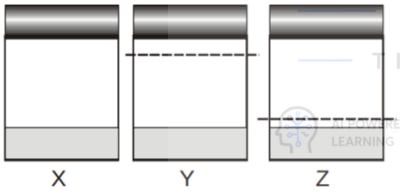
Class XII | Session 2026-27
Subject - Physics
Sample Question Paper - Set 8

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 energy band diagrams for three semiconductor samples of silicon are as shown. We can then assert that **[1]**



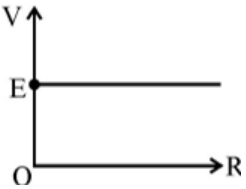
a) Sample X has been doped with equal amounts of third and fifth group impurities while samples Y and Z are undoped

b) Sample X is undoped while both samples Y and Z have been doped with a fifth group impurity

c) Sample X is undoped while samples Y and Z have been doped with a third group and fifth group impurity respectively

d) Sample X is undoped while samples Y and Z have been doped with a fifth group and a third group impurity respectively

2. A cell of emf (E) and internal resistance r is connected across a variable external resistance R. The graph of terminal potential difference V as a function of R is- **[1]**

a)


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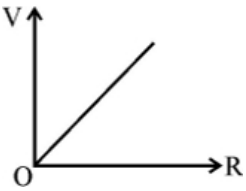
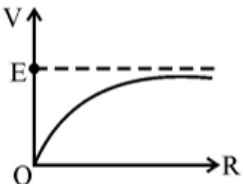
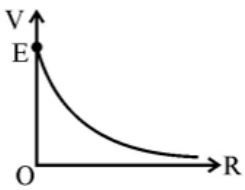


c) 

d) 

3. The focal length of a concave mirror is f. An object is placed at a distance x from the focus. The magnification is **[1]**

a) $\frac{f}{x}$

b) $\frac{f}{(f+x)}$

c) $\frac{x}{f}$

d) $\frac{(f+x)}{f}$

4. The arrangement fo two magnetic poles of equal and opposite strengths separated by a finite distance is called: **[1]**

a) Magnetic dipole

b) Magnetic current

c) Magnetic pole

d) Magnetic field

5. A long, hollow conducting cylinder is kept co-axially inside another long, hollow conducting cylinder of a larger radius. Both the cylinders are initially electrically neutral. **[1]**

Which of the following statements is correct based on the above-mentioned condition?

a) No potential difference appears between the two cylinders when a uniform line charge is kept along the axis of the cylinders.

b) No potential difference appears between the two cylinders when same charge density is given to both the cylinders.

c) A potential difference appears between the two cylinders when inner cylinder is charged.

d) A potential difference appears between the two cylinders when a charge density is given to the outer cylinder.

6. A tape-recorder records sound in the form of **[1]**

a) the magnetic field on the tape

b) electrical energy

c) magnetic energy

d) variable resistance on the tape

7. The electric fan works on the principle of : **[1]**

a) Electric motor

b) Both electric motor and dynamo

c) Electric mechanism

d) Electric dynamo

8. How does the magnetic susceptibility χ of a paramagnetic material change with absolute temperature T? **[1]**

a) $\chi \propto e^T$

b) $\chi \propto T$

c) $\chi \propto T^{-1}$

d) χ = constant

9. Interference is possible in **[1]**

a) neither light nor sound waves

b) both light and sound waves

c) sound waves only

d) light waves only

10. Out of the following which one is not a property of field lines: **[1]**

a) They form closed loops

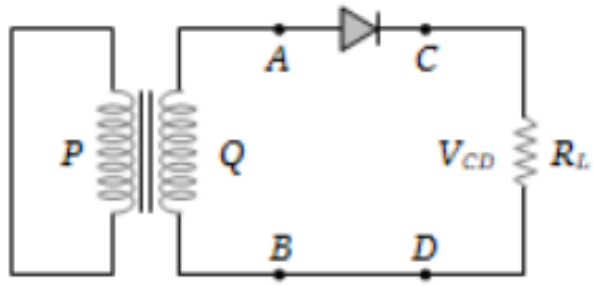
b) Field lines are continuous curves without any breaks

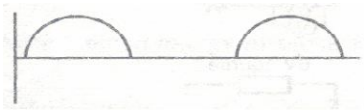
c) Two field lines cannot cross each other

d) Field lines start at positive charges and end at negative charges

[1]

11. 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?



a) 

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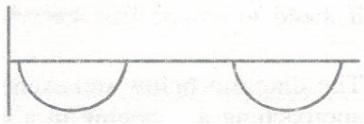
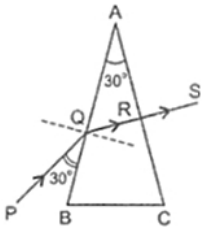
c) 

d) 

12. In the diagram, a prism of angle 30° is used. A ray PQ is incident as shown. An emergent ray RS emerges perpendicular to the second face. The angle of deviation is: **[1]**



a) 60^o

b) 0^o

c) 45^o

d) 30^o

13. **Assertion (A):** In the process of photoelectric emission, all emitted electrons have the same kinetic energy. **[1]**
Reason (R): According to Einstein's equation $E_k = hv - \phi_0$.

