

Dear student following is a Moderate level [00●00] test paper. Score of 15 Marks in 10 Minutes would be a satisfactory performance. Questions 1-10 (+3, -1). (All Questions have Single Options correct)

Q.1 A particle moves with constant angular velocity in a circle. During the motion its
 (A) Energy is conserved
 (B) Momentum is conserved
 (C) Energy and momentum both are conserved
 (D) None of the above is conserved

Q.2 Cream gets separated out of milk when it is churned, it is due to
 (A) Gravitational force (B) Centripetal force
 (C) Centrifugal force (D) Frictional force

Q.3 A particle moves in a circular orbit under the action of a central attractive force inversely proportion to the distance 'r'. The speed of the particle is
 (A) Proportional to r² (B) Independent to r
 (C) Proportional to r (D) Proportional to 1/r

Q.4 A motorcycle is going on an overbridge of radius R. The driver maintains a constant speed. As the motorcycle is ascending on the overbridge, the normal force on it
 (A) Increases (B) Decreases
 (C) Remains the same (D) Fluctuates

Q.5 A body of mass 1 kg is rotating in a vertical circle of radius 1m. What will be the difference in its kinetic energy at the top and bottom of the circle ? Take g = 10 ms⁻².
 (A) 10 J (B) 20 J
 (C) 30 J (D) 50 J

Q.6 A body is moving along a circular path with constant speed v. What is the change in velocity, when the angle described by the body at the centre of the circle be θ ?
 (A) Zero (B) 2v sin (θ / 2)
 (C) 2v sinθ (D) 2v sin2θ

Q.7 A boy is seated on top of a hemispherical mound of ice of radius R. He is given a little push and he starts sliding down the ice. If ice is frictionless, the boy will leave the ice at a point whose height is

(A) $\frac{3R}{4}$ (B) $\frac{2R}{\sqrt{3}}$ (C) $\frac{2R}{3}$ (D) $\frac{R}{3}$

Q.8 A satellite is revolving around the earth in a circular orbit at an altitude h where the acceleration due to gravity is g. If the earth is a sphere of radius r, the time period of the satellite is given

(A) $2\pi\sqrt{\frac{h}{g}}$ (B) $2\pi\sqrt{\frac{r}{g}}$
 (C) $2\pi\sqrt{\frac{(h+r)}{g}}$ (D) $2\pi\sqrt{\frac{(r-h)}{g}}$

The following questions consist of two statements one labelled Assertion (A) and the another labelled Reason (R). Select the correct answers to these questions from the codes given below :

(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 correct explanation of A
 (C) A is true but R is false
 (D) A is false but R is true.

Q.9 Assertion : When an automobile while going too fast around a curve overturns, its inner wheels leave the ground first.

Reason : For a safe turn the velocity of automobile should be less than the value of safe limit velocity.

Q.10 Assertion : Improper banking of roads causes wear and tear of tyres.

Reason : The necessary centripetal force is provided by the force of friction between the tyres and the road.



PHYSICS IIT JEE (JUNE 4th WEEK CLASS TEST 1) (CIRCULAR - MOTION) ANSWER KEY

Name : Roll No. :

	A	B	C	D		A	B	C	D		A	B	C	D
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
										10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	C	B	A	B	B	C	C	B	A

SOLUTIONS

Sol.1 (A)

In uniform circular motion (constant angular velocity) kinetic energy remains constant but due to change in velocity of particle its momentum varies.

Sol.2 (C)

Particles of cream are lighter so they get deposited near the centre of circular path.

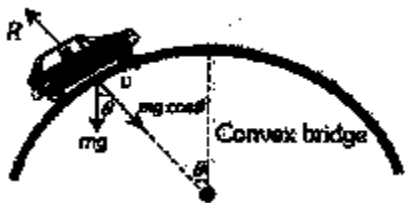
Sol.3 (B)

$$\frac{mv^2}{r} \propto \frac{K}{r} \Rightarrow v \propto r^0$$

i.e. speed of the particle is independent of r.

