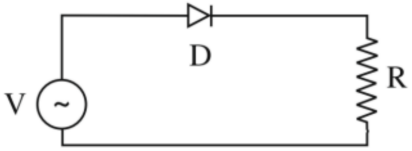
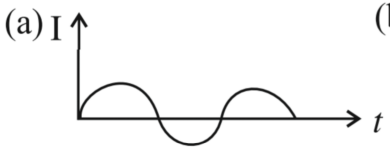
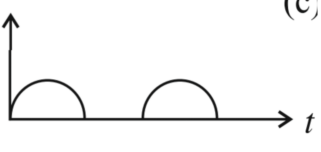
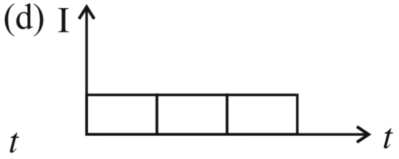
Pre-Board Examination : 2025-26

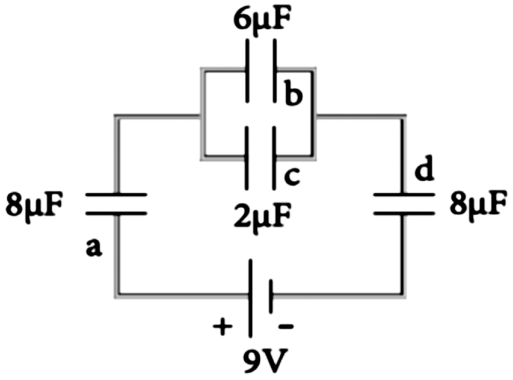
Sub : Physics

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

Time – 3 hours **Full marks-70**

1.	**Answer following questions : 1x8=8**
i	A charge q is distributed over a metal sphere of radius R. The electric field and the electric potential at the centre are: (a) $E = 0, V = 0$ (b) $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{R^2}, V = \frac{1}{4\pi\varepsilon_0}\frac{q}{R}$ (c) $E = 0, V = \frac{1}{4\pi\varepsilon_0}\frac{q}{R}$ (d) $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{R^2}, V = 0$
ii	The Relaxation time in conductor (a) increases with increase in temperature (b) decreases with increase in temperature (c) is independent of temperature (d) First increase then decreases with increase in temperature
iii	The force per unit length between two, long current carrying conductors is F. If the current in each conductor is doubled and distance between theme is halved, what will be the new force per unit length between them? (a) 2F (b) F (c) 8F (d) 16 F

iv	Current in a circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average EMF of 200V is induced, the self Inductance of the coil is: (a) 4H (b) 5H (c) 3H (d) 40H
v	The power factor of LCR circuit at resonance is (a) 0.707 (b) 1 (c) Zero (d) 0.5
vi	A proton and electron have same velocity. Which one option is correct for deBroglie wavelength of Proton (λ_P) and electron (λ_e) ? (a) $\lambda_P = \lambda_e \neq 0$ (b) $\lambda_P < \lambda_e$ (c) $\lambda_P > \lambda_e$ (d) $\lambda_P = \lambda_e = \mathbf{0}$
vii	Nucleus of an atom of mass no. 24 and atomic no. 11 consists of:Two nuclei of mass numbers 1 and 27 have their radii ratio as— (a) 2 : 5 (b) 5 : 2 (c) 1 : 5. (d) 1 : 3
vii i	A half wave rectifier circuit is constructed using a p-n function diode D, load resistance R and AC source as shown below:  The output current through R varies as— (a)  (b)  (c) (c)  (d) 

