

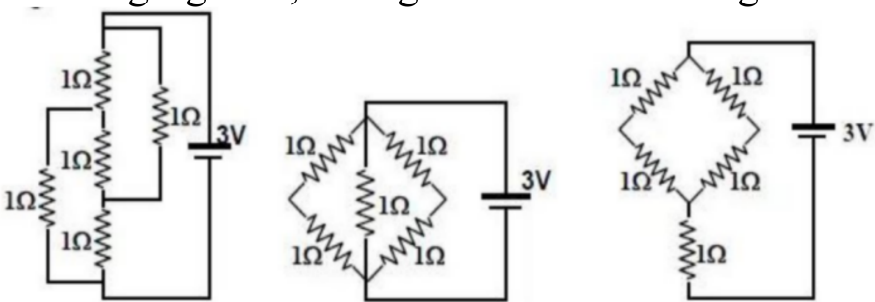
# Pre-Board Examination : 2025-26

## Sub : Physics

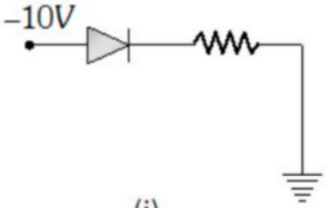
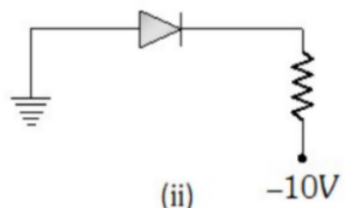
(The figures in the margin indicate full marks for the questions)

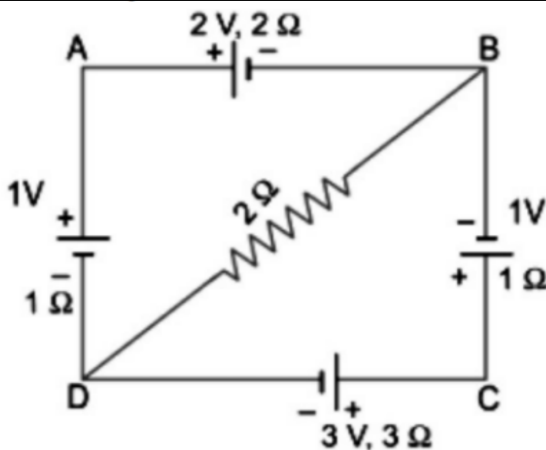
Time – 3 hours

Full marks-70

1. Answer following questions :		1x8=8
a	Give SI unit and dimensional formula of absolute permittivity of vacuum .	1
b	What is electrostatic shielding?What is its use?	1
c	If $P_1$ , $P_2$ and $P_3$ be the power disipated in the following figures , arrange them in ascending order. 1 	1
d	What is 1 tesla? Give its relation with 1gauss .	1
e	DC is blocked by capacitor but freely allowed by an inductor , explain why .	1
f	Define 1 ampere .	1
g	Define 1 henry .	1
h	Draw the ray diagram showing the deviation of a ray of light produced by an equilateral prism.	1
2	Find the expression for Coulomb's law in the vector form .	2

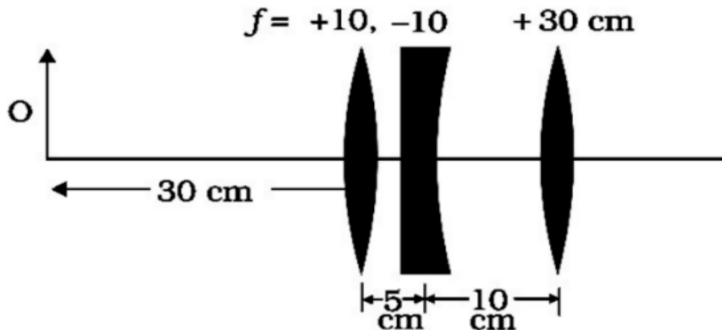
3	<p>Draw equipotential surface due to (i) a point charge (ii) an electric dipole . How much work is to be done in moving a point charge from one point to another over an equipotential surface .</p> <p style="text-align: right;">2</p>
4	<p>Find expression for current through a conductor in terms of its drift velocity .</p> <p style="text-align: right;">2</p>
5	<p>The number density of electrons in copper conductor is <math>8.5 \times 10^{28} \text{ m}^{-3}</math>. How long an electron take to drift from one end of 3 m long wire to the other end ? The area of cross-section of the wire is <math>2.0 \times 10^{-6} \text{ m}^2</math> and it is carrying a current of 3.0 A.</p> <p style="text-align: right;">2</p>
6	<p>Explain how moving coil galvanometer can be converted into an ammeter .</p> <p style="text-align: right;">2</p>
7	<p>Two moving coil meters, <math>M_1</math> and <math>M_2</math> have the following particulars:  <math>R_1 = 10 \, \Omega</math>, <math>N_1 = 30</math>, <math>A_1 = 3.6 \times 10^{-3} \text{ m}^2</math>, <math>B_1 = 0.25 \text{ T}</math>  <math>R_2 = 14 \, \Omega</math>, <math>N_2 = 42</math>, <math>A_2 = 1.8 \times 10^{-3} \text{ m}^2</math>, <math>B_2 = 0.50 \text{ T}</math>  (The spring constants are identical for the two meters)  Determine the ratio of (a) current sensitivity and (b) voltage sensitivity of <math>M_2</math> and <math>M_1</math> .</p> <p style="text-align: right;">2</p>
8	<p>Find the expression for rotational emf .</p> <p style="text-align: right;">2</p> <p>Or</p> <p>A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, hat is the change of flux linkage with the other coil?</p> <p style="text-align: right;">2</p>

