9/2012

SUBJECT : PHYSICS (SET-I) II

Time : 3 Hrs.

M.M.: 70

General Instructions :

i) All questions are compulsory.

ii) Question Number 1-8 are very short answer type questions carrying 1 mark each.

iii) Question Number 9-18 are short answer type questions carrying 2 marks each.

iv) Question Number 19-27 are short answer type questions carrying 3 mark each.

v) Question Number 28-30 are long answer type questions carrying 5 mark each.

vi) There is no overall choice, but choice is given in one question of 2 marks, one question of 3 marks and in all questions of 5 marks.

Q1. What is the work done by centripetal force in rotating a stone tied to a string?

Q2. Suggest a suitable physical situation for the following velocity time graph.
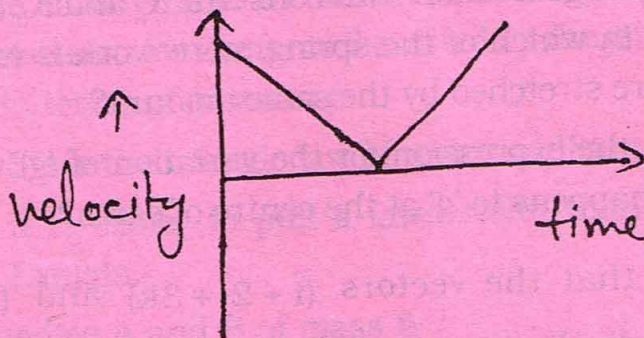
Q3. A horse has to apply move force to start a cart than to keep it moving. Why?

Q4. Give the magnitude and direction of the net force acting on a stone of mass 0.1 kg just after it is dropped from the window of a stationary train.

Q5. Can mechanical energy be negative? Explain.

(1)

Q6. The radii of two planets are R and 2R respectively and their densities are ρ and $\rho/2$ respectively. What is the ratio of acceleration due to gravity at their surfaces?

Q7. What is the weight felt by a person in a lift when it has free fall? Why?

Q8. If $\left|\bar{A}\right| = 1$, $\left|\bar{B}\right| = 1$ and $4\bar{A}.\bar{B} = \left|\bar{A} + \bar{B}\right|$, then find the angle between $\bar{A}$ and $\bar{B}$.

Q9. Check the accuracy of the following formula $n = \dfrac{k}{l}\sqrt{\dfrac{T}{m}}$ where K is a dimensionless constant, n is the frequency of transverse waves in a string of length l and m is mass per unit length under tension T.

Q10. A balloon is ascending at the rate of 14 ms^{-1} at a height of 90m above the ground when a packet is dropped from the balloon. After how much time and with what velocity does it reach the ground?

Q11. A stone breaks the window glass into pieces, while a bullet pierces through the same, why?

Q12. Two springs A and B with constant K_A and K_B ($K_A > K_B$) are given. In which of the spring more work is to be done if they are stretched by the same amount?

Q13. Derive the expression for the variation of (g) with depth. What happens to 'g' at the centre of earth?

Q14. Prove that the vectors $(\hat{i} + 2\hat{j} + 3\hat{k})$ and $(2\hat{i} - \hat{j})$ are perpendicular to each other.

Q15. The masses m_1, m_2 and m_3 of the three bodies shown in the figure are 5, 2, and 3 kg respectively. Calculate the values of tension T_1, T_2 and T_3 while the whole system is going upwards with an acceleration of 2 ms^{-2}. (g = 9.8 ms^{-2})
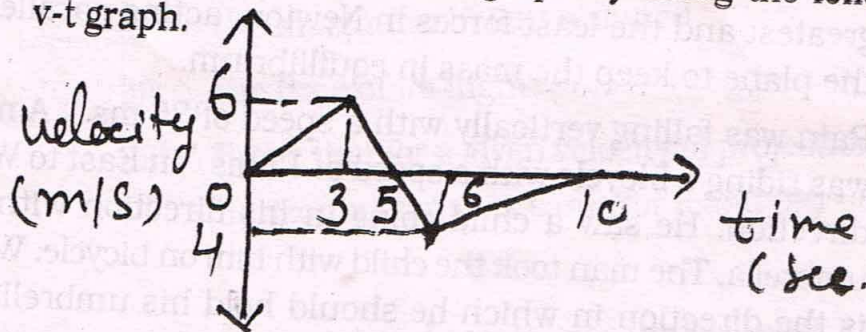

(2)
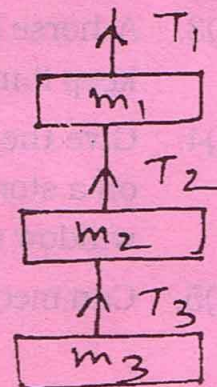
Q16. Two masses of 250 kg and 1000 kg separated by 3m, where should a third object of 50 kg be placed so that the net gravitational force on the third body is zero?