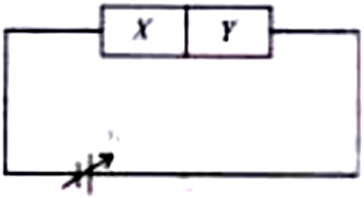
2	For the given capacitor configuration  (a) Find the total capacitance of the given combination of capacitors. (b) Total charges stored in arrangement. 2
3	Give the limitation of Ohm's law with proper diagrams. 2
4	The oscillating magnetic field of an electromagnetic wave is given by: ½ + ½ +1 =2 $B_z = 10^{-4} \sin [2 \times 10^{10} t - 30 \pi x]$ Vm^{-1} **T** (i) Obtain the value of the wavelength of the em wave. (ii) Give the direction of propagation of the em wave (iii)Write down the expression for the oscillating magnetic field
5	Electromagnetic wave with wavelength (i) λ_1 is used in satellite communication. (ii) λ_2 is used to kill germs in water purifier. (iii) λ_3 is used to detect leakage of oil in underground pipelines. (iv) λ_4 is used to improve visibility in runways during

	fog and mist conditions. Identify and name the part of electromagnetic spectrum to which these radiations belong. 2 Or Identify the following electromagnetic radiations as per the frequencies given below. Write one application of each. (a) 10^{20} Hz (b) 10^{9}Hz (c) 10^{11}Hz 2
6	Draw the wavefront due to -- (i) point source of light (ii) due to refraction of light through convex lens with point object at the focus 2
7	Draw the graphs showing that stopping potential and the frequency of the incident light. From it obtain (i) Threshold frequency (ii) Planck's constant 2 Or Give the photon picture of electromagnetic radiation.2
8	Draw the diagram showing an electromagnetic wave propagating along +X axis . Write down the Important points related to it . 2
9	The work function of caesium metal is 2.14 eV. When light of frequency 6 $\times 10^{14}$Hz is incident on the metal surface, photoemission of electrons occurs. What is the (a) maximum kinetic energy of the emitted electrons, (b) Stopping potential, and (c) maximum speed of the emitted photoelectrons? 2
10	State the limitation of Bohr's atomic model . 2 Or

	What are H_α , H_β and H_γ lines ? 2
11	How long can an electric lamp of 100W be kept Glowing by fusion of 2.0 kg of deuterium? Take the Fusion reaction as $_1^2H + _1^2H \rightarrow _2^3He + n + 3.27\ MeV$ 2 Or What radioactivity ? What are the different types of It ? Name the with examples . 2
12	**(i)** State the properties of electric charges. **(ii)** Draw the electric lines of force due to (a) two unequal and positive charges . (b) an electric dipole , made up of +q and - q , seperated by a distance of d . 1+2= 3 Or (i) Prove that electric intensity is negative gradiant of electric potential at a point in an electric field . (ii) Prove that no work is done in moving a test charge over an equipotential surface . 2+1=3
13	Find the expression for energy stored in a capacitor . Find its energy density . 3 Or **(i)** Give the difference between polar and non polar molecules . **(ii)** What do you mean by polarisation of a dielectric ? **(iii)** What is electric susceptibility ? 1½+½+1=3
14	What is drift velocity ? Find an expression for it. 3 Or The resistance of the platinum wire of a platinum

	resistance thermometer at the ice point is 5 Ω and at steam point is 5.2 Ω. When the thermometer is inserted in a hot bath, the resistance of the platinum wire is 5.8 Ω. Calculate the temperature of the bath. 3
15	(i) Express Biot Savart's law in vector form . (ii) Mention the similarities and dissimilarities between Biot Savart's law and Coulomb's law. 1+2=3 Or (i) Prove that a charged particle entering a magnetic field perpendicularly follows a circular path . (ii) Find the radius of the circular path and the time period of revolution . 1½ +1½ = 3
16	Derive an expression for the self inductance of a solenoid. On what factor it depends ? What will happen if a insulating medium is placed inside it . 2+ ½ + ½ = 3 Or (i) State Faraday's laws of electromagnetic induction . **(ii)** The magnetic flux passing perpendicular to the plane of coil is given by $\phi = 4t^2+5t+2$ where ϕ is in weber and t is in second. Calculate the magnitude of instantaneous emf induced in the coil when t = 2 sec. 1+2=3
17	A sinusoidal voltage is applied to an electric circuit containing element X in which voltage leads the current by $\pi/2$. (a) Identify X . (b) Find the power consumed in X during full cycle of

