HALF YEARLY EXAMINATION, 2016–17

PHYSICS

Time : 3 hrs. **Class : XI** **M.M. : 70**

General Instructions :

(i) All questions are compulsory.

(ii) Question numbers 1 to 5 are very short answer questions and carry 1 mark each.

(iii) Question numbers 6 to 10 are short answer questions and carry 2 marks each.

(iv) Question numbers 11 to 22 are also short answer questions and carry 3 marks each.

(v) Question number 23 is a value based question carries 4 marks.

(vi) Question numbers 24 to 26 are long answer questions and carry 5 marks each.

(vii) Use log tables, if necessary. Use of calculators is not allowed.

1. Two ball bearings of mass m each moving in opposite directions with same speed v collide head on with each other. If the collision is perfectly elastic, what will be the outcome of the collision ?

2. Action and reaction are equal and opposite. Why do they not balance each other ?

3. When can an object be considered as a point object ?

4. A retarding force is applied to stop a motor car. If the speed of the motor car is doubled, how much more distance will it cover before stopping under the same retarding force.

5. Draw position time graphs of uniform motion for two objects having zero relative velocity.

6. A monkey is ascending a branch with constant acceleration. If the breaking strength is 160% of the monkey's weight, what is the maximum acceleration permitted for the monkey ?

A particle is projected upwards from the surface of the earth of radius R with a kinetic energy equal to half the minimum valu needed for it to escape. To what height does it rise above the surface of the earth ?

OR

If 'g' is the acceleration of the gravity, on the earth's surface, find the gain in potential energy of a body of mass 'm' when taken from the surface of earth at a height equal to three times the radius of the earth 'R'.

8. What is conservation law of linear momentum ?

A body of mass 1 Kg initially at rest explodes and breaks in to three fragments of masses in the ratio 1 : 1 : 3. The two pieces of equ mass fly off perpendicular to each other with a speed of 30 m/s each. What is the velocity of the heavier fragment ?

9. The voltage across a lamp is $V = (6.0 \pm 0.1)$ Volt and the current passing through it $I = (4 \pm 0.2)$ ampere. Find the power consumed by the electric lamp with proper error limit. Given that $P = VI$.

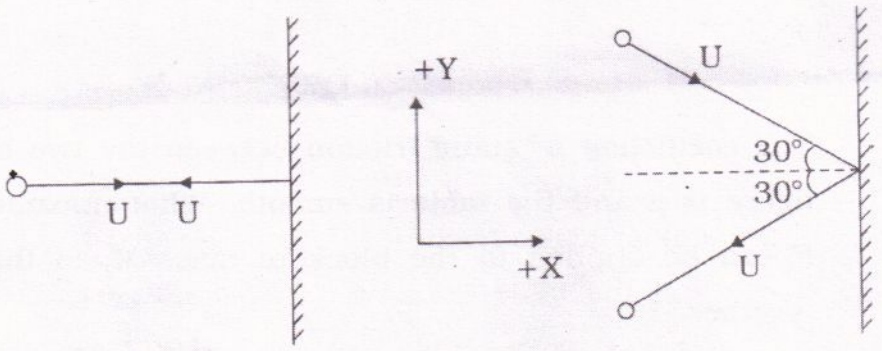
10. Find the expression which gives the effect on 'g" of the altitude 'h' for (i) $h << R$ and (ii) $h >> R$. Where 'R' is the radius of the earth.

11. A spring of force constant k is cut in to two pieces of lengths l_1 and l_2. Calculate force constant of each part.

12. Two identical billiard balls strike a rigid wall with the same speed but at different angles and get reflected without any change in a speed as shown in figure.

(i) What is the direction of the force 4 on the wall due to each ball ?

(ii) What is the ratio of the magnitudes of impulses imparted to the balls by the wall ?



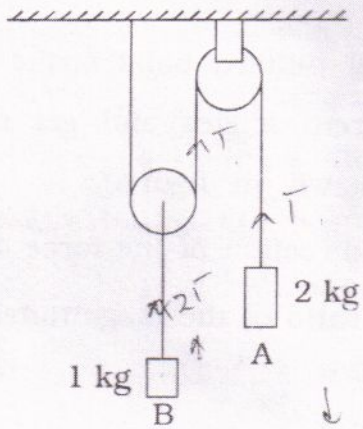
(a) (b)

13. State and prove the expression of kinetic energy and work energy theorem by calculus method.

14. A particle traversed half the distance with a velocity v_0. The remaining part of the distance was covered with velocity v_1 for half the time, and with velocity v_2 for the other half of the time. Prove

