Amity Saket

First Terminal Examination 2014 - 2015

Class – XI

Subject – Physics

Time : 3 Hours **Max. Marks : 70**

General Instructions **:**

(a) All questions are compulsory.

(b) There are 26 questions in total.

(c) Questions 1 to 5 carry 1 mark each.

(d) Questions 6 to 10 carry 2 marks each.

(e) Questions 11 to 22 carry 3 marks each.

(f) Question 23 carry 4 marks.

(g) Questions 24 to 26 carry 5 marks each.

(h) Use of calculators is not permitted. However you may use log tables wherever required.

---

1. "Accurate measurement of a physical quantity may not be a precise measurement." Explain the statement.

2. A ball is thrown vertically upward with a velocity 20 m/s. It takes 4 seconds to return to its original position. Draw velocity-time graph for the motion of the ball.

3. Two bodies of masses M and m are allowed to fall from the same height. If the air resistance be same for each body, will the two bodies reach the earth simultaneously. Justify your answer.

4. A truck and a car with the same kinetic energy are brought to rest by the application of the brakes which provide equal retarding force. Which of them will come to rest in a shorter distance ? Give reason.

5. Springs A and B are identical except that A is stiffer than B. In which spring is more work expended if they are stretched by the same force ? Justify it.

6. Write dimensions of $\frac{a}{b}$ in the relation $F = a\sqrt{x} + bt^2$ where F is force, x is distance and t is time.

7. Derive equation $s = ut + \frac{1}{2}at^2$ using calculus method.

8. A balloon with mass M is descending down with an acceleration a, $a < g$. What mass m of its contents must be removed so that it starts moving up with an acceleration a ?

9. The distance between the centres of carbon and oxygen atoms in the carbon monoxide gas molecule is 1.13 Å. Locate the centre of mass of the gas molecule relative to carbon atom.

10. A particle of mass 0.5 kg travels in a straight line with a velocity $y = 5x^{5/2}$ m/s. How much work is done by the net force during the displacement from x = 0 to x = 2 m ?

OR

A bullet of mass 0.01 kg and travelling at a speed of 500 m/s strikes a block of mass 2 kg which is suspended by a string of length 5 m. The centre of gravity of the block is found to rise a vertical distance of 0.1 m. What is the speed of the bullet after it emerges from the block ?

11. If dimensions of length are expressed as $G^x c^y h^z$ where G, c, h are universal gravitational constant, speed of light and Planck's constant respectively, what are the values of x, y and z ?

12. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of L is 20.0 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 s using a wrist watch of 1 s resolution. What is the accuracy in the determination of g ?

13. A car accelerates from rest at a constant rate A for some time after which it retards at a constant rate B to come to rest. If the time elapsed is T seconds, calculate the maximum velocity reached and the total distance travelled in terms of A, B and T.

OR

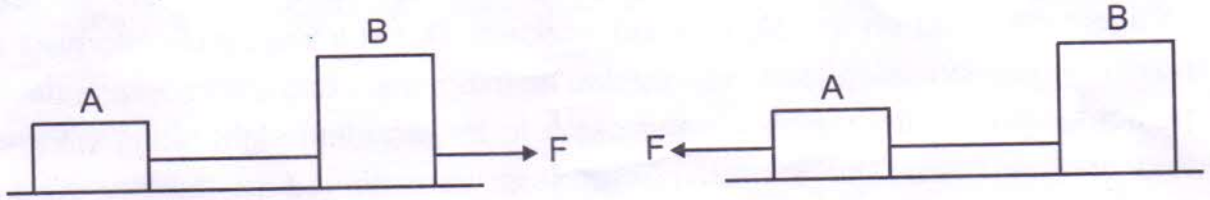
A car, starting from rest, accelerates at the rate f through a distance S, then continues at constant speed for some time t and then decelerates at the rate $\frac{f}{2}$ to come to rest. If total distance is 5S then prove that $S = \frac{1}{2} ft^2$.

14. In a harbour, wind is blowing at the speed of 70 km/h and the flag on the mast of a boat anchored in the harbour flutters along the NE direction. If the boat starts moving at a speed of 50 km/h to the north, what is the magnitude and direction of velocity of the flag on the mast of the boat ?

15. A man can swim with a speed of 4 km/h in still water. How long does he take to cross the river 1 km wide, if the river flows steadily at 3 km/h and he makes his strokes normal to the river current ? How far from the river does he go, when he reaches the other bank ?

16. Find a unit vector perpendicular to each of the vectors $A = 3i + j + 2k$ and $B = 2i - 2j + 7k$ and the angle between them.

17. Two bodies of masses 10 kg and 20 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string. A horizontal force F = 600 N is applied to (i) B (ii) A along the direction of string. What is the tension in the string in each case ?



