

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 The ratio of the angular speed of minutes hand and hour hand of a watch is
 (A) 6 : 1 (B) 12 : 1
 (C) 1 : 6 (D) 1 : 12

Q.2 For a particle in circular motion, the centripetal acceleration is
 (A) less than its tangential acceleration
 (B) equal to its tangential acceleration
 (C) more than its tangential acceleration
 (D) may be more or less than its tangential acceleration.

Q.3 A body is revolving with a uniform speed v in a circle of radius r . The tangential acceleration is
 (A) v / r (B) v^2 / r (C) zero (D) v / r^2

Q.4 Two particles of equal masses are revolving in circular paths of radii r_1 and r_2 respectively with the same speed. The ratio of their centripetal forces is
 (A) $\frac{r_2}{r_1}$ (B) $\sqrt{\frac{r_2}{r_1}}$ (C) $\left(\frac{r_1}{r_2}\right)^2$ (D) $\left(\frac{r_2}{r_1}\right)^2$

Q.5 Radius of the curved road on national highway is R . Width of the road is b . The outer edge of the road is raised by h with respect to inner edge so that a car with velocity v can pass safe over it. The value of h is
 (A) $\frac{v^2 b}{Rg}$ (B) $\frac{v}{Rg}$ (C) $\frac{v^2 R}{g}$ (D) $\frac{v^2 b}{R}$

Q.6 In a circus stuntman rides a motorbike in a circular track of radius R in the vertical plane. The minimum speed at highest point of track will be
 (A) $\sqrt{2gR}$ (B) $2gR$ (C) $\sqrt{3gR}$ (D) \sqrt{gR}

Q.7 A string of length $L = 1$ m is fixed at one end and carries a mass of 100 g at the other end. The string makes $\sqrt{5} / \pi$ revolutions per second about a vertical axis passing through its second end. What is the angle of inclination of the string with the vertical ?
 (Take $g = 10 \text{ ms}^{-2}$)
 (A) 30° (B) 45° (C) 60° (D) 75°

Q.8 A simple pendulum of length $r = 1$ m and bob mass 100 g is swinging with an angular amplitude of 60° . What is the tension in the string when the bob passes through the equilibrium position ? (Take $g = 10 \text{ ms}^{-2}$)
 (A) 1 N (B) 2 N (C) 3 N (D) 4 N

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 : In circular motion, work done by centripetal force is zero.
Reason : In circular motion centripetal force is perpendicular to the displacement.

Q.10 Assertion : When a vehicle takes a turn on the road, it travels along a nearly circular path.
Reason : In circular motion, velocity of vehicle remains same.

PHYSICS IIT JEE (JUNE 3rd WEEK CLASS TEST 5) (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.	B	D	C	A	A	D	C	B	A	C

SOLUTIONS

Sol.1 (B)

Angular speed of minute hand,

$$\omega_m = \frac{2\pi}{60 \times 60} \text{ rad/s.}$$

Angular speed of hour hand,

$$\omega_h = \frac{2\pi}{12 \times 60 \times 60} \text{ rad/s.}$$

$$\therefore \frac{\omega_m}{\omega_h} = 12$$

Sol.2 (D)

Sol.3 (C)

A body revolving in a circle with a uniform speed has radial acceleration only and no tangential acceleration.

Sol.4 (A)

$$F = \frac{mv^2}{r}$$

If m and v are constants then

$$F \propto \frac{1}{r}$$

$$\therefore \frac{F_1}{F_2} = \left(\frac{r_2}{r_1} \right)$$

Sol.5 (A)

We know that

$$\tan \theta = \frac{v^2}{Rg} \text{ and } \tan \theta = \frac{h}{b}$$

Hence

$$\frac{h}{b} = \frac{v^2}{Rg}$$

$$\Rightarrow h = \frac{v^2 b}{Rg}$$

Sol.6 (D)

