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Time : 2½ Hours

PHYSICS

Subject Code

H	7	0	2
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Total No. of Questions : 25 (Printed Pages : 11)

Maximum Marks : 55

- INSTRUCTIONS :**
- (i) Attempt *All* questions.
 - (ii) Q. No. 1 to Q. No. 4 are multiple choice questions. Candidates are to choose and write the most suitable answer. Each carries *one* mark.
 - (iii) Q. No. 5 to Q. No. 7 are very short answer type questions and each carries *one* mark.
 - (iv) Q. No. 8 to Q. No. 15 are short answer type questions carrying *two* marks each, with internal choice in *one* question only.
 - (v) Q. No. 16 to Q. No. 23 are short answer type questions carrying three marks each, with internal choice in one question only.
 - (vi) Q. No. 24 and 25 are long answer type questions carrying *four* marks each with internal choice in each question.
 - (vii) Use of calculators is not permitted. However, log tables will be provided on request.
 - (viii) You may use the following values of physical constants wherever necessary :
 $c = 3 \times 10^8 \text{ ms}^{-1}$
 $e = 1.6 \times 10^{-19} \text{ C}$
 $h = 6.6 \times 10^{-34} \text{ Js}$
 $m_e = 9.1 \times 10^{-31} \text{ kg}$
 $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$
 $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$.

1. The value of power factor in series LCR-circuit at resonance is

- Zero
- 1
- $\frac{1}{2}$
- $\frac{1}{\sqrt{2}}$

2. The maximum distance upto which TV transmission from a TV tower of height h can be received is proportional to

- $h^{1/2}$
- h
- $h^{3/2}$
- h^2

3. Velocity of light in free space is equal to

- $\sqrt{\epsilon_0 \mu_0}$
- $\frac{\epsilon_0}{\mu_0}$
- $\sqrt{\frac{\epsilon_0}{\mu_0}}$
- $\frac{1}{\sqrt{\epsilon_0 \mu_0}}$

4. A capacitor of capacitance C_1 is charged upto a potential V and then connected in parallel to an uncharged capacitor of capacitance C_2 . The final potential difference across each capacitor would be

