Class : XII || AHSEC || Pre Board Examination , 2024-25

Subject : Physics ||Full marks : 70||Time : 3hours|| Set - 05

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

Section A :: Each question carries 1 mark

1. A p-type semiconductor can be obtained by adding
   a) phosphorus to pure germanium
   b) gallium to pure silicon
   c) arsenic to pure silicon d)
   antimony to pure germanium

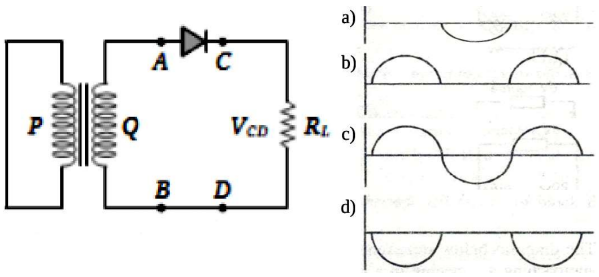
2. When a current flows in a wire, there exists an electric field in the direction of:
   a) flow of current b) opposite to the flow of current
   c) perpendicular to the flow of current
   d) at an angle of 45° to the flow of current

3. Which of the following is used in optical fibers?
   a) Scattering b) Refraction
   c) Diffraction d) Total internal reflection

4. If we carry a charge once around an equipotential path, then work done by the charge is
   a) infinity b) negative c) zero d) positive

5. When a charged particle enters in a uniform magnetic field, its kinetic energy.
   a) decreases b) becomes zero
   c) remains constant d) increases

6. In the half wave rectifier circuit shown which one of the following wave forms is true for V_{CD}, the output across C and D?



7. What is Lorentz force ? Write an expression for it .

Section B :: Each question carries 2 marks

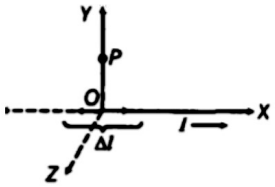
8.Two charges 5 × 10^{-8} C and -3×10^{-8} C are located 16 cm apart. At what point (s) on the line joining the two charges is the electrical potential zero? Take the potential at infinity to be zero. [2]

9. Explain the formation of depletion layer in a PN junction diode with the help of drift and diffusion method. [2]

10. Explain, with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier. [2]

11. If Bohr's quantisation postulate (angular momentum $= \frac{nh}{2\pi}$) is a basic law of nature, it should be equally valid for the case of planetary motion also. Why then do we never speak of quantisation of orbits of planets around the sun? [2]

12. An element M = $\triangle l = \triangle x\ \hat{i}$ is placed at the origin (as shown in figure) and carries a current I = 2 A. Find out the magnetic field at a point P on the Y-axis at a distance Δx = 1.0 cm due to the element . Also, give the direction of the field produced. **[2]**



OR

A horizontal overhead power line carries a current of 90 A in east to west direction. What is the magnitude and direction of the magnetic field due to the current 1.5 m below the line? **[2]**

13.A closely wound solenoid of 800 turns and area of cross $2.5\times10^{-4}m^2$ section carries a current of 3.0 A. What is its associated magnetic moment? [2]

14. A plane electromagnetic wave travels in free space along x-axis. At a particular point in space, the electric field along y-axis is 9.3 V/m. Find the magnitude and direction magnetic induction (B) .s [2]

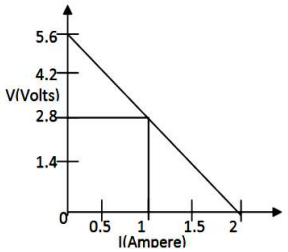
15. Write down the expression for wave number .
A hydrogen atom initially in the ground level absorbs a photon, which excites it to the **n = 4** level. Determine the wavelength and frequency of photon. [2]

16. From the relation $\boldsymbol{R = R_0A^{1/3}}$, where $\boldsymbol{R_0}$ is a constant and *A* is the mass number of a nucleus, show that the nuclear matter density is nearly constant [2]

17. Draw the ray diagram of the Cassegrain telescope . What are the types of mirrors used ? Name them . [2]

Section c :: Each question carries 3 marks

18. 4 cells of identical emf E and internal resistance r are connected in series to a variable resistor. The following graph shows the variation of terminal voltage of the combination with the current output.
(i)What is the emf of each cell used?
(ii)For what current from the cells, does maximum power dissipation occurin the circuit?



