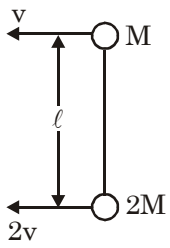
CLASS TEST

SECTION-I

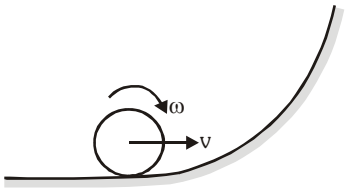
Single Correct Answer Type **8 Q. [3 M (–1)]**

1. On a smooth level ground we keep a light rod to which 2 masses M & 2M are attached. The velocities of these mass at the moment is shown here. Choose the **INCORRECT** statement.



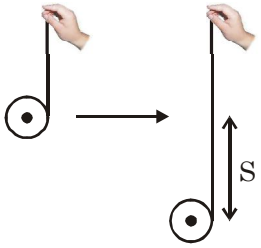
(A) The velocities of masses remain constant.
(B) The angular velocity of the rod is V/L clockwise
(C) The rod is under tension
(D) The centre of mass will move in a straight line.

2. A solid sphere rolling without slipping on a horizontal rough surface and starts rising on inclined rough surface as shown in the figure assume pure rolling throughout the motion. Choose the **INCORRECT** statement :-



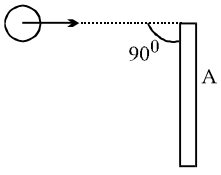
(A) friction force is zero when moving on horizontal surface
(B) direction of friction force is upward when moving upward on inclined plane
(C) direction of friction force is upward when moving downward on inclined plane.
(D) friction force is always opposite to the motion of the sphere.

3. In the given figure, a light string is wound round the rim of a yo-yo of mass m and radius r. One end of the string is held by a person. When the yo-yo is released from rest, it falls and rotates at a linear acceleration of 0.8g. What is the tension in the string?



(A) 0 (B) 0.2 mg (C) 0.4 mg (D) 0.8 mg

4. A thin rod of mass M and length L is struck at one end by a ball of clay of mass m, moving with speed v as shown in figure. The ball sticks to the rod. After the collision, the angular momentum of the clay-rod system about A, the midpoint of the rod, is

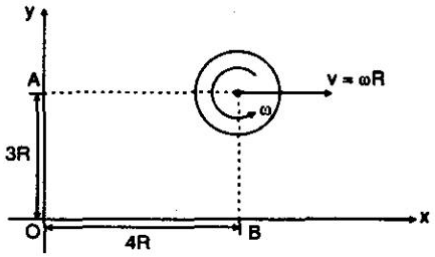


(A) $\left(m+\frac{M}{3}\right)\left(\frac{vL}{2}\right)$ (B) $\left(m+\frac{M}{12}\right)\left(\frac{vL}{2}\right)$ (C) $\frac{mvL}{2}$ (D) mvL

5. A solid spherical body of mass 2 kg projected on a rough horizontal ground having coefficient of friction '0.2'. If the initial velocity of sphere is 14m/s and it have zero angular velocity. Find the net work by the friction when sphere starts pure rolling :

(A) 56 Joule (B) 60 Joule (C) 98 Joule (D) 48 Joule

6. A disc of mass M and radius R moves in the x-y plane as shown in the figure. The angular momentum of the disc at the instant shown is:



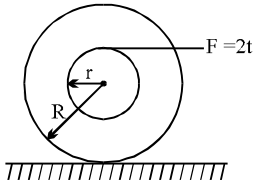
(A) $\frac{5}{2}mR^2\omega$ along- z axis about O

(B) $\frac{5}{2}mR^2\omega$ along + z axis about O

(C) zero about point A

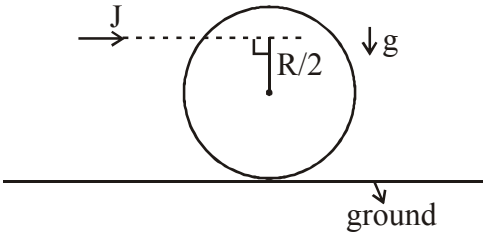
(D) $4\,mR^2\omega$ along +Z axis about A

