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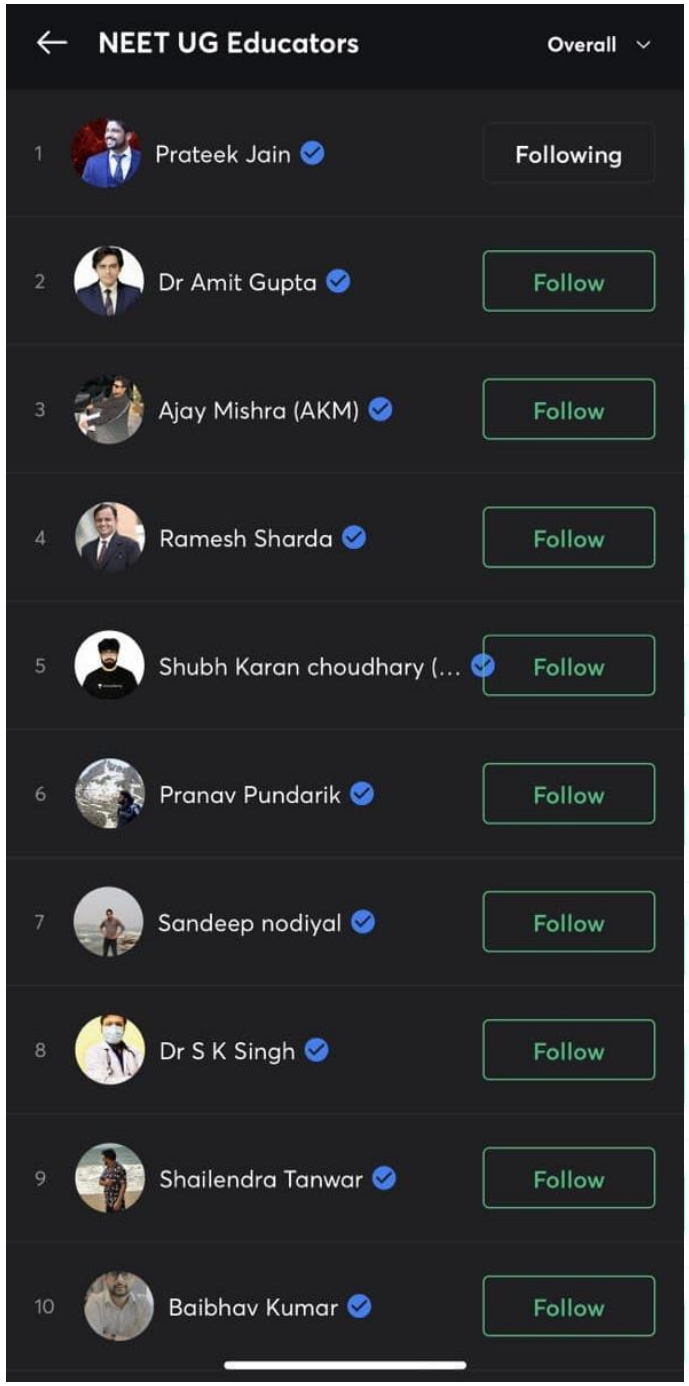

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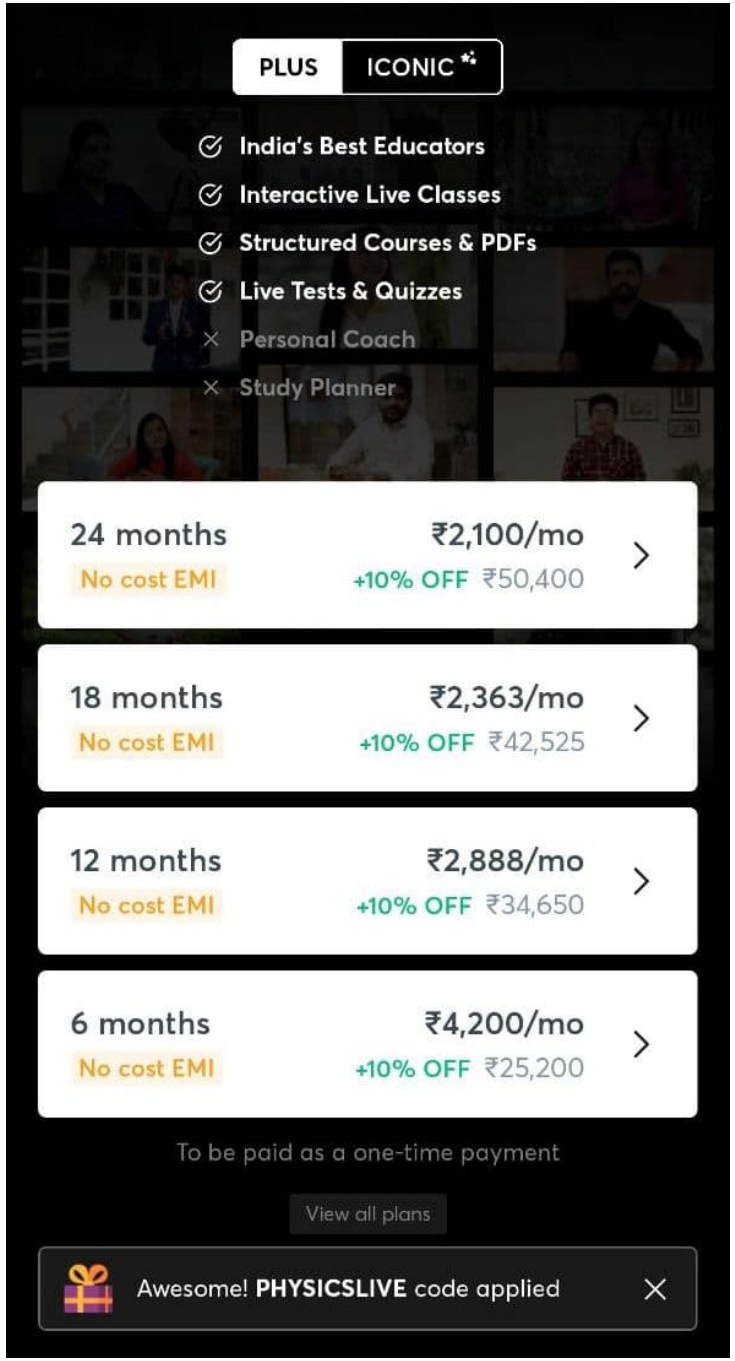

