CLASS TEST

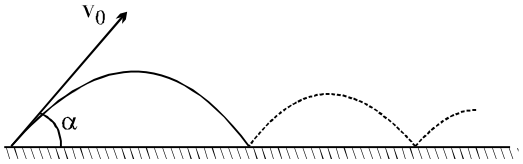
SECTION-I

Single Correct Answer Type **6 Q. [3 M (–1)]**

1. A particle of mass m and momentum $\vec{P}$ moves an a smooth horizontal table and collides directly and perfectly elastically with a similar particle (of mass m) having momentum $-\vec{2P}$. The loss (–) or gain (+) in the kinetic energy of the first particle in the collision is

(A) $+\frac{p^2}{2m}$ (B) $-\frac{p^2}{4m}$ (C) $+\frac{3p^2}{2m}$ (D) zero

2. A particle of mass 'm' is projected with velocity v_0 at an angle 'α' with the horizontal. The coefficient of restitution for any of its impact with the smooth ground is e.



(A) Total time taken by the particle before it stops moving vertically is $\frac{2v_0 \sin\alpha}{g(1-e)}$

(B) Total horizontal distance moved in the time before it stops moving vertically is $\frac{v_0^2 \sin 2\alpha}{2g(1-e)}$

(C) Average force on the particle over the time interval in which it makes first 'n' impacts with ground equals $\frac{mg}{2}(1-e^n)$ directed upwards.

(D) Average force on the particle over the time interval in which it makes first 'n' impact equals $\frac{mg}{2}(1-e^n)$ directed downwards

3. A particle is projected at an angle to the horizontal from a point on a smooth horizontal floor. It is found that ratio of the first maximum height attained to maximum height reached by it after 3rd collision with the floor is $\frac{10^{12}}{2^{36}}$. Find coefficient of restitution between particle and floor.

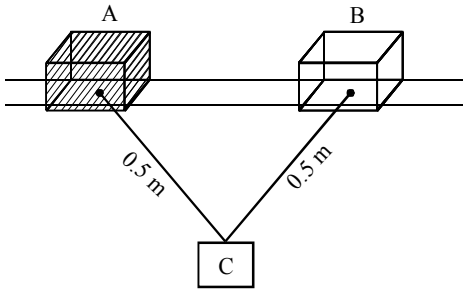
(A) 0.72 (B) 0.64 (C) 0.56 (D) None of the above

4. A circus acrobat of mass M leaps straight up with initial velocity V_0 from a trampoline. As he rises up, he takes a trained monkey of mass m hanging from a branch at a height h above the trampoline. What is the maximum height attained by the pair (from the branch) ?

(A) $\frac{M}{M+m}\left(\frac{V_0^2}{2g}-h\right)$ (B) $\left(\frac{M}{M+m}\right)^2\left(\frac{V_0^2}{2g}-h\right)$

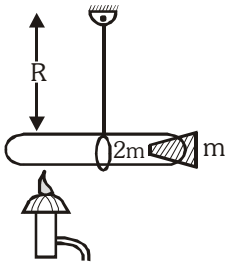
(C) $\left(\frac{m}{M+m}\right)\left(\frac{V_0^2}{2g}-h\right)$ (D) $\left(\frac{m}{M+m}\right)^2\left(\frac{V_0^2}{2g}-h\right)$

5. In the figure shown two blocks A & B each of mass m having initial separation of 80 cm are placed on smooth horizontal rails. Another block C having mass 2m is attached with A & B with the help of string of length 0.5 m each. Block C lies 30 cm vertically below the rails. The coefficient of restitutions is $\frac{1}{\sqrt{2}}$ for any collision. The maximum separation between block A & B on rails after they collide when system is released from the rest position :-



(A) 30 cm (B) 40 cm (C) 60 cm (D) 80 cm

6. A test tube of mass 2m closed with a cork of mass m contains a drop of liquid of negligible mass. When the test tube is heated, the liquid evaporates and the cork flies off under the pressure of the gas. What must be the minimum velocity with which the cork must be ejected such that the test tube describes a full circle of radius R about the pivot ? (Assuming test tube as a point object)



(A) $\sqrt{5Rg}$ (B) $2\sqrt{5Rg}$

(C) $2\sqrt{3Rg}$ (D) $2\sqrt{4Rg}$

Multiple Correct Answer Type 4 Q. [4 M (–1)]