9	<p>Draw the wavefront due to -- <math>1 + 1 = 2</math></p> <p>(i) refraction of light through a convex lens , for an object at infinity</p> <p>(ii) due to dispersion of light through a prism .</p>
10	<p>Define distance of closest approach .</p> <p>Estimate the distance of closest approach to the nucleus (<math>Z = 80</math>) if a 10 MeV <math>\alpha</math>-particle before it comes momentarily to rest and reverses its direction.</p> <p style="text-align: right;">2</p>
11	<p>Identify the bias in the figures below</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(i)</p> </div> <div style="text-align: center;">  <p>(ii)</p> </div> </div> <p>In half wave rectifier, what is the output frequency if the input frequency is 50 Hz. What is the output frequency of a full wave rectifier for the same input frequency. <math>1+1=2</math></p>
12	<p>State Gauss's law ? Using Gauss's law , find electric field due to point charge. <math>1+2= 3</math></p> <p>Or</p> <p>Find the expression for electric potential due to an electric dipole at an arbitrary point . <math>3</math></p>
13	Find the potential difference between B and D



14	<p>Using Ampere's circuital law , find an expression magnetic field due to a solenoid. <span style="float: right;">3</span></p> <p>Or</p> <p>Find the expression for torque acting on a rectangular coil , placed perpendicularly in a uniform magnetic field . <span style="float: right;">3</span></p>
15	<p>The magnetic field in a plane electromagnetic wave is given by</p> $B_y = 2 \times 10^{-7} \sin (0.5 \times 10^3 x + 1.5 \times 10^{11} t) \text{ T}$ <p>(i) What is the wavelength and frequency of the wave?</p> <p>(ii) What is the amplitude of the electric field?</p> <p>(iii) Write an expression for the electric field.</p> <p>(iv) What is its direction of propagation ?</p> <p style="text-align: right;">[Take <math>c = 3 \times 10^8 \text{ m s}^{-1}</math>.] <span style="float: right;">3</span></p> <p>Or</p> <p>Define displacement current . Find an expression for it. <span style="float: right;">3</span></p>

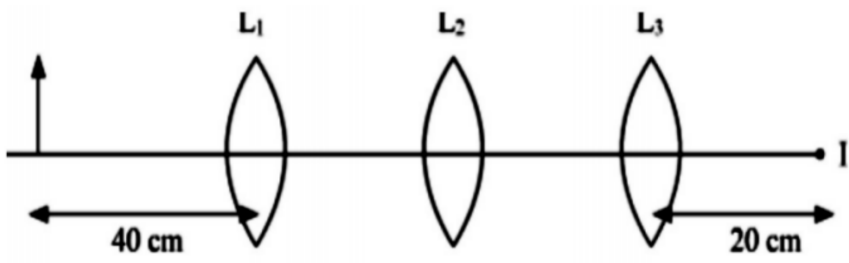
- 16 Find the position of the image formed by the lens combination given in the diagram below



3

Or

You are given three lenses  $L_1$ ,  $L_2$  and  $L_3$  each of focal length 20 cm. A object is kept at 40 cm in front of  $L_1$ , as shown. The final real image is formed at the focus I of  $L_3$ . Find the separation between  $L_1$ ,  $L_2$  and  $L_3$ .



3

- 17 (i) The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. If focal length of the lens is 12 cm, find the refractive index of the material of the lens. How its refractive index will change if it is taken to a liquid of refractive index of 1.3.

