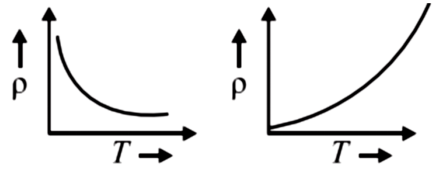
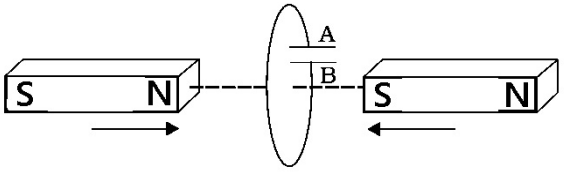
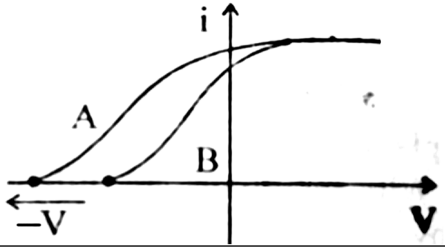
Pre-Board Examination : 2025-26

Sub : Physics

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

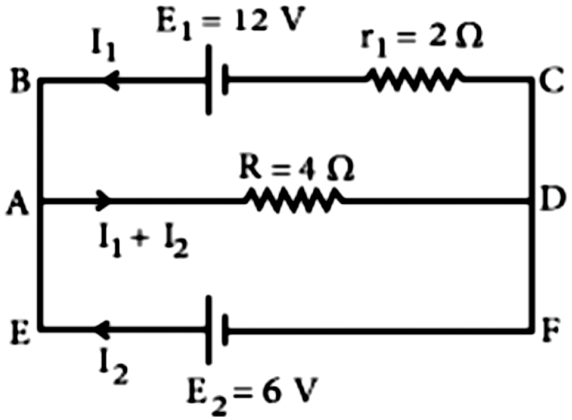
Time – 3 hours **Full marks-70**

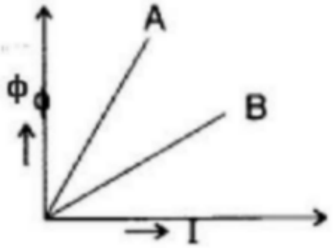
1.	**Answer following questions :**	**1x8=8**
a	Inside a conductor , electric field is _____ (zero / constant) , where as electric potential is _____ (zero/constant). [Fill up both the blank positions]	1
b	The temperature (T) dependence of resistivity of materials A and material B is represented by fig (i) and fig (ii) respectively. Identify material A and material B.  fig. (i) fig. (ii) (a) A is copper and B is germanium (b) A is germanium and B is copper (c) A is nichrome and B is germanium (d) A is copper and B is nichrome	1
c	If two identical currents , flowing through straight conductors of infinite extent, seperated by 10 cm in vacuum , made to attract each other by a force of 2×10^{-6} N /m , then magnitude of the current is _____ . (Fill up the blank)	1

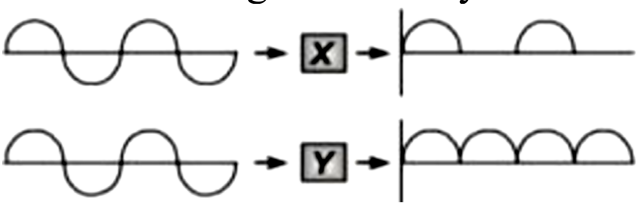
d	Predict the polarity of the capacitor as shown in the following diagram  1
e	Draw the ray diagram showing the rotation of a ray by 90^0 , while passing through an isosceles prism. 1
f	In the following figure which radiation, A or B has higher frequency? 1 
g	Nucleus of an atom of mass no. 24 and atomic no. 11 consists of: (i) 11 protons and 13 neutrons (ii) 11 electrons, 11 protons and 13 neutrons (iii) 11 protons and 13 electrons (iv) 11 electrons, 11 protons and 11 neutrons
h	In intrinsic semiconductors at room temperature, which of the following statement about n_e (concentration of free electrons) and n_h (concentration of holes) is correct - (a) $n_e > n_h$ (b) $n_e < n_h$ (c) $n_e = n_h$ **(d)** $n_e >> n_h$