Minimum speed at the highest point of vertical circular path $v = \sqrt{gR}$

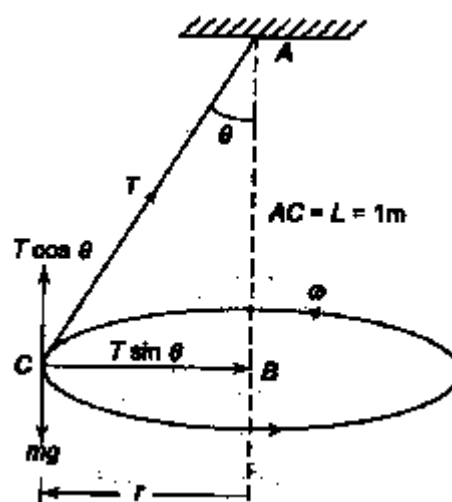
Sol.7 (C)

Given,

$$m = 100 \text{ g} = 0.1 \text{ kg, } n = \frac{\sqrt{5}}{\pi} \text{ Hz and } L = 1 \text{ m.}$$

Referring to Fig., tension T can be resolved into two perpendicular components : T sin θ and T cos θ. The horizontal component T sin θ provides the centripetal force for circular motion and the vertical component T cos θ balances with the weight mg. Thus, since R = CB = L sin θ

$$\begin{aligned} T \sin \theta &= \frac{mv^2}{R} = m\omega^2 R \\ &= m\omega^2 L \sin \theta \quad \dots\dots(i) \end{aligned}$$



$$\text{and } T \cos \theta = mg \quad \dots\dots(ii)$$

From (i) we have $T = m\omega^2 L = m\omega^2$ ($\because L = 1\text{m}$)

Using this Eq. (ii) we get,

$$m\omega^2 \cos \theta = mg$$

$$\text{or } \cos \theta = \frac{g}{\omega^2} = \frac{g}{4\pi^2 n^2}$$

$$\cos \theta = \frac{10}{4\pi^2 \times \frac{5}{\pi^2}} = 0.5$$

Which gives $\theta = 60^\circ$.

Sol.8 (B)

When the bob passes through the equilibrium position O, the tension in the string is given by

$$T = mg + \frac{mv^2}{r}$$

where v is the speed of the bob at O. Now, the potential energy of the bob at the extreme position A = mgh (see Fig.) which is

converted into kinetic energy $\frac{1}{2}mv^2$ when it reaches O. There fore

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

or $v^2 = 2gh$.

Using this we get

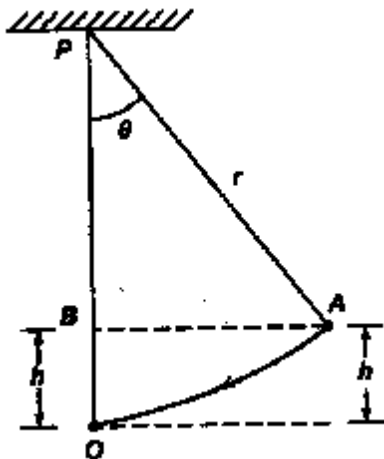
$$T = mg + \frac{2mgh}{r}$$

Now in triangle PBA, $PB = r \cos \theta$. Therefore, $h = PO - PB = r - r \cos \theta = r(1 - \cos \theta)$.

Using this value of h, the tension is

$$T = mg + 2mg(1 - \cos \theta)$$

$$T = mg \{1 + 2(1 - \cos \theta)\}$$



Given, $m = 100 \text{ g} = 0.1 \text{ kg}$, $r = 1 \text{ m}$ and $\theta = 60^\circ$. Putting these values, we get $T = 2 \text{ N}$.

Sol.9 (A)

We know that $W = Fs \cos \theta$

in the circular motion if $\theta = 90^\circ$ then $W = 0$

Sol.10 (C)

In circular motion the frictional force acting towards the centre of the horizontal circular path provides the centripetal force and avoid overturning of vehicle. Due to the change in direction of motion, velocity changes in circular motion.