Topics : Units & Dimensions, Motion in 1D, Plane, NLM & Law of motion, Work Power & Energy , System of particles & Rotational Motion, Gravitation

Time Allowed: 3 hours | **Class 11 - Physics** | **Maximum Marks: 70**

1. Solve with due regard to significant figures $\sqrt{6.5 - 6.32}$. **[1]**

2. Which of the following have same dimensions? **[1]**

   a) torque and force
   b) potential energy and force
   c) Planck's constant and momentum
   d) torque and potential energy

3. A drag racer starts her car from rest and accelerates at 10.0 m/s^2 for the entire distance of 400 m . What is the speed of the race car in m/s at the end of the run? **[1]**

   a) 89.4
   b) 87.2
   c) 86.0
   d) 90.3

4. If the equation for the displacement of a particle moving on a circular path is given by $\theta = 2t^3 + 0.5$, where θ is in radians and t in seconds, then, the angular velocity of the particle at t = 2 s is **[1]**

   a) 8 rad s^{-1}
   b) 12 rad s^{-1}
   c) 36 rad s^{-1}
   d) 24 rad s^{-1}

5. A force vector applied on a mass is represented as $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ and accelerates with 1 m/s^2. What will be the mass of the body? **[1]**

   a) 20 kg
   b) $10\sqrt{2}$ kg
   c) $2\sqrt{10}$ kg
   d) 10 kg

6. A block of mass 10 kg is sliding on a surface inclined at an angle of 30° with the horizontal. If the coefficient of friction between the block and the surface is 0.5, find the acceleration produced in the block. **[1]**

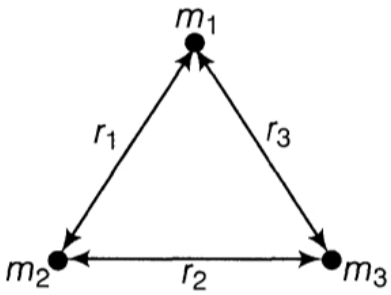
7. The radius of gyration of a solid disc about one of its diameter is given by: **[1]**

   a) $\frac{R}{2}$
   b) $\frac{R}{\sqrt{2}}$
   c) 2R
   d) $\sqrt{2}$R

8. A uniform metallic rod rotates about its perpendicular bisector with constant angular speed. If it is heated uniformly to raise its temperature slightly, then **[1]**

   a) its speed of rotation increases
   b) its speed increases because its moment of inertia increases
   c) its speed of rotation remains same
   d) its speed of rotation decreases

9. Gravitational potential energy of a system of particles as shown in the figure is **[1]**



a) $\frac{-Gm_1m_2}{r_1} - \frac{Gm_2m_3}{r_2} + \frac{Gm_1m_3}{r_3}$

b) $\frac{Gm_1m_2}{r_1} + \frac{Gm_2m_3}{r_2} - \frac{Gm_1m_3}{r_3}$

c) $\frac{Gm_1m_2}{r_1} + \frac{Gm_2m_3}{r_3} + \frac{Gm_1m_3}{r_3}$

d) $\left(\frac{-Gm_1m_2}{r_1}\right) + \left(\frac{-Gm_2m_3}{r_2}\right) + \left(\frac{-Gm_1m_3}{r_3}\right)$

10. **State True or False:** **[1]**

Acceleration of a body or system is always in the direction of force. **[1]**

11. A racecar accelerates on a straight road from rest to a speed of 180 kmh^{-1} in 25 s. Assuming uniform acceleration of the car throughout, find the distance covered in this time **[2]**

12. A person sitting in a moving train throws a ball vertically upwards. How will the ball appear to move to an observer (i) sitting inside the train (ii) standing outside the train? Give reason. **[2]**

13. A cyclist moves along a circular path of radius 70 m. If he completes one round in 11 s, calculate **[2]**

i. total length of path,
ii. magnitude of the displacement,
iii. average speed, and
iv. magnitude of average velocity

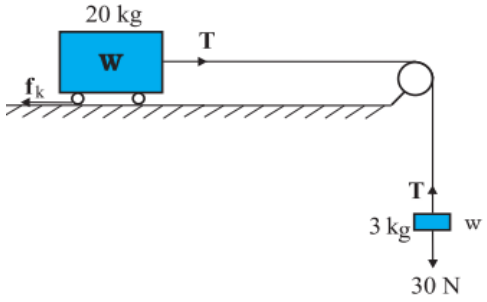
14. Two bodies whose masses are m_1 = 50 kg and m_2 = 150 kg are tied by a light string and are placed on a frictionless horizontal surface. When m_1 is pulled by a force F, and acceleration of 5 ms^{-2} is produced in both the bodies. Calculate the value of F. What is the tension in the string? **[2]**

15. i. State principle of conservation of momentum. **[2]**

ii. A bullet of mass 'm' is fired from a gun of mass **M** with a horizontal velocity **V**. Calculate the recoil velocity **v** of the gun.

16. A ball of mass 0.1 kg is suspended by a string 30 cm long. Keeping the string always taut, the ball describes a horizontal circle of radius 15 cm. Calculate the angular speed. **[2]**

17. What is the acceleration of the block and trolley system shown in a Figure? if the coefficient of kinetic friction between the trolley and the surface is 0.04? What is the tension in the string? (Take g = 10 ms^{-2}). Neglect the mass of the string. **[2]**



18. Define angular acceleration. Give its SI unit and dimensional formula. How is it related to linear (tangential) acceleration? **[2]**

19. The distance between the earth and the moon is 3.85 $\times$ 10^8 metre. At what point in between the two will the gravitational field intensity be zero? Mass of the earth = 6.0 $\times$ 10^{24} kg, mass of the moon = 7.26 $\times$ 10^{22} kg. **[2]**

20. If earth has a mass 9 times and radius 4 times than that of a planet "P". Calculate the escape velocity at the planet 'P' if its value on earth is 11.2 kms^{-1}. **[2]**

21. Draw the following graphs (expected nature only) representing motion of an object under free fall. Neglect air resistance. **[3]**

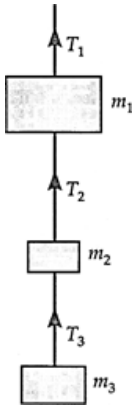
i. Variation of position with respect to time.

ii. Variation of velocity with respect to time.

iii. Variation of acceleration with respect to time.