7. A set of n–identical cubical blocks lies at rest parallel to each other along a line on a smooth horizontal surface. The separation between the near surfaces of any two adjacent blocks is L. The block at one end is given a speed v towards the next one at time t = 0. All collisions are completely inelastic, then :

(A) The last block starts moving at $t = n\,(n-1)\frac{L}{2v}$

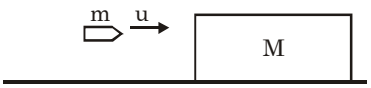
(B) The last block starts moving at $t = (n-1)\frac{L}{v}$

(C) After all collisions the centre of mass of the system will have a speed $\frac{v}{n}$

(D) After all collisions the centre of mass of the system will have a speed v.

8. A bullet of mass m travelling horizontally with speed u strikes a wooden block of mass 'M' placed on a smooth horizontal plane. The penetration is assumed uniform and the bullet comes to rest after penetrating a distance 'd' into the block. Then choose the correct statement:

(A) Ultimately the total loss of kinetic energy is $\frac{mMu^2}{2(M+m)}$



(B) The value of the resistance force (assumed constant) offered by the wood is $F = \frac{mMu^2}{2d(M+m)}$

(C) The distance covered by the bullet w.r.t. the ground before it comes to rest w.r.t. block is $\frac{dm}{M+m}$

(D) The block moves greater distance than the bullet w.r.t. ground.

9. Two particles A & B of masses m and 2m respectively are connected through a spring in its natural length. They are projected directly away from each other along spring with the same speed. Mark the correct statement(s) :

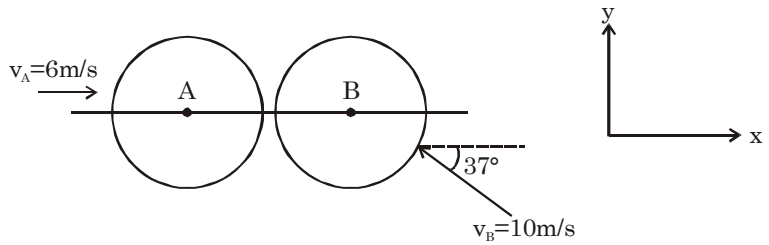
(A) At the moment of maximum distance between them, the particles are moving with same speed in same direction

(B) At the moment of maximum distance between them, the particles are moving with same speed in opposite direction

(C) Minimum individual speed of the particles A & B are both zero

(D) Minimum individual speed of the particles A & B are both non-zero

10. Two identical discs of mass 2kg are moving with initial velocities $\vec{v}_A$ and $\vec{v}_B$ and collide as shown. If the collision is perfectly elastic,



(A) Velocity of A after collision is $-8\hat{i}$ m/s.

(B) Velocity of B after collision is $6\hat{i}$ m/s.

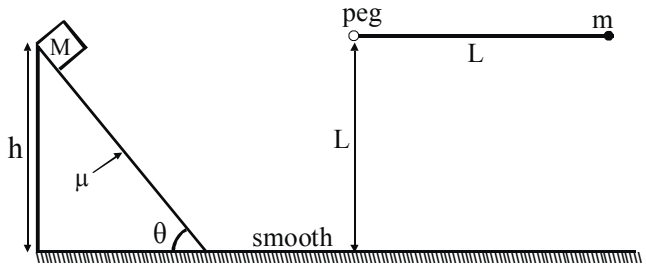
(C) Impulse of collision on A is $-28\hat{i}$ Ns.

(D) Loss of KE of B during collision is 28 J.

Linked Comprehension Type (2 Para × 3Q.) [3 M (-1)]
(Single Correct Answer Type)

Paragraph for Question 11 to 13

A large mass M is released from rest at the top of an inclined plane of angle θ and friction coefficient μ. At the same time, a pendulum consisting of a small mass m and (massless) string of length L is released at height L (horizontally). The large mass slides down the incline and smoothly onto the table, continues across the frictionless table, and collides with the pendulum's mass just as the pendulum has reached the bottom of its swing and is approaching the large mass. The two masses stick together after the collision.