	the AC . (c) What is wattless current . ½+1½+1=3 Or What is mean or average value of AC ? Obtain its relation with peak value of the AC . 1+2=3
18	State the condition for total internal reflection of light to take place at an interface separating two transparent media. Hence derive the expression for the critical angle in terms of refractive indices of the two medium .Name an application of total internal reflection , used in medical science 1+1+1= 3 Or (i) If f = 0.5 m for a glass lens, what is the power of the lens? (ii) The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. Its focal length is 12 cm. What is the refractive index of glass? **(iii)** A convex lens has 20 cm focal length in air. What is focal length in water? (Refractive index of air-water =1.33, refractive index for air-glass =1.5) ½+1+1½=3
19	**(i)** Give the differences between P type and N type semiconductor **(ii)** In an extrinsic semiconductor, the number density of holes is 4×10^{20} m $^{-3}$. If the number density of intrinsic carriers is 1.2×10^{15} m $^{-3}$, then find the number density of electrons in it . 1½+1½=3 Or Draw the energy band diagrams for metal , insulator

	and semiconductor . Give their differences . 3
20	Two semiconductor materials X and Y shown in given figure are made by doping germanium crystal with Indium and Arsenic respectively. The two are joined end to end and connected to a battery as shown below
	
	Or **(i)** Will the junction be forward biased or reverse biased ? **(ii)** Sketch I-V graph for this arrangement. **(iii)** What is the forbidden band energy of germanium ?What does it mean ? 1+1+1=3 Or (i) What is doping ? Why it required ? (ii) Sn, C and Si, Ge are all group 4 elements. Yet Sn is a conductor, C is an insulator while Si and Ge are semiconductor. Explain Why? 1½+1½=3

21	**(i)** Give the construction and working principle of a moving coil galvanometer . **(ii)** What is an ideal ammeter ? **(iii)** An ammeter of resistance 0.8 Ω can measure a current up to 1.0 A. Find the value of shunt resistance required to convert this ammeter to measure a current up to 5.0 A. 2½+1+1½ =5 Or (i) Differentiate among the Paramagnetic , Ferromagnetic and Diamagnetic substances in respect of following parameters **(a)** Behaviour in presence of external magnetic field **(b)** Relative magnetic permeability **(c)** Effect of temperature (ii) Write two examples each of Paramagnetic , Ferromagnetic and Diamagnetic substances. 3+2 =5
22	**(i)** Draw a labelled ray diagram of a reflecting type telescope . **(ii)** Mention the two advantages of a reflecting type telescope over the refracting telescope. **(iii)** Four lenses L_1 , L_2 , L_3 , L_4 of focal lengths +15cm , -15cm , +120 cm and +150 cm are available for making a telescope. To produce the largest magnification, which are the lenses you will choose ? 2+2+1 =5 Or (i) Define the phenomenon of interference .What are different types of it ? Define them.

	(ii) Draw the diagram of the Young's double slit experiment for interference . (iii) Write the expression for the fringe width for bright and dark fringe of interference. 1+½+1+1+1½+1= 5

23	**(i)** Write down the Rutherford's atomic model . State the limitations of this atomic model .
	(ii) Write the relation between radius of the atomic orbit ($\mathbf{r_n}$) and the principal quantum number (n) .
	(iii) The radius of innermost electron orbit of a hydrogen atom is 5.3×10^{-11}m. Determine its radius in n = 3 orbit. 2+1+2 = 5
	Or
	(i) What is nuclear force ? State its properties.
	(ii) Calculate the energy released in MeV in the deuterium-tritium fusion reaction:
	$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + n$
	using data
	m($^{2}_{1}H$)=2.014102u;
	m($^{3}_{1}H$)=3.016049 u;
	m($^{4}_{2}He$)= 4.002603 u;
	m_n = 1.008665 u,
	1u = 931.5 MeV/c^2
	½+2+2½= 5