OR

The radius of the earth is increased by 5%. The mass of the earth remains unchanged. What will be the change in escape velocity?

Q17. Find the acceleration-time graph by using the following v-t graph.

Q18. If the velocity of a particle is given by $v = \sqrt{180 - 16x}$ ms^{-1} what will be its acceleration?

Q19. A jet of water of cross sectional area A and velocity v moving normally hits on a stationary flat plate. The mass per unit volume of water is ρ. By dimensional analysis, determine an expression for the force F exerted by the jet against the plate in terms of A, v and ρ.

Q20. (i) State the triangle law of vector addition.

(ii) It is easier to pull a lawn roller than to push it. Explain.

Q21. Two bodies A and B of mass 5 kg and 10 kg in contact with each other rest on a table against a rigid wall. The coefficient of friction between the bodies and the tale is .15. A force of 200N is applied


(3)
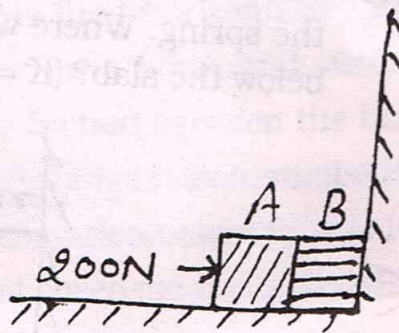
horizontally to A. What are (a) the reaction of the partition. (b) the action-reaction forces between A and B? What happens when the wall is removed? Does the answer to (b) change when the bodies are in motion.

OR

A mass of 200 kg is placed on a rough inclined plane of angle 30°. If coefficient of limiting friction is $\frac{1}{\sqrt{3}}$, find the greatest and the least forces in Newton, acting parallel to the plane to keep the mass in equillibrium.

Q22. Rain was falling vertically with a speed of 35 ms^{-1}. A man was riding a bicycle with a speed of 12 ms^{-1} in East to West direction. He saw a child going in his direction without umbrella. The man took the child with him on bicycle. What is the direction in which he should hold his umbrella to save the child & himself from rain?

Q23. Derive an expression for the orbital velocity of a satellite in the orbit. Reduce it to an orbit close to the surface of earth. How is it related to escape velocity?

Q24. Prove that the total mechanical energy remains constant for a ball of mass m dropped from a tower of height h.

Q25. Two masses 8 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses and the tension in the string when the masses are released.

Q26. A small block of mass m is pressed against a horizontal spring fixed at one end to compress the spring through 5cm. When released the block moves horizontally till it leavs the spring. Where will it hit the ground at a distance 2m below the slab? [K = 100 N/m, m = 100g]

2m

(4)
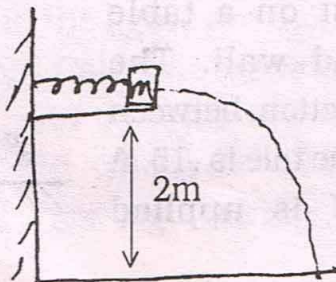
Q27. (i)   Write the number of significant figure in 0.1498.

(ii)   The length and breadth and height of a block is (5.7 ± .01) cm, (3.4 ± .02) and (7.2 + .03) cm. Find volume of the block with error limits.

Q28. A projectile is fired at an angle θ with the horizontal -

(a)   Show that its trajectory is a parabola

(b)   Obtain expression for -

(i)   the maximum height attained

(ii)   the time of its flight

(iii)   Prove that for a given velocity of projection, the horizontal range is same for θ and (90 - θ)

OR

A car starts from rest and accelerates uniformly at 5 m/s², then moves uniformly and then retards at 5 m/s² to come to rest. The total time of motion is 25s. The average velocity during the time is 72 km/h. How long does the car move uniformly?

Q29. (i)   What is the need of banking of roads?

(ii)   Find the expression for maximum velocity of vehicle on a banked road.

OR

(i)   Derive an expression for work done in moving a body up an inclined plane.

(ii)   A bullet of mass .01 kg is fired horizontally into a 4kg wooden block at rest on a horizontal surface. The coefficient of kinetic friction between the block and the surface is 0.25. The bullet remains embedded in the block and the combination moves 20m before coming to rest. With what speed did the bullet strike the block?

(5)

Q30. (i) Show that in case of one dimensional elastic collision of two bodies, the relative velocity of separation after the collision is equal to the relative velocity of approach before the collision.

(ii) If the momentum of the body increases by 20% keeping the mass same, what will be the increase in the K.E. of the body?

OR

(i) An elastic spring of spring constant 'k' is compresed by an amount x. Show that it potential energy is

$$\frac{1}{2} Kx^2 ?$$

(ii) A body of mass 2 kg is initially at rest. A constant force of 5N acts on it for 10s. Calculate the average power of the force.