# Pre-Board Examination : 2025-26

## Sub : Physics

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

**Time – 3 hours** **Full marks-70**

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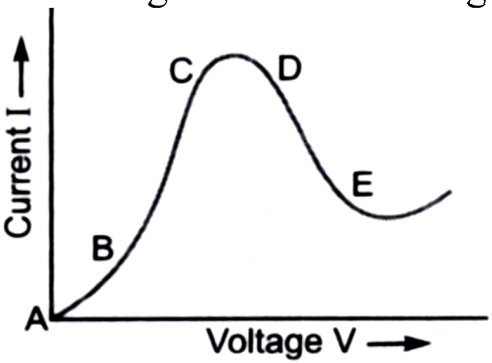
| **1.** | **Answer following questions : 1x8=8** |
| **a** | If the force of attraction between two charges of equal magnitude is $9\times10^5$ N, separated by a distance of 1 m in vacuum , then magnitude of each charge will be<br>(a) 1 C (b) 0.1 C (c) 0.01 C (d) 0.001C |
| **b** | Graph showing the variation of current versus voltage for a material GaAs as shown in figure. Which region of indicate negative resistance<br>  <br><br>(a)AB (b)BC (c)AC. (d)DE |
| **c** | Which material has negative susceptibility<br>(a) Paramagnetic (b) Ferromagnetic<br>(c) Diamagnetic (d) None of these |

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| **d** | If a change in current of 0.01 A in one coil produces a change in magnetic flux of 2 x $10^{-2}$ weber in another coil, then the mutual inductance between coils is<br>(a) 0 (b) 1H (c) 2H (d) 3H |
| **e** | (i) Which of the following quantity remains constant in an ideal transformer?<br>(a) Current (b) Voltage<br>(c) Power (d) All of these |
| **f** | Energy of photon depends upon<br>(a) Intensity (b)Saturation current<br>(c)frequency (d)none |
| **g** | The series of spectrum when electron jumps from n = 5 to n = 3 is<br>(a) Lymen (b) Balmer<br>(c) Paschen (d) Bracket |
| **h** | A In an insulator energy band gap is<br>(a) $E_g$= 0eV (b) $E_g$> 3eV<br>(c) $E_g$< 3eV (d) None |
| **2** | Give two similarities and disimilarities between Coulomb's law of electrostatics and Newton's law of Gravitation. 2 |
| **3** | An aluminum wire of diameter 0.24 cm is connected in series to a copper wire of diameter 0.16 cm. The wires carry an electric current of 10 A. Find<br>(a) current density of free electrons in the aluminum wire |

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| | (b) drift velocity of electrons in the copper wire. (Number density of free electrons in Copper $=8.4\times10^{28}m^{-3}$) 2 |
| **4** | In an EM wave propagating along X-direction magnetic field oscillates at a frequency of $3\times10^{10}$ Hz along Y direction and has an amplitude of $10^{-7}$T. Find the expression for electric field . Find the wave velocity . 2 |
| **5** | In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of $2.0\times10^{10}$ Hz and amplitude 48 V $m^{-1}$. [c = $3\times10^{8}$ m/s]<br>(a) What is the wavelength of the wave?<br>(b) What is the amplitude of the oscillating magnetic field? . 2<br>Or<br>Show that the average energy density of the E field equals the average energy density of the B field. 2 |
| **6** | How does the width of interference fringes in young's double slit experiment change when?<br>(i)The distance between the slit and the screen is decreased<br>(ii)The frequency of the source is increased.<br>(iii) Seperation between the slits is doubled . 2 |
| **7** | (i) Light of wavelength 3500 Å is incident on two metals A and B. Which metal will yield more photoelectrons if their work functions are 5 eV and 2 eV respectively? |