Sol.4 (A)

$$R = mg \cos\theta - \frac{mv^2}{r}$$



when θ decrease $\cos\theta$ increases i.e., R increases.

Sol.5 (B)

Velocity at the top is \sqrt{gr} and that at the bottom is $\sqrt{5gr}$.

Difference in kinetic energy

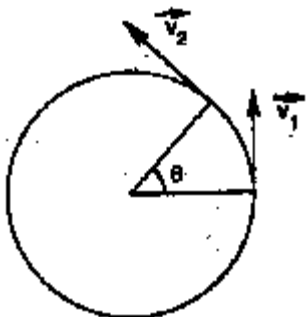
Difference in kinetic energy

$$\begin{aligned} \frac{1}{2} M [5gr - gr] &= 2Mgr \\ &= 2 \times 1 \times 10 \times 1 = 20 \end{aligned}$$

Sol.6 (B)

Here $v_1 = v_2 = v$.

So, $\Delta v = |\vec{v}_2 - \vec{v}_1|$



$$\sqrt{v^2 + v^2 - 2vv \cos\theta} = 2v \sin(\theta/2).$$

Sol.7 (C)

As the boy is given a little push, his initial speed can be taken to be zero. Suppose he leaves the mound at point P at a height h. The force acting on him are his weight mg and the normal reaction F. It is clear that

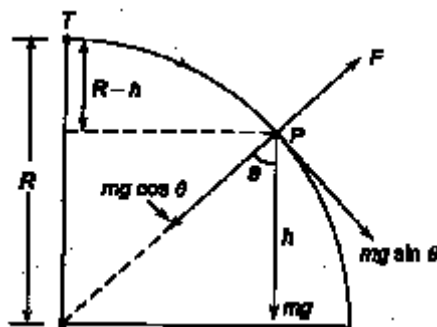
$$\text{at point P } mg \cos\theta - F = \frac{mv^2}{R} \quad \dots(1)$$

Where v is the speed of the boy at P. This is the speed with which he leaves the ice. Energy conservation gives

$$\frac{1}{2} mv^2 = mg(R - h) \quad \dots(ii)$$

Using Eqs (i) and (ii) we get,

$$mg \cos\theta - F = 2mg \left(\frac{R - h}{R} \right) \quad \dots(iii)$$



As the boy leaves the mound, the normal reaction F vanishes. Thus, putting $F = 0$ in

$$\text{Eq. (iii), we have } \cos\theta = 2 \left(\frac{R - h}{R} \right)$$

But $\cos\theta = \frac{h}{R}$. Therefore, we get $\frac{h}{R} = 2 - \frac{2h}{R}$

$$\text{or } h = \frac{2}{3}R.$$

Sol.8 (C)

Let m be the mass of the satellite. The centripetal force necessary to keep the satellite in orbit is provided by the gravitational force mg. Thus

$$\frac{mv^2}{R} = mg, \text{ where } R = (h + r)$$

or $m\omega^2 R = mg$ ($\because v = \omega R$) where ω is the angular speed.

$$\text{or } m \left(\frac{2\pi}{T} \right)^2 R = mg$$

$$\text{or } T = 2\pi \sqrt{\frac{R}{g}} = 2\pi \sqrt{\frac{(h+r)}{g}}$$

Sol.9 (B)

When automobile moves in circular path then reaction on inner wheel and outer wheel will be different.

$$R_{\text{inner}} = \frac{M}{2} \left[g - \frac{v^2 h}{ra} \right] \text{ and } R_{\text{outer}} = \frac{M}{2} \left[g + \frac{v^2 h}{ra} \right]$$

In critical condition $v_{\text{safe}} = \sqrt{\frac{gra}{h}}$

If v is equal or more that thus critical value then reaction on inner wheel becomes zero. So it leaves the ground first.

Sol.10 (A)

When roads are not properly banked, force of friction between tyres and road provides partially the necessary centripetal force. This cause wear and tear of tyres.