Class XII | Session 2026-27
Subject - Physics
Sample Question Paper - Set 5

General Instructions:

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. All the sections are compulsory.
4. **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of four marks each and **Section E** contains three long answer questions of five marks each.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
6. Use of calculators is not allowed.

Section A

1. The resistivity of a semiconductor at room temperature is in between: **[1]**

   a) 10^6 to 10^8 Ω cm
   b) 10^{10} to 10^{12} Ω cm
   c) 10^{-2} to 10^{-5} Ω cm
   d) 10^{-3} to 10^6 Ω cm

2. In a Wheatstone's bridge, all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance of the combination as seen by the battery is: **[1]**

   a) $\frac{R}{2}$
   b) R
   c) $\frac{R}{4}$
   d) 2R

3. A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen, then **[1]**

   a) half the image will disappear
   b) no image will be formed
   c) intensity of the image will increase
   d) complete image will be formed

4. The ratio of magnetic fields due to a small bar magnet in the end on position to the broad side on position is **[1]**

   a) 1 : 4
   b) 1 : 2
   c) 2 : 1
   d) 1 : 1

5. A parallel plate capacitor of 1 μF capacity is discharging through a resistor. If its energy reduces to half in one **[1]**

second, the value of resistance will be:

a) $\frac{16}{\ln(2)}\text{M}\Omega$ b) $\frac{4}{\ln(2)}\text{M}\Omega$

c) $\frac{2}{\ln(2)}\text{M}\Omega$ d) $\frac{9}{\ln(2)}\text{M}\Omega$

6. An electron with velocity $\vec{v} = \left(v_x\,\hat{i} + v_y\hat{j}\right)$ moves through a magnetic field $\vec{B} = \left(B_x\,\hat{i} - B_y\hat{j}\right)$. The force $\vec{\text{F}}$ on the electron is : (e is the magnitude of its charge) **[1]**

a) $e\left(v_xB_y - v_yB_x\right)\hat{k}$ b) $e\left(v_xB_y + v_yB_x\right)\hat{k}$

c) $-e\left(v_xB_y + v_yB_x\right)\hat{k}$ d) $-e\left(v_xB_y - v_yB_x\right)\hat{k}$

7. When a coil is joined to a cell, current grows with a time constant τ. The current will reach 10% of it's steady-state value in time **[1]**

a) 2τ b) $\tau\ln\left(0.9\right)$

c) τ d) $\tau\ln\left(10/9\right)$

8. Which one of the following has negative value of susceptibility? **[1]**

a) Iron b) Aluminium

c) Lead d) Nickel

9. Two coherent monochromatic light beams of intensities I and 4I are superposed. The maximum and minimum possible intensities in the resulting beam are **[1]**

a) 5I and 3I b) 9I and 2I

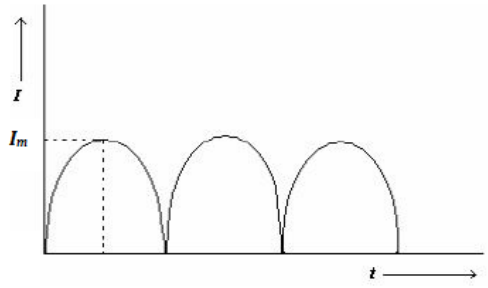
c) 5I and I d) 9I and I

10. If an electron has an initial velocity in a direction different from that of an electric field, then the path of the electron is $(\theta \neq 180^\circ)$ **[1]**

a) a circle b) a parabola

c) an ellipse d) a straight

11. The output current I versus time (t) curve of a full wave rectifier is shown in the figure. The average value of the output current in this case is **[1]**



a) I_m b) Zero

c) $\frac{2I_m}{\pi}$ d) $\frac{I_m}{\pi}$

12. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will: **[1]**

a) Become zero b) Become infinite

c) Remain same as in air d) Reduce

13. **Assertion (A):** Photoelectric process is instantaneous process. **[1]**

Reason (R): When photons of energy (hv) greater than work function of metal (ϕ_0) are incident on a metal, the electrons from metal are emitted with no time lag.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

14. **Assertion (A):** A capacitor can be given only a limited amount of charge. **[1]**

Reason (R): After a limited value of charge, the dielectric strength of dielectric between the capacitor plates breaks down.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

15. **Assertion (A):** Skiers use air glasses. **[1]**

Reason (R): Light reflected by snow is partially polarised.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

16. **Assertion (A):** Series L-C-R circuit is a **voltage magnifier**. **[1]**

Reason (R): In series L-C-R circuit at resonance voltage drop across inductance ((or capacitance) is Q (quality factor) times the applied voltage.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

Section B

17. The magnetic field in a plane electromagnetic wave is given by $B_y = 12 \times 10^{-8} \sin (1.20 \times 10^7 z + 3.60 \times 10^{15} t)$. Calculate the **[2]**

i. Energy density associated with the Electromagnetic waves
ii. Speed of the wave.