[3]

19.A bar magnet is placed in a uniform magnetic field with its magnetic moment making an angle θ with the field.
(i) Find an expression for the torque acting on the magnet and hence define its magnetic moment.

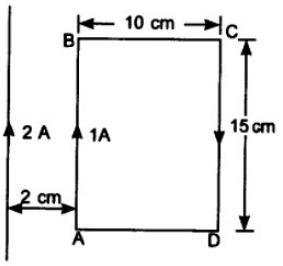
(ii) Write an expression for potential energy of the magnet in this orientation.When is this energy minimum? [3]

20. Ultra-violet light of wavelength 200 nm from a source is incident on a metal surface.Stopping potential is **-2.5** V
(i) Calculate the work function of the metal, and
(ii) How would the surface respond to a high intensity red light of wavelength 6328 Å produced by a laser? **[3]**

21. Name the process involved in the sun for the production of energy . Describe how energy is produced . **[3]**

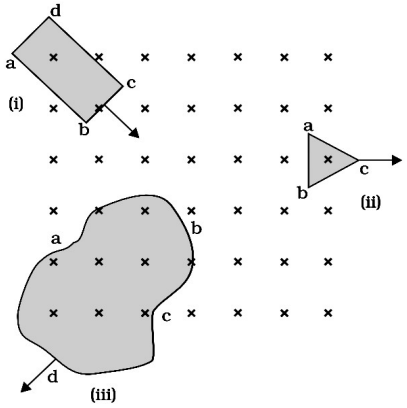
22. Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is
(i) attractive, (ii) repulsive.Write two important conclusions which you can draw regarding the nature of the nuclear forces. **[3]**

23. Find the force on the rectangular coil Give its direction .



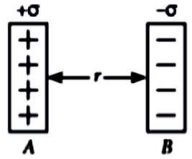
[3]

24. State Lenz's law .
Following figure shows planar loops of different shapes moving out of or into a region of a magnetic field which is directed normal to the plane of the loop away from the reader. Determine the direction of induced current in each loop using Lenz's law.



[3]

25. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs having magnitude of 17×10^{-22} Cm^{-2} as shown.



(i) Find electric field in the outer region of the first plate
(ii) Find electric field in between the two plates .
(iii) Find the force acting on an alpha particle placed in between the two plates .

26. Define internal resistance of a cell **.**
A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit?

Section D :: Each question carries 5 marks

27. (i) Obtain the refraction formula for a convex spherical surface , with object in the rarer medium .
(ii) A compound microscope uses an objective lens of focal length 4 cm and eyepiece lens of focal length 10 cm. An object is placed at 6 cm from the objective lens. Calculate its magnifying power . **[5]**
OR
(i) In Young's double slit experiment, monochromatic light of wavelength λ illuminates the pair of slits separated by a small distance of b and produces an interference pattern in a screen at a distance of L from the sources . Find the phase difference in the experiment . Prove that the central bright fringe forms at the centre of the screen .
(ii) The intensity at the central maxima in Young's double-slit experiment is I_o. Find out the intensity at a point where the path difference is **λ/6** . **[5]**

28.(i) Describe briefly the process of loss of energy when two parallel plate capacitor are connected parallely to each other . Derive an expression for the loss of energy in the process .
(ii) A 600pF capacitor is charged by a 200V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. How much electrostatic energy is lost in the process? **[5]**
Or
A parallel plate capacitor has a square plate of side 12cm and seperated by 2 mm. The right plate is earthed and the left plate is given a charge of 10μC.
(i) Determine the capacitance of the capacitor.
(ii)The space between the plates is filled with a liquid of dielectric constant 2 . What is the capacitance now ?
(iii) Compare the energy stored in both the cases . **[5]**

29: (i) Prove that RMS value of AC is about 70% of the peak value of the AC .
(ii) An inductor of 200 mH, a capacitor of 400μF and a resistor of 10 Ω are connected in series to ac source of 50 V of variable frequency. Calculate the angular frequency at which maximum power dissipation occurs in the circuit and the value of Q-factor in the circuit. **[5]**
Or
An ac voltage $V = V_0 \sin\omega t$ is applied to a pure inductor of inductance L. Obtain an expression for the current in the circuit with the help of phasor diagram .
Prove that the average power supplied to an inductor over one complete cycle is zero. **[5]**