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):** If the distance between parallel plates a capacitor is halved and dielectric constant is made three times then the capacitance becomes six times. **[1]**
Reason (R): Capacitance of the capacitor does not depend upon the nature of the material of the plates of the capacitor.

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):** Young's double slit experiment can be performed using a source of white light. **[1]**
Reason (R): The wavelength of red light is less than the wavelength of other colours in white light.

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 and R is also false

16. **Assertion (A):** If the frequency of the applied AC is doubled, then the power factor of a series R-L circuit decreases. **[1]**

Reason (R): Power factor of series R-L circuit is given by $\cos\phi = \frac{2R}{R^2+\omega^2L^2}$.

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. A plane electromagnetic wave is moving along x-direction. The frequency of the wave is 10^{15} Hz and the electric field at any point is varying sinu-soidally with time with an amplitude of 2 Vm^{-1}. Calculate the average densities of the electric and magnetic fields. **[2]**

18. A magnetic dipole is placed in the position of stable equilibrium in a uniform electric field B. **[2]**

i. How much is the potential energy of the magnet?

ii. If it is rotated through 180°, then what will be the amount of work done?

OR

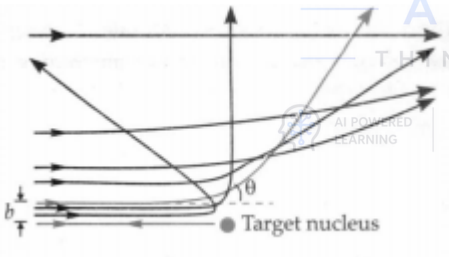
An iron ring of mean circumferential length 30 cm and cross-section 1 cm^2 is wound uniformly with 300 turns of wire. When a current of 0.032 A flows in the windings; the flux in the ring is 2×10^{-6} Wb. Find the flux density in the ring, magnetising field intensity and relative permeability of iron.

19. A semiconductor is known to have an electron concentration of 8×10^{13} per cm^3 and a hole concentration of 5×10^{12} per cm^3, **[2]**

i. Is the semiconductor n-type or p-type?

ii. What is the resistivity of the sample if the electron mobility is 23,000 cm^2 / Vs and hole mobility is 100 cm^2/ Vs?

20. The trajectories, traced by different α-particles, in Geiger-Marsden experiment were observed as shown in Fig. **[2]**



What names are given to the symbols **b** and θ shown here?

What can we say about the values of b for (i) θ = **0°** and (ii) $\theta \simeq \pi$ radians?

21. How is the equation for Ampere's circuital law modified in the presence of displacement current? Explain. **[2]**

Section C

22. A student connects a cell, of emf ε_2 and internal resistance r_2 with a cell of emf ε_1 and internal resistance r_1, such that their combination has a net internal resistance less than r_1. This combination is then connected across a resistance R. **[3]**

Draw a diagram of the 'set-up' and obtain an expression for the current flowing through the resistance.

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. With the help of a suitable diagram, explain the formation of depletion region and potential barrier in a p-n junction. How does its width change when the junction is **[3]**

i. forward biased and

ii. reverse biased?

25. Draw a plot of potential energy of a pair of nucleons as a function of their separations. Mark the regions where the nuclear force is **[3]**

i. attractive and

ii. repulsive.

Write any two characteristic features of nuclear forces.

26. Hydrogen atom in its ground state is excited by means of monochromatic radiation of wavelength $975\overset{o}{A}$. **[3]**

i. How many different lines are possible in the resulting spectrum?

ii. Calculate the longest wavelength amongst them. You may assume the ionization energy for hydrogen atom as 13.6 eV.

27. For sound waves, the Doppler formula for frequency shift differs slightly between the two situations: **[3]**

a. source at rest; observer moving, and

b. source moving; observer at rest.

The exact Doppler formulas for the case of light waves in vacuum are, however, strictly identical for these situations. Explain why this should be so. Would you expect the formulas to be strictly identical for the two situations in case of light travelling in a medium?

28. Define the term self-inductance of a solenoid. Obtain the expression for the magnetic energy stored in an inductor of self-inductance L to build up a current I through it. **[3]**

OR

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.

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.