18. The hysteresis loss for a specimen of iron weighing 12 kg is equivalent to 300 Jm^{-3} $cycle^{-1}$. Find the loss of energy per hour at 50 cycle s^{-1}. Density of iron is 7500 kg m^{-3}. **[2]**

OR

An iron sample having mass 8.4 kg is repeatedly taken over cycles of magnetisation and demagnetisation at a frequency of 50 cycles s^{-1}. It is found that 3.2×10^4 J of energy is dissipated as heat in the sample in 30 minutes. Find the energy dissipated per unit volume per cycle in the iron sample. Density of iron = 7200 kg m^{-3}.

19. A semiconductor has the electron concentration of 8×10^{13} cm^{-3} and hole concentration of 4×10^{13} cm^{-3}. Is the semiconductor p-type or n-type? Also calculate the resistivity of this semiconductor. Given electron mobility = 24,000 cm^2 V^{-1} s^{-1} and hole mobility = 200 cm^2 V^{-1} s^{-1}. **[2]**

20. a. Differentiate between **impact parameter** and **distance of closest approach** in alpha particle scattering **[2]**

experiment. Identify, situations when impact parameter is (i) minimum, and (ii) very large.

b. An electron cannot revolve around the nucleus in a hydrogen atom at an arbitrary distance. Explain.

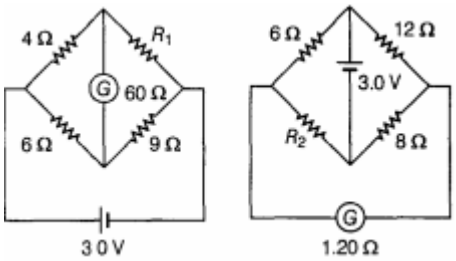
21. State the condition under which a charged particle moving with velocity v goes undeflected in a magnetic field B. **[2]**

Section C

22. Define the current sensitivity of a galvanometer. Write its SI unit. **[3]**

Figure shows two circuits each having a galvanometer and a battery of 3 V.

When the galvanometer in each arrangement do not show any deflection, obtain the ratio R_1/R_2.



23. The maximum kinetic energy of the photoelectrons emitted is doubled when the wavelength of light incident on the photosensitive surface changes from λ_1 to λ_2. Deduce expressions for the threshold wavelength and work function for the metal surface in terms of λ_1 and λ_2. **[3]**

24. Draw the energy band diagram of a p-type semiconductor. Deduce an expression for the conductivity of a p-type semiconductor. **[3]**

25. Distinguish between nuclear fission and fusion. Show how in both these processes energy is released. Calculate the energy release in MeV in the deuterium-tritium fusion reaction: ${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}_{0}n^{1}$ **[3]**

Using the data:

$m\left({}^{2}_{1}H\right)$ = 2.014102 u

$m\left({}^{3}_{1}H\right)$ = 3.016049 u

$m\left({}^{4}_{2}He\right)$ = = 4.002603 u

m_n = 1.008665 u

1amu = 931.5 $\frac{MeV}{c^2}$

26. It is found experimentally that 13.6 eV energy is required to separate a hydrogen atom into a proton and an electron. Compute the orbital radius and the velocity of the electron in a hydrogen atom. **[3]**

27. In a diffraction pattern due to a single slit, how will the angular width of central maximum change, if **[3]**

a. Orange light is used in place of green light,

b. the screen is moved closer to the slit,

c. the slit width is decreased?

Justify your answer in each case.

28. A metallic rod of length l and resistance R is rotated with a frequency ν, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius l, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere. **[3]**

i. Derive the expression for the induced emf and the current in the rod.

ii. Due to the presence of the current in the rod and of the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.

iii. Hence obtain the expression for the power required to rotate the rod.

OR

i. Define the term self-inductance and write its S.I. unit.

ii. Obtain the expression for the mutual inductance of two long co-axial solenoids S_1 and S_2 wound one over the other, each of length L and radii r_1 and r_2 and n_1 and n_2 number of turns per unit length, when a current I is set up in the outer solenoid S_2.