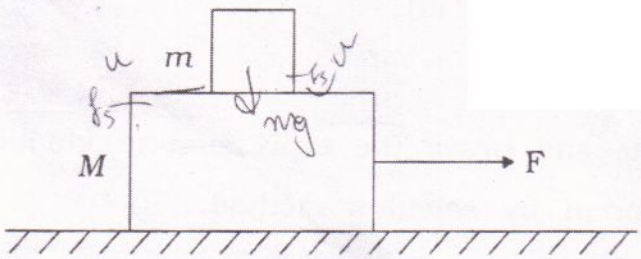
that the average speed of the particle averaged over the whole time of motion is $\frac{2v_0(v_1 + v_2)}{(v_1 + v_2 + 2v_0)}$.

15. Find the accelerations of the blocks A and B (in the form of g no need to put the values) in the situation given in the figure and specify the upward and downward motion of the blocks respectively.



OR

The coefficient of static friction between the two blocks shown in the figure is μ and the table is smooth. What maximum horizontal force F can be applied to the block of mass M so that the blocks move together ?



16. Prove that Newton's second law is the real law. Why is it so called ?

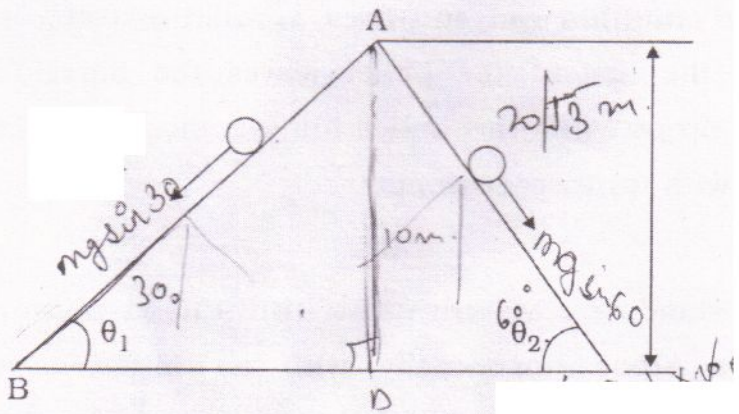
17. Prove the distance-time relation and velocity-displacement relation by calculus method.

18. Construct a new physical quantity having dimensions of length in terms of universal constants G (universal constant of gravitation), (speed of light) and h (Planck's constant).

19. State Kepler's laws of planetry motion and explain the deduction of third law.

20. What is the uniform circular motion and explain why is this motion an accelerated motion. Derive the expression of centripetal acceleration with the help of neat and clean diagram.

21. Two inclined frictionless tracks, one gradual and the other steep meet at a from where two stones are allowed to slide down from rest, on each track. Will the stones reach the bottom at the same time ? Will they reach there with the same speed ? Explain, Given $\theta_1 = 30°$, $\theta_2 = 60°$ and $h = 10$ m, what are the speeds and times taken by the two stones ?



22. What is the gravitational potential energy and derive its expression ? What is the significance of the negative sign in the formula ?

23. On a foggy night, a train was coming from Agra to Delhi at a slow speed. The train was almost full to its capacity as people were coming after visiting the Taj Mahal. Suddenly the driver sighted another train at some distance ahead of him moving in the same direction on the same track but with slower speed. He applied brakes to slow down his train and averted a major rail accident. The driver of the train was awarded for the same.

(i) What are the abilities of driver which you will appreciate ?

(ii) If the first train is moving with velocity v_1 and velocity of the other train is v_2, show that there will be no collision if : $d > \frac{(v_1 - v_2)^2}{2a}$.

(iii) What is the relative velocity of two objects moving with same velocity in the same direction ?

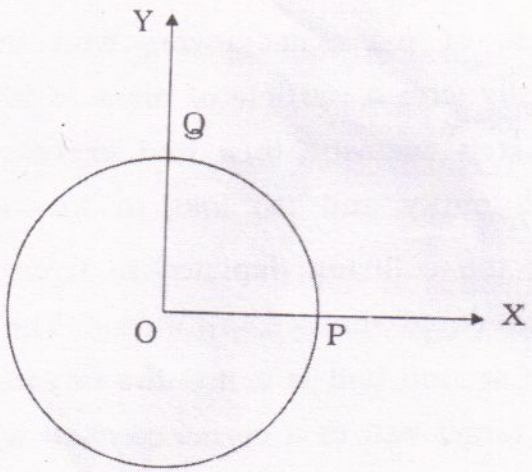
24. Find the equation of the trajectory of a projectile which is projected at an angle 'θ' with the horizontal and find its (i) time of flight (ii) maximum height (iii) Horizontal range and maximum horizontal range.

