NEET PYQ

Physics by Saleem Sir

CIRCULAR MOTION

CIRCULAR MOTION:

60. A bob is whirled in a horizontal plane by means of a string with an initial speed of ω rpm. The tension in the string is T. If speed becomes 2ω while keeping the same radius, the tension in the string becomes.

[NEET - 2024]

(1) T (2) $4T$

(3) $\frac{T}{4}$ (4) $\sqrt{2}T$

61. A particle is executing uniform circular motion with velocity $\vec{v}$ and acceleration $\vec{a}$. Which of the following is true?

[NEET - 2023-Manipur]

(1) $\vec{v}$ is a constant; $\vec{a}$ is not a constant

(2) $\vec{v}$ is not a constant; $\vec{a}$ is not constant

(3) $\vec{v}$ is a constant; $\vec{a}$ is a constant

(4) $\vec{v}$ is not a constant; $\vec{a}$ is a constant

62. A block of mass 10 kg is in contact against the inner wall of a hollow cylindrical drum of radius 1 m. The coefficient of friction between the block and the inner wall of the cylinder is 0.1. The minimum angular velocity needed for the cylinder to keep the block stationary when the cylinder is vertical and rotating about its axis, will be (g = 10 m/s^2)

[NEET 2019]

(1) 10π rad/s (2) $\sqrt{10}$ rad/s

(3) $\frac{10}{2\pi}$ rad/s (4) 10 rad/s

63. One end of string of length l is connected to a particle of mass m and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed v, the net force on the particle (directed towards centre) will be (T represents the tension in the string)

[NEET 2017]

(1) $T+\frac{mv^2}{l}$ (2) $T-\frac{mv^2}{l}$

(3) Zero (4) T

64. A car is negotiating a curved road of radius R. The road is banked at an angle θ. The coefficient of friction between the tyres of the car and the road is μ_s. The maximum safe velocity on this road is:

[NEET-I 2016]

(1) $\sqrt{\frac{g}{R}\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

(2) $\sqrt{\frac{g}{R^2}\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

(3) $\sqrt{gR^2\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

(4) $\sqrt{gR\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

65. Two stones of masses m and $2m$ are whirled in horizontal circles, the heavier one in a radius $r/2$ and the lighter one in radius r. The tangential speed of lighter stone is n times that of the value of heavier stone when they experience same centripetal forces. The value of n is:

[NEET - 2015]

(1) 4 (2) 1

(3) 2 (4) 3

66. A car is moving in a circular horizontal track of radius 10 m with a constant speed of 10 m/s. A bob is suspended from the roof of the car by a light wire of length 1.0 m. The angle made by the wire with the vertical is:

[Karnataka NEET 2013]

(1) π/3 (2) π/6

(3) π/4 (4) 0°

67. A car of mass 1000 kg negotiates a banked curve of radius 90 m on a frictionless road. If the banking angle is 45°, the speed of the car is:

[NEET - 2012]

(1) 20 ms^{-1}

(2) 30 ms^{-1}

(3) 5 ms^{-1}

(4) 10 ms^{-1}

68. A gramophone record is revolving with an angular velocity ω. A coin is placed at a distance r from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if:

[NEET - 2010]

(1) $r = mg\omega^2$ (2) $r < \frac{\omega^2}{\mu g}$

(3) $r \le \frac{\mu g}{\omega^2}$ (4) $r \ge \frac{\mu g}{\omega^2}$

69. A roller coaster is designed such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is 20 m. The speed of the car at the top of the hill is between.

[NEET - 2008]

(1) 16 m/s and 17 m/s
(2) 13 m/s and 14 m/s
(3) 14 m/s and 15 m/s
(4) 15 m/s and 16 m/s

70. A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km/hr. The centripetal force is:

[NEET - 1999]

(1) 1000 N (2) 750 N
(3) 250 N (4) 1200 N

71. A ball of mass 0.25 kg attached to the end of a string of length 1.96 m is moving in a horizontal circle. The string will break if the tension is more than 25 N. What is the maximum speed with which the ball can be moved?

[NEET - 1998]

(1) 5 m/s (2) 3 m/s
(3) 14 m/s (4) 3.92 m/s

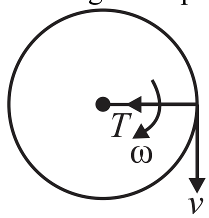
Answer Key

60. (2)
61. (2)
62. (4)
63. (4)
64. (4)
65. (3)
66. (3)
67. (2)
68. (3)
69. (3)
70. (1)
71. (3)

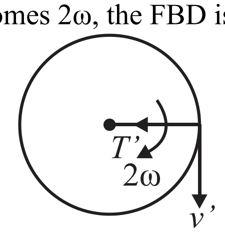
Solution

60. (2)

Sol. When the bob is moving with speed 'ω', then *FBD* is,



Let 'r' be the radius of the circle.
Applying Newton's second law on mass of the bob 'm' along centripetal direction, we have
$T = mr\omega^2$ ...(i)
When speed becomes 2ω, the FBD is



$T' = mr(2\omega)^2 = mr(4\omega^2)$

or $mr = \dfrac{T'}{4\omega^2}$ ...(ii)

Using value of equation (ii) in equation in (i),

$T = \dfrac{T'\omega'}{4\omega^2} = \dfrac{T'}{4}$

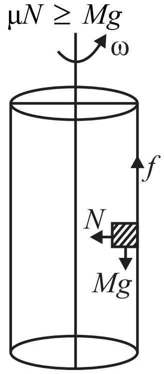
Hence, $T' = 4T$

61. (2)

Sol. Direction of velocity is changing so it is not a constant and centripetal acceleration changes continuously as $\vec{v}$ is not constant and therefore $\vec{a}$ is also not constant.

