Class XII | Session 2026-27
Subject - Physics
Sample Question Paper - Set 10

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.

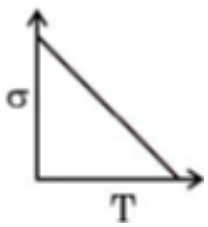
Section A

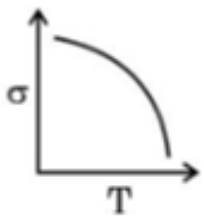
1. If N is Avogadro number, M is atomic weight and ρ, the density, the number of free electrons per unit volume of a monovalent metallic crystal can be expressed as **[1]**

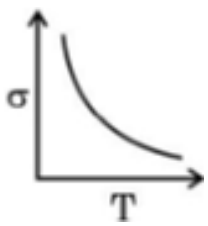
   a) $\frac{N}{\mu M}$ b) $\frac{\rho N}{M}$

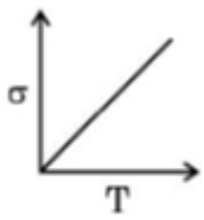
   c) $\frac{MN}{\rho}$ d) $\frac{\rho M}{N}$

2. Which one of the following is the correct representation of variation of conductivity of a conductor with temperature? **[1]**

   a) 

   b) 

   c) 

   d) 

3. The principal behind optical fibre is: **[1]**

a) Total internal reflection

b) Both Total external reflection and Total internal reflection

c) Diffraction

d) Total external reflection

4. A bar magnet of pole strength (m) and magnetic moment (M) is cut perpendicular to its axis in two equal halves. The new pole strength (m') and magnetic moment (M') of each part are respectively: **[1]**

a) m and $\frac{M}{2}$

b) m and M

c) 2m and $\frac{M}{2}$

d) $\frac{m}{2}$ and 2M

5. Two charges $3 \times 10^{-8}C$ and $-2 \times 10^{-8}C$ are located 15 cm apart. At what point on the line joining them, the potential will be zero. **[1]**

a) 3 cm from first charge

b) 9 cm from first charge

c) None of these

d) 6 cm from first charge

6. The Magnetic Resonance Imaging (MRI) is based on the phenomenon of **[1]**

a) Nuclear magnetic resonance

b) Electron paramagnetic resonance

c) Electron spin resonance

d) Diamagnetism of human tissues

7. Two identical circular coaxial coils A and B, arranged in vertical planes parallel to each other, carry currents in the same direction. If the distance between the coils is decreased at a constant rate, the current: **[1]**

a) increases in both A and B.

b) increases in A and decreases in B.

c) decreases in both A and B.

d) remains same in both A and B.

8. At a point on the right bisector of a magnetic dipole, the magnetic: **[1]**

a) field is perpendicular to the axis of dipole

b) potential is zero at all points on the right bisector

c) potential varies as $\frac{1}{r^2}$

d) field varies as r^3

9. If two sources have a randomly varying phase different ϕ(t), the resultant intensity will be given by **[1]**

a) 2 I_0

b) $\frac{3}{2}I_0$

c) $\frac{I_0}{2}$

d) $\frac{I_0}{\sqrt{2}}$

10. The number of electric field lines crossing an area ΔS is n_1 when $\Delta\vec{S}||\vec{E}$, while number of field lines crossing same area is n_2 when $\Delta\vec{S}$ makes an angle of 30° with $\vec{E}$, then: **[1]**

a) $n_1 < n_2$

b) $n_1 = n_2$

c) $n_1 > n_2$

d) cannot say anything.