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| | (ii) Define threshold frequency. 2 |
| **8** | Name the constituent radiation of electromagnetic spectrum which is used for (i) aircraft navigation (ii) studying the crystal structure. Write the frequency range for each . 2 |
| **9** | (i) State two important features of Einstein's photoelectric equation.<br>(ii) Radiation of frequency $10^{15}$ Hz is incident on two photosensitive surfaces P and Q. There is no photoemission from surface P. Photoemission occurs from surface Q but photoelectrons have zero kinetic energy. Explain these observations & find the value of work function for surface Q. 2 |
| **10** | Using the Rydberg formula, calculate the wavelengths<br>of the first four spectral lines in the Lyman series of the hydrogen spectrum. 2 |
| **11** | How much energy should be given to uranium to eject one proton from its nucleus?<br>**Given:** $^{238}_{92}U = 238.05079\ amu$<br>$^{237}_{91}Pa = 237.05121\ amu$<br>$^{1}_{1}H = 1.00783\ amu$<br>$1\ amu = 931.5\ MeV$<br>2<br>Or<br>Distinguish between isotopes and isobars. Give one example for each of the species. 2 |

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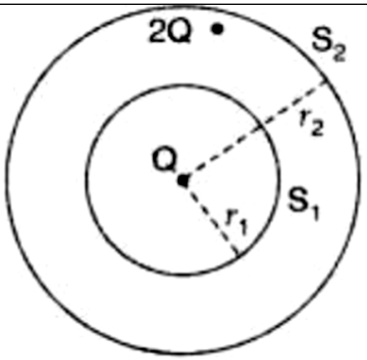
| **12** |  <br>A sphere $S_1$ of radius $r_1$ encloses a net charge Q. If there is another concentric sphere $S_2$ of radius $r_2$ ($r_2 > r_1$) enclosing charge 2Q.<br>**(i)** Find the ratio of the electric flux through $S_1$ and $S_2$.<br>**(ii)** How will the electric flux through sphere $S_1$ change if a medium of dielectric constant K is introduced in the space inside $S_2$ in place of air? 3<br>Or<br>(i) Apply Gauss's law to derive the expression for electric field intensity due to a thin sheet of charge .<br>(ii) Draw the graph between the electric intensity due to a thin sheet of charge and the distance of the point of observation from the thin sheet of charge . 2+1=3 |
| **13** | (i) The electric potential V at any point in space is given $V = 20x^3$ volt, where x is in meter. Calculate the electric intensity at point P (1, 0, 2).<br>(ii) Find equivalent capacitance between A and B in the combination given below: each capacitor is |

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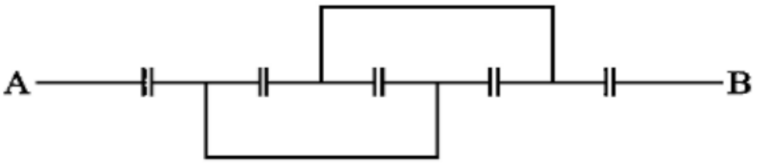
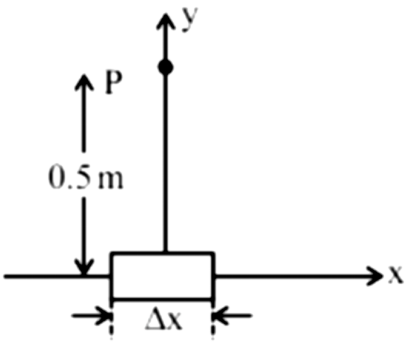
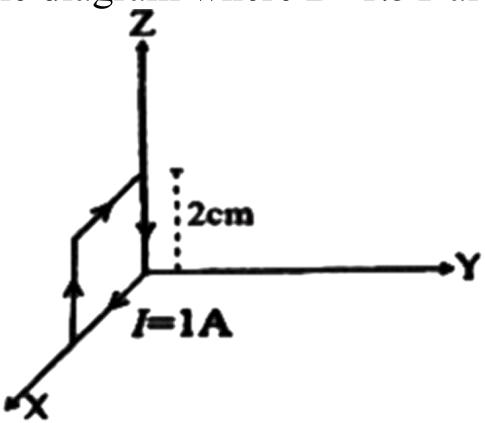
| | of 2 μF.<br>  <br><br>3<br>Or<br>Prove that electric field at the surface of a charged conductor is $\vec{E} = \frac{\sigma}{\varepsilon_0}\hat{n}$ ,where σ is the surface charge density and $\hat{\boldsymbol{n}}$ is a unit vector normal to the surface in the outward direction. 3 |
| **14** | (i) Prove that drift velocity of the free electrons in a conductor is time dependent velocity .<br>(ii) How does drift velocity of free electrons in conductor is related to temperature ? 3<br>Or<br>(i) A silver wire has a resistance of 2.1 Ω at 27.5 °C, and a resistance of 2.7 Ω at 100 °C. Determine the temperature coefficient of resistivity of silver.<br>(ii) Show the variation of resistivity of<br>(a)Nichrome with temperature<br>(b) Silicon with temperature. 2+1=3 |
| **15** | (i) An element Δx is placed at the origin and carries a large current of 10 A . What is the magnetic field on the y-axis at a distance of 0.5 m. Δx = 1 cm. |




