Time : 3 Hours
Maximum Marks : 70

PHYSICS
ISC
Sample Question Papers

Self Assessment Paper 1

General Instructions :

All questions are compulsory.
This question paper is divided into 4 Sections, A, B, C and D as follows:
Section A
Section A is of twelve marks. All parts of this Section are compulsory.
Section B
Question numbers 2 to 12 carry 2 marks each with two questions having internal choice.
Section C
Question numbers 13 to 19 carry 3 marks each with two questions having internal choice.
Section D
Question numbers 20 to 22 are long-answer type questions and carry 5 marks each.
Each question has an internal choice.
The intended marks for questions are given in brackets [ ].
All working, including rough work, should be done on the same sheet as and adjacent to the rest of the answer.
Answers to sub parts of the same question must be given in one place only. A list of useful physical constants is given at the end of this paper.
A simple scientific calculator without a programmable memory may be used for calculations.

SECTION - A (12 Marks)

Answer all questions.

Question 1

A. Choose the correct alternative (a), (b), (c) or (d) for each of the questions given below: **[5×1]**

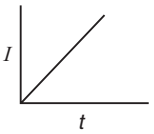
(i) Relative permittivity of water is 81. If e_w and e_0 are permitivities of water and vacuum respectively, then :

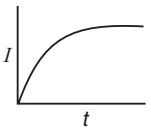
(a) $\varepsilon_0 = 9\varepsilon_w$ **(b)** $\varepsilon_0 = 81\varepsilon_w$
(c) $\varepsilon_w = 9\varepsilon_0$ **(d)** $\varepsilon_w = 81\varepsilon_0$

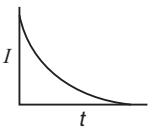
(ii) A metallic wire having length of 2 m and weight of 4×10^{-3} N is found to remain at rest in a uniform and transverse magnetic field of 2×10^{-4} T. Current flowing through the wire is :

(a) 10 A **(b)** 5 A
(c) 2 A **(d)** 1 A

(iii) A solenoid L and a resistance R are connected in series to a battery through a switch. When the switch is put on, current I flowing through it varies with time t as shown in which of the graphs given below :

(a) 

(b) 

(c) 

(d) 

(iv) The loss of power in a transformer can be reduced by :

(a) increasing the number of turns in primary. **(b)** increasing ac voltage applied to primary.

(c) using a solid core made of steel. **(d)** using a laminated core of soft iron.

(v) A fish which is at a depth of 12 cm in water $\left(\mu = \frac{4}{3}\right)$ is viewed by observer on the bank of a lake. Its apparent depth as observed by the observer is :

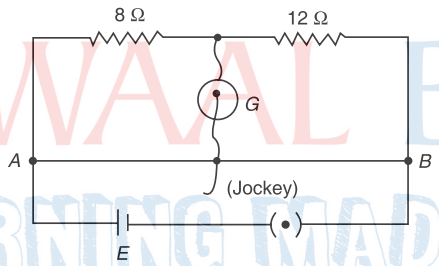
(a) 3 cm **(b)** 9 cm

(c) 12 cm **(d)** 16 cm

B. Answer the following questions briefly and to the point. **[7×1]**

(i) Write Coulomb's law in vector form.

(ii) In the circuit, given figure below the length of the wire AB = 400 cm. Where should the jockey J be placed, so that the galvanometer shows a zero deflection ?



(iii) Write an expression of magnetic flux density 'B' at a point in end-on position or an axial position of a magnetic dipole. (Derivation not required)

AI **(iv)** An a.c. generator generates an emf 'e' given by: e = 311 sin (100πt) volt. Find the rms value of the emf generated by the generator.

(v) An ideal inductor does not consume any power even though both V and I are non zero. Explain in brief.

(vi) Show, by giving a simple example, how EM waves carry energy and momentum.

(vii) Calculate dispersive power of a transparent material.
Given, n_v = 1.56, n_r = 1.54, n_y = 1.55

SECTION - B (22 Marks)

*Attempt **all** questions*

2. A sphere S of radius r, encloses a net charge Q. If there is another concentric sphere S_2 of radius $r_2 (r_2 > r_1)$ enclosing charge 2Q, find the ratio of the electric flux through S_1 and S_2. 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? **2**

3. Name one material whose resistivity decreases with rise in temperature. Explain briefly on the basis of free electron theory why the resistivity decreases. **2**

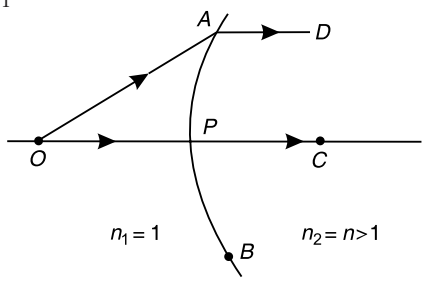
4. A proton and a deuteron, each moving with velocity $\vec{v}$ enter simultaneously in the region of magnetic field $\vec{B}$ acting normal to the direction of velocity. Trace their trajectories establishing the relationship between the two. **2**

5. If the current in the primary coil is reduced from 3 A to zero in 0.001 s, the induced emf in the secondary coil is 1500 volt. Calculate the mutual inductance between two coils. **2**

OR

How does a charge q oscillating at certain frequency produce electromagnetic waves ?
Sketch a schematic diagram depicting electric and magnetic fields for an electromagnetic wave propagating along the Z-direction. **2**

6. In the figure shown, O is a point object placed in air on the axis of a spherical surface APB of a glass block. OA is an incident ray. The direction of the refracted ray AD in the glass block is parallel to the principal axis PC, $CP = CA = R$ is the radius of the spherical surface. Show that the object distance $PO = u = R/(n-1)$, where $n_2 = n$ and $n_1 = 1$.