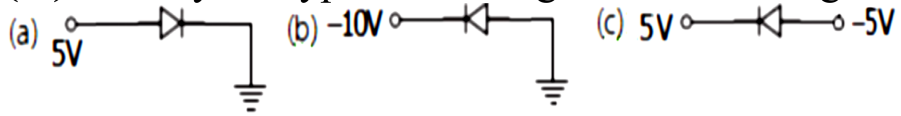
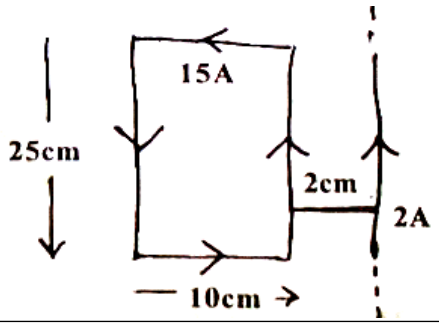
2	Match the following ----------4 x½ =2 (A)Electric potential ---------- (a) [$M^0 L^{-2} T^1 A^1$] (B)Electric permittivity -------- (b) [$M^{-1} L^{-2} T^4 A^2$] (C) Capacitance ---------- (c) [$M^{-1} L^{-3} T^4 A^2$] (D) Electric polarisation ------ (d) [$M^1 L^2 T^{-3} A^{-1}$]
3	Define the term 'mobility' of charge carriers in a current carrying conductor. Prove that mobility of charge carriers decreases with rise in temperature . ½ + 1½ =2
4	The oscillating electric field of an electromagnetic wave is given by: ½ + ½ +1 =2 $E = 30 \sin [2 \times 10^{11} t + 300 \pi x] Vm^{-1}$ (a) Obtain the value of the wavelength of the electromagnetic wave. (b) Write down the expression for the oscillating magnetic field.
5	a) Arrange the following electromagnetic waves in the descending order of their wavelengths. (i) Microwaves (ii) Infrared rays (iii) Ultraviolet radiation (iv) gamma-rays (b) Write one use each of any two of them . 2 Or Write down Maxwell's equations. 2
6	What are coherent sources of light ? Write down the condition for sustained interference . 2
7	Draw the graphs showing that stopping potential is independent of intensity of incident light but depends

	on the frequency of the incident light. Or Draw the graph between stopping potential and frequency of incident radiation and from obtain threshold frequency and Planck's constant. 1+1=2
8	Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W. (a)What is the energy of a photon in the light beam? (b) How many photons per second are emitted by the source? ½ + 1½ =2
9	Define impact parameter . Two alpha particles P and Q deflect by 10° and 120° angles in Rutherford's gold foil experiment. Which of the following is DEFINITELY true about the two particles? 1+1=2 A. Impact parameter of P > Impact parameter of Q B. Impact parameter of P < Impact parameter of Q.
10	Define 1 amu .Calculate the energy equivalent of 1amu in MeV. 2 Or Explain how energy is produced in Sun . 2
11	Draw the energy band diagram (at T > 0 K) for n-type and p-type semiconductors. 2 Or An intrinsic semiconductor has equal electron and hole concentration of 6×10^{16} m^{-3}. On doping with

	certain impurity the electron concentration increases to 9×10^{22} m^{-3}. Identify the extrinsic semiconductor. Calculate the new hole concentration. 2
12	Find an expression for electric potential due to a point charge at any position . 3 Or Find an expression for electric field due to a straight conductor of infinite extend of uniform line charge density λ , using Gauss's law . 3
13	Applying Kirchhoff's laws of current electricity , establish the Wheatstone bridge's balanced condition. 3 Or In the electric network shown in figure, use Kirchhoff's rules to calculate the power consumed by the resistance R = 4Ω.  3
14	Using Biot Savart's law , find an expression magnetic Field due a current loop at a point on its axis. 3 Or

	A long straight wire of a circular cross-sectional radius 'R', carrying steady current I , which is uniformly distributed across this cross-section. Using Ampere's circuital law , calculate the magnetic field at a distance (r) (i) region $r < R$ and (ii) $r > R$. Establish your result graphically . 3
15	Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other. 3 Or (i) A plot of magnetic flux (ϕ) versus current (I) is shown in the figure for two inductors A and B. Which of the two has larger value of self-inductance?  **(ii)** Prove that Lenz's law is obeying the principle of conservation of mechanical energy . 1+2=3
16	A sinusoidal voltage is applied to an electric circuit Containing element X in which current leads the voltage by π/2. 1+1+1=3 (a) Identify X (b)Write the formula for the reactance of X & name it (c)Draw the graph showing the variation of the reactance of X with frequency of ac voltage.