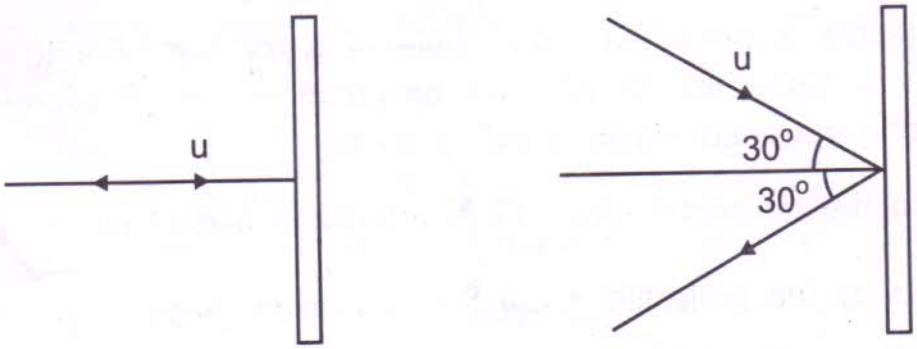
18. Give reasons :

(a) Wheels of a vehicle are provided with mud guards.

(b) It is difficult to drive a nail into a wooden block without supporting it.

(c) It is difficult to put a cycle into motion than to maintain its motion.

19. Two identical billiard balls strike a rigid wall with the same speed but at different angles, and get reflected without loss of speed, as shown in figure. What is (i) the direction of force of the wall due to each ball ? and (ii) the ratio of magnitudes of the impulses imparted on the two balls by the wall ?



20. A body of mass M is moved along a straight line by a machine delivering a constant power P. Find the expression for the distance moved by the body in terms of M, P and t.

21. Draw the variation of potential energy and kinetic energy of a block attached to a spring, which obeys Hook's law. Derive an expression for the P.E. of an elastic stretched spring.

22. From a uniform circular disc of diameter D, a circular disc of diameter $\frac{D}{6}$ and having its centre at a distance of $\frac{D}{4}$ from the centre of disc is scooped out. Determine the centre of mass of the remaining portion.

23. A fast moving train collided against a stationary strain. Moving train was damaged very badly and the passengers were injured seriously. This accident took place near the village of Robin. When he came to know about the accident, he started shouting. Villagers gathered on the sight of the accident. Robin immediately informed the nearby police station on telephone. He started helping the villagers to evacuate the injured persons from the train. Police party came to the accident sight along with ambulances and fire brigades. The injured passengers were shifted to the nearby hospital for treatment.

(a) Why was the fast moving train damaged badly ?

(b) What are the values displayed by Robin ?

24. (a) A body is projected at an angle θ with the horizontal. Derive expressions for (i) maximum height attained (ii) total time of flight (iii) horizontal range.

(b) Show that there are two values of time for same height during the course of flight of a projectile and the sum of these times is equal to total time of flight.

OR

(a) A projectile is projected horizontally from the top of a tower with uniform velocity u. Show that its path will be parabolic. Derive expression for time of flight and maximum height reached by it.

(b) If R be the horizontal range for θ inclination and H be the maximum height reached by the projectile, show that maximum range is given by $\frac{R^2}{8H} + 2H$.

25. (a) What is the need for banking of roads ? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at an angle θ. Coefficient of friction is μ.

(b) A circular race track of radius 400 m is banked at an angle of 10°. If the coefficient of friction between the wheels of a race car and the road is 0.2, what is :

(i) optimum speed of the race car to avoid wear and tear on its tyres.

(ii) maximum permissible speed to avoid slipping ($\tan 10^\circ = 0.1763$)

OR

(a) A small body tied to one end of the string is whirled in a vertical circle.

(i) Represent the forces on a diagram when the string makes an angle θ with initial position.

(ii) Find the tension and velocity at the highest and lowest point respectively.

(b) A bucket containing water is tied to one end of a rope of length 2.5 m and rotated about the other end in a vertical circle in such a way that the water in it does not spill. What is the minimum velocity of the bucket at which this happens and how many rotations per minute is it making then ?

26. (a) Discuss the elastic collision between two balls in one dimension and obtain the expression for their velocities after collision.

(b) A ball is dropped on the ground from a height of 1 m. The coefficient of restitution is 0.6. To what height will the ball rebound.

OR

(a) A moving body collides with a stationary body of different mass. After perfectly inelastic collision, both the bodies stick together and move with a common velocity. Derive an expression for this common velocity and loss in kinetic energy during the collision.

(b) A ball falls under gravity from a height of 10 m with an initial downward velocity 'u'. It collides with the ground, loses 50 % of the energy in collision and then rises back to the same height. Find the initial velocity 'u'.

****