First Terminal Examination 2016 - 2017

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 carries 4 marks (Value based question).

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

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

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1. The bob A of a pendulum released from $30°$ to the vertical hits another bob B of the same mass at rest on a table as shown in figure. How high does the bob A rise after the collision? Assume the collision to be elastic.
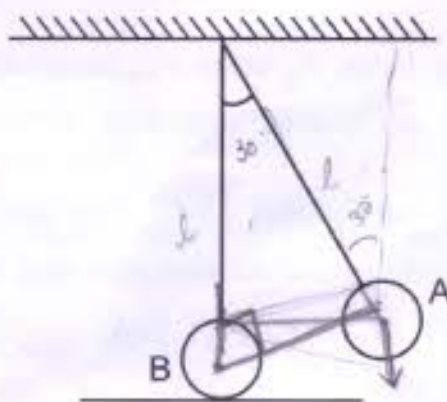
2. A body is moving uni-directionally under the influence of a source of constant power. Its displacement is proportional to t^n. Find the value of n.

3. Can an object be accelerated without speeding up or slowing down? Explain with an example.

4. 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.

5. A vernier callipers has 50 divisions on the sliding scale, a screw gauge has Pitch of 1 mm and 100 divisions on the circular scale. Which of the two is more precise device for measuring length ?

6. When 1 metre, 1 Kg and 1 minute are taken as fundamental units, the magnitude of force is 36 units. What is the value of this force on c.g.s. system ?

7. Derive equation $S = ut + \dfrac{1}{2}at^2$ 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. If two particles of masses m_1 and m_2 move with velocities v_1 and v_2 towards each other on a smooth horizontal table, what is the velocity of their C.M. ?

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

OR

Draw the graph of spring force F_S and displacement x. From the graph, find an expression for the P.E. of an elastic stretched spring.

11. Assuming the mass M of the largest stone that can be moved by a flowing river depends on velocity V, density ρ and acceleration due to gravity g. Show that M varies directly as the sixth power of velocity of flow.

12. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\dfrac{L}{g}}$. 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 90s using a wrist watch of 1s resolution. What is the accuracy in the determination of g ?

13. On a two lane road, car A is travelling with a speed of 36 km/hr. Two cars B and C approach car A in opposite directions with a speed of 54 km/hr each. At a certain instant when distance AB is equal to AC, both being 1 km, B decides to overtake A before C crosses. What minimum acceleration of car B is required so that both will meet A simultaneously?

OR

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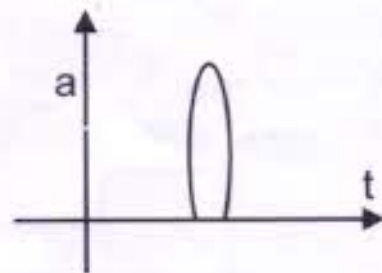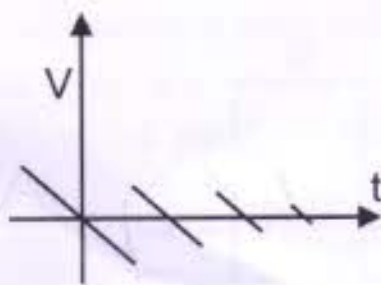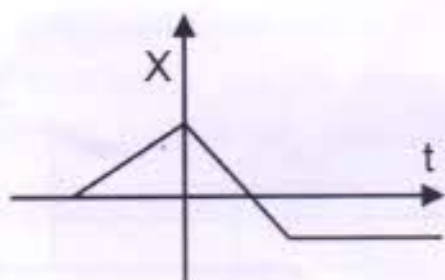
14. In a harbour, wind is blowing at the speed of 70 km/h and the flag on the mast of a boat anchored in the harbour flutters along the NE direction. If the boat starts moving at a speed of 50 km/h to the north, what is the magnitude and direction of velocity of the flag on the mast of the boat ?

15. A river 800 m wide flows at the rate of 5 km/hr. A swimmer who can swim at 10 km/hr in still water wishes to cross the river straight.

(a) Along what direction must he strike ?

(b) What should be his resultant velocity ?