• $\frac{C_2 V}{C_1 + C_2}$

• $\frac{C_1 V}{C_1 + C_2}$

• $\left(1 + \frac{C_2}{C_1}\right) V$

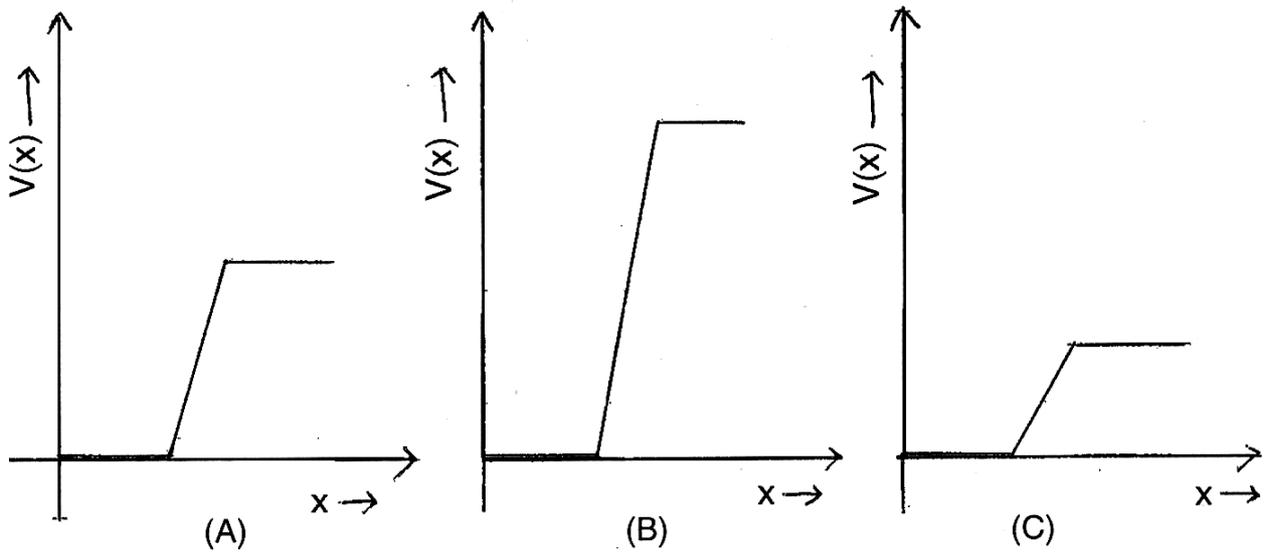
• $\left(1 - \frac{C_2}{C_1}\right) V$

5. What is the ratio of speed of gamma rays and radiowaves in vacuum ?
6. Write any one factor that prevents a baseband signal of low frequency to be transmitted over long distance directly.
7. Two polaroids are aligned so that the intensity of light emerging out of them is maximum. Through what angle one of them should be rotated so that the intensity of light emerging out of them is reduced to half ?
8. Using Gauss's law derive an expression for electric field at a point near a thin uniformly charged infinite plane sheet. Draw necessary diagram.

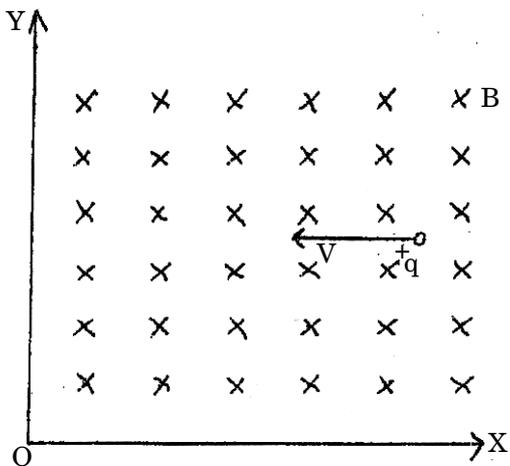
OR

Obtain an expression for the electric field \vec{E} at a distance 'r' from the centre of the electric dipole on its axial line. Draw necessary diagram.

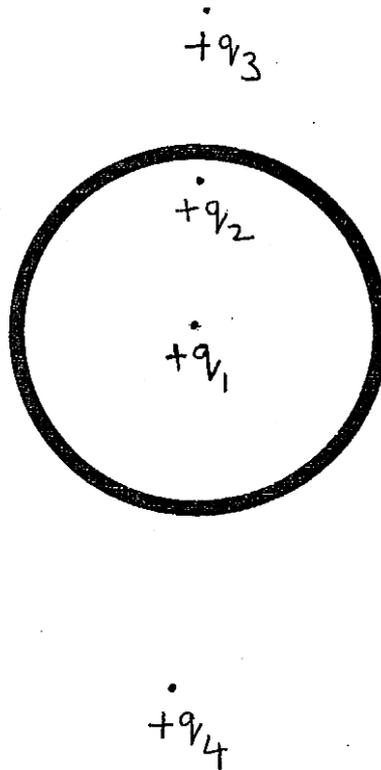
9. The graph of potential barrier $V(x)$ versus width of depletion region (x) for an unbiased p-n junction diode is shown in graph (A).
 Graphs (B) and (C) are obtained after biasing the same diode in different ways.
 Identify the type of biasing used for graphs (B) and (C).



10. A point charge $+q$ moving with speed \vec{v} enters a uniform magnetic field \vec{B} that is acting into the plane of paper as shown.
- What is the path followed by the charge $+q$?
 - What would be the change in the path if its velocity has a component parallel to \vec{B} ?



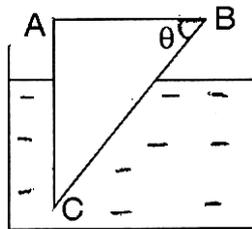
11. Why eddy currents are undesirable ? How can they be minimised ?
12. Using the equation representing law of radioactive decay, obtain an equation to show that half-life of a radioactive substance is equal to 0.693 times its average life.
13. Four charges $+q_1$, $+q_2$, $+q_3$ and $+q_4$ are placed as shown in the figure. $+q_1$ and $+q_2$ are enclosed by uniformly charged spherical shell.
- Which charges experience
- Maximum electrostatic force due to the shell ?
 - Minimum electrostatic force due to the shell ?