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]**

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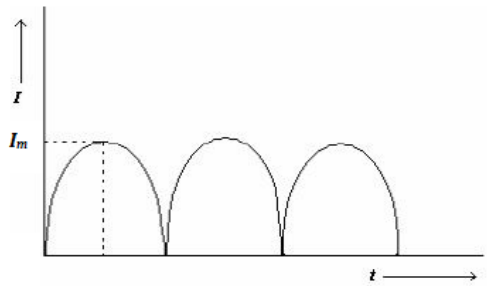


a) I_m b) Zero

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

12. Which of the following pairs of media has the least value of critical angle? **[1]**

a) Glass to air b) Glass to water

c) Diamond to water d) Diamond to air

13. **Assertion (A):** In his study of photoelectric emission, Hallwachs connected a negatively charged zinc plate to an electroscope. He found that negatively charged particles were emitted from the zinc plate under the action of visible light. **[1]**

Reason (R): An uncharged zinc plate becomes positively charged when it is irradiated by visible 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 but R is true.

14. **Assertion:** 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) Assertion and reason both are correct statements and reason is correct explanation for assertion. b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement. d) Assertion is wrong statement but reason is correct statement.

15. **Assertion (A):** Interference pattern is made by using yellow light instead of red light, the fringes becomes narrower. **[1]**

Reason (R): In Young's double slit experiment, fringe width is given by $\beta = \frac{\lambda D}{d}$.

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):** In alternating current, the direction of motion of free electrons changes periodically. **[1]**

Reason (R): Alternating current changes its direction after a certain is always constant.

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

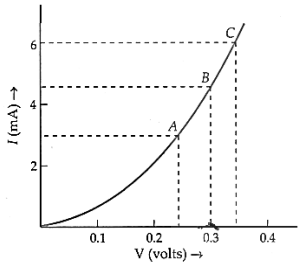
17. a. Which one of the following electromagnetic radiations has least frequency: **[2]**
UV radiations, X-rays, Microwaves?
b. How do you show that electromagnetic waves carry energy and momentum?
c. Write the expression for the energy density of an electromagnetic wave propagating in free space.

18. Two equal and unlike poles placed 5 cm apart in the air attract each other with a force of 14.4×10^{-4} N. How far from each other should they be placed so that the force of attraction will be 1.6×10^{-4} N? **[2]**

OR

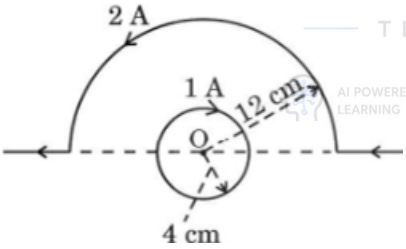
A short bar magnet placed in a horizontal plane has its axis aligned along the magnetic north-south direction. Null points are found on the axis of the magnet at 14 cm from the centre of the magnet. The earth's magnetic field at the place is 0.36 G and the angle of dip is zero. What is the total magnetic field on the normal bisector of the magnet at the same distance as the null–point (i.e., 14 cm) from the centre of the magnet? (At null points, field due to a magnet is equal and opposite to the horizontal component of earth's magnetic field.)

19. The figure shows the characteristic curve of a junction diode. Determine the d.c. and a.c. resistance of the diode, when it operates at 0.3 V. **[2]**



20. 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]**

21. A current carrying circular loop and a straight wire bent partly in the form of a semicircle are placed as shown in the figure. Find the magnitude and direction of net magnetic field at point O. **[2]**



Section C

22. A conductor of length I is connected to a DC source of potential V. If the length of the conductor is tripled by gradually stretching it, keeping V constant, how will **[3]**
i. drift speed of electrons and
ii. resistance of the conductor be affected? Justify your answer

23. a. State briefly, with what purpose was Davisson and Germer experiment performed and what inference was drawn from this. **[3]**
b. Obtain an expression for the ratio of the accelerating potentials required to accelerate a proton and an α-particle to have the same de-Broglie wavelength associated with them.

24. How is a light emitting diode fabricated? Briefly explain the basic processes involved in the emission of spontaneous radiation from it. Write two advantages of LED lamps over the incandescent low power lamps. **[3]**

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25. Plot a graph showing the variation of binding energy per nucleon as a function of mass number. Which property of nuclear force explains the approximate constancy of binding energy in the range $30 < A < 170$? **[3]**

How does one explain the release of energy in both processes of nuclear fission and fusion from the graph?