2

7. Show graphically the intensity distribution in Fraunhofer's single slit diffraction experiment. Label the axes. **2**

OR

AI In photo-electric effect, what is meant by the terms :
(i) Work function of a metal.
(ii) Stopping potential.

8. **(i)** Find maximum frequency of X-rays produced by an X-ray tube operating at a tube potential of 66 kV.
(ii) State any one difference between characteristic X-rays and continuous X-rays. **2**

9. Draw energy level diagram for Balmer series for transition between energy levels. **2**

10. Two bulbs are rated (P_1, V) and (P_2, V). If they are connected (i) in series and (ii) in parallel across a supply, V, find the total power dissipated in the two combinations in terms of P_1 and P_2? **2**

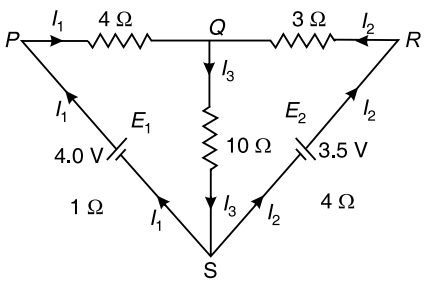
11. A photon emitted during the de-excitation of electron from a state n to the first excited state in a hydrogen atom, irradiates a metallic cathode of work function 2 eV, in a photo cell, with a stopping potential of 0.55 V. Obtain the value of the quantum number of the state n. **2**

12. A hydrogen atom in the ground state is excited by an electron beam of 12.5 eV energy. Find out the maximum number of lines emitted by the atom from its excited state. **2**

SECTION - C (21 Marks)

*Attempt **all** questions*

AI **13.** In the circuit, given below, E_1 and E_2 are batteries having emfs 4·0 V and 3·5 V respectively and internal resistance 1 Ω and 2 Ω respectively. Using Kirchhoff's laws, calculate currents : I_1, I_2 and I_3.



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14. Obtain an expression for magnetic flux density B at the centre of a circular coil of radius R, having N turns and carrying a current I. **3**

15. Obtain an expression for resonant frequency 'f_0' of a series LCR circuit. **3**

16. Show that the axial chromatic aberration ($f_R - f_V$) for a convex lens is equal to the product of its mean focal length (f) and dispersive power (ω) of its material *i.e.*, Prove : **3**

$$f_R - f_V = \omega f$$

AI **17.** What is Compton scattering ? Mention the important conclusion drawn from the phenomena of compton scattering. **3**

18. **(a)** Three photodiodes D_1, D_2 and D_3 are made of semiconductors having band gaps of 2.5 eV, 2 eV and 3 eV respectively. Which of them will not be able to detect light of wavelength 600 nm? **3**

(b) Why photodiodes are required to operate in reverse bias explain.

OR

Distinguish between emf and terminal potential difference of a cell.

19. **(a)** State Gauss's law for magnetism. Explain its significance. **3**

(b) Write four important properties of the magnetic field lines due to a bar magnet.

SECTION - D (15 Marks)

*Attempt **all** questions from this Section*

20. **(a)** Under which conditions can a rainbow be observed? Distinguish between primary and secondary rainbow.

(b) Give the expression for the velocity of electron in the first orbit of hydrogen atom for the radius in the ground state of hydrogen atom.

Hence, derive the expression for the magnetic field (B) at the centre of the nucleus due to the circular motion of electron. **5**

OR

The current flowing through a conductor is given by $I = neAv_d$. **(i)** Identify each term in the equation. **(ii)** Obtain an expression for V_d, if the current flowing through the conductor of length l has its ends maintained at a potential difference V volt.

AI **21.** **(a)** The ionisation potential of hydrogen atom is 13.6 eV. Draw the energy level diagram showing four levels. Calculate :

(i) The energy of the photon emitted, when an electron falls from the third orbit to the second orbit.

(ii) The wavelength of this photon.

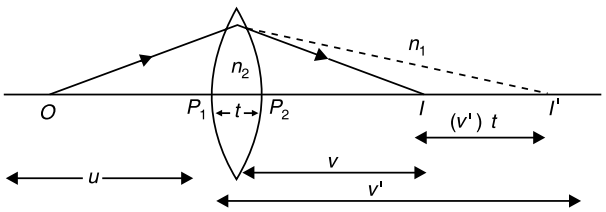
(b) **(i)** What are matter waves ?

(ii) Show with the help of a labelled graph how their wavelength (λ) varies with their linear momentum (p). **5**

OR

(a) Compare the photoelectric effect with wave theory of light. Also discuss in detail why the wave theory failed to explain it.

(b) Starting with an expression for refraction at a single spherical surface, obtain an expression for lens maker's formula.



22. **(a)** Describe very briefly any four regions of electromagnetic spectrum mentioning their special properties/features.

(b) A transformer has 500 turns in its primary and 1000 turns in its secondary winding. The primary voltage is 200 V and the load in the secondary is 100 Ω. Calculate the current in the primary, assuming it to be an ideal transformer. **5**

OR

(a) Derive an expression for motional emf, induced across the end of a conducting rod moving in a uniform perpendicular magnetic field.

(b) **(i)** State Gauss' law.

(ii) In an electric dipole, at which point is the electric potential zero ?

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