QB365

Important Questions - Laws of Motion

11th Standard CBSE

Physics

Reg.No. : | | | | | | |

Time : 01:00:00 Hrs

Total Marks : 50

Section-A

1) A body is acted upon by a number of external forces. Can it remain at rest ? **1**

2) If force is acting on a moving body perpendicular to the direction of motion, then what will be its effect on the speed and direction of the body ? **1**

3) A man suspends a fish from the spring balance held in his hand and the balance reads 9.8 N, While shifting the balance to his other hand, the balance slips and falls down. What will be the reading of the balance during the falls ? **1**

4) A body is moving in a circular path such that its speed always remains constant. Should there be a force action on the body? **1**

5) What is the acceleration of a train travelling at 50 ms^{-1} as it goes round a curve of 250m radius? **1**

6) A heavy points mass tied to the end of string is whirled in a horizontal circle of radius 20 cm with a constant angular speed. What is angular speed if the centripetal acceleration is 980 cms^{-2} ? **1**

7) Carts with rubber tyres are easier to ply than those with iron types. Explain. **1**

8) A ball of 1 g released down an inclined plane describe a circle of radius 10 cm in the vertical plane on reaching the bottom. What is the minimum height of the inclined plane? **1**

9) Why are porcelain objects wrapped in paper or straw before packing for transportation ? **1**

10) A woman throws an object of mass 500 g with a speed of 25 m/s. **1**

(i) What is the impulse imparted to the objects?

(ii) If the object hits a wall and rebounds with half the original speed, what is the change in momentum of the object ?

Section-B

11) A woman throws an object of mass 500 g with a speed of 25 m/s. **2**

(ii) If the object hits a wall and rebounds with half the original speed, what is the change in momentum of the object ?

12) Why does a child feel more pain when she falls down on a hard cament floor, than when she falls on the soft muddy ground in the garden ? **2**

13) A force of 128 If acts on a mass of 490 g for 10 s. What velocity will it give to the mass ? **2**

14) A force of 16 N acts on a ball of mass 80 g for 1 μ s, Calculate the acceleration and the impulse. **2**

15) Two billiard balls each of mass 0.5 kg moving in opposite directions with speed 6 m/s collide and rebound with the same speed. What is the impulse imparted to each ball due to the other ? **2**

16) If the speed of stone is increased beyond the maximum permissible value and the string breaks suddenly, which of the following correctly describes the trajectory of the stone after the string breaks
(iii) the stone flies off at an angle with the tangent whose magnitude depends on the speed of the particle? **2**

17) A body of mass 5 kg is acted upon by two perpenticular forces 8 N and 6 N . Find the magnitude and direction of the acceleration. **2**

18) A batsman deflects a ball by an angle of 45^0 without changing its initial speed, which is equal to 54 km / h. What is the impulse imparted to the ball ? Mass of the ball is 0.15 kg. **2**

19) A train rounds an unbanked circular bend of radius 30m at a speed of 54 km/h. The mass of the train is 10^6kg. What provides the centripetal force requires for this purpose, the engine or the rails? what is the angle of banking required to prevent wearing out of the rail? **2**

20) You may have seen in a circus a motorcyclist driving in vertical loops inside a death well (a hollow spherical chamber with holes, so the spectators can watch from outside). Explain clearly, why the motorcyclist does not drop down when he is at the uppermost point, with no support from below. What is the minimum speed required at the uppermost position to perform a vertical loop if the radius of the chamber is 25 m? **2**

Section-C

21) A body placed on a rough inclined plane just begins to slide, when the slope of the plane equal to 1 in 4. Calculate the coefficient of friction. **5**

22) A block of mass m is held against a rough vertical wall by pressing it with a finger. If the coefficient of friction between the block and the wall is J..land the acceleration due to gravity is g, calculate the minimum force required to be applied by finger to hold the block against the wall? **5**

23) A hammer weighing 1 kg moving with the speed of 20 m / s strikes the head of a nail driving it 20 cm into a wall. Neglecting the mass of the nail, calculate **5**
(i) the acceleration during the impact
(ii) the time interval during the impact
(iii) the impulse.

24) A hammer weighing 1 kg moving with the speed of 20 m / s strikes the head of a nail driving it 20 cm into a wall. Neglecting the mass of the nail, calculate **5**
(ii) the time interval during the impact

****

Section-A

1) **1**

Yes, if the external forces acting on the body caan be represented in magnitude and direction by the sides of a closed polygon taken in the same order.

2) **1**

No change in speed, but change in direction is possible. Forces acting on a body in circular motion is an example.

3) Zero **1**

4) 1

When a body is moving along a circular path, speed always remains constant and a centripetal force is acting on the body.

5) 1

Given, velocity, v = 50 ms_{-1} Radius, r = 250 m Centripetal accleration, a = $\frac{v^2}{r}$ a = $\frac{50 \times 50}{250}$ = 10 ms_{-1}

6) 1

Here, radius r =20 cm Centripetal acceleration, = 980 cms^{-2} We know that centripetal acceleration, a =rω^2

$$\omega = \sqrt{\frac{a}{r}} = \sqrt{\frac{980}{20}} \qquad \omega = \sqrt{49} = 7 rad/s$$

7) 1

The carts with rubber tyres are easier to ply than those with iron types because the coefficient of friction between rubber and concrete is less than between iron and the road

8) 25 cm 1

9) 1

Porcelain objects are wrapped in paper or straw before packing to reduce the chances during transportation. During transportation sudden jerks or even fall can take place. Forces are created at the point of collision and the force takes longer time to reach the porcelain objects through paper or straw for same change in momentum as $F = \Delta p / \Delta t$ and therefore a lesser force acts on object.