62. (4)

Sol. To keep the block stationary,
Frictional force ≥ weight
$\mu N \geq Mg$



Here, $N = M\omega^2 r$
$r = 1$ m, $\mu = 0.1$
For minimum ω, $\mu M\omega^2 r = Mg$

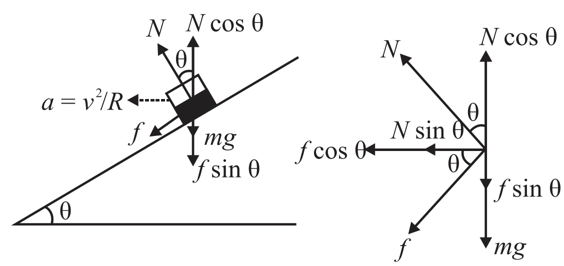
$$\vec{v}\omega = \sqrt{\frac{g}{\mu r}} = \sqrt{\frac{10}{0.1\times 1}} = 10 \text{ rad s}^{-1}$$

63. (4)

Sol. Centripetal force $\left(\dfrac{mv^2}{l}\right)$ is provided by tension net force on the particle will be equal to tension T.

64. (4)

Sol.



For vertical equilibrium on the road,

$N\cos\theta = mg + f\sin\theta$

$\Rightarrow mg = N\cos\theta - f\sin\theta$

Centripetal force for safe turning,

$$N\sin\theta + f\cos\theta = \frac{mv^2}{R}$$

$$\frac{v^2}{Rg} = \frac{N\sin\theta + f\cos\theta}{N\cos\theta - f\sin\theta}$$

$$\Rightarrow \frac{v_{max}^2}{Rg} = \frac{N\sin\theta + \mu_s N\cos\theta}{N\cos\theta - \mu_s N\sin\theta}$$

$$v_{max} = \sqrt{Rg\left(\frac{\mu_s + \tan\theta}{1-\mu_s\tan\theta}\right)}$$

65. (3)

Sol. Let v be tangential speed of heavier stone. Then, centripetal force experienced by lighter stone is

$$(F_c)_{lighter} = \frac{m(nv)^2}{r}$$

and that of heavier stone is $(F_c)_{heavier} = \dfrac{2mv^2}{(r/2)}$

But $(F_c)_{lighter} = (F_c)_{heavier}$

$$\therefore \frac{m(nv)^2}{r} = \frac{2mv^2}{(r/2)} \text{ or, } n^2\left(\frac{mv^2}{r}\right) = 4\left(\frac{mv^2}{r}\right)$$

$n^2 = 4$ or $n = 2$

66. (3)

Sol. Let θ is the angle made by the wire with the vertical.

$$\therefore \tan\theta = \frac{v^2}{rg}$$

Here, v = 10 m/s, r = 10 m, g = 10 m/s^2

$$\therefore \tan\theta = \frac{(10\,\text{m/s})^2}{10\,\text{m}\left(10\,\text{m/s}^2\right)} = 1$$

$$\theta = \tan^{-1}(1) = \frac{\pi}{4}$$

67. (2)

Sol. Here, m = 1000 kg, R = 90 m, θ = 45°

For banking, $\tan\theta = \frac{v^2}{Rg}$

or $v = \sqrt{Rg\tan\theta}$

$= \sqrt{90\times 10\times \tan 45^\circ}$ = 30 ms^{-1}

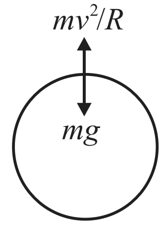
68. (3)

Sol. The coin will revolve with the record, if Force of friction ≥ centripetal force

$\mu mg \geq mr\omega^2$ or $\geq r \leq \frac{\mu g}{\omega^2}$

69. (3)

Sol. $mg = \frac{mv^2}{R} \Rightarrow v = \sqrt{Rg}$



$v = \sqrt{20\times 10} = \sqrt{200} = 14.1$ m/s

i.e., between 14 and 15 m/s.

70. (1)

Sol. $F_{\text{centripetal}} = \frac{mv^2}{R}$; $v = \left(36\times\frac{5}{18}\right)\text{m/s}$

$$F_{\text{centripetal}} = \frac{500\times\left(36\times\frac{5}{18}\right)^2}{50} = 1000\text{ N}$$

71. (3)

Sol. $\frac{mv^2}{r} = 25$; $v = \sqrt{\frac{25\times 1.96}{0.25}}$ =14 m/s

72. (2)

Sol. When milk is churned, cream gets separated due to centrifugal force.