CBSE Board
Class XII Physics
Sample Paper - 3

Time: Three Hours **Maximum Marks: 70**

General Instructions

(a) All questions are compulsory.

(b) There are 29 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 16 carry two marks each, questions 17 to 25 carry three marks each and questions 27 to 29 carry five marks each.

(c) Question 26 is a value based question carrying four marks.

(d) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the given choices in such questions.

(e) Use of calculator is not permitted.

(f) You may use the following physical constants wherever necessary.

$e = 1.6 \times 10^{-19}$ C
$c = 3 \times 10^{8}$ m s^{-1}
$h = 6.6 \times 10^{-34}$ J s
$\mu_o = 4\pi \times 10^{-7}$ T ma^{-1}
$K_B = 1.38 \times 10^{23}$ J K^{-1}
$N_A = 6.023 \times 10^{23}$ /mole
$m_n = 1.6 \times 10^{-27}$ kg

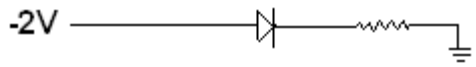
---

1. Is the force acting between two point electric charges q_1 and q_2 kept at some distance apart in air, attractive or repulsive when (i) $q_1q_2 > 0$ (ii) $q_1q_2 < 0$? (1)

2. On a graph show the stopping potential for a given photosensitive surface varying with the frequencies n_1 and n_2 of incident radiations where $n_1 > n_2$. Given that intensity is same for both light radiations. (1)

3. A message signal of frequency 10 kHz is used to modulate a carrier of frequency 1 MHz. Find the side bands produced. (1)

4. Is the diode in the following circuit forward biased or reverse biased? Give reason for your answer.



(1)

5. What is the frequency range of signals that are transmitted using optical fibres? (1)

6. A spherical Gaussian surface encloses charges q_1 and q_2 with
$q_1 = 8.85\times10^{-6}C$ and $q_2 = -8.85\times10^{-6}C$

(i) Calculate the electric flux passing through the surface.

(ii) How would the flux change if the spherical Gaussian surface is replaced with a cubical Gaussian surface and why? (1)

7. For a given thermocouple, the emf generated across its ends is given by $E = at + bt^2$ where t in °C is the temperature of the hot junction, the cold junction being at 0 °C. If a = 10 mV /°C and b = -0.02 mV/°C^2, calculate the value of inversion temperature in °C. (1)

8. A 3.0 V battery is connected to an ammeter and a resistor of 3 ohms in series with it. What is the value of the current if the ammeter used is a galvanometer with a resistance of 60 ohm? (1)

9. An electric bulb B and a parallel plate capacitor C are connected in series to the a.c. mains. The bulb glows with some brightness. How will the glow of the bulb be affected on introducing a dielectric slab between the plates of the capacitor? Give reasons in support of your answer. (2)

10. Discuss the intensity of transmitted light when a Polaroid sheet is rotated between two crossed Polaroids. (2)

11. Why is NAND gate called a universal gate. How can it to be used to realize a basic OR gate? (2)

12. What is modulation? What are the different types of modulation? (2)

13. Nuclear density of hydrogen is $2.3\text{x}10^{17}$ kg/ m^3. Given A = 56 for iron, find its nuclear density. (2)

14. Distinguish between frequency modulation and amplitude modulation. (2)

15. State Ampere's circuital law. Write the expression for the magnetic field at the centre of a circular coil of radius R carrying a current I. Draw the magnetic field lines due to this coil. (2)

OR

15.0 μF capacitor is connected to a 220V, 50Hz source. Find the capacitive reactance and the rms current in the circuit. If the frequency is doubled, what happens to the capacitive reactance and the current? (2)

16. Write the expression for the force acting on a charged particle of charge q moving with velocity **v** in the presence of a magnetic field **B**.
Show that in the presence of this force
(i) the kinetic energy of the particle does not change.
(ii) its instantaneous power is zero. (2)

17. In Young's double slit experiment using monochromatic light of wavelength λ, the intensity at a point on the screen where path difference is λ, is K units. What is the intensity of light at a point where path difference is λ/3? (3)

18. An electron, α-particle and a proton have the same de-Broglie wavelength. Which of these particles has (i) minimum kinetic energy, (ii) maximum kinetic energy, and why? (3)

19. State the law of radioactive decay. Establish a mathematical relation between half-life period and disintegration constant of a radioactive nucleus. (3)

20. In the fusion reaction $_1H^2 + _1H^2 \text{ ---------> } _2He^3 + _0n^1$, the masses of deuteron, helium and neutron expressed in amu are 2.015, 3.017 and 1.009 respectively. If 1 kg deuterium undergoes complete fusion, find the amount of total energy released. (3)

21. We do not choose to transmit an audio signal by just directly converting it to an e.m. wave of the same frequency. Give three reasons for the same. (3)

22. A parallel plate capacitor is charged to potential V by a source of emf E. After removing the source, the separation between the plates is doubled.
How will the following change:

