

**SUBJECT : PHYSICS (SET-I)**

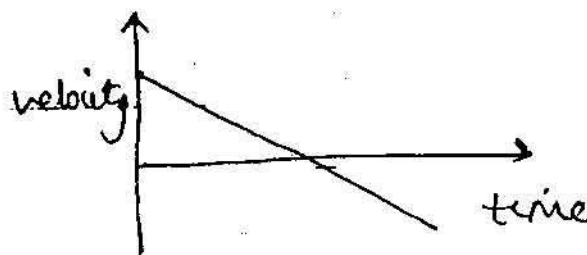
Time : 3 Hrs.

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 earth's gravitational force in keeping the moon in its orbit for its one revolution?
- Q2. Suggest a suitable physical situation for the following velocity-time graph :



- Q3. Why is it difficult to put a cycle in motion than to maintain its motion?
- Q4. Give the magnitude and direction of net force acting on a car moving with a constant velocity of 30 km/h on a rough road.
- Q5. Is it possible to have a situation where  $E - U < 0$ , where  $E$  is the mechanical energy and  $U$  is the potential energy. Give reason for your answer.

Q6. Two planets A and B have masses in the ratio 2:1 and their radii are in the ratio 1:4. Find the ratio of acceleration due to gravity of these planets?

Q7. Action and reaction are equal and opposite. Why do they not cancel out each other?

Q8. If  $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$ , then find the value of  $\vec{A} \cdot \vec{B}$

Q9. Check the correctness of the given equation using

dimensions :  $V = \sqrt{\frac{T}{\mu}}$  where V is the speed of the transverse

waves in a string.  $\mu$  is the mass attached to the string and T is the tension in the string.

Q10. A ball is thrown vertically upwards with an initial speed of 20 m/s from the top of a building 25m high. How high will the ball go and how long will it take to reach the ground? ( $g = 10 \text{ m/s}^2$ )

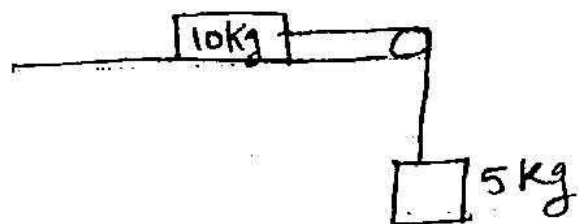
Q11. A cricket player while catching a ball, pulls his hand back. Why?

Q12. Two springs with constants  $K_1$  and  $K_2$  are given such that  $K_1 > K_2$ . In which spring, more work is to be done if they are stretched by same force? Explain.

Q13. Derive the expression for the variation of 'g' with height above the earth's surface. Represent it graphically for  $h \ll R_e$ .

Q14. Determine the value of  $\lambda$  such that  $\vec{A} = 2\hat{i} + \lambda\hat{j} + \hat{k}$  and  $\vec{B} = 4\hat{i} - 2\hat{j} - 2\hat{k}$  are perpendicular to each other.

Q15. A body of mass 10 kg is placed on a smooth horizontal surface. It is connected to a massless



string which passes over a frictionless pulley and is connected to another mass of 5 kg as shown. Find the

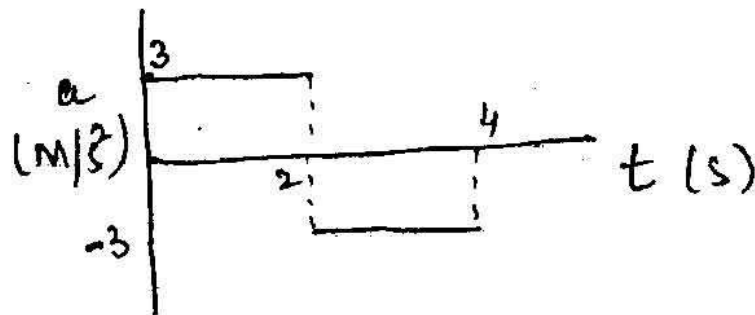
tension in the string when the masses slide with acceleration. ( $g = 10 \text{ m/s}^2$ )

- Q16. Two masses of 100 kg and 400 kg are separated by 1m. Where should a third object of 10 kg be placed so that the net gravitational force on the third object is zero.