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NEET & AIIMS
PYQs Solution

Topic : Circular motion

By Physicsaholics Team

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PYQs on Following Subtopic:

Direction Of Angular Velocity

Q. The direction of the angular velocity vector is along

AIIMS | AIIMS 2004 | Motion In A Plane

AIIMS

A the tangent to the circular path

B the inward radius

C the outward radius

D the axis of rotation

Ans. D

PYQs on Following Subtopic:

Relation between Linear and Angular Quantities

A body is whirled in a horizontal circle of radius 20 cm. It has angular velocity of 10 rad/s. What is its linear velocity at any point on circular path?

(A) 10 m/s (B) 2 m/s

(C) 20 m/s (D) $\sqrt{2}$ m/s

$v = \omega R$

$= 10 \times \frac{20}{100}$

$= 2 \text{ m/sec}$

NEET

Ans. B

A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 s for every circular lap. The average velocity and average speed for each circular lap respectively is [CBSE AIPMT 2006]

(a) 0, 0
(b) 0, 10 m/s
(c) 10 m/s, 10 m/s
(d) 10 m/s, 0

$v = \omega r$

$|\vec{v}_{av}| = 0$

$v_{av} = \frac{2\pi R}{T} = \frac{2 \times 3.14 \times 100}{62.8} = 10 \text{ m/sec}$

Ans. b

. A wheel has angular acceleration of $3\ rad/s^2$ and an initial angular speed of $2\ rad/s$. In a time of 2 s, it has rotated through an angle (in radian) of.

[CBSE AIPMT 2007]

(a) 6 (b) 10 (c) 12 (d) 4

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$= 2 \times 2 + \frac{1}{2} \times 3 \times 4^2$

$= 10\ rad$

Ans. b

NEET 2021

Q) A particle moving in a circle of radius R with a uniform speed takes a time T to complete one revolution. $\Rightarrow T = \frac{2\pi R}{V} \Rightarrow V = \frac{2\pi R}{T}$

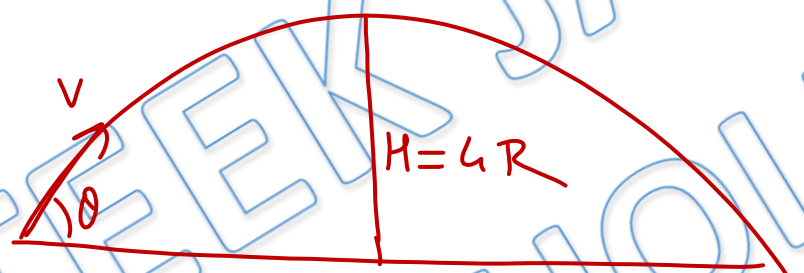
If this particle were projected with the same speed at an angle ' θ ' to the horizontal, the maximum height attained by it equals 4R. The angle of projection, θ, is then given by :

(1) $\theta = \sin^{-1}\left(\frac{2gT^2}{\pi^2 R}\right)^{1/2}$

(2) $\theta = \cos^{-1}\left(\frac{gT^2}{\pi^2 R}\right)^{1/2}$

(3) $\theta = \cos^{-1}\left(\frac{\pi^2 R}{gT^2}\right)^{1/2}$

(4) $\theta = \sin^{-1}\left(\frac{\pi^2 R}{gT^2}\right)^{1/2}$



$H = 4R = \frac{V^2 \sin^2\theta}{2g}$

$\sin^2\theta = \frac{8gRT^2}{4\pi^2 R^2}$

$\sin\theta = \sqrt{\frac{2gT^2}{\pi^2 R}}$

Ans. 1

PYQs on Following Subtopic:

Tangential and
Radial Acceleration

. An electric fan has blades of length 30 cm measured from the axis of rotation. If the fan is rotating at 120 rev/min, the acceleration of a point on the tip of the blade is

[CBSE AIPMT 1990]

(a) 1600 ms^{-2}

(b) 47.4 ms^{-2}

(c) 23.7 ms^{-2}

(d) 50.55 ms^{-2}

Centripe

$R = 0.3\,m$

$\omega = 120\ rev/min = \frac{120 \times 2\pi\ rad}{60\ Sec} = 4\pi$

$a = a_c = \omega^2 R = 16\pi^2 \times 0.3 = 47.4\ m/Sec^2$

Ans. b

PYQs on Following Subtopic:

