

Circular motion Conceptual Questions

Multiple choice Questions

Question 1: A small car and a big truck travel at the same speed v around the icy banked curve road. Small car which has a mass m negotiates the curve without slipping. Truck, which has a mass $2.5m$, will

- Also negotiate the curve without slipping.
- Tend to slide down (i.e. toward the inside of the curve).
- Tend to slide up (i.e. toward the outside of the curve).
- None of these

Solution-1. (a)

Explanation

For banked curved road we know

$$v = \sqrt{gr \tan \theta}$$

So speed does not depend on mass.

Since small car was able to cross the road, the truck will also be able to cross the road

Question 2: A car moves with a constant speed on the hilly road.

P_1 -> Pressure exerted by the car tyres on the road when the car crosses through dip between two hills

P_2 -> Pressure exerted by the car tyres on the road when the car crosses through top of the hills

P_3 -> Pressure exerted by the car tyres on the road when the car crosses through a level stretch near the bottom of the hill

Please pick the correct order

(A) $P_1 > P_3 > P_2$

(B) $P_2 > P_3 > P_1$

(C) $P_1 > P_2 > P_3$

(D) None of these.

Solution -2 (a)

Explanation

At the dip between the two hills, the normal force needs to support both the centripetal force and weight of the car. So it is largest

At the top of the hill, the weight will provide the support to both the normal force and centripetal force. So it is least

On level normal, the normal force will only support the weight

True or False statement

Question 3 Acceleration and velocity vector are perpendicular to each other at every point in uniform circular motion

Question 4 When a body moves in uniform circular motion, the kinetic energy of the body remains unchanged through out the motion

Question 5 A ball is rotated in a horizontal circle with the help of string. If we cut the string in between, the ball will moves along the tangent of the horizontal circle at that time

Question 6 The outer rail is slightly higher than inside rail at the turning point so as to provide the centripetal force to the train at the curve

Question 7 In the wall of death, the motorcycle cycle does not fall as the frictional force between wall and motorcycle acts upwards and balance the weight of the motorcycle

Solution 3 (True)

Explanation

Acceleration is always directed towards the center and velocity is along the tangent

Solution 4 (True)

Explanation

$$K = \frac{1}{2}mv^2$$

So since speed is constant, KE remains unchanged

Solution 5 (True)

Explanation

When the string is cut, centripetal force disappear and the object move along the straight line path of the velocity

Solution 6 (True)

Explanation

The outer rail is slightly higher then inside rail so as to provide the centripetal force through Normal reaction

Solution 7 (True)

Explanation

In the wall of death, the normal force provides the centripetal force and frictional force support the weight of the body

Link Type comprehension

Ram, Shyam and Manoj are riding a merry go round which is turning with constant angular velocity. They are at distance R_1 , R_2 and R_3 respectively from the center of the merry go round. The distances are in this following order

$$R_1 < R_2 < R_3$$

All the person are having same mass approximately

Question 8 Which person will experience highest acceleration?

- a) Ram
- b) Shyam
- c) Manoj
- d) Insufficient information

Question 9 which person will have lowest velocity?

- a) Ram
- b) Shyam
- c) Manoj
- d) Insufficient information

Question 10 which person has to hold on the merry round most tightly?

- a) Ram
- b) Shyam
- c) Manoj
- d) Insufficient information

Solution 8-10

Explanation:

Each person will move in uniform circular motion and the centripetal force will be provide by there grip on merry go round. Now for each person, velocity, acceleration and force can be given by

$$a = \frac{v^2}{R}$$
$$v = R\omega$$
$$F = \frac{mv^2}{R}$$

As Ram is at lowest distance, it will experience the lowest velocity

As Manoj is highest distance, it will experience highest velocity and highest acceleration

As mass are same and Manoj is at highest distance, he has to hold on most tightly

- 8) c
- 9) a
- 10) c

Multiple choice Questions

Question 11 What force is responsible for holding a car in an unbanked curve? .

- a) The horizontal component of the normal force
- b) The vertical component of the normal force.
- c) Frictional force
- d) The car's weight

Solution 11 (c)

Explanation

In unbanked curve, the frictional force between the tyres and road provides the necessary centripetal force

Question 12 When a ball at rest hangs by a single vertical string, tension in the string is Mg . If the ball is made to move in a horizontal circle so that the string describes a cone, string tension.

- a) Is Mg .
- b). is greater than Mg , always.
- c) . Is less than Mg , always.
- d) may be greater or less than Mg depending on the speed of the ball

Solution 12 (b)

Question 13 A object of mass is tied to a string of length L and whirled with speed v in circular path. Which of the following statement is correct?

- a) The tension T and weight of the object will be only forces acting on the object
- b) The tension T ,Weight of the object and centripetal force mv^2/R inwards will be acting on the object
- c) The tension T ,Weight of the object and centripetal force mv^2/R outwards will be acting on the object
- d) Not sufficient information

Solution 13 (a)

Explanation:

Centripetal force is not any new kind of force. It is just a force. We require centripetal force for circular motion but it comes from force exerting on the object only. So only tension and weight are the force acting on the object