CBSE

SYSTEM OF PARTICLES AND ROTATIONAL MOTION WS 12

Class 11 - Physics

Section A

1. A solid cylinder of mass 3 kg is rolling on a horizontal surface with velocity 4 ms^{-1}. It collides with a horizontal spring of force constant 200 Nm^{-1}, The maximum compression produced in the spring will be **[1]**

   a) 0.5 m
   b) 0.6 m
   c) 0.2 m
   d) 0.7 m

2. A sphere rolls down an inclined plane of inclination θ. What is the acceleration as the sphere reaches bottom? **[1]**

   a) $\frac{2}{5}g\sin\theta$
   b) $\frac{5}{7}g\sin\theta$
   c) $\frac{3}{5}g\sin\theta$
   d) $\frac{2}{7}g\sin\theta$

3. A solid cylinder is rolling without slipping on a plane having inclination θ and the coefficient of static friction μ_s. The relation between θ and μ_s is **[1]**

   a) $\tan\theta \leq 3\mu_s$
   b) $\tan\theta < 3\mu_s^2$
   c) $\tan\theta > 3\mu_s$
   d) $\tan\theta \neq 3\mu_s$

4. A solid sphere, disc and solid cylinder all of the same mass and made of the same material are allowed to roll down (from rest) on the inclined plane, then **[1]**

   a) solid sphere reaches the bottom first
   b) disc will reach the bottom first
   c) solid sphere reaches the bottom last
   d) all reach the bottom at the same time

5. **Assertion:** When a sphere is rolling on a horizontal table, it slows down and eventually stops. **[1]**
   Reason: When the sphere rolls on the table, both the sphere and the surface deform near the contact. As a result, the normal force does not pass through the centre and provides an angular deceleration.

   a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
   b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
   c) Assertion is correct statement but reason is wrong statement.
   d) Assertion is wrong statement but reason is correct statement.

6. **Assertion:** A solid sphere is rolling on a rough horizontal surface. Tangential acceleration of contact point is zero. **[1]**
   Reason: For contact point, tangential acceleration is given by $a_t = a_{CM} - \alpha R = 0$.

   a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
   b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
   c) Assertion is correct statement but reason is
   d) Assertion is wrong statement but reason is

wrong statement.

correct statement.

7. **Assertion (A):** In case of pure rolling, the force of friction becomes zero. **[1]**

Reason (R): The speed at the point of contact is zero.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

8. **Assertion (A):** If bodies slide down an inclined plane without rolling, then all bodies reach the bottom simultaneously. **[1]**

Reason (R): Acceleration of all bodies are equal and independent of the shape.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

9. **Assertion:** A ring and a disc of same mass and radius begin to roll without slipping from the top of and inclined surface at t = 0. The ring reaches the bottom of incline at time t_1 while the disc reaches the bottom at time t_2, then $t_1 > t_2$. **[1]**

Reason: Disc will roll down the plane with a large acceleration because of its smaller moment of inertia.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

10. **Assertion (A):** The tendency of skidding or overturning is quadrupled, when a cyclist doubles his speed of turning. **[1]**

Reason (R): Angle of bending increases as the velocity of the vehicle increases.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

11. **Assertion:** In case of rolling without sliding, friction force can act in forward and backward direction both. **[1]**

Reason: The angular momentum of a system will be conserved only about that point about which external angular impulse is zero.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

Section B

12. A cylinder of mass 5 kg and radius 30 cm is rolling down an inclined plane at an angle of 45° with the horizontal. Calculate **[2]**

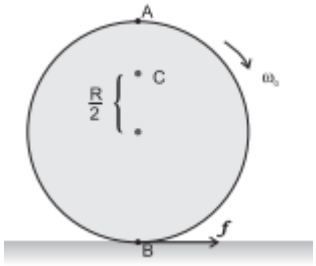
i. force of friction,

ii. acceleration with which the cylinder rolls down and

iii. the minimum value of static friction so that cylinder does not slip while rolling down the plane.

13. A wheel has a constant angular acceleration of 4.2 rad/s^2. During a certain 8.05 s interval, it turns through angle of 140 rad. Assuming that wheel started from rest, how long it had been in motion before the start of the 8.0 s? **[2]**

14. Explain why friction is necessary to make the disc in Fig, roll in the direction indicated. **[2]**



a. Give the direction of frictional force at B, and the sense of frictional torque, before perfect rolling begins.

b. What is the force of friction after perfect rolling begins?

Section C

15. A solid sphere rolls down two different inclined planes of the same heights but different angles of inclination. **[3]**

a. Will it reach the bottom with the same speed in each case?

b. Will it take longer to roll down one plane than the other? If so, which one and why?

16. A cylinder of mass 10 kg and radius 15 cm is rolling perfectly on a plane of inclination 30^o. The coefficient of static friction μs = 0.25. **[3]**

i. How much is the force of friction acting on the cylinder?

ii. What is the work done against friction during rolling?

iii. If the inclination θ of the plane is increased, at what value of θ does the cylinder begin to skid, and not roll perfectly?

Section D

17. **State True or False:** **[5]**

(a) For perfect rolling motion, work done against friction is zero. **[1]**

(b) During rolling, the force of friction acts in the same direction as the direction of motion of the CM of the body. **[1]**

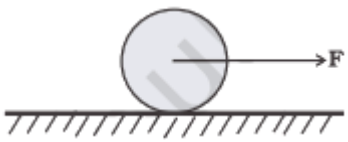
(c) A wheel moving down a perfectly frictionless inclined plane will undergo slipping (not rolling) motion. **[1]**

(d) The instantaneous speed of the point of contact during rolling is zero. **[1]**

(e) The instantaneous acceleration of the point of contact during rolling is zero. **[1]**

18. A metre scale AB is held vertically with its one end A on the floor and is then allowed to fall. Find the speed of the other end B when it strikes the floor, assuming that the end on the floor does not slip. **[5]**

19. A uniform disc of radius *R*, is resting on a table on its rim. The coefficient of friction between disc and table is μ (Figure). **[5]**



Now the disc is pulled with a force $\vec{F}$ as shown in the figure. What is the maximum value of F for which the disc rolls without slipping?

20. A solid cylinder rolls up an inclined plane of angle of inclination 30°. At the bottom of the inclined plane the centre of mass of the cylinder has a speed of 5 m/s. **[5]**

a. How far will the cylinder go up the plane?

b. How long will it take to return to the bottom?

21. A metal bar 70 cm long and 4.00 kg in mass supported on two knife-edges placed 10 cm from each end. A 6.00 kg load is suspended at 30 cm from one end. Find the reactions at the knife-edges. (Assume the bar to be of uniform cross-section and homogeneous). **[5]**