Uniform & Non-Uniform Circular Motion

Q) A particle moving in a circle of radius R with a uniform speed takes a time T to complete one revolution.
If this particle were projected with the same speed at an angle ' θ ' to the horizontal, the maximum height attained by it equals 4R. The angle of projection, θ, is then given by :

(1) $\theta = \sin^{-1}\left(\frac{2gT^2}{\pi^2 R}\right)^{1/2}$

(2) $\theta = \cos^{-1}\left(\frac{gT^2}{\pi^2 R}\right)^{1/2}$

(3) $\theta = \cos^{-1}\left(\frac{\pi^2 R}{gT^2}\right)^{1/2}$

(4) $\theta = \sin^{-1}\left(\frac{\pi^2 R}{gT^2}\right)^{1/2}$

NEET 2021

Ans. 1

. The position vector of a particle **R** as a function of time is given by

$$\vec{\mathbf{R}} = 4\sin(2\pi t)\,\hat{\mathbf{i}} + 4\cos(2\pi t)\,\hat{\mathbf{j}}$$

where R is in metre, t is in seconds and $\hat{\mathbf{i}}$ and $\hat{\mathbf{j}}$ denote unit vectors along x and y-directions, respectively. Which one of the following statements is wrong for the motion of particle? *[CBSE AIPMT 2015]*

(a) Acceleration is along $-\mathbf{R}$

(b) Magnitude of acceleration vector is $\frac{v^2}{R}$, where v is the velocity of particle

(c) Magnitude of the velocity of particle is 8 m/s

(d) Path of the particle is a circle of radius 4 m

$x = 4\sin 2\pi t$

$y = 4\cos 2\pi t$

$\sin^2\theta + \cos^2\theta = 1$

$\frac{x^2}{16} + \frac{y^2}{16} = 1$

$x^2 + y^2 = 16$

$R = 4$

$\vec{V} = 4 \times 2\pi \cos 2\pi t\,\hat{i} - 4 \times 2\pi \sin 2\pi t\,\hat{j}$

$\vec{V} = 8\pi\left[\cos 2\pi t\,\hat{i} - \sin 2\pi t\,\hat{j}\right]$

$V = 8\pi$

Ans. c

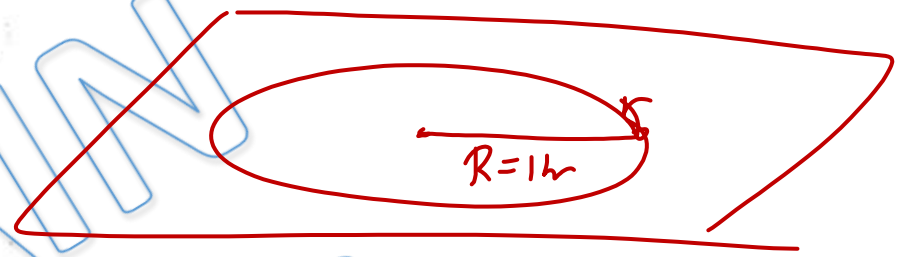
A stone tied to the end of a string of 1 m long is whirled in a horizontal circle with a constant speed. If the stone makes 22 revolutions in 44 s, what is the magnitude and direction of acceleration of the stone? *[CBSE AIPMT 2005]*

(a) $\frac{\pi^2}{4}$ ms^{-2} and direction along the radius towards the centre

(b) π^2 ms^{-2} and direction along the radius away from centre

(c) π^2 ms^{-2} and direction along the radius towards the centre

(d) π^2 ms^{-2} and direction along the tangent to the circle



$\omega = \frac{22 \text{ rev}}{44 \text{ Sec}} = \frac{2\pi \text{ rad}}{2 \text{ Sec}}$

$= \pi \text{ rad/Sec}$

$a = a_c = \omega^2 R$

$= \pi^2 \times 1$

$= \pi^2$ towards Centre

Ans. c

A particle moves along a circle of radius $\left(\frac{20}{\pi}\right)$ m with constant tangential acceleration. If the velocity of the particle is 80 m/s at the end of the second revolution after motion has begin, the tangential acceleration is

[CBSE AIPMT 2003]

(a) 160 π m/s^2

(b) 40 m/s^2

(c) 40 π m/s^2

(d) 640 π m/s^2

Ans. b

A particle is moving with a constant speed v in a circle. What is the magnitude of average velocity after half rotation? NEET 2019

(a) $2v$ (b) $2v/\pi$ (c) $v/2$ (d) $v/2\pi$

$$t = \frac{\pi R}{v}$$

$$|\vec{v}_{av}| = \frac{2R}{\pi R/v}$$

$$= \frac{2v}{\pi}$$

Ans. b

Assertion : A body with constant acceleration always moves along a straight line.

Reason : A body with constant acceleration may not speed up. ***[1998]***

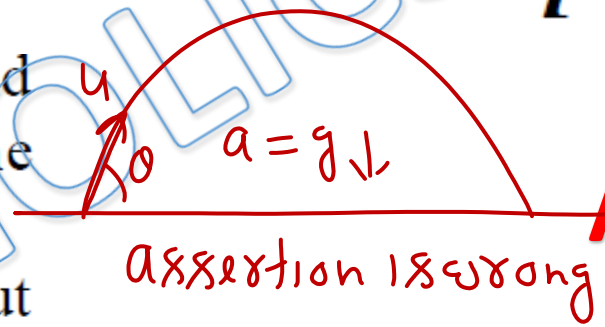
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.