Section D

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

Microwave oven: The spectrum of electromagnetic radiation contains a part known as microwaves. These waves have frequency and energy smaller than visible light and wavelength larger than it. What is the principle of a microwave oven and how does it work? Our objective is to cook food or warm it up. All food items such as fruit, vegetables, meat, cereals, etc., contain water as a constituent. Now, what does it mean when we say that a certain object has become warmer? When the temperature of a body rises, the energy of the random motion of atoms and molecules increases and the molecules travel or vibrate or rotate with higher energies. The frequency of rotation of water molecules is about 2.45 gigahertz (GHz). If water receives microwaves of this frequency, its molecules absorb this radiation, which is equivalent to heating up water. These molecules share this energy with neighbouring food molecules, heating up the food. One should use porcelain vessels and non-metal containers in

a microwave oven because of the danger of getting a shock from accumulated electric charges. Metals may also melt from heating. The porcelain container remains unaffected and cool, because its large molecules vibrate and rotate with much smaller frequencies, and thus cannot absorb microwaves. Hence, they do not get eaten up. Thus, the basic principle of a microwave oven is to generate microwave radiation of appropriate frequency in the working space of the oven where we keep food. This way energy is not wasted in heating up the vessel. In the conventional heating method, the vessel on the burner gets heated first and then the food inside gets heated because of transfer of energy from the vessel. In the microwave oven, on the other hand, energy is directly delivered to water molecules which is shared by the entire food.

(a) As compared to visible light microwave has frequency and energy

a) Frequency is less but energy is more
b) more than visible light
c) less than visible light
d) equal to visible light

(b) When the temperature of a body rises

a) the energy of the random motion of atoms and molecules remains same.
b) the energy of the random motion of atoms and molecules decreases.
c) the random motion of atoms and molecules becomes streamlined.
d) the energy of the random motion of atoms and molecules increases

(c) The frequency of rotation of water molecules is about

a) 2.45 kHz
b) 2.45 GHz
c) 2.45 MHz
d) 2.45 THz

OR

In the microwave oven

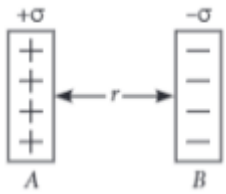
a) The vessel gets heated first, and then the food grains inside
b) The vessel gets heated first and then the water molecules collect heat from the body of the vessel
c) Energy is directly delivered to the food grains.
d) Energy is directly delivered to water molecules which is shared by the entire food

(d) Why should one use porcelain vessels and non-metal containers in a microwave oven?

a) Because it will prevent the food items to become hot
b) Because it may crack due to high frequency
c) Because of the danger of getting a shock from accumulated electric charges
d) Because it will get too much hot

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. i. Draw a ray diagram to show the working of a compound microscope. Obtain the expression for the total magnification for the final image to be formed at the near point. **[5]**

ii. In a compound microscope an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye-piece has a focal length of 5 cm and the final image is formed at the near point, find the magnifying power of the microscope.

OR

a. Derive the relation a sin $\theta = \lambda$ for the first minimum of the diffraction pattern produced due to a single slit of width **a** using light of wavelength λ.

b. State with reason, how the linear width of central maximum will be affected if (i) monochromatic yellow light is replaced with red light, and (ii) distance between the slit and the screen is increased.

c. Using the monochromatic light of same wavelength in the experimental set-up of the diffraction pattern as well as in the interference pattern where the slit separation is 1 mm, 10 interference fringes are found to be within the central maximum of the diffraction pattern. Determine the width of the single slit, if the screen is kept at the same distance from the slit in the two cases.

32. Calculate potential on the axis of a disc of radius R due to a charge Q uniformly distributed on its surface. **[5]**

OR

a. Describe briefly the process of transferring the charge between the two plates of a parallel plate capacitor when connected to a battery. Derive an expression for the energy stored in a capacitor.

b. A parallel plate capacitor is charged by a battery to a potential difference V. It is disconnected from the battery and then connected to another uncharged capacitor of the same capacitance. Calculate the ratio of the energy stored in the combination to the initial energy on the single capacitor.

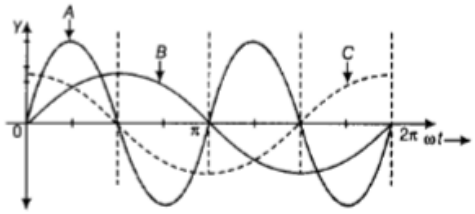
33. i. An ac source generating a voltage V = V_0 sin ωt is connected to a capacitor of capacitance C. Find the expression of the current I flowing through it. Plot a graph of V and I versus ωt to show that the current is $\frac{\pi}{2}$ ahead of the voltage. **[5]**

ii. A resistor of 200 Ω and a capacitor of 15 μF are connected in series to a 220 V, 50 Hz ac source. Calculate the current in the circuit and the rms voltage across the resistor and the capacitor. Why the algebraic sum of these voltages is more than the source voltage?

OR

A device X is connected to an AC source, V = V_0 sin ωt. The variation of voltage, current and power in one cycle is

shown in the following graph.



i. Identify the device X.

ii. Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit? Justify the answer.

iii. How does its impedance vary with the frequency of the AC source? Show graphically.

iv. Obtain an expression for the current in the circuit and its phase relation with AC voltage.