7. A time varying force F = 2t is applied on a spool rolling as shown in figure. The angular momentum of the spool at time t about bottommost point is:



(A) $\frac{r^2t^2}{R}$ (B) $\frac{(R+r)^2}{r}t^2$ (C) $(R+r)t^2$ (D) data is insufficient

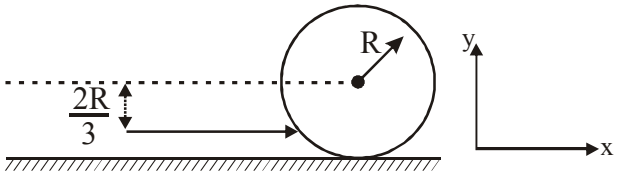
8. A disc is placed vertically at rest on a rough horizontal ground. An impulse J is imparted to the disc as shown in the fig. Then just after the impulse imparted the disc will,



(A) slip forward (B) slip backward (C) starts pure rolling (D) None

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

9. A billiard ball initially at rest is given a sharp blow by a cue stick. The force is horizontal and is applied at a distance 2R/3 below the centreline, as shown in figure. The initial speed of the ball is v_0, and the coefficient of kinetic friction is μ_k.



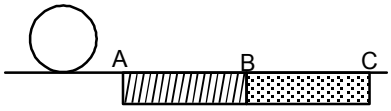
(A) Initially kinetic friction acts in $-\hat{i}$ direction.

(B) Initially kinetic friction in $\hat{i}$ direction.

(C) Ball instantaneously starts pure rolling.

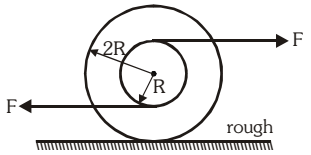
(D) Initial angular velocity of ball is $\frac{5v_0}{3R}$.

10. A rigid body performing rolling motion without slipping encounters horizontal fixed tracks AB (smooth) and BC (rough with $\mu = 1$) as shown. Choose the **CORRECT** statement(s) :-



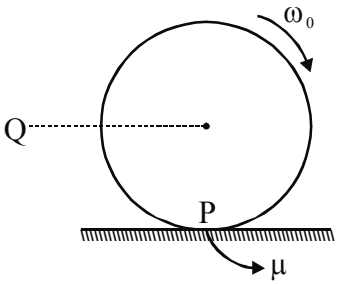
(A) the body will slow down over BC
(B) the body will start slipping on AB
(C) the body will roll without slipping over the whole stretch AC
(D) the angular velocity of the body remains constant over the whole stretch AC.

11. A spool is pulled horizontally on rough surface by two equal and opposite forces as shown in the figure. Select current statement(s).



(A) Frictional force acts rightward. (B) Frictional force acts leftward.
(C) The centre of mass remains stationary. (D) The centre of mass moves towards right.

12. A disc of mass 'm' and radius 'R' is rotating with angular speed ω_0 and speed zero as shown and then placed on a rough surface (coefficient of friction = μ) and left. Then

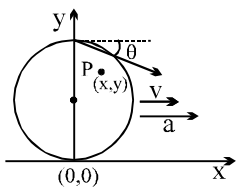


(A) angular momentum of disc is conserved about point Q.
(B) angular momentum of disc is conserved about point P on the ground.
(C) initially the force of friction is μmg leftward.
(D) initially the force of friction is μmg rightward.

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

Paragraph for Questions no. 13 and 14

A disc having radius R is rolling without slipping on a horizontal (x-z) plane. Centre of the disc has a velocity v and acceleration a as shown.