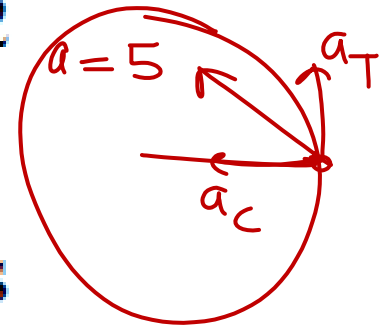
AIIMS

Ans. e

The acceleration of a body in a non-uniform circular motion is 5 ms^{-2}. Which one of the following is correct? ***[2009]***

AIIMS

(a) The radial acceleration and the tangential accelerations are 3 ms^{-2} and 4 ms^{-2} respectively.



$a^2 = a_c^2 + a_T^2$

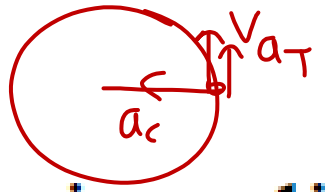
(b) The radial and the tangential accelerations are 2 ms^{-2} and 3 ms^{-2} respectively.

(c) The radial and the tangential accelerations are both 5 ms^{-2}.

(d) The radial and the tangential acceleration are 5 ms^{-2} and 3 ms^{-2} respectively.

Ans. a

For a particle in a uniformly accelerated circular motion



AIIMS ***[2011]***

(a) velocity is radial and acceleration has both radial and transverse components

(b) velocity is transverse and acceleration has both radial and transverse components

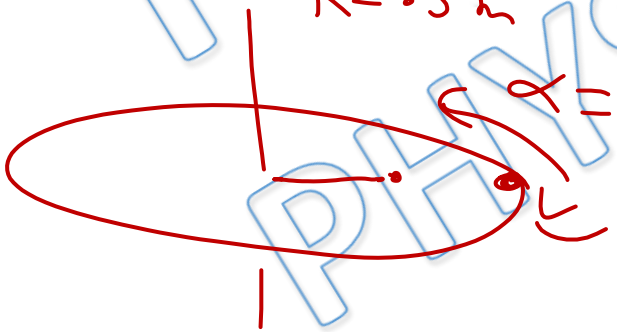
(c) velocity is radial and acceleration is transverse only

(d) velocity is transverse and acceleration is radial only

Ans. b

5. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of 2.0 rad s^{-2}. Its net acceleration in ms^{-2} at the end of 2.0 s is a approximately [NEET 2016]

(a) 7.0 (b) 6.0 (c) 3.0 (d) 8.0



$a_T = \alpha R = 2 \times .5 = 1$

$\omega = 0 + 2 \times 2 = 4 \Rightarrow a_c = \omega^2 R = 16 \times .5 = 8$

$a = \sqrt{a_c^2 + a_T^2} = \sqrt{64 + 1} \simeq 8.$

Ans. d

PYQs on Following Subtopic:

Centripetal Force

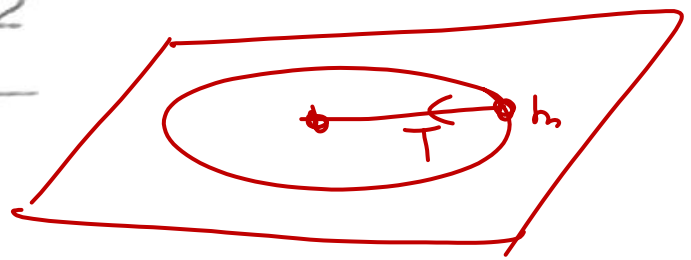
2. One end of the string of length l is connected to a particle of mass m and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed v, the net force on the particle (directed towards center) will be (T represents the tension in the string) [NEET 2017]

(a) T

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

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

(d) Zero



Ans. a

A ball of mass m is tied up with string and rotated along a horizontal circle of radius r. At an instant, its velocity is v, and tension in string is T, the force required for circular motion is

(a) $T - \frac{mv^2}{r}$ (b) $T + \frac{mv^2}{r}$

(c) $\frac{mv^2}{r}$ (d) zero

AIIMS (2013)

Ans. c

A particle of mass m moves with constant speed along a circular path of radius r under the action of force F. Its speed is

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

$v^2 = \frac{Fr}{m}$

$v = \sqrt{\frac{Fr}{m}}$

(a) $\sqrt{\frac{Fr}{m}}$ (b) $\sqrt{\frac{F}{r}}$

(c) $\sqrt{Fmr}$ (d) $\sqrt{\frac{F}{mr}}$

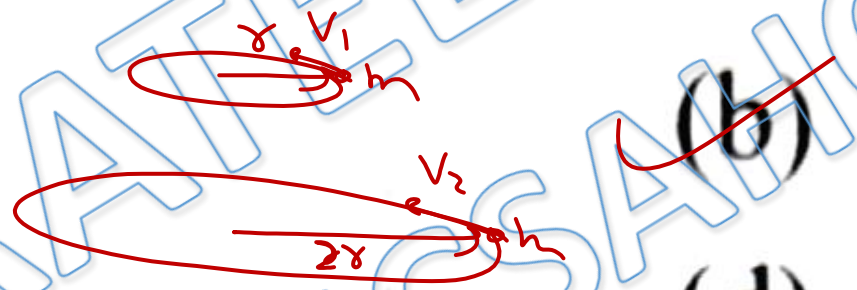
AIIMS (2008)