10) Given, Mass of the object (m) = 500 g = 0.5 kg 1

Speed of the object (v) = 25 m/s

(i) Impulse imparted to the object

= change in the momentum = mv - mu

= m (v - u) = 0.5 (25 - 0) = 12.5 N-s

(ii) Velocity of the object after rebounding = -$\frac{25}{2}$ m/s

v' = -12.5 m/s

∴ Change in momentum = m (v' - v)

= 0.5 (- 12.5 - 25) = -18.75 N-s

Section-B

11) Given, Mass of the object (m) = 500 g = 0.5 kg 2

Speed of the object (v) = 25 m/s

(ii) Velocity of the object after rebounding = -$\frac{25}{2}$ m/s

v' = -12.5 m/s

∴ Change in momentum = m (v' - v)

= 0.5 (- 12.5 - 25) = -18.75 N-s

12) **2**

When a child falls on a cement floor, her body comes to rest instantly.

BUt F x Δ t = cahnge in momentum = constant.

As time of stopping Δ t decreases, therefore F increases and hence child feel more pain. When she falls on a soft muddy ground in the garden, the time of stopping increases and hence F decreases and she feels lesser pain.

13) 25.6 m/s **2**

14) 200m/s^2 , 1.6 x 10^{-5} kg-m/s **2**

15) 3 kg-m /s **2**

16) **2**

The part correctly describes the trajectory of the stone after the spring breaks because when a stone tied to one end of a string is whirled round in a circle then velocity of the stone at any point is along the tangent at that point. If the string breaks suddenly, then stone flies off tangentially, along the direction of its velocity.

17) 2 m/s^2, making an angle tan^{-1}(4/3) from 6 N force **2**

18) 4.16 kg-m / s **2**

19) Radius of circular bend, r = 30m **2**

Speed of the train, v = 54 km/h

$$= 54 \times \frac{5}{18} m/s \qquad \left[\because 1km/h = \frac{5}{8} m/s\right]$$

= 15 m/s

Let θ be the angle of banking required to prevent wearing out the rails, then

$$\tan\theta = \frac{v^2}{rg} = \frac{(15)^2}{30 \times 9.8} = \frac{225}{30 \times 9.8} = 0.7653\theta = \tan^{-1}(0.7653) = 37.4^o$$

20) **2**

When the motorcyclist is at the uppermost point of the death well, then weight of the cyclist, as well as the normal reaction R of the ceiling of the chamber, is in downward direction. These forces are balanced by the outward centrifugal force acting on the motorcyclist

$$\therefore \qquad Rg + mg = \frac{mv^2}{r}$$

Where, v = Speed of the motorcyclist

m = mass of (motorcycle + driver)

r = radius of the death well.

As the forces acting on the motorcyclist are balanced, therefore, motorcyclist does not fall down.

The minimum speed required to perform a vertical loop is given by

$$mg = \frac{mv^2 min}{r}$$

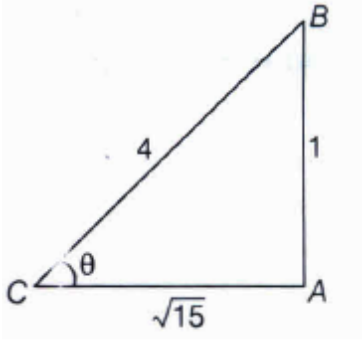
[∵ In the case weight of the object = centripetal force]

or $v_{min} = \sqrt{rg} = \sqrt{25 \times 9.8} = 15.65 m/s$

Section-C

21) 5

The slope of the plane equal to 1 in 4 implies that if BC=4 and AB=1. Suppose that the plane is inclined at angle θ with the horizontal AC. From the relation between the coefficient of friction and angle of repose, we have



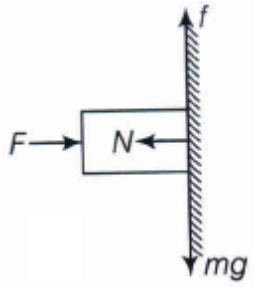
$$\mu = \tan\theta\mu = \frac{AB}{AC} = \frac{AB}{\sqrt{BC^2 - AB^2}} = \frac{1}{\sqrt{4^2 - 1^2}} = \frac{1}{\sqrt{16-1}}\mu = \frac{1}{\sqrt{15}} = 0.258$$

22) 5

Given mass of the block=m

Coefficient of friction between the block and the wall = μ

Let a force F be applied on the block 10 hold the block against the wall. The normal reaction of mass be Nand force offriction acting upward be f· In equilibrium, vertical and horizontal forces should be balanced separately.



f=mg ...(i)

F=N ..(ii)

But force of friction (f)=μN

=μN [using Eq(ii)] .....(iii)

From Eqs. (i) and (iii),we get

$$\mu F = mg \quad or \quad F = \frac{mg}{\mu}$$

23) (i)-2000 m / s^2 5

(ii)0.01 s

(iii)-20 N

24) 0.01 s 5