetic field of 0.8 T perpendicular to its axis of rotation, at a constant angular speed of 60 rad/s. Calculate the maximum emf generated and power dissipated in the coil.
	Section D
29	**Read the following paragraph & answer the**

questions follow

Maxwell showed that the speed of an electromagnetic wave depends on the permeability and permittivity of the medium through which it travels. The speed of an electromagnetic wave in free space is given by $c = c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$. The fact led Maxwell to predict that light is an electromagnetic wave. The emergence of the speed of light from purely electromagnetic considerations is the crowning achievement of Maxwell's electromagnetic theory. The speed of an electromagnetic wave in any medium of permeability μ and permittivity ε will be $\frac{c}{\sqrt{K\mu_r}}$ the dielectric constant of the medium and μ_r is the relative permeability.

(i) The dimensions of $\frac{1}{2}\varepsilon_0 E^2$ (ε_0 : permittivity of free space; E = electric field) is

(A) MLT^{-1} (B) $ML^{-1}T^{-2}$

(C) ML^2T^{-2} (D) ML^2T^{-1}

	(ii)	Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of the vacuum. If M = mass, L = length, T = time and A = electric current, then (A) $[\varepsilon_0] = ML^2T^{-1}$ (B) $[\varepsilon_0] = MLT^{-2}A^{-2}$ (C) $[\varepsilon_0] = M^{-1}L^{-3}T^{-4}A^2$ (D) $[\varepsilon_0] = M^{-1}L^{-3}T^2A$

(iii) An electromagnetic wave of frequency 3 MHz passes from vacuum into a dielectric medium with permittivity $\varepsilon = 4$. Then

(A) wavelength is halved and the frequency remains unchanged.

(B) wavelength and frequency both remain unchanged

(C) wavelength is doubled and the frequency remains unchanged

(D) wavelength is doubled and the frequency becomes half

OR

The electromagnetic waves travel with

(A) the speed of light $c = 3 \times 10^8$ ms^{-1} fluid medium.

(B) the speed of light $c = 3 \times 10^8$ ms^{-1} in solid medium

(C) the speed of light $c = 3 \times 10^8$ ms^{-1} in free space

(D) the same speed in all media

(iv) Which of the following are not electromagnetic waves?

cosmic rays, γ-rays, β-rays, X-rays

(A) β-rays

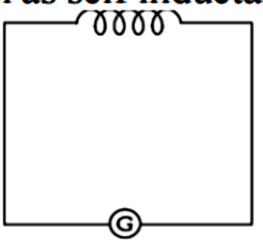
(B) X-rays

(C) γ-rays

(D) cosmic rays

30 **Read the following paragraph & answer the questions follow.**

Self Induction. When a current I flows through a coil, flux linked with it is $\varphi = LI$, where L is a constant known as self inductance of the coil.



Any charge in current sets up an induced emf in the coil. Thus, self inductance of a coil is the induced emf set up in it when the current passing through it changes at the unit rate. It is a measure of the opposition to the growth or the decay of current flowing through the coil. Also, value of self inductance depends on the number of turns in the solenoid, its area of cross-section and the permeability of its core material.

(i) The inductance in a coil plays the same role as
- (A) inertia in mechanics
- (B) energy in mechanics
- (C) momentum in mechanics
- (D) force in mechanics

(ii) A current of 2.5 A flows through a coil of inductance 5 H. The magnetic flux linked with the coil is
- (A) 0.5 Wb
- (B) 12.5 Wb

(C) zero
(D) 2 Wb

(iii) The inductance L of a solenoid depends upon its radius R as
(A) $L \propto CR$
(B) $L \propto \frac{1}{R}$
(C) $L \propto R_2$
(D) $L \propto R_3$

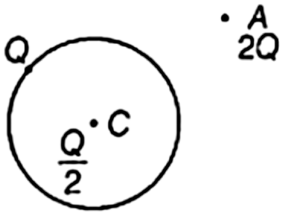
(iv) The unit of self-inductance is
(A) Weber ampere
(B) Weber-1 ampere
(C) Ohm second
(D) Farad

Section E

31 (i) Draw a ray diagram to show the image formation by a combination of two thin convex lenses in contact.
Obtain the expression for the power of this combination in terms of the focal lengths of the lenses.

(ii) A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is $\frac{3}{4}$th of the angle of prism. Calculate the speed of light in the prism.

	OR A parallel beam of monochromatic light falls normally on a narrow slit and the light, coming out of the slit, is obtained on a screen, kept behind, parallel to the slit plane. What kind of pattern do we observe on the screen and why? How does the (i) angular width (ii) linear width of the principal maximum, in this pattern change when the screen is moved, parallel to itself, away from the slit plane? State two points of difference between this pattern and the interference pattern observed in the Young's double slit experiment.

32	(i) Explain using suitable diagram, the difference in the behaviour of a (a) conductor and (b) dielectric in the presence of external electric field. Define the terms polarisation of a dielectric and write its relation with susceptibility. (ii) A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge $\frac{Q}{2}$ is placed at its centre C and an another charge +2 Q is placed outside the shell at a distance x from the centre as shown in figure.  Find (a) the force on the charge at the centre of the shell and at point A, (b) the electric flux through the shell.

33	(i)	An alternating emf $E = E_0 \sin \omega t$ is applied as an input in a purely, resistive circuit of resistance R. (a) What is the current in the circuit? (b) What is the phase difference between the emf and the current? (c) Draw the graphical representation of the emf and the current. (d) Draw the phasor diagram for a purely resistive circuit.
	(ii)	A resistance of 10 Q is connected to a AC rated 110 V, 50 Hz, then find the rms current.
		OR
	(i)	A diagram of AC generator is shown below (a) Here, P → Armature coil B_1 or B_2 → Brushes (b) What is the principle and working of an AC generator.
	(ii)	Deduce the expression for alternating emf induced in the generator when the coil rotates with angular velocity.