Ans. a

If the radii of circular paths of two particles of same mass are in the ratio 1 : 2, then to have a constant centripetal force, their velocities should be in a ratio of

(a) 4 : 1 (b) $1 : \sqrt{2}$ AIIMS

(c) 1 : 4 (d) $\sqrt{2} : 1$ *(1996)*



$$\frac{mV_1^2}{\gamma} = \frac{mV_2^2}{2\gamma}$$

$$\frac{V_1}{V_2} = \frac{1}{\sqrt{2}}$$

Ans. b

The radii of circular paths of two particles of same mass are in ratio 6 : 8, then what will be velocities ratio if they have a constant centripetal force?

$r_1 \quad r_2 = 6 : 8$

$\frac{m v_1^2}{6r} = \frac{m v_2^2}{8r}$

$\frac{v_1^2}{v_2^2} = \frac{3}{4}$

$\frac{v_1}{v_2} = \frac{\sqrt{3}}{2}$

(a) $\sqrt{3} : 4$ (b) $4 : \sqrt{3}$

(c) $2 : \sqrt{3}$ (d) $\sqrt{3} : 2$

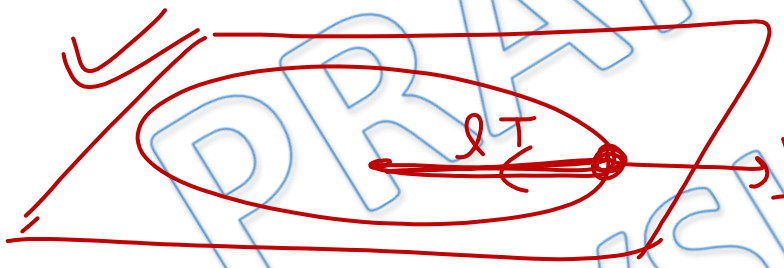
AIIMS (2015)

Ans. d

A stone of mass 0.3 kg attached to a 1.5 m long string is whirled around in a horizontal circle at a speed of 6 m s^{-1}. The tension in the string is

(a) 5 N (b) 6 N (c) 7.2 N (d)None of these

AIIMS



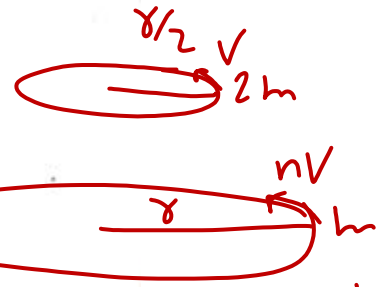
$T = \frac{3 \times 36}{5} = 7.2\ N$

Ans. c

Two stones of masses m and $2m$ are whirled in horizontal circles, the heavier one in a radius $\frac{r}{2}$ 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

[CBSE AIPMT 2015]

(a) 2
(b) 3
(c) 4.
(d) 1



$\frac{2mv^2}{r/2} = \frac{mn^2v^2}{r}$

$\frac{4mv^2}{r} = \frac{mv^2}{r} \times n^2$

$n^2 = 4$

$n = 2$

Ans. a

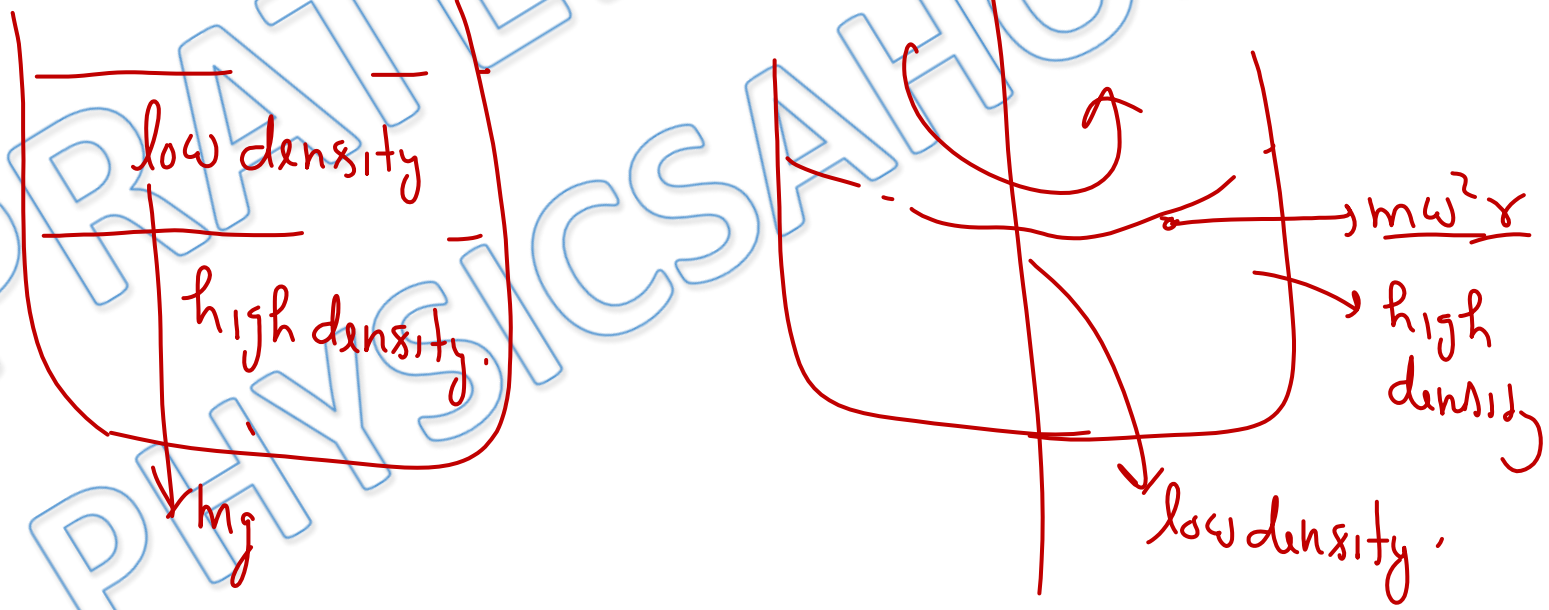
PYQs on Following Subtopic:

