Sample Paper-04
Physics (Theory)
Class – XI

Time allowed: 3 hours **Maximum Marks: 70**

General Instructions:

a) All the questions are compulsory.
b) There are **26** questions in total.
c) Questions **1** to **5** are very short answer type questions and carry **one** mark each.
d) Questions **6** to **10** carry **two** marks each.
e) Questions **11** to **22** carry **three** marks each.
f) Questions **23** is value based questions carry **four** marks.
g) Questions **24** to **26** carry **five** marks each.
h) 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 in five marks each. You have to attempt only one of the choices in such questions.
i) Use of calculators is **not** permitted. However, you may use log tables if necessary.
j) You may use the following values of physical constants wherever necessary:
k)

$c = 3x10^{8} m/s$

$h = 6.63x10^{-34} Js$

$e = 1.6x10^{-19} C$

$\mu_o = 4\pi x10^{-7} TmA^{-1}$

$\frac{1}{4\pi\varepsilon_0} = 9x10^{9} Nm^2C^{-2}$

$m_e = 9.1x10^{-31} kg$

1. Name the two pairs of physical quantities whose dimensions are same.
2. What is the apparent weight felt by a person in an elevator, when it is accelerating? (i) upward and (ii) downward
3. Justify: "When several passengers are standing in a moving bus, it is said to be dangerous."
4. What are the factors on which the degrees of freedom of gas depend?
5. What are the characteristics of elastic collision?
6. At what temperature will the average velocity of oxygen molecules be sufficient so as to escape from the earth?[Given: Escape velocity from the earth is 11.0 km/sec and the mass of one molecule of oxygen is 5.34 x 10^{-26} kg].
7. Write the expression for C_v and C_p of a gas in terms of gas constant R and constant γ where $\gamma = \frac{C_p}{C_v}$
8. On what factors do the critical velocity of the liquid depends?
9. What will be the magnitude and the direction of acceleration of the stone when a stone tied to the end of a string 80 cm long is whirled in a horizontal circle with a constant speed and if the stone makes 14 revolutions in 25 s?

10. Explain if angular momentum and rotational kinetic energy can be conserved in a system whose moment of inertia is decreased.
11. An enclosure of volume four litres contains a mixture of 8 g of oxygen 14 g of nitrogen and 22 g of carbon dioxide. If the temperature of the mixture is 27^0C, find the pressure of the mixture of gases. Given R = 8.315 J k^{-1} mol^{-1}
12. Justify the statement: "On the earth satellite, the ratio of its velocity at apogee to its velocity at perigee is equal to the inverse ratio of its distance from apogee and perigee".
13. Calculate the acceleration due to gravity at the surface of Mars if its diameter is 6760 km and mass one tenth that of the earth by assuming that the diameter of earth is 12742 km and acceleration due to gravity on the earth is 9.8 m/s^2.
14. A bird is sitting on the floor of a closed glass cage and the cage is in the hand of a girl. Will the girl experience any change in the weight of the cage when the bird (i) starts flying in the cage with a constant velocity (ii) flies upwards with acceleration (iii) flies downwards with acceleration?
15. Calculate the total number of air molecule in a room of capacity 25.0 m^3 at a temperature of 27^0 C and 1 atm pressure.
16. Under what conditions would your weight become zero?
17. What is the angle at which the two nuclei fly apart if a nucleus at rest is all of a sudden splits into two small nuclei?
18. Find how high will it rise and how much time will it take to return to its point of projection if a body is thrown up with a velocity of 748.4ms^{-1}?
19. How should one kg of water at 5^0C be so divided that one part of it when converted into ice at 0^0C would by this change of state provide a quantity of heat that would be sufficient to vaporize the other part?
20. A perfect Carnot engine utilizes an ideal gas. The source temperature is 500 K and sink temperature is 375 K. If the engine takes 600 kcal per cycle from the source, then calculate
    (a) The efficiency of the engine
    (b) Work done per cycle
    (c) Heat rejected to the sink per cycle
21. What is the frequency of a second pendulum in an elevator moving up with an acceleration of $\frac{g}{2}$?

Or

If a rocket moving at a speed of 200 m/s towards a stationary target emitting a wave of frequency 1000 Hz and some of the sound reaching the target gets reflected back to the rocket as an echo, then calculate
(a) The frequency of the sound detected by the target
(b) The frequency of the echo detected by the rocket

22. Calculate the minimum energy required to launch a 250 kg satellite from earth's surface at an altitude of 2R when r is the radius of the earth and is equal to 6400 km.
23. Vinita went to her grandfather's village for vacation. She saw a bullock cart got struck in wet mud and the driver was not able to push it out by himself. Vinita ran to his help and together they pushed it out, but the iron rim of the wheel came out. They tried to put it on the wheel but it was smaller than diameter of wheel. Suddenly she collected some wood and set them on fire and heated the rim and it slipped on the wheel.
    (a) What nature is shown by Vinita?
    (b) Name the property of solid used here?
    (c) To what temperature had Vinita heated the ring so as to fit the rim of the wheel if the diameter of the rim and ring were 6.243 m and 6.231 m respectively at 27^0C? [Coefficient of linear expansion of iron = 1.20 x 10^{-5} K^{-1}

24. Calculate the percentage increase in the length of a wire of diameter 2.5 mm stretched by a force of 100 kg f if Young's modulus Y for the wire = 12.5 x 10^{11} dyne cm^{-2}

Or

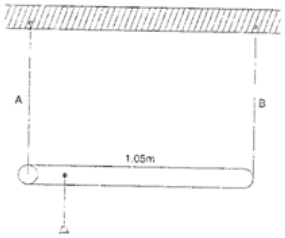
Water stands at a depth 'H' in a tank whose side walls are vertical. If a hole is made on one of the walls at a depth 'h' below the water surface, then find
(i) At what distance from the foot of the wall does the emerging stream of water strike the floor?
(ii) What value of h this range is maximum?

25. A cylindrical piece of work of density of base area 'A' and high 'h' floats in a liquid of density 'ρ'. If the cork is depressed slightly and then released, then show that the cork oscillates up and down simple harmonically with a period $T = 2\pi\sqrt{h\rho/\rho_1 g}$.

Or

Give the characteristic of stationery waves.

26. A rod of length 1.05 m having mass is supported at its ends by two wires of steel A and aluminium B of equal length having cross-sectional areas 1.0 mm^2 and 2.0 mm^2 respectively. At what point along the rod should a mass m be suspended in order to produce
(a) Equal stresses
(b) Equal strains in both steel and aluminium wires.



Or

Air is streaming past a horizontal air plane wing such that its speed is 120 ms^{-1} over the upper surface and 90 ms^{-1} at the lower surface. If the density of air is 1.3 kg m^{-3}, then
(a) Find the difference in pressure between the top and bottom of the wing.
(b) Calculate the gross lift of the wing if wing is 10 m long and has an average width of 2 m.