CLASS – XI

PHYSICS

Time Allowed : 3 hours   _Maximum Marks : 70_

SET-

General Instruction:

(i)   _All questions are compulsory._

(ii)   _There is no over all choice. However an internal choice has been provided in one question of two marks, one question of three marks, all three questions of five marks._

(iii)   _Question number 1 to 5 marks are very short answer type questions, carrying one mark each._

(iv)   _Question number 6 to 10 short answer type questions, carrying two marks each._

(v)   _Question number 12 to 22 are short type questions, carrying three marks each._

(vi)   _Question number 23 is a value based question carrying four marks._

(vii)   _Question number 24 to 26 are long type question, carrying five marks each._

(v)   _Use of calculator is not permitted. However you may use log table if necessary._

1.   What do the following two quantities represent?   1
(i) Slope of v-t graph,
(ii) Area under v-t graph.

2.   When a shaving brush is taken out of water, its hairs cling together. Why?   1

3.   Define coefficient of friction. What is its unit?   1

4.   What is inertia? Name the quantity that gives the measure of inertia.   1

5.   How many significant figures are there in the following quantities?   1
(i) 20.3150 ms^{-1} (ii) 0.01307 m^2

6.   A physical quantity Y is given by $\dfrac{a^2 b^{3/2}}{c^4 d^{1/2}}$. The percentage error in a, b, c, d,   2
are 1%, 4%, 3%, 2%   respectively. Find the percentage error in Y.

OR

If Energy, Velocity and Time are fundamental units, what will be the   2
dimension of surface tension?

1

7. What is a heat engine? Obtain an expression for its efficiency in terms of temperatures of source and sink.   2

8. What is escape speed of a planet? Obtain expression for the escape speed of the earth.   2

9. The displacement of a body of mass m, in periodic motion, from its mean position is given by $x = A\sin\omega t$. Obtain expression for the kinetic energy of the body in term of x.   2

10. By using the expression for the pressure of the gas $P = \dfrac{1}{3} nmv^2$, show that the average kinetic energy of a gas molecule is 3/2KT, where K is Boltzman's constant, T is temperature, n is the number of molecule per unit volume, m is the mass and v is the average speed of the molecule.   2

11. For a body thrown from ground with speed u at an angle θ with horizontal, obtain expression for (i) its time of flight and (ii) its horizontal range.   3

OR

11. What is projectile motion? Show that the path of a body thrown from ground with speed u at an angle θ with horizontal is a parabolic curve.   3

12. A car started from rest and accelerated with uniform acceleration a_1 for 10 seconds then decelerated with uniform deceleration a_2 to finally come to rest in next 5 seconds. Show that $\dfrac{a_1}{a_2} = \dfrac{1}{2}$.   3

13. What is angular momentum of a body? Show that the rate of change of angular momentum of a particle is equal to the torque acting on it. (τ = dL/dt)   3

14. Obtain an expression for kinetic energy of a rolling body in terms of its mass, speed of its centre of mass, radius and radius of gyration.
When a solid roller is allowed to roll down an incline surface from height h, then obtain expression for its speed at the bottom of the incline.   3

15. What is gravitational potential? Obtain an expression for it at a height h from the surface of earth.   3

16. State only one basic point of difference between elastic and inelastic collisions. Show that velocity of separation of the two bodies is equal to their velocity of approach, for elastic collision in one dimension.   3

17. What is simple harmonic motion (S.H.M.)? Show that the motion of a simple pendulum is simple harmonic.   3

18. A body is thrown from ground with a speed v_0 at an angle θ with horizontal. Show that $4H = R\tan\theta$, where H is maximum height and R is horizontal range. 3

19. By using first law of thermodynamics show that $C_p - C_v = R$, where C_p and C_v are molar specific heat capacity of gas at constant pressure and volume respectively, and R is gas constant. 3

20. What is banking of track? Obtain expression for the maximum velocity with which a vehicle can take turn safely over circular rough horizontal track. 3

21. State and prove work-energy theorem, for a non uniform force. 3

22. State Law of Equipartition of Energy. Show that the molar specific heat of a mono atomic gas at constant volume is $(3/2)R$, where R is gas constant. 3

23. Construction of metro line was carried out day and night. One night, when the work was in full swing, suddenly chain of the crane, lifting the heavy concrete block, broke and it fell down. Immediately, people from the nearby area came for help. They lifted the concrete block and saved many lives. Injured were transferred to the hospital without waiting for police to arrive. 4
    (i) What values of locals helped in saving lives?
    (ii) A crane having steel ropes is used to lift heavy load upto 10^4 kg. The elastic limit for steel is 3×10^8 Nm^{-2}. What should be the radius r of the steel rope used?

24. Draw velocity-time graph of uniformly accelerated motion. By using this graph deduce equations of motion, (i) $v = u + at$, and (ii) $x = ut + \frac{1}{2}at^2$, where the terms have their usual meaning. 5

    A body is thrown vertically upward with a speed 20 m/s from ground. After some time it returned back to the ground. Draw speed-time graph for the whole journey with proper scale.

    OR

24. State parallelogram law of vector addition. Obtain expressions for the magnitude and direction of the resultant of two vectors a and b with θ is angle between them. 5
    Show by diagram only, that $\mathbf{a} + \mathbf{b} = \mathbf{b} + \mathbf{a}$.(vector addition is commutative)

25. State and prove Bernoulli's theorem. Why do the asbestos roof of houses get lifted in hurricane? 5

    OR

25. Why is the pressure on the concave side of a liquid drop or bubble more than that on its convex side? 5
    Show that $p_i - p_o = 2S/R$, where p_i & p_o are inside and outside pressures of liquid drop, S is the surface tension and R is the radius of the drop.

26.   (a) What are stationary waves? Obtain expression for the frequency of the   5
       fundamental mode of the stationary wave on a stretched string.

       (b) A string of mass 2.5 kg is under a tension of 200 N. The length of the
       stretched string is 20.0 m. If the transverse jerk is struck at one end of the
       string, how long does the disturbance take to reach the other end?

                                    OR

26.   (a) What is Doppler effect in sound? Derive an expression for the apparent   5
       frequency when a source is moving towards stationary observer.

       (b) A whistling train, running at a speed of 30 ms^{-1}, passes across a standing
       person. The frequency of the whistle is 480 Hz. What is the apparent
       change in the frequency of the whistle that the person observes while the
       train passing across him? Speed of sound in air is 330 ms^{-1}.

Some important constants:
$G = 6.67 \times 10^{-11} \ Nm^2kg^{-2}$
$g = 10 \ ms^{-2}$
K (Boltzmann constant) = $1.38 \times 10^{-23} \ JK^{-1}$
Mass of the earth = $6 \times 10^{24} \ kg$
Radius of the earth = 6400 km