Centrifugal Force

When milk is churned, cream gets separated due to [CBSE AIPMT 1991]

(a) centripetal force (b) centrifugal force

(c) frictional force (d) gravitational force



Ans. b

PYQs on Following Subtopic:

Motion on Vertical
Circular wall / Death-Well

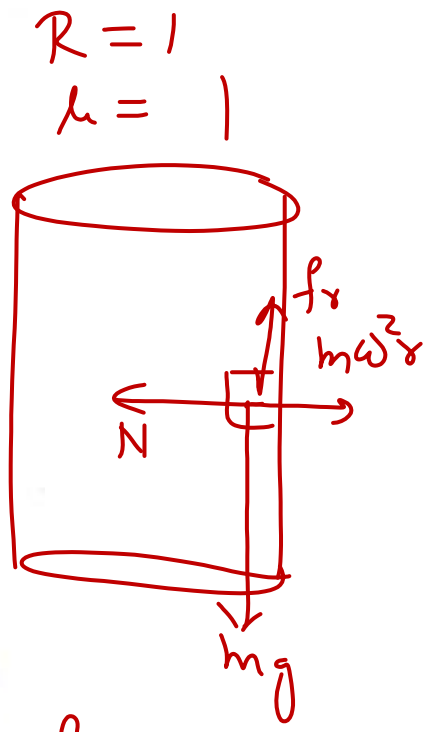
A block of mass 10 kg is in contact against the inner wall of a hollow cylindrical drum of radius 1 m. The coefficient of friction between the block and the inner wall of the cylinder is 0.1. The minimum angular velocity needed for the cylinder to keep the block stationary when the cylinder is vertical and rotating about its axis, will be ($g = 10\ m/s^2$) [NEET 2019]

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

(b) 10 rad/s

(c) 10π rad/s

(d) $\sqrt{10}$ rad/s



$f_r = mg$

$f_{r_{max}} \geq mg$

$\mu N \geq mg$

$\mu m\omega^2 r \geq mg$

Circular

$\omega^2 \geq \frac{g}{\mu r}$

$\geq \frac{10}{0.1 \times 1}$

≥ 100

Ans. b

PYQs on Following Subtopic:

Motion of a Vehicle on Circular Path

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

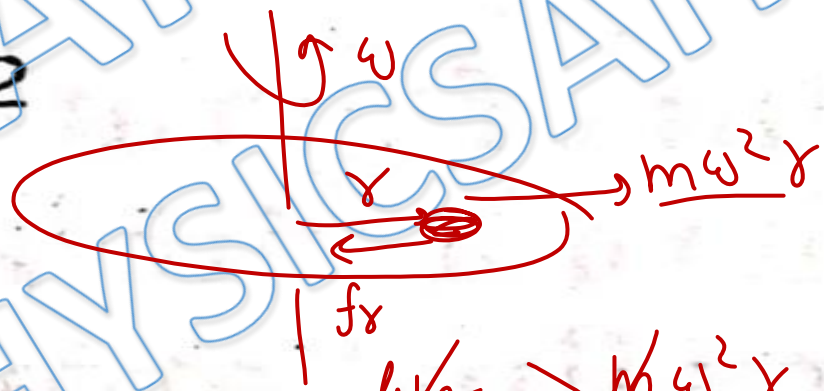
[CBSE AIPMT 2010]

(a) $r = \mu g \omega^2$

(b) $r < \dfrac{\omega^2}{\mu g}$

(c) $r \leq \dfrac{\mu g}{\omega^2}$

(d) $r \geq \dfrac{\mu g}{\omega^2}$



$\mu mg \geq m\omega^2 r$

$r \leq \mu g/\omega^2$

Ans. c

PYQs on Following Subtopic:

Motion on incline plane

. A car is negotiating a curved road of radius R. The road is banked at 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 2016]