(ii) Under what condition a moving charge will follow a helical path in a magnetic field.Explain. 3

Or

Find the magnitude and direction of the torque acting on the square loop of side 2 cm as shown in the diagram where B=1.5T along positive Z axis.

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**16** (i) What is electromagnetic induction

(ii) The magnetic field through a circular loop of wire, 12cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the current induced in the loop .

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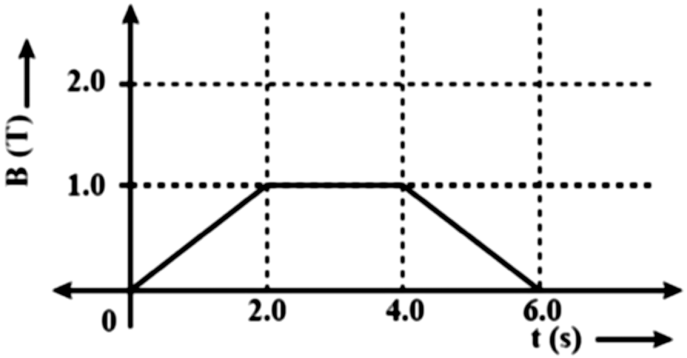
| |  <br>(iii) Draw the graph between current and time . 3<br>Or<br>Derive an expression for the energy stored in a solenoid . Also find its energy density . 2+ 1 = 3 |
| **17** | (i)An ac voltage of emf $e = E_0 \sin \omega t$ is applied across an inductor of self inductance L, find an expression for the AC flowing in the circuit. Draw the phasor diagram to show the phase relationship between current and voltage.<br>(ii)What is inductive reactance ? Draw its variation with ω . 1½+1+½=3<br>Or<br>Find the expression for power in LCR circuit . 3 |
| **18** | (i) State the principle on which the working of an optical fiber is based.<br>(ii) What are the necessary conditions for this phenomenon to occur?<br>(iii) Write down some uses of it . 1+1+1= 3<br>Or<br>(i) A beam of light consisting of two wavelength |

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| | 800 nm and 600 nm is used to obtain the interference pattern in young's double slit experiment on a screen placed 1.4 m away. If the separation between two slits in 0.28 mm. Calculate the least distance from the central bright maximum, where the bright fringes of two wavelengths coincide.<br>(ii) Find the position of the $5^{th}$ dark fringe from the central bright fringe due 800 nm. 1½+1½=3 |
| **19** | **(i)** What intrinsic semiconductor ? Draw its energy band diagram at ordinary temperature . 1+1=2<br>**(ii)** In a p-n junction, width of depletion region is 300 nm and electric field of $7\times10^{5}$ V/m exists in it. Find the height of potential barrier. 1<br>Or<br>(i) Give the differences among metal , insulator semiconductor and in terms of conductivity. 1<br>(ii) Carbon, silicon and germanium have four valence electrons each. These are characterized by valence and conduction bands separated by energy band gap respectively equal to $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$. Arrange them in descending order . 1<br>(iii) What reverse saturation current . 1 |