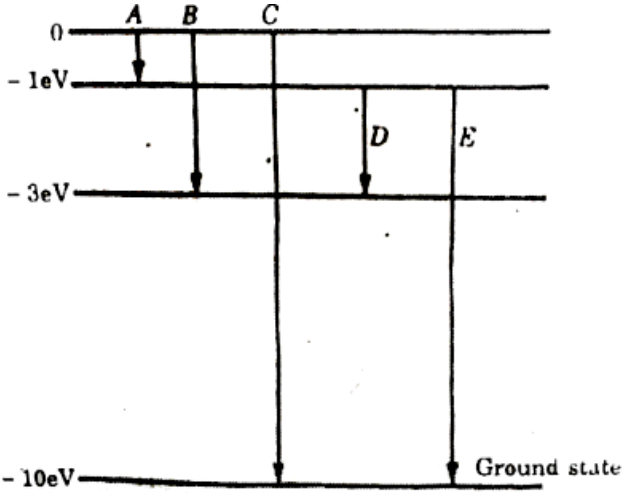
	Or What is RMS value of an AC ? Obtain its relation with peak value of the AC . 1+2=3
17	Derive the lens maker's formula for a convex lens of refractive index 'μ' and focal length 'f ' with 'R_1'and 'R_2' as the radii of curvature , placed in air. 2½+½=3 Or (i)Write down the condition for minimum deviation. (ii)Obtain the relation between refractive Index of a prism and angle of minimum deviation . 1+2=3
18	Draw the IV characteristics of a PN junction diode . From it, identify and define knee voltage and zener voltage . 1+1+1=3 Or What are the two main processes involved in the formation of PN junction diode . Explain them . 3
19	With the help of a circuit diagram, explain , how a *PN* junction diode works as a fullwave rectifier. Draw the input and output wave-forms. 3 Or (i) An a.c. signal is fed into two circuits X and Y and the corresponding output in the two cases have the wavefront shown in figure. Identify X and Y.  1

	(ii) A p-n junction diode has a depletion layer of thickness 500 nm and an electric field 16 x 10^5 V/m. Find the barrier potential created the depletion layer .1 **(iii)** Identify the types of baising in the following :-  1	
20	State Bohr's postulates . 3 Or State the laws of photo electric effect . 3	
21	**(i)** Find the expression for torque acting on a bar magnet placed in uniform magnetic field . **(ii)** Differentiate between Diamagnetic, Paramagnetic and Ferromagnetic substances. 2+ 3 =5 Or **(i)** Find an expression for the force acting between two parallel conductors of infinite extent , carrying currents in same direction **(ii)** Figure shows a rectangular current carrying loop of side 25 cm and 10 cm , carrying a current of 15A , placed 2cm away from a long straight conductor carrying a current of 2A .  	

	What is the direction and magnitude of the net force acting on the loop ? 3 + 2 =5 Or (i) Find the expression for torque acting on a bar magnet placed in uniform magnetic field . (ii) Differentiate between Diamagnetic, Paramagnetic and Ferromagnetic substances. 2+ 3 =5
22	**(i)** With the help of a neat and labeled ray diagram, obtain an expression for the magnifying power of the astronomical telescope in normal adjustment . Find the expression for its magnifying power. **(ii)** A small telescope has an objective lens of focal length 144cm and an eyepiece of focal length 6.0cm . What is the magnifying power of the telescope? What is the separation between the objective and the eyepiece? 2½+1+1+½ =5 Or (i) What is plane wavefront ? Draw it (ii) Using Huygen's principle establish prove laws of reflection . (iii) The intensity of two superposing waves are $4I_0$ and I_0 . The intensity of the bright fringe is $7I_0$. Find out the phase difference between the two superposing waves . 1+2½+1½= 5
23	(i) Draw the energy level diagram to show the different series of hydrogen spectra.

(ii) Find the limit of Balmar series of Hydrogen spectrum .

(iii) The energy levels of an atom of element X are shown in the diagram. Which one of the level transitions will result in the emission of photons of wavelength 620nm? support your answer with mathematical calculations. Find the longest wavelength in the following spectra .



1½+1+2½ = 5

Or

(i) Draw the graph showing the variation of binding energy per nucleon with the mass number. Give few significance of the graph With the help of the graph , explain the phenomenon of nuclear fission and fusion .

(ii) The table below represents the binding energy per nucleon and mass number of a few elements.

Element	Mass Number	Binding energy per nucleon (MeV)
Hydrogen	1	0
Helium`	2	7.4
Lithium	6	4.9
Iron	56	8.8
Gold	197	7.7
Uranium	238	7.5

Study the table and answer the following questions.

(a)Which one is having highest binding energy ?

(b) Which element has the highest mass defect per nucleon ? Calculate.

(c) Of lithium and gold which element has a more tightly bound nucleus? $2\frac{1}{2}+\frac{1}{2}+1\frac{1}{2}+\frac{1}{2}= 5$