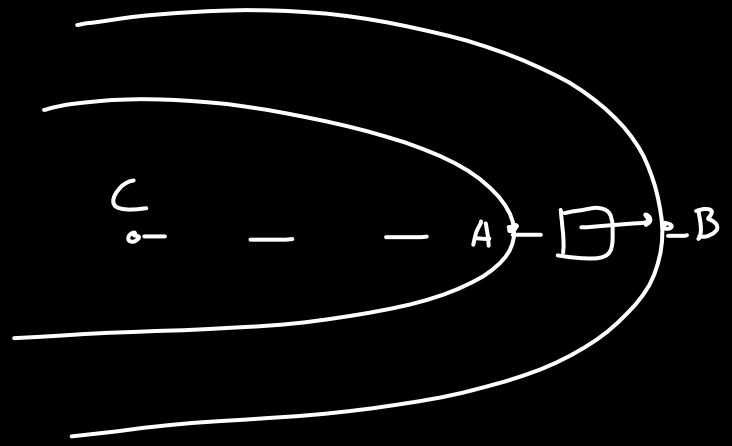
(a) $\sqrt{gR\left(\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$

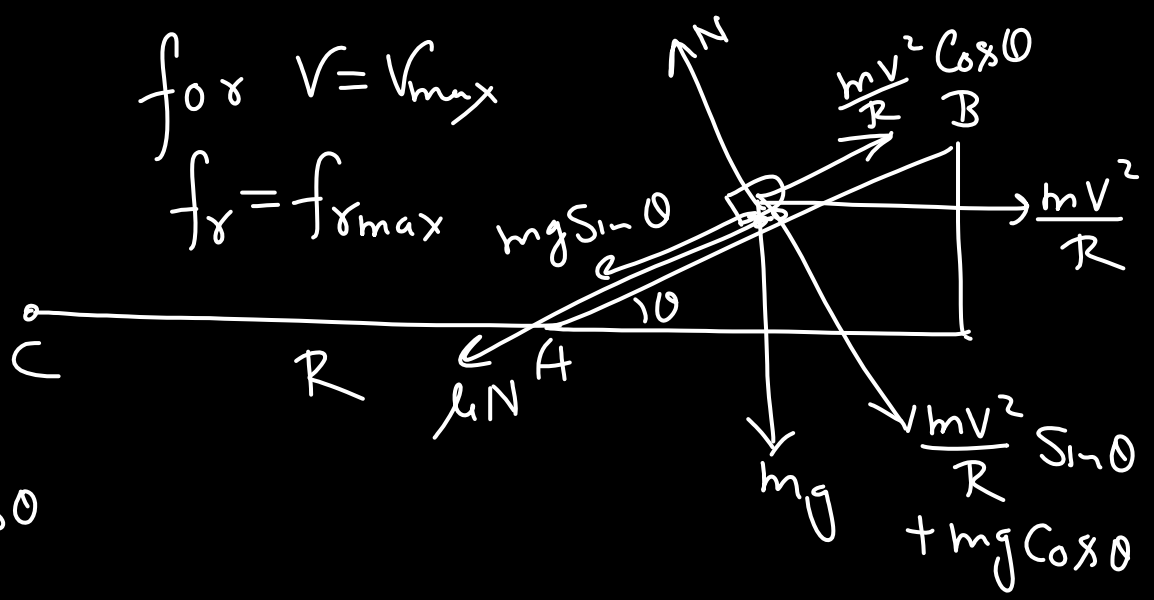
(b) $\sqrt{\frac{g}{R}\left(\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$

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

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

Ans. a





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

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

$$mg\sin\theta + \frac{\mu mv^2}{R}\sin\theta + \mu mg\cos\theta = \frac{mv^2}{R}\cos\theta$$

$$mg(\sin\theta + \mu\cos\theta) = \frac{mv^2}{R}(\cos\theta - \mu\sin\theta)$$

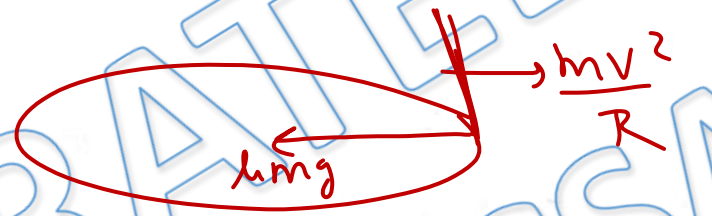
$$v^2 = \frac{Rg(\sin\theta + \mu\cos\theta)}{\cos\theta - \mu\sin\theta} = \frac{Rg(\tan\theta + \mu)}{1 - \mu\tan\theta}$$

If a cyclist moving with a speed of 4.9 m/s on a level road can take a sharp circular turn of radius 4 m, then coefficient of friction between the cycle tyres and road is

(a) 0.51 (b) 0.41

(c) 0.71 (d) 0.61

AIIMS (1999)



$\mu mg = \frac{mv^2}{R}$

$\mu \times 10 = \frac{(4g)^2}{4}$

$\mu = \frac{(4g)^2}{40} = \frac{25}{40_8} = \frac{5}{8} = 6.2$ --

Ans. d

Assertion & Reasons

- **If both assertion & reasons are true and reason is the correct explanation of assertion.**
- **If both assertion & reasons are true but reason is not the correct explanation of assertion.**
- **Is assertion is true but reason is false.**
- **If both assertion & reason are false.**

Assertion: On a rainy day, it is difficult to drive a car or bus at high speed.

Reason: The value of coefficient of friction is lowered on wetting the surface.

(1995, 1999)

AIIMS

Ans. a

Assertion : Centripetal force is always required for motion in curved path.

Reason : On a banked curved track, vertical component of normal reaction provides the necessary centripetal force.