26. An electron in a hydrogen atom makes transitions from orbits of higher energies to orbits of lower energies. **[3]**

a. When will such transitions result in (a) Lyman (b) Balmer series?

b. Find the ratio of the longest wavelength in Lyman series to the shortest wavelength in Balmer series.

27. A plane wavefront is propagating from a rarer into a denser medium. Use Huygens principle to show the refracted wavefront and verify Snell's law. **[3]**

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

Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of the same length wound one over the other.

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?

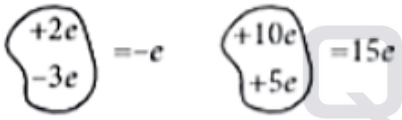
a) Because it will prevent the food items to become hot

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. The smallest charge that can exist in nature is the charge of an electron. During friction, it is only the transfer of electrons that makes the body charged. Hence net charge on anybody is an integral multiple of the charge of an electron [1.6×10^{-19} C] i.e. **[4]**



$q = \pm ne$

where n = 1, 2, 3, 4,...

Hence nobody can have a charge represented as 1.1e, 2.7e, $\frac{3}{5}$e, etc.

Recently, it has been discovered that elementary particles such as protons or neutrons are composed of more elemental units called quarks.

i. Find the number of electrons if the body has 3.2×10^{-18} C of charge.

ii. If a charge on a body is 1 nC, then how many electrons are present on the body?

iii. If a body gives out 10^9 electrons every second, how much time is required to get a total charge of 1 C from it?

iv. A polythene piece rubbed with wool is found to have a negative charge of 3.2×10^{-7} C. Calculate the number of electrons transferred.

Section E

31. a. Draw a ray diagram for formation of a real and diminished image of an object kept in front of a concave mirror. Hence derive the mirror equation. **[5]**

b. A concave mirror of focal length 10 cm produces a real image which is 3 times the size of the object. Find the distance of the object from the mirror.

OR

i. Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light. Hence, obtain the conditions for the angular width of secondary maxima and secondary minima.

ii. Two wavelengths of sodium light of 590 nm and 596 nm are used in turn to study the diffraction taking place at a single slit of aperture $2 \times 10^{-6} m$. The distance between the slit and the screen is 1.5m. Calculate the separation between the positions of first maxima of the diffraction pattern obtained in the two cases.

32. A capacitor of capacitance C_1 is charged to a potential V_1 while another capacitor of capacitance C_2 is charged to a potential difference V_2. The capacitors are now disconnected from their respective charging batteries and connected in parallel to each other. **[5]**

i. Find the total energy stored in the two capacitors before they are connected.

ii. Find the total energy stored in the parallel combination of two capacitors.

iii. Explain the reason for the difference of energy in parallel combination in comparison to the total energy before they are connected

OR

a. If two similar large plates, each of area A having surface charge densities $+\sigma$ and $-\sigma$ are separated by a distance d in air, then find the expression for

i. the field at points between the two plates and on the outer side of the plates. Specify the direction of the field in each case.

ii. the potential difference between the plates.

iii. the capacitance of the capacitor so formed.

b. Two metallic spheres of radii R and 2R are charged so that both of these have the same surface charge density σ. If they are connected to each other with a conducting wire, in which direction will the charge flow and why?

33. An emf ε = 100 sin 314 t is applied across a pure capacitor of 637 μF. Find **[5]**

i. the instantaneous current I

ii. instantaneous power P

iii. the frequency of power and

iv. the maximum energy stored in the capacitor.

OR

i. An ac source of voltage $V = V_0 \sin \omega t$ is connected to a series combination of L, C, and R. Use the phasor diagram to obtain expressions for impedance of the circuit and phase angle between voltage and current. Find the condition when the current will be in phase with the voltage. What is the circuit in this condition called?

ii. In a series, LR circuit $X_L = R$ and power factor of the circuit is P_1. When capacitor with capacitance C such that $X_L = X_C$ is put in series, the power factor becomes P_2. Calculate $\frac{P_1}{P_2}$.

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