14. A right angled prism is kept partially inside water as shown in the figure. A ray of light is incident normally on face AB. It is observed that the ray of light just grazes along the surface BC after falling on it. Find the value of θ .

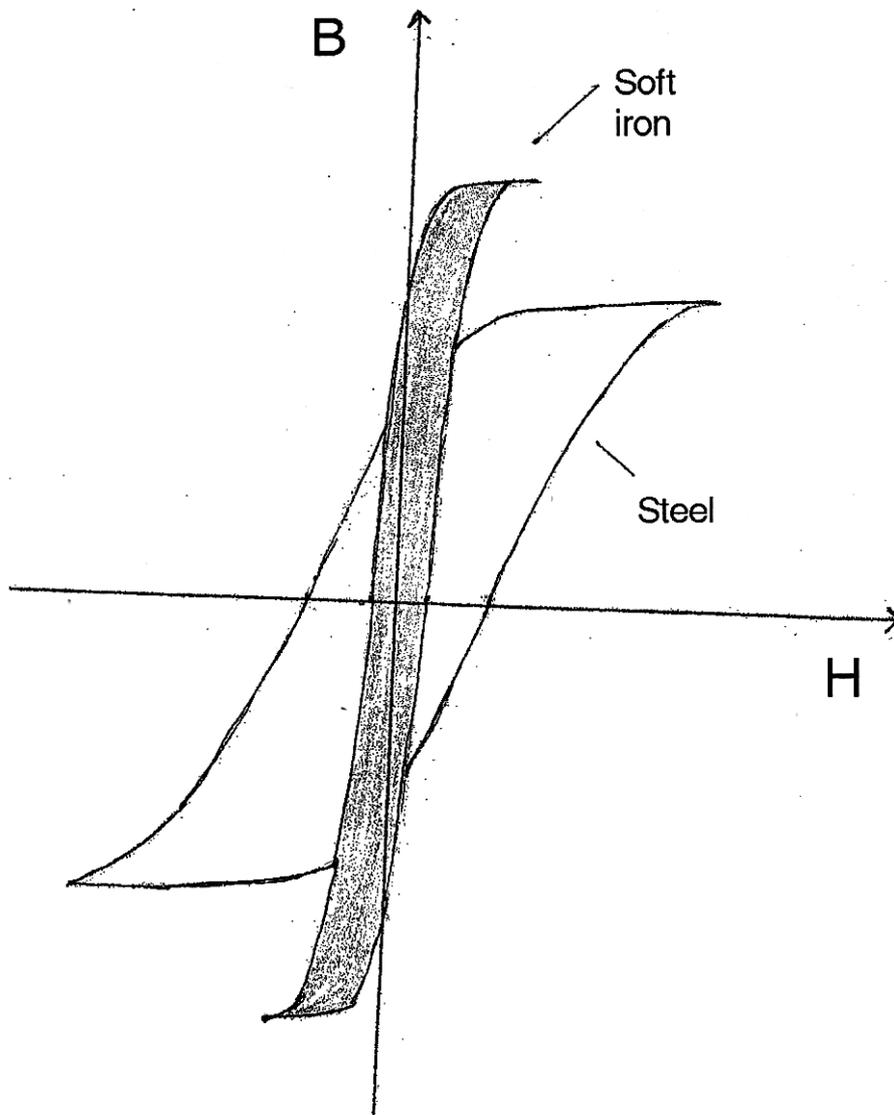
R.I. of material of prism is $\frac{3}{2}$.

R.I. of water is $\frac{4}{3}$.



15. When the energy of the incident radiation is increased by 20%, the maximum kinetic energy of the photoelectrons emitted from a metal surface increased from 0.5 eV to 0.8 eV. Find the work function of the metal.
16. Two coherent sources S_1 and S_2 separated by a certain distance d , produce an interference pattern on a screen. Obtain an expression for path difference between the waves reaching a point on the screen at a distance y from the centre of the pattern. Hence find the expression for fringe width for constructive interference only.

17. Hysteresis loops for two materials soft iron and steel are shown in the figure below. The area of hysteresis loop for soft iron is smaller than that for steel.



- i) Which material has greater retentivity ?
- ii) Which material has larger coercivity ?
- iii) If both the materials are to go through repeated cycles of magnetisation which material will dissipate greater heat energy ?