A hunter aims his gun and fires a bullet directly at a monkey in a tree. At the instant the bullet leaves the barrel of the gun, the monkey drops. Will the bullet hit the monkey ? Substantiate your answer with proper reasoning.

OR

(i) A hiker stands on the edge of a cliff 490 m above the ground and throws a stone horizontally with an initial speed of 15 m/s. Neglecting air resistance, find the time taken by the stone to reach the ground, and the speed with which it hits the ground.
(Take $g = 9.8\ m/s^2$)

(ii) A particle moves in a circle of radius 4.0 cm clockwise at constant speed of 2 cm/s. If $x\hat{}$ and $y\hat{}$ are unit acceleration vectors along X-axis and Y-axis respectively (in cm/s^2), find the acceleration of the particle at the instant halfway between P and Q.



25. What do you mean by the phenomenon of the banking of roads ? What is the purpose of it.

Find the maximum velocity of a vehicle on a banked road with the help of a suitable labelled diagram, with which it can take turn without slipping.

Show that maximum speed with which a car can turn on a banked road without skidding is greater than that on unbanked road.

What is the speed at which a banked road can be rounded even when there is no friction ?

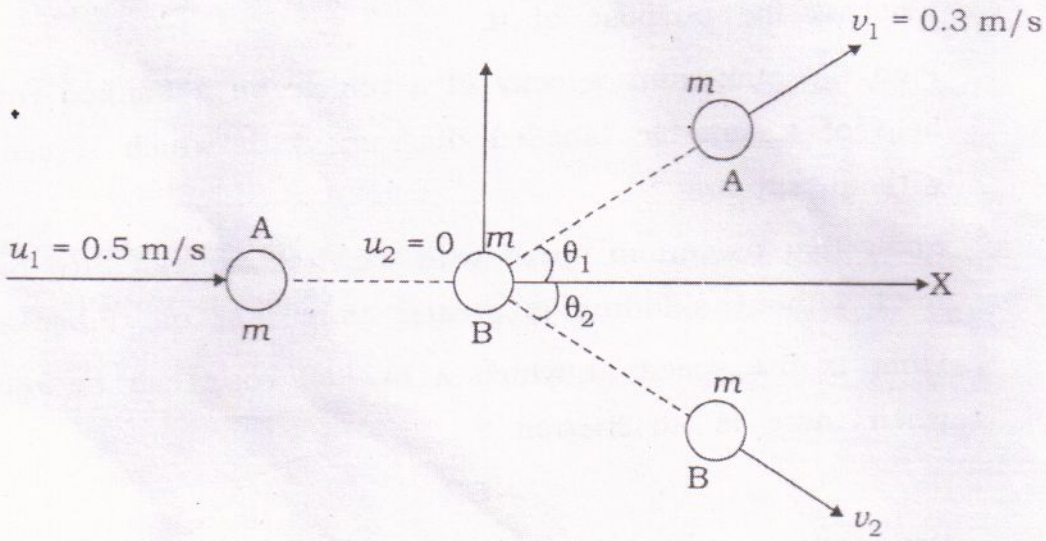
OR

Define the terms "angle of friction" and the "angle of repose" and prove the relation between them with the help of suitable diagrams.

A particle of mass 0.2 Kg has an initial speed of 5 m/s at the bottom of a rough inclined plane of inclination of 30° and vertical height 0.5 m. What is the speed of the particle as it reaches the top of the inclined plane ? (Take $\mu = \frac{1}{\sqrt{3}}$, $g = 10\ m/s^2$)

26. (i) A particle of mass m moving with an initial velocity u collides inelastically with a particle of mass M initially at rest. If the collision is completely inelastic then find expressions for (a) final velocity of combined entity and (b) loss in kinetic energy during collision.

(ii) Consider the collision depicted in figure to be between two billiard balls with equal masses $m_1 = m_2$. The first ball is called the cue while the second ball is called the target. The billiard player wants to sink the target ball in a corner pocket, which is at an angle $\theta_2 = 37°$. Assume that the collision is elastic and that friction and rotational motion are not important. Obtain θ_1.



OR

Explain what is meant by potential energy of a spring ? Obtain an expression for it and discuss the nature of its variation also show the variation of K.E, P.E. and T.E. with distance. A ball of mass m is dropped from a height h on a platform fixed at the top of a vertical spring. The platform is depressed by a distance x. What is the spring constant K ?