11. Assuming the mass M is released at a height h, what is the its velocity when it reaches the flat part of the table?

(A) $\sqrt{2gh(1+\mu\tan\theta)}$ (B) $\sqrt{gh(1+\mu\cot\theta)}$ (C) $\sqrt{2gh(1-\mu\cot\theta)}$ (D) $\sqrt{gh(1-\mu\tan\theta)}$

12. For what initial height h of the mass M will the combined mass come to rest immediately after the collision? [Take μ=0]

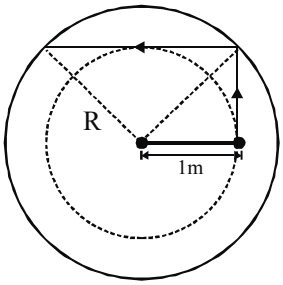
(A) $\frac{m^2}{M^2}L$ (B) $\left(\frac{m^2+M^2}{M^2}\right)L$ (C) $\left(\frac{M^2}{m^2}\right)L$ (D) $\left(\frac{m^2}{m^2+M^2}\right)L$

13. What must the initial height h have been in order for the pendulum of the combined mass to complete the vertical circle in the counterclockwise direction? [Take μ=0 and M = 2m]

(A) $h = \frac{L\left(\sqrt{2}+3\sqrt{5}\right)^2}{8}$ (B) $h = \frac{L\left(3\sqrt{2}-\sqrt{5}\right)^2}{4}$ (C) $h = \frac{L\left(3\sqrt{2}+\sqrt{5}\right)^2}{9}$ (D) none

Paragraph for question 14 to 16

A small ball of mass 1 kg is kept in circular path of radius 1m in fixed concentric smooth horizontal ring of radius R. Angular speed of the ball in the circular motion is 1 rad/s. At a certain moment the string, which kept the ball in the circular path breaks and the ball goes off tangentially to the wall of rigid, fixed ring and bounces off elastically and again hits the ring and bounces off. After completing one round about the centre, the seventh collision takes place exactly at the position of the first collision.



14. Total impulse imparted to the ring by the ball in first three collision will be

(A) √3 Ns (B) 2 Ns (C) 1 Ns (D) 3 Ns

15. Following quantities of the ball will remain a constant relative to the centre of the ring during one complete cycle of collisions.

(A) linear momentum (B) kinetic energy

(C) velocity, kinetic energy (D) Acceleration

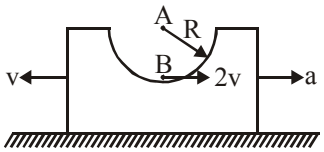
16. Value of radius of the ring R will be

(A) $\frac{2}{\sqrt{3}}$ m (B) $\sqrt{3}m$ (C) $\sqrt{2}m$ (D) 2m

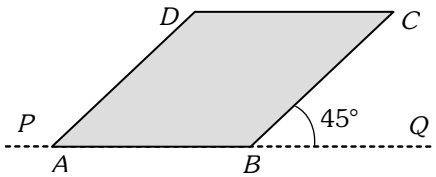
SECTION-III

Numerical Grid Type (Single digit Ranging from 0 to 9) 2 Q. [4 M(0)]

1. A bead kept at the bottom of a wedge moves towards right with a velocity 2v. If the wedge moves towards left with a velocity v while accelerating towards right with an acceleration a as shown then the magnitude of acceleration of the bead is x units. Find x if v = 3 and R = 9 units.



2. A thin sheet cut in the shape of a parallelogram of mass 500 g is shown in the figure. Each side of the parallelogram is 6 m. Find the moment of inertia (SI units) of the sheet about the axis PQ that coincides with edge AB of the sheet.



CLASS TEST # 39 **ANSWER KEY**

SECTION-I

Single Correct Answer Type **6 Q. [3 M (–1)]**

1. Ans. (C) **2. Ans. (A)** **3. Ans. (B)** **4. Ans. (B)**

5. Ans. (C) **6. Ans. (B)**

Multiple Correct Answer Type **4 Q. [4 M (–1)]**

7. Ans. (A,C) **8. Ans. (A,B)** **9. Ans. (A,C)** **10. Ans. (A, C, D)**

Linked Comprehension Type **(2 Para × 3Q.) [3 M (-1)]**

(Single Correct Answer Type)

11. Ans. (C) **12. Ans. (A)** **13. Ans. (A)** **14. Ans. (B)**

15. Ans. (B) **16. Ans. (A)**

SECTION-III

Numerical Grid Type (Single digit Ranging from 0 to 9) **2 Q. [4 M(0)]**

1. Ans. 9 **2. Ans. 3**