22. State the law of conservation of linear momentum. Prove it by using the second law of motion. Give two situations where the linear momentum remains conserved. **[3]**

23. The masses m_1, m_2 and m_3 of the three bodies shown in figure are 5, 2 and 3 kg respectively . Calculate the values of the tensions T_1, T_2 and T_3 when **[3]**



i. the whole system is going upward with an acceleration of 2 ms^{-2} and

ii. the whole system is stationary. Given g = 9.8 ms^{-2}.

24. A body of mass m moving with speed v collides elastically head-on with another body of mass m initially at rest. Show that the moving body will come to a stop as a result of this collision. **[3]**

25. A person decides to use his bath-tub water to generate electric power to run a 40 W bulb. The bath-tub is located at a height of 10 m from the ground and it holds 200 litres of water. He installs a water-driven wheel generator on the ground. At what rate should the water drain from the bathtub to light the bulb? How long can he keep the bulb on, if the bath-tub was full initially? The efficiency of the generator = 90%. Take g = 9.8 ms^{-2}. **[3]**

26. From a uniform circular disc of diameter D, a circular disc or hole of diameter $\frac{D}{6}$ and having its centre at a distance of from the centre of the disc is scooped out. Determine the centre of mass of the remaining portion. **[3]**

27. Define angular momentum. Derive the relation between angular momentum and torque. **[3]**

28. A metre stick is balanced on a knife edge at its centre. When two coins, each of mass 5 g are put one on top of the other at the 12.0 cm mark, the stick is found to be balanced at 45.0 cm. What is the mass of the metre stick? **[3]**

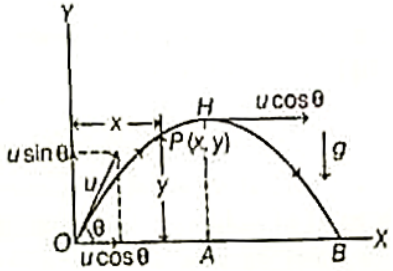
29. A cord is wound around the circumference of a wheel of diameter 0.3 m. The axis of the wheel is horizontal. A mass of 0.5 kg is attached at the end of the cord and it is allowed to fall from rest. If the weight falls 1.5 m in 4s, what is the angular acceleration of the wheel? Also find out the moment of inertia of the wheel. **[3]**

30. Derive an expression for g (acceleration due to gravity) at a depth d from the surface of earth. Consider the earth as a sphere of uniform mass density. What happens to **g** at the centre of earth. **[3]**

31. **Read the text carefully and answer the questions:** **[5]**

Projectile motion is a form of motion in which an object or particle is thrown with some initial velocity near the earth's surface and it moves along a curved path under the action of gravity alone. The path followed by a projectile is called its trajectory, which is shown below.

While resolving velocity (u) into two components, we get (a) u cos θ along OX and (b) u sin θ along OY.



(a) The example of such type of motion is

a) motion of boat in sea
b) a javelin thrown by an athlete
c) motion of ball thrown vertically upward
d) motion of car on a banked road

(b) The acceleration of the object in horizontal direction is

a) increasing
b) zero
c) constant
d) decreasing

(c) The vertical component of velocity at point H is

a) equal to horizontal component
b) double to that at O
c) zero
d) maximum

(d) A cricket ball is thrown at a speed of 28 ms in a direction 30° with the horizontal. The time taken by the ball to return to the same level will be

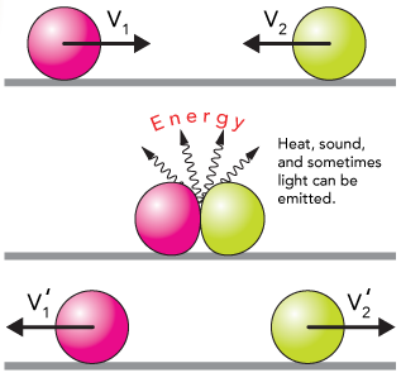
a) 2.0 s
b) 3.0 s
c) 4.0 s
d) 2.9 s

(e) In above case, the distance from the thrower to the point where the ball returns to the same level will be

a) 39 m
b) 69 m
c) 68 m
d) 72 m

32. **Read the text carefully and answer the questions:** **[5]**

An **elastic collision** is a **collision** in which there is no net loss in kinetic energy in the system as a result of the **collision**. Both momentum and kinetic energy are conserved quantities in **elastic collisions**.



(a) In which motion, momentum changes but K.E does not?

a) linear motion
b) straight-line motion
c) circular motion
d) parabolic motion

(b) The coefficient of restitution for elastic collision is:

a) 1
b) -1
c) infinite
d) 0

(c) Two balls at the same temperature collide. What is conserved?

a) Force
b) kinetic energy
c) velocity
d) momentum

(d) The momentum of two objects moving with the same speed but in opposite directions upon collision is

a) Fall
b) increased
c) decreased
d) zero

(e) In elastic collision, the relative speed of approach and separation is:

a) unequal
b) zero
c) equal
d) infinite