Sample Paper-02
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. Find the angular velocity of the hour hand of clock.
2. Write down the value of Stefan's constant in SI units if its value in CGS system is 5.67×10^{-5} erg s^{-1} cm^{-2} K^{-4}.
3. Give the unit and dimension of moment of inertia?
4. Why a man standing near the top of an old wooden step-ladder feels unstable?
5. What happens to the potential energy of the spring when it is compressed or stretched?
6. If breaking stress of steel = 8.0×10^{8} Nm^{-3}, density of steel = 8.0×10^{3} kg m^{-3} and g=10 ms^{-2}, find the greatest length of steel wire that can hang vertically without breaking.

Or

A steel wire 0.72 m long has a mass of 5.0×10^{-3}kg. If the wire is under a tension of 60 N, then what is the speed of the transverse waves on the wire?

7. What will be the ratio of the moments of masses if one of the mass is 'n' times as heavy as the other, have equal K.E?
8. A boy is swinging in the sitting position. How will the period of the swing be changed if he stands up?
9. If the mass of a box measured by a grocer's balance is 2.3 kg and two gold pieces of masses 20.15 g and 20.17 g are added to the box, then calculate
   (a) The total mass of the box.

(b) The difference in the masses of the pieces to correct significant figures.

10. What is the angle of projection at which the H_{max} and range are equal?
11. A Carnot engine whose heat sink is at 27^0C has an efficiency of 40%. By how many degrees should the temperature of source be changed to increase the efficiency by 10% of the original efficiency?

Or

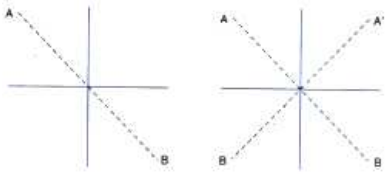
A flask contains argon and chlorine in the ratio 2:1 by mass. The temperature of the mixture is 27^0C. Obtain the ratio of

(i) Average K.E. per molecule

(ii) Root mean square speed v_{max} of the molecules of the two gases.

Given: Atomic mass of argon = 39.9 u; Molecular mass of chlorine = 70.9 u.

12. Find the pressure required to compress a gas adiabatically at atmospheric pressure to one fifth of its volume (Given: $\Upsilon = 1.4$)
13. If a block of mass M is placed on a frictionless, inclined plane of angle θ. Determine
    (a) The acceleration of the block after it is released
    (b) The force exerted by the incline on the block
14. Calculate the rms speed of oxygen molecules at 1092 K, if the density of oxygen at STP = 1.424 kg m^{-3}.
15. Find the centre of mass of the remaining disc, if a circular hole of radius 1 m is cut off from a disc of radius 6 m and the centre of the hole is 3 m from the centre of the disc.
16. If a block of mass 2 kg is pulled up on a smooth incline of angle 30^0 with horizontal and the block moves with an acceleration of 1 ms/^{2}, then
    (a) Find the power delivered by the pulling force at a time 4 seconds after motion starts.
    (b) What is the average power delivered during these four seconds after the motion starts?
17. Show the variation of potential energy, K.E and the total energy of a body freely on earth from a height 'h' by using a graph.
18. An automatic manufacturer claims that its super-deluxe sports car will accelerate from rest to a speed of 42.0 ms^{-1} in 8.0 s assuming that the acceleration is constant.
    (a) Determine the acceleration of car in ms^{-2}
    (b) Find the distance the car travels in 8.0 s
    (c) Find the distance the car travels in 8^{th} second.
19. A monkey of mass 40 kg climbs on a rope which stands a maximum tension of 600 N. In which of the following cases will the rope break.
    (i) When the monkey climbs up with an acceleration of 6 ms^{-2}
    (ii) When the monkey climbs down with an acceleration 4 ms^{-2}
    (iii) When the monkey climbs up with a uniform speed of 5 ms^{-1}
    (iv) When the monkey falls down the rope nearly freely under gravity
20. Find the moment of inertia of the system about the bisector line AB when two uniform thin identical rods, each of mass m and length L are joined so as to form a cross as shown in the diagram?



21. Deduce an expression for the orbital velocity of a satellite revolving around the earth in a circular orbit at a height 'h' above earth surface.

22. A thermodynamic system is taken an original state to an intermediate state by the linear process shown in the diagram. If its volume is then reduced to the original value from E to F by an isobaric process, then calculate the total work done by the gas from D to E to F.
23. Rishi was discussing about science to his elder sister Shri in the dining room and so their mother came who was cooking in the kitchen shouted at them. All of a sudden, he saw his mother sweating and feeling hot inside the kitchen. Rishi opened the door of the refrigerator thinking that this might relieve her from heat. But, his sister immediately rushed towards him and closed the door. She then made him understand that opening of refrigerator would increase the temperature of the room.
    (a) What values of Shri do you appreciate?
    (b) Why a room cannot be cooled by opening the door of refrigerator?
    (c) If the temperature inside an ideal refrigerator is 285 K, then how much heat is delivered to room for every one joule of work done on working substance when room temperature is 320 K?
24. (i) Show that work done by a stretching force to produce certain extension in the wire is W = ½ stretching force x extension.
    (ii) A wire that obeys Hooke's law is of length l_1 when it is in equilibrium under a tension F_1. Its length becomes l_2 when the tension is increased to F_2. Calculate the energy stored in the wire during this process.

    Or

    A cubical block of steel of density 7.8 g cm^{-3} floats on mercury (density 13.6 g cm^{-3})with its sides vertical. Assume the side of the cube to be 10cm.
    (a) What length of the block is above the mercury surface?
    (b) If water is poured on the mercury surface, what will be the height of the water column, when the water surface just covers the top of the mercury surface?
25. (a) What causes variation in velocity of a particle?
    (b) A car travels first half of a length S with velocity v_1. The second half is covered with velocities v_2 and v_3 for equal intervals. Find the average velocity of the motion.

    Or

    (a) Define centripetal acceleration. Give examples.
    (b) If the length of the seconds hand is 4 cm, calculate
    (c) The speed of the tip of the second's hand.
    (d) The angular speed of the second's hand of a clock.
26. Four identical cylindrical column of steel support a big structure of mass 50000kg. The inner and outer radii of each column are 30 cm and 40 cm respectively. Assuming the load distribution to be uniform, calculate the compressional strain of each column. The Young's modulus of steel is 2.0 x 10^{11} Pa.

    Or

    Determine the velocity of water at a point where the diameter is 4 cm when water flows through a horizontal pipe of varying cross section at the rate of 20 L per minute.