(c) How much time he would take ?

16. If $\vec{A}$, $\vec{B}$ and $\vec{C}$, are three vectors such that $\vec{A}.\vec{B} = \vec{A}.\vec{C}$, $\vec{A} \times \vec{B} = \vec{A} \times \vec{C}$, $\vec{A} \neq 0$ then prove that $\vec{B} = \vec{C}$.

17. Give reasons for the following :

(a) A body projected horizontally moves with the same horizontal velocity although it is under the action of force of gravity.

(b) A bullet is dropped from a certain height and at the same time, another bullet is fired horizontally from the same height. They will reach the ground at the same time.

(c) A stone tied to the end of a string is whirled in a circle. If the string breaks, the stone flies off tangentially.

18. Two bodies of masses 5 kg and 10 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string. A horizontal force F = 300 N is applied to (i) B (ii) A along the direction of string. What is the tension in the string in each case ?

19. (a) Draw the variation of potential energy and kinetic energy of a block attached to a spring, which obeys Hook's law.

(b) The P.E. of a certain spring when stretched through 10 cm is 5 J. Calculate the amount of work that must be done to stretch it through an additional distance of 10 cm.

20. A trolley of mass 20 kg rests on a horizontal surface. A mass-less string tied to the trolley passes over a frictionless pulley and a load of 5 kg is suspended from other end of string. If coefficient of kinetic friction between trolley and surface be 0.1, find the acceleration of trolley and tension in the string. (g = 10 m/s^2)
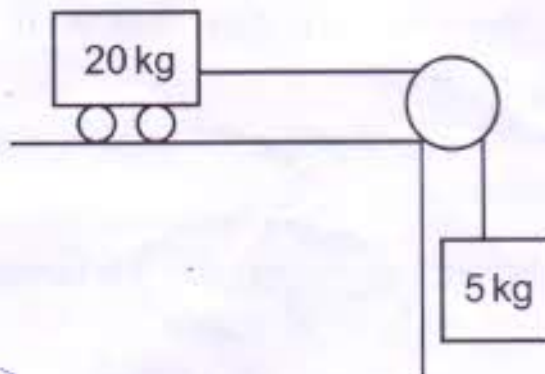
21. From a uniform circular disc of diameter R, a circular disc of diameter R/6 and having its centre at a distance of R/4 from the centre of disc is scooped out. Determine the centre of mass of the remaining portion.

22. (a) A particle of mass m is moving in a horizontal circle of radius 'r', under a centripetal force equal to $(-K/r^2)$ where K is constant. What is the total energy of the particle ?

(b) What is the significance of negative total energy ?

23. Rahim went to an animal show where monkeys were swinging on the ropes. Suddenly a rope broke and the monkey fell down and was severely injured, Rahim spoke to the manager of the show and advised him about the strength of the rope to be used for such purposes.

(a) What values of Rahim inspired you ?

(b) Monkey of mass 40 Kg climbs on the rope which can withstand a maximum tension of 600 N. In which of the following cases will the rope break ?

(i) Climbs up with an acceleration of 6 m/s²

(ii) Climbs down with an acceleration of 4 m/s²

(iii) Climbs up with a uniform speed of 5 m/s

(iv) Falls down the rope nearly under gravity

(Ignore the mass of the rope, Take g = 10 m/s²)

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) Velocity at any instant.

(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 horizontal range of the projectile.

(b) Show that the maximum horizontal range is four times the maximum height attained by a projectile which is fired along the required oblique direction.

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. Coeff. 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. $(\tan 10° = 0.1763)$

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 stone of mass 100 g is suspended from the end of a weightless string of length 1 m and is allowed to swing in a vertical plane. The speed of the mass is 2 m/s, when the string makes an angle of $60°$ with the vertical. Calculate the tension in the string at angle $\theta = 60°$. Also calculate the speed at the lower most point.

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

(b) Show that two equal masses undergoing perfectly elastic collision with one of them initially at rest move at right angle to each other after collision.

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 bullet of mass 12 g moving with a velocity of 70 m/s gets embedded in a freely suspended wooden block of 0.4 kg. What is the velocity acquired by the block ?

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