(i) electric field,
(ii) potential difference, and
(iii) capacitance of the capacitor? Justify your answers. (3)

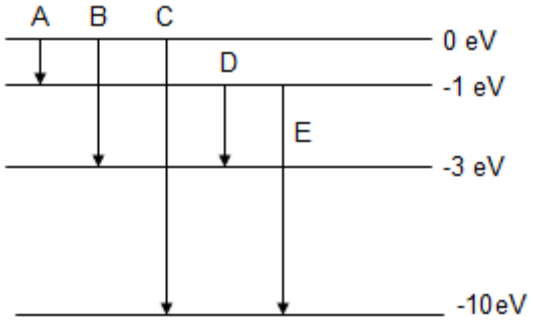
23. For a transistor, the current amplification factor is 0.8 when the transistor is connected in common emitter configuration. Calculate the change in the collector current when the base current changes by 6 mA. (3)

OR

How many electrons should be removed from a coin of mass 3.2 g, so that it just float in an electric field of intensity 10^{10} NC^{-1}, directed upward. (3)

24. When a transistor amplifier of current gain of 75 is given an input signal, $V_i = 2 \sin (157t + \pi/2)$, the output signal is found to be $V_0 = 200 \sin (157t + 3\pi/2)$.
In which mode is the transistor being used? Justify your result with proper explanation. (3)

25. The energy levels of an atom of element are shown in the following diagram. Which one of the level transitions will result in the emission of photons of wavelength 620 nm? Support your answer with mathematical calculations. (3)



26. One day Sita was coming back to home from school by her school bus. She saw a man was lying down at the road side and no one was there to help him. She thought it as the case of a major accident. She asked the driver to stop the bus and came out of the bus. She took the injured person to the nearest hospital taking help of a taxi. She sent the patient under treatment and for the condition analysis through X-ray etc. After his first aid, she called her parents and explained the entire situation. Her parents felt proud of Sita and her bravery. When the patient became conscious she took his parents contact number and called them to take care of the patient. The patient's parents thanked her and obliged her for the help.

(a) What are the values that are associated with Sita?
(b) What is an X-ray? How it is used in the medical field? (4)

27.

(a) Define the term dipole moment and its direction. State its SI unit. Deduce the expression for the torque acting on it.

(b) In a particular situation, it has its dipole moment aligned with the electric field. Is the equilibrium stable or unstable? (5 marks)

OR

A transistor is used in common emitter mode in an amplifier circuit. When a signal of 20 mV is added to the base-emitter voltage, the base current changes by 20 μA and the collector current changes by 2 mA. The load resistance is 5 $k\Omega$. Calculate (a) the factor β, (b) the input resistance R_{BE}, (c) the transconductance and (d) the voltage gain. (5)

28.

(a) State Lenz's law. Which conservation law can be used to explain this law?

(b) A wheel with 10 metallic spokes each 0.5m long is rotated with a speed of 120rev/min in a plane normal to the horizontal component of earth's magnetic field at a place where the earth's field is 0.4×10^{-4}G. What is the induced emf between the axle and the rim of the wheel?

(c) Two moving coil meters, M_1 and M_2 have the following particulars:

$R_1 = 10\ \Omega$, $N_1 = 30$,

$A_1 = 3.6 \times 10^{-3}\ m^2$, $B_1 = 0.25$ T

$R_2 = 14\ \Omega$, $N_2 = 42$

$A_2 = 1.8 \times 10^{-3}\ m^2$, $B_2 = 0.50$ T

(The spring constants are identical for the two meters). Determine the ratio of (a) current sensitivity and (b) voltage sensitivity of M_2 and M_1. (5)

OR

(a) An electron & a proton moving with the same speed enter a uniform magnetic field B perpendicularly. Which particle will have larger radius of its circular path? Find the ratio of their radii. The masses of electron & proton are 9.1×10^{-31} kg & 1.67×10^{-27} kg.

(b) Show that for a moving charged particle in a uniform magnetic field, the kinetic energy of the particle remains constant.

(c) A coil placed in the plane of the page has a current in the clockwise direction when looking from above. What will be the change in the magnetic field at the center of the coil if

(i) the current through the coil is reduced to half?

(ii) radius of the coil is doubled ?

(iii) what will be the direction of the magnetic field? (5 marks)

29.

(a) Derive an expression for the magnifying power of an astronomical telescope. Draw a ray diagram showing image formation in it.

(b) An astronomical telescope consists of two thin lens set 36cm apart and has a magnifying power 8. Calculate the focal length of the lens.

(c) A giant refracting telescope at an observatory has an objective lens of focal length 15 cm. If an eye-piece of focal length 1.0 cm is used, what is the angular magnification of the telescope? If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is 3.48×10^6 m, and the radius of lunar orbit is 3.8×10^8 m. (5)

OR

Prove that $\frac{-\mu_1}{u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$ when refraction occurs from rarer to denser medium at a convex refracting spherical surface.