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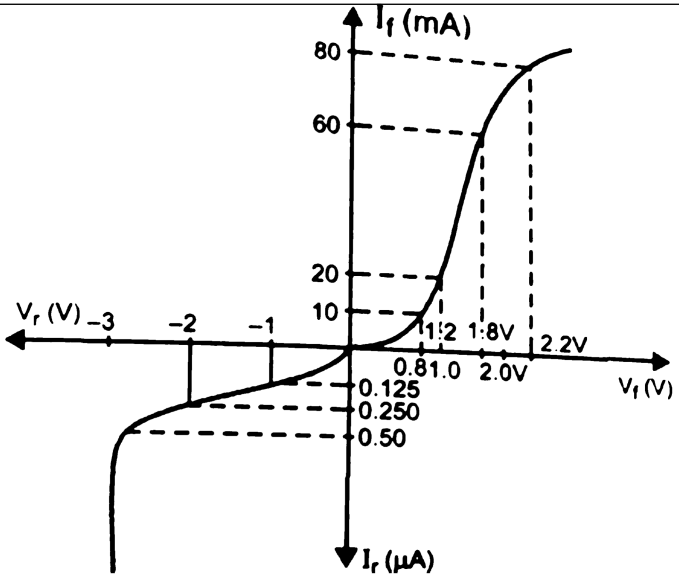
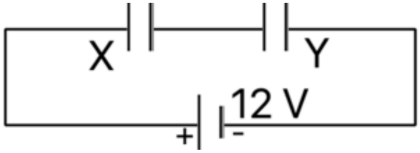
| **20** |  <br>(i) Calculate the resistance of the diode during forward and reverse biasing.<br>(ii) Find the knee voltage and Zener voltage in the graph. . 2+½+½=3<br>Or<br>Explain the working of full wave rectifier. 3 |
| **21** | Fig. shows two parallel plate capacitors X and Y having same area of plates and same separation between them : X has air while Y has dielectric of constant 4 as medium between plates.<br>  <br>(a) calculate capacitance of each capacitor, if equivalent capacitance of combination is 4μF<br>(b) calculate potential difference between plate X and Y |

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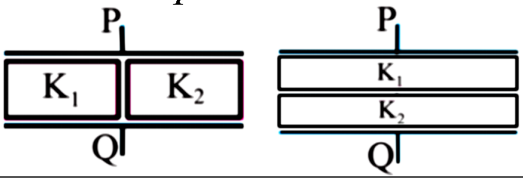
| | (c)Find the ratio of electrostatic energy stored in X & Y.<br>**Or**<br>You are given an air filled parallel plate capacitor. Two slabs of dielectric constants $K_1$and $K_2$ having been filled in between the two plates of the capacitor as shown in Fig. What will be the capacitance of the capacitor of initial area was A distance between plates d?<br>  |
| **22** | (i) Draw a labelled ray diagram of astronomical telescope . Write the formula for magnifying power . 3<br>**(ii)** An optical instrument uses eye-lens of power 20 D and the objective lens of power 50 D. Name the optical instrument and calculate its magnifying power if it forms the final image at infinity. 2<br>Or<br>**(i)** Explain the formation secondary maxima due to diffraction of light through a single slit . **2½**<br>**(ii)** Graphical Representation of intensity pattern for diffraction . **1**<br>**(iii)** In the experiment on diffraction due to a single slit, show that the angular width of the central maximum is twice that of the first order secondary maximum. **1½** |

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| **23** | **(i)** Show that the energy of an electron in the orbit of the hydrogen atom varies inversely as $n^2$, where n is the principal quantum number of the atom.<br>**(ii)** The ground state energy of hydrogen atom is **-13.6 eV**. what is the kinetic energy and the potential energy of an electron in the 2nd excited state . 3+2 = 5<br>Or<br>**(i)** What 1 amu ? Give its energy equivalent .<br>**(ii)** Convert 5 mg of matter into MeV .<br>(iii) Give the difference between nuclear fission and nuclear fision. 1½+1½ + 2 =5 |