13. Speed of the point P having coordinates (x,y) is:

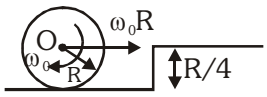
(A) $\frac{v\sqrt{x^2+y^2}}{R}$ (B) $\frac{v\sqrt{x^2+(y+R)^2}}{R}$ (C) $\frac{v\sqrt{x^2+(y-R)^2}}{R}$ (D) None

14. If $v = \sqrt{2aR}$ the angle θ between acceleration of the top most point and horizontal is:

(A) 0 (B) 45° (C) $\tan^{-1} 2$ (D) $\tan^{-1}\left(\frac{1}{2}\right)$

Paragraph for Questions no. 15 and 16

A cylinder of mass m and radius R is rolling without slipping on a horizontal surface with angular velocity ω_0. The velocity of centre of mass of cylinder is $\omega_0 R$. The cylinder comes across a step of height R/4 (Assume required friction is present at edge of the step.) Answer the following questions based on above information.



15. Then the angular velocity of cylinder just after the collision is (Assume cylinder remains in contact and no slipping occurs on the edge of the step :-

(A) $5\omega_0/6$ (B) ω_0 (C) $2\omega_0/3$ (D) $6\omega_0/5$

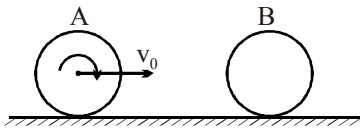
16. Find the maximum angular velocity (ω_0) of cylinder so that cylinder rides up the step without slipping or jumping

(A) $\frac{3}{5}\sqrt{\frac{3g}{R}}$ (B) $\frac{2}{5}\sqrt{\frac{3g}{R}}$ (C) $\frac{1}{5}\sqrt{\frac{3g}{R}}$ (D) $\frac{2}{5}\sqrt{\frac{g}{R}}$

SECTION-III

Numerical Grid Type (Ranging from 0 to 9) 1 Q. [4 M (0)]

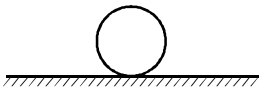
1. A hollow spherical ball A rolling (v_0 = 10 m/s) without slipping on rough horizontal plane strikes another identical ball headon as shown in the figure. Collision is perfectly elastic. During the collision, the angular velocity of either of the balls does not change. Velocity (in m/s) of ball B when it starts pure rolling is



SECTION-IV

Matrix Match Type (4 × 4) 1 Q. [8 M (for each entry +2(0)]

1. Assume that a spherical ball is kept on a rough ground. Column-I indicates situation related to ball and column-II indicates effect that friction has on the ball.



	Column-I		**Column-II**
(A)	Ball is suddenly given clockwise ω centre of mass initially at rest.	(P)	Increases v_{cm}
(B)	Ball is given a velocity to right without any ω	(Q)	Decreases v_{cm}
(C)	Ball is given clockwise ω and given velocity to right such that $v_{cm} < \omega R$	(R)	Increases ω
(D)	Ball is given clockwise ω and velocity to right such that $v_{cm} > \omega R$	(S)	Decreases ω

SPECIAL CLASS TEST ON ROTATION # 11 **ANSWER KEY**

SECTION-I

Single Correct Answer Type **8 Q. [3 M (–1)]**

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

5. Ans. (A) **6. Ans. (A)** **7. Ans. (C)** **8. Ans. (C)**

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

9. Ans. (A,D) **10. Ans. (C, D)** **11. Ans. (A,D)** **12. Ans. (B,D)**

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

(Single Correct Answer Type)

13. Ans. (A) **14. Ans. (B)** **15. Ans. (A)** **16. Ans. (B)**

SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **1 Q. [4 M (0)]**

1. Ans. 6

SECTION-IV

Matrix Match Type (4 × 4) **1 Q. [8 M (for each entry +2(0)]**

1. Ans. (A)-P,S ; (B)-Q,R ; (C)-P,S ; (D)-Q,R