(2015)

AIIMS

Ans. c

Assertion : On a banked curved track, vertical component of normal reaction provides the necessary centripetal force.

Reason : Centripetal force is not always required for turning.

(2018)

AIIMS

Ans. d

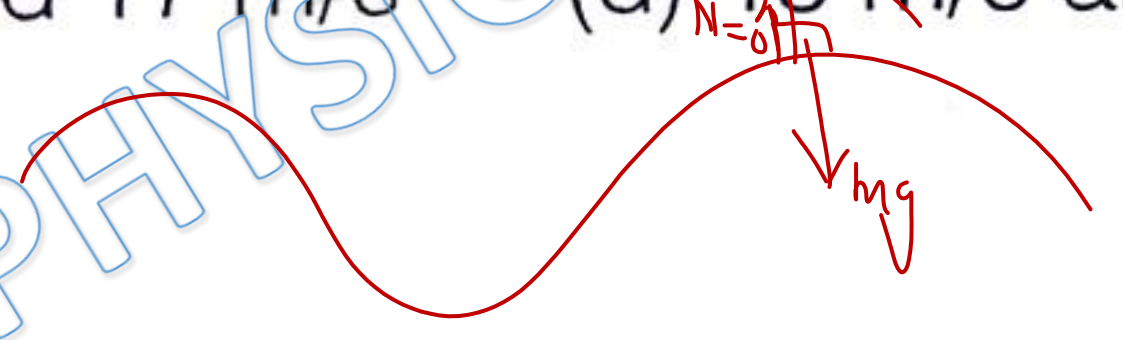
PYQs on Following Subtopic:

Condition of leaving contact in vertical circular motion

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

[CBSE AIPMT 2008]

(a) 14 m/s and 15 m/s (b) 15 m/s and 16 m/s
(c) 16 m/s and 17 m/s (d) 13 m/s and 14 m/s



$\frac{mv^2}{R} = mg$

$v = \sqrt{gR} = \sqrt{10 \times 20}$

$= \sqrt{200}$

Ans. a

PYQs on Following Subtopic:

EFFECT OF EARTH'S ROTATION ON APPARENT WEIGHT

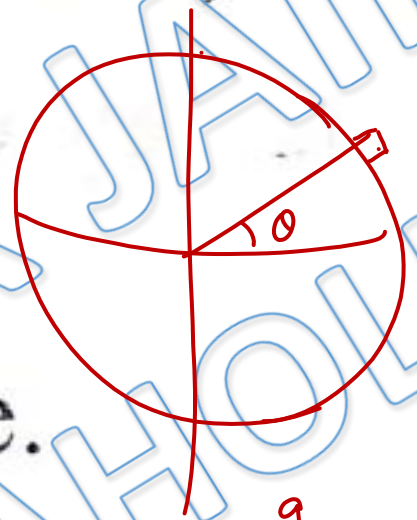
What will be the effect on the weight of a body placed on the surface of earth, if earth suddenly stops rotating?

(a) No effect.

(b) Weight will increase.

(c) Weight will decrease.

(d) Weight will become zero. (2014)



AIIMS

$g_{eff} = g - R\omega^2 \cos^2\theta$

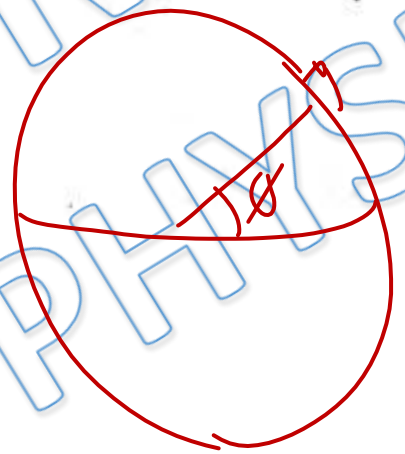
Ans. b

Find out the correct relation for the dependance of change in acceleration due to gravity on the angle at the latitude, due to rotation of earth

(a) $dg \propto \cos\phi$ (b) $dg \propto \cos^2\phi$

(c) $dg \propto \cos^{3/2}\phi$ (d) $dg \propto \dfrac{1}{\cos\phi}$

AIIMS (2012)



$g_{eff} = g - R\omega^2\cos^2\phi$

$(g - g_{eff}) = dg = R\omega^2\cos^2\phi$

Ans. b

Assertion: The difference in the value of acceleration due to gravity at pole and equator is proportional to square of angular velocity of earth.

Reason: The value of acceleration due to gravity is minimum at the equator and maximum at the pole. *(2010)*

$g_{eff} = g - R\omega^2 \cos^2\phi$

at pole $g_{eff} = g$

at equator $g_{eff} = g - R\omega^2$

$\Delta g = R\omega^2$

AIIMS

a) If both assertion & reasons are true and reason is the correct explanation of assertion.

b) If both assertion & reasons are true but reason is not the correct explanation of assertion.

c) Is assertion is true but reason is false.

d) If both assertion & reason are false.

Ans. b

Assertion : At pole value of acceleration due to gravity g is greater than that of equator.

Reason : Earth rotates on its axis in addition to revolving round the sun. *(2001)*

AIIMS

a) If both assertion & reasons are true and reason is the correct explanation of assertion.

b) If both assertion & reasons are true but reason is not the correct explanation of assertion.

c) Is assertion is true but reason is false.

d) If both assertion & reason are false.

Ans. a

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Chalo niklo