3

Or

Find the expression for the equivalent focal length of

	the combination of two thin lenses in contact . 3
18	<p>Establish Snell's law using Huygen's principle . 3</p> <p>Or</p> <p>In a Young's double slit experiment, the slits are 2mm apart and a light of wavelengths 750nm is used . The screen is at a distance 2 m from the slits .Calculate the fringewidth and the seperation between 7th dark and 4th bright fringe . 3</p>
19	<p>(i) The ground state energy of hydrogen atom is - 13.6 eV. What are the kinetic and potential energies of electron in this state?</p> <p>(ii) What are the two limitations of the Rutherford's atomic model? 1+2=3</p> <p>Or</p> <p>(i) A hydrogen atom initially in the ground state absorbs a photon which excites it to the n- 4 level. Determine the wavelength of the photon. 2</p> <p>(ii) The radius of innermost electron orbit of a hydrogen atom is <math>5.3 \times 10^{-11} \text{m}</math>. Determine its radius in <math>n = 4</math> orbit. 1</p>
20	<p>The neutron separation energy is defined as the energy required to remove a neutron from the nucleus. Obtain the neutron separation energy of the nuclei <math>{}_{20}\text{Ca}^{41}</math> from the following data: 3</p> <p><math>m({}_{20}\text{Ca}^{40}) = 39.962591 \text{ u}</math> ,</p> <p><math>m({}_{20}\text{Ca}^{41}) = 40.962278 \text{ u}</math> and</p> <p><math>m_n = 1.008665 \text{ u}</math></p>

	<p>Or</p> <p>(i)) Write down the expression for the radius of a nucleus .</p> <p>(ii) Two nuclei have mass numbers in the ratio 27 : 125. What is the ratio of their nuclear radii ?</p> <p>(iii) Prove that nuclear density of a nucleus is constant . <span style="float: right;">3</span></p>
21	<p>Find the expression for impedance of LCR circuit .</p> <p>In a series LCR circuit with <math>L = 5.0 \text{ H}</math> , <math>C = 80\mu\text{F}</math>, <math>R=40 \Omega</math> connected to a variable frequency 240 V source. Calculate resonant frequency and the current at resonance. <span style="float: right;">3+2=5</span></p> <p>Or</p> <p>(i) Draw a labelled diagram of a step-up transformer. Obtain the ratio of secondary to primary voltage in terms of number of turns and currents in the two coils. <span style="float: right;">3</span></p> <p>(ii) A power transmission line feeds input power at 2200 V to a step-down transformer with its primary windings having 3000 turns. Find the number of turns in the secondary to get the power output at 220 V. <span style="float: right;">2</span></p>
22	<p>(i) Write the Einstein's photo electric equation .</p> <p>(ii) A proton and an alpha particle are accelerated through the same potential. Which one of the two has greater de Broglie wavelength ?</p> <p>(iii) Mention the outcomes of Hallwachs' and Lenerd's experiment graphically. <span style="float: right;">1½+1½+2=5</span></p> <p>Or</p>

(i) The following table gives the values of work functions for a few sensitive metals.

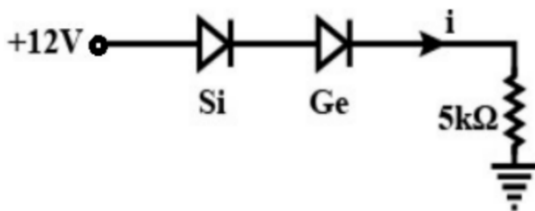
S. No.	Metal	Work function(eV)
1.	Na	1.92
2.	K	2.15
3.	Mo	4.17

If each of these metals is exposed to radiations of wavelength 3300nm, which of these will not emit Photo-electrons and why?

(ii) Give the photon picture of the electromagnetic waves.

23 (i) Write the distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams. Draw their energy band diagrams .

(ii) If the knee voltage of Si and Ge diodes are 0.7 V and 0.3 V respectively , then find the current through 5 K $\Omega$  resistor



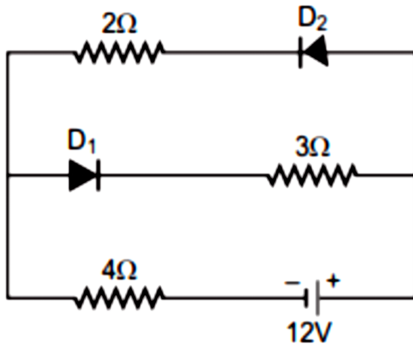
Or

(i) Explain briefly with the help of necessary diagrams, the forward and the reverse biasing of a p-n junction diode. Also draw their characteristic curves



in the two cases.

(ii) The circuit shown in the figure has two oppositely connected ideal diodes connected in parallel. Find the current flowing through each diode in the circuit.



$$3+2=5$$