OR

Two spheres of radius  $R$  and  $2R$  are touching each other. If the density of each sphere is  $\rho$ , then find the gravitational force of attraction between them.

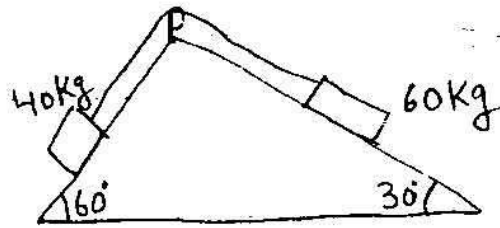
- Q17. A particle starts from rest at  $t = 0$  and has the acceleration-time graph as shown. Draw the corresponding velocity-time graph for 4s and find the distance covered in 4s.



- Q18. If the velocity of a particle varies with its position as  $v = \sqrt{100 - 4x}$ , then find the acceleration of the particle.
- Q19. Derive the dimensional formula for momentum ( $p$ ) in terms of velocity ( $v$ ), density ( $d$ ) and frequency ( $f$ ).
- Q20. (i) State the parallelogram law of vector addition.  
(ii) Explain walking of a person on a horizontal surface using resolution of vectors.
- Q21. A block of mass 15 kg is placed on a long trolley. The coefficient of static friction between the block and trolley is 0.18. The trolley accelerates from rest at the rate of  $.5 \text{ m/s}^2$  for 20s and then moves with uniform velocity. Discuss the motion of the block as viewed by (a) a stationary observer on the ground (b) an observer moving with the trolley.

OR

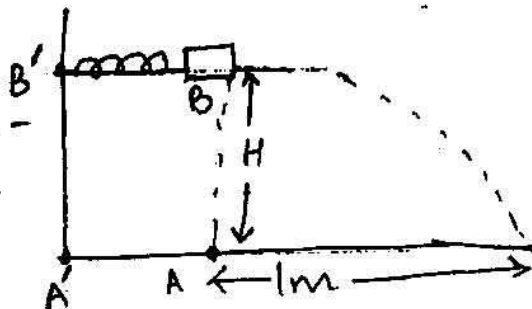
Two blocks are connected by light, inextensible string over a frictionless pulley resting on two smooth inclined planes as shown.



Determine the acceleration of the blocks and tension in the string.

- Q22. A child fell into the river. He did not know swimming so he started to flow along with the water current at  $3\text{ m/s}$  (horizontally). He is  $1\text{ m}$  away from the river bank. A man saw him and jumped into the river to save him at  $5\text{ m/s}$  directly from the point in front of the child. In which direction, should the man swim to save the child in (a) shortest time (b) shortest distance.
- Q23. Derive the expression for the escape velocity of an object from the surface of earth. Also find the expression for the escape velocity if the object revolves around the earth at a height  $h$  above the surface with speed  $v$ .
- Q24. Prove that gravitational force is conservative force. Give an example of non-conservative force.
- Q25. A batsman deflects the ball by an angle of  $45^\circ$  without changing its speed which is  $54\text{ km/h}$ . What is the impulse imparted to the ball? Mass of the ball is  $0.15\text{ kg}$ . If the time of impact is  $0.1\text{ s}$ , then find the force exerted by the batsman on the ball.
- Q26. A small block of mass  $100\text{ g}$  rests on a horizontal surface pressing a spring fixed at B by  $5\text{ cm}$ . When released, the block moves horizontally and hits the ground  $1\text{ m}$  away from point A. Find the height (H) of point B from the point A. Spring constant,  $K = 100\text{ N/m}$