18. Use Biot-Savart law to derive the expression for the magnetic field due to a circular coil carrying current at a point P along its axis. Draw necessary diagram. What is the direction of magnetic field at P if the current is in anticlockwise direction ?

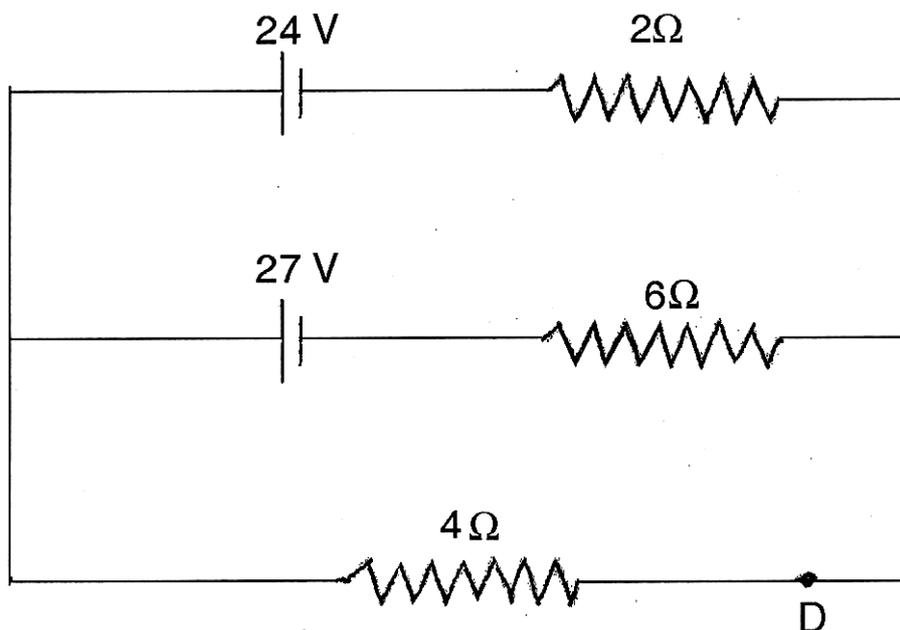
OR

Obtain an expression for the torque on a rectangular current carrying loop suspended in a uniform magnetic field. Angle between the magnetic field and the normal to the coil is θ . Draw necessary diagram. In which orientation will the loop be in stable equilibrium ?

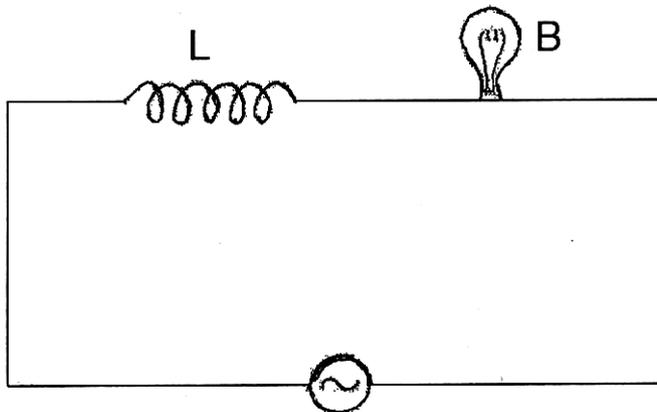
19. Derive an equation to determine the internal resistance of a cell by using a potentiometer. Draw necessary circuit diagram. Why is potentiometer preferred over voltmeter for comparison of e.m.f. of cells ?

