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:

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

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

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

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

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

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

1. Comment: "A body at higher temperature contains more heat".

2. What is apparent weight of the floating block, when a block of wood is floating in a lake?

3. Fill in the blanks:

    a) 6 ms^{-2} = --------------- kmh^{-2}

    b) 1 m = ------------------ light year

4. What happens to surface tension when impurity is mixed in liquid?

5. Is it possible for the relative velocity of two bodies moving in opposite direction to be greater than the absolute velocity of either?

6. Calculate the percentage of heat used for doing work, if a steam engine intakes steam at 200^0 C and after doing work exhausts it directly in air at 100^0 C. Assume the engine to be ideal engine.

Or

Calculate the temperature at which the root mean square velocity of nitrogen molecules will be equal to 8 km s^{-1}

7. Find an expression for the weight of a body at the centre of the earth.

8. Give reasons: "The springs made of steel and not of copper".

9. If a bullet of mass 20g is moving with a speed of 150 m s^{-1} strikes a target and is brought to rest after piercing 10 cm into it, then calculate the average force of resistance offered by the target.

10. Find the time period of motion if a mass m is dropped in a tunnel along the diameter of earth from height h above the surface of earth. Is the motion simple harmonic?

11. The acceleration due to gravity on the surface of moon is 1.7 ms^{-2}. What is the time period of a simple pendulum on the moon if it time period is 3.5 s on earth?

12. Discuss the effect of temperature on the velocity of sound in gases. State Newton's second law of Motion. On its basis derive the relation between force and acceleration.

13. A particle starts SHM from the mean position. Its amplitude is A and its time period T. at one time its speed is half that of the maximum aped. What is this displacement.

14. What is a thermostat? Briefly explain its principle?

15. A liquid drop of diameter 4 mm breaks into 1000 droplets of equal size. Calculate the resultant change in surface energy, the surface tension of the liquid is 0.07 Nm^{-1}?

16.

    i)   When is the work done said to be zero?

    ii)   Give two examples from daily life where according to physics, work done is zero.

17. A wood ball of density ρ is immersed in water of density σ to depth h and then released. Find the height H above the surface of water upto which the ball jumps out of water.

18. Explain the following w.r.t. associating it with vector.

    a) The length of a wire bent into a loop

    b) A plane area

    c) A sphere

19. State whether the following statement is true or false with proper reason.

    (i)   The net acceleration of particle in circular motion is always along the radius of the circle towards the centre.

    (ii)   The velocity vector of a particle at a point is always along the tangent to the path of the particle at that point.

(iii)   The acceleration vector of a particle in uniform circular motion averaged over one cycle is a null vector.

20.

a) What is the coefficient of performance (β) of a Carnot refrigerator working between 30^0 C and 0^0 C?

b) What would be the kinetic energy of 1 g of nitrogen gas at 77^0C. Given R = 8.31 J mol^{-1} K^{-1}

21. A block with a mass of 3.0 kg is suspended from an ideal spring having negligible mass and stretches the spring by 0.2 m

(i)   What is the force constant of the spring

(ii)   What is the period of oscillation of the block if it is pulled down and released?

22. A wire of length *l* and area of cross section A is stretched by the application of a force. If the Young's modulus is Y what is the work done per unit volume?

Or

A spring balance reads 10 kg when a bucket of water is suspended from it. Explain what will be the reading o spring balance when

i)   An ice cube of mass 1.5 kg is put into bucket

ii)   An iron piece of mass 7.8 kg suspended by another string is immersed with half of its volume inside the water in the bucket. [Relative density of iron =7.8]

23. Sara was afraid on going anywhere by air. But, she couldn't avoid going by an air. Her friend Hema who knew her problem was with her. Inside the plane Hema saw that Sara was very quiet and feeling uncomfortable. She tried to talk to Sara but she didn't answer. As the plane was about to take off, Hema started fighting with Sara without any cause for diverting her mind. While fighting Sara didn't realize that plane had taken off and now she was in air. She felt very happy to overcome her fear.

i)   What values do you associate with Hema?

ii)   An aeroplane takes off at an angle of 30^0 to the horizontal. If the component of its velocity along the horizontal is 250 km/h. what is the actual velocity? Find also the vertical component of velocity.

iii)   The blades of an aeroplane propeller are rotating at the rate of 600 revolutions per minute. Calculate its angular velocity?

24. If a body executing linear SHM has a velocity of 3 cm s^{-1} when its displacement is 4 cm and a velocity of 4 cm s^{-1} when its displacement is 3 cm, then

(a) Find the amplitude and period of the oscillation

(b) Calculate the total energy of oscillation if the mass of the body is 50 g,

Or

If a sonometer wire of length 110 cm is stretched with a tension T and fixed at its ends is divided into three segments by placing two bridges below, then where the bridges should be placed so that the fundamental frequencies of the segments are in the ratio 1:2:3?

25. If a ball of mass 100 g is projected vertically upwards from the ground with a velocity of 49 m/s and at the same time another identical ball is dropped from a height of 98 m to fall freely along the same path as followed by the first ball, then after sometime the two balls collide and stick together and finally fall together. Find the time of fight of the masses.

Or

A gun kept on a straight horizontal road to hit a car traveling along the same road away from the gun with a uniform speed of 72 km/h. The car is at a distance of 500 m fr4om the gun when the gun is fired at an angle of 45^0 to the horizontal. Find

(i)   The distance of the car from the gun when the shell hits it

(ii)   The speed of projection of the shell from the gun

26. An object starts from rest and covers total distance X in the below manner:

It first has uniform acceleration a_1 from some time t_1 moves with the speed acquired at the end of t_1 for some distance and is then given a uniform retardation a_2 so that it is again at rest at the end of the journey. Explain that the journey is covered in least time if this body is accelerated

For a time $\left[\dfrac{2Xa_2}{a_1(a_1+a_2)} \right]^{\frac{1}{2}}$ and this minimum time is $\left[2x\left(\dfrac{1}{a_1}+\dfrac{1}{a_2} \right) \right]^{\frac{1}{2}}$

Or

From the top of the tower 156.8 m high a projectile is thrown up with velocity of 39.2 ms^{-1}, making an angle 30^0 with horizontal direction. Find the distance from the foot of tower where it strikes the ground and the time taken by it .