State &  
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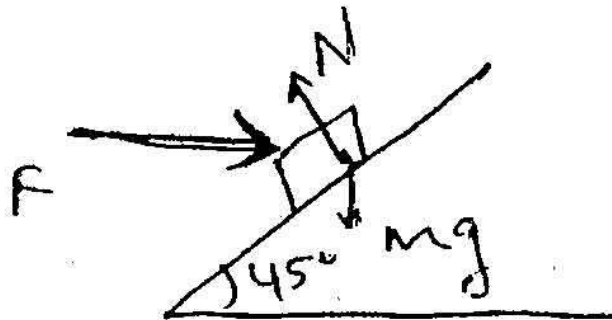


- Q27. (i) Write the number of significant figures in 0.0180.  
 (ii) The percentage error in the measurement of length of a rectangle is 3% and that in its breadth is 5%. Find the percentage error in its area.
- Q28. (i) A projectile is fired at an initial speed 'u' at an angle ' $\theta$ ' with the horizontal. Write the equation for its trajectory. Obtain the expressions for its range and time of flight.  
 (ii) Find the angle of projection for which range of a projectile is equal to its height.

OR

A car starts from rest and accelerates uniformly at  $5 \text{ m/s}^2$ , then moves uniformly and then retards at the  $5 \text{ m/s}^2$  to come to rest. The total time of motion is 25s. The average velocity during the time is equal to 72 km/h. How long does the car move uniformly?

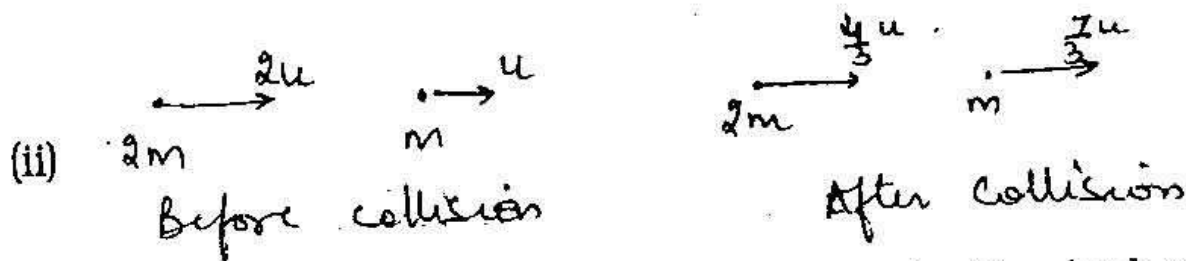
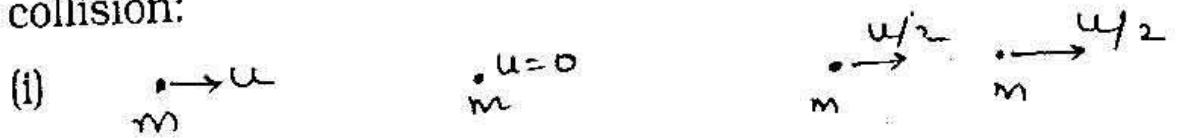
- Q29. A 10 kg body is pushed up a 4m long frictionless plane inclined at  $45^\circ$  by a horizontal force (F) :
- (a) If the speed at the bottom is 4 m/s and the top is 8 m/s, how much work (W) is done by the force (F)?  
 (b) Suppose the coefficient of friction between the body and the plane is 0.15, what work will the force do and how far up the plane does the body go?



OR

Two bodies of masses  $M_1$  and  $M_2$  moving with speeds  $u_1$  and  $u_2$  in same direction collide elastically. Derive the expressions for their final speeds  $V_1$  and  $V_2$ . In the given

situations, check which figure represents an elastic collision:



Q30. Derive an expression for the maximum speed with which a vehicle can take turn on curved banked road, if the coefficient of friction between road and vehicle is  $\mu$ .

OR

- (a) Define centripetal acceleration and mark its direction in a uniform circular motion. Derive an expression for the centripetal acceleration.
- (b) Why does a cyclist bend while moving along a curved road at very high speed?