Section D

29. **Read the text carefully and answer the questions:** **[4]**

In an electromagnetic wave both the electric and magnetic fields are perpendicular to the direction of propagation, that is why electromagnetic waves are transverse in nature. Electromagnetic waves carry energy as they travel through space and this energy is shared equally by the electric and magnetic fields. Energy density of an electromagnetic waves is the energy in unit volume of the space through which the wave travels.

(a) The electromagnetic waves propagated perpendicular to both $\vec{E}$ and $\vec{B}$. The electromagnetic waves travel in the direction of

a) $\vec{E} \cdot \vec{B}$ b) $\vec{B} \times \vec{E}$

c) $\vec{B} \cdot \vec{E}$ d) $\vec{E} \times \vec{B}$

(b) Fundamental particle in an electromagnetic wave is

a) proton b) photon

c) phonon d) electron

(c) Electromagnetic waves are transverse in nature is evident by

a) polarisation b) diffraction

c) reflection d) interference

OR

For a wave propagating in a medium, Name the property that is independent of the others.

a) wavelength b) all these depend on each other

c) velocity d) frequency

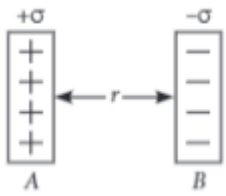
(d) The electric and magnetic fields of an electromagnetic waves are

a) in phase and parallel to each other. b) in phase and perpendicular to each other

c) in opposite phase and parallel to each other d) in opposite phase and perpendicular to each other

30. Surface charge density is defined as charge per unit surface area of surface charge distribution. i.e., $\sigma = \frac{dq}{dS}$. **[4]**

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 17.0×10^{-22} Cm^{-2} as shown. The intensity of electric field at a point is E = $\frac{\sigma}{\varepsilon_0}$, where ε_0 = permittivity of free space.



i. What is E in the outer region of the first plate?

ii. What is E in the outer region of the second plate?

iii. What is E between the plates?

iv. What is the ratio of E from right side of B at distances 2 cm and 4 cm?

v. In order to estimate the electric field due to a thin finite plane metal plate, What is the shape of the Gaussian surface?

Section E

31. a. With the help of a labelled ray diagram, explain the construction and working of a Cassegrain reflecting telescope. **[5]**

b. An amateur astronomer wishes to estimate roughly the size of the Sun using his crude telescope consisting of an objective lens of focal length 200 cm and an eyepiece of focal length 10 cm. By adjusting the distance of the eyepiece from the objective, he obtains an image of the Sun on a screen 40 cm behind the eyepiece. The diameter of the Sun's image is measured to be 6.0 cm. Estimate the Sun's size, given that the average Earth-Sun distance is 1.5×10^{11} m.

OR

a. Sketch the refracted wavefront for the incident plane wavefront of light from a distant object passing through a convex lens.

b. Using Huygens' principle, verify the laws of refraction when light from a denser medium is incident on a rarer medium.

c. For yellow light of wavelength 590 nm incident on a glass slab, the refractive index of glass is 1.5. Estimate the speed and wavelength of yellow light inside the glass slab.

32. Derive an expression for the electric potential at a point due to an electric dipole. Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge. **[5]**

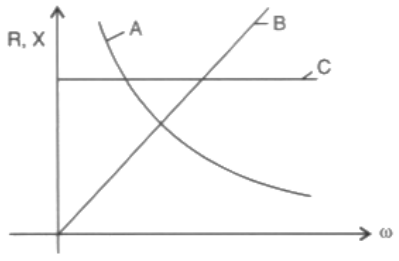
OR

Derive an expression for equivalent capacitance of three capacitors when connected

i. in series and

ii. in parallel.

33. i. The figure shows the variation of resistance and reactance versus angular frequency. Identify the curve which corresponds to inductive reactance and resistance. **[5]**



ii. Show that series LCR circuit at resonance behaves as a purely resistive circuit. Compare the phase relation between current and voltage in series LCR circuit for (i) $X_L > X_C$, (ii) $X_L = X_C$ using phasor diagrams.

iii. What is an acceptor circuit and where it is used?

OR

i. Draw a labelled diagram of a step-up transformer and describe its working principle. Explain any three causes for energy losses in a real transformer.

ii. A step-up transformer converts a low voltage into high voltage. Does it violate the principle of conservation of energy? Explain.

iii. A step-up transformer has 200 and 3000 turns in its primary and secondary coils respectively. The input voltage given to the primary coil is 90 V. Calculate:

1. The output voltage across the secondary coil
2. The current in the primary coil if the current in the secondary coil is 2.0 A.