20. Using Kirchhoff's laws determine the current through the resistor $4\ \Omega$ in the network shown in the figure.

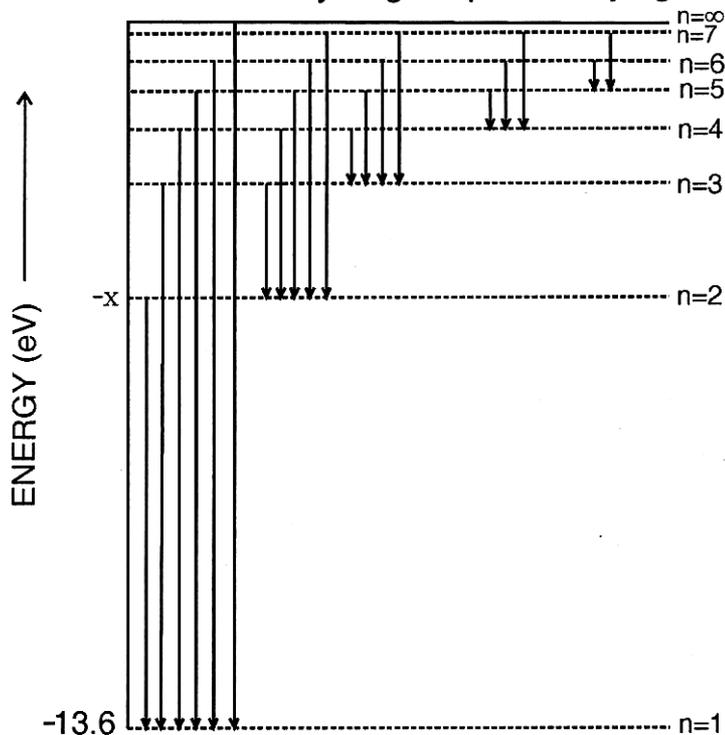
What is the charge accumulated at point D ?



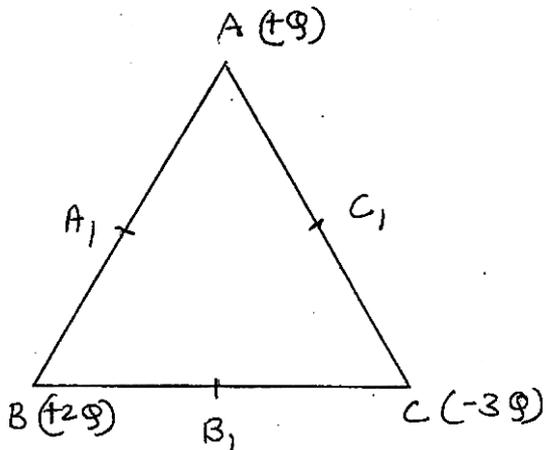
21. An open coil inductor L of inductive reactance X_L is connected in series with a bulb B and an a.c. source. How would brightness of the bulb change when
- number of turns in the inductor are reduced ?
 - an iron rod is inserted into the interior of the inductor ?
 - a capacitor of capacitive reactance $X_C = X_L$ is connected in series in the circuit ?



22. Figure shows the energy levels of hydrogen atom.
- Name the series of hydrogen spectrum which has the radiation of least wavelength.
 - Write the value of X in eV for the electron in $n = 2$ orbit.
 - Name the series of hydrogen spectrum lying in visible region.



23. Three point charges $+Q$, $+2Q$ and $-3Q$ are placed at the vertices of an equilateral triangle ABC of side l . If these charges are displaced to the midpoints A_1 , B_1 and C_1 respectively, find the amount of work done in shifting the charges to the new locations.



24. Obtain an expression for the refractive index of the material of a prism in terms of angle of prism and the angle of minimum deviation.

Draw necessary ray diagram.

If rays of red and blue light are incident on the given prism, then which ray will have the larger value of angle of minimum deviation ?

OR

Derive an expression for refraction at a convex spherical surface when object lies in the rarer medium of R.I. n_1 and real image is formed in the denser medium of R.I. n_2 . Draw necessary ray diagram.

If the medium of R.I. n_2 is replaced by another medium of R.I. n_3 where $n_3 > n_2$, what would be the change in the image distance ?

25. Draw the transfer characteristics of a base-biased transistor in its common emitter configuration.

Which region of this characteristic is used when it works as an amplifier ? With the help of a circuit diagram explain how n-p-n transistor can be used as an amplifier in common-emitter configuration. Hence show that input and output voltages are out of phase by 180° .

OR

The voltage waveforms of inputs A and B of a logic gate are given in the figure. Output Y is shown for time intervals $t_1 - t_2$ and $t_2 - t_3$.

- Identify the logic gate.
- Draw its logic symbol.
- Using this logic symbol, draw a circuit to obtain logic operation of OR gate.
- Draw the output waveform for time intervals $t_3 - t_4$ and $t_4 - t_5$.
- Give one use of logic gate.

