Class 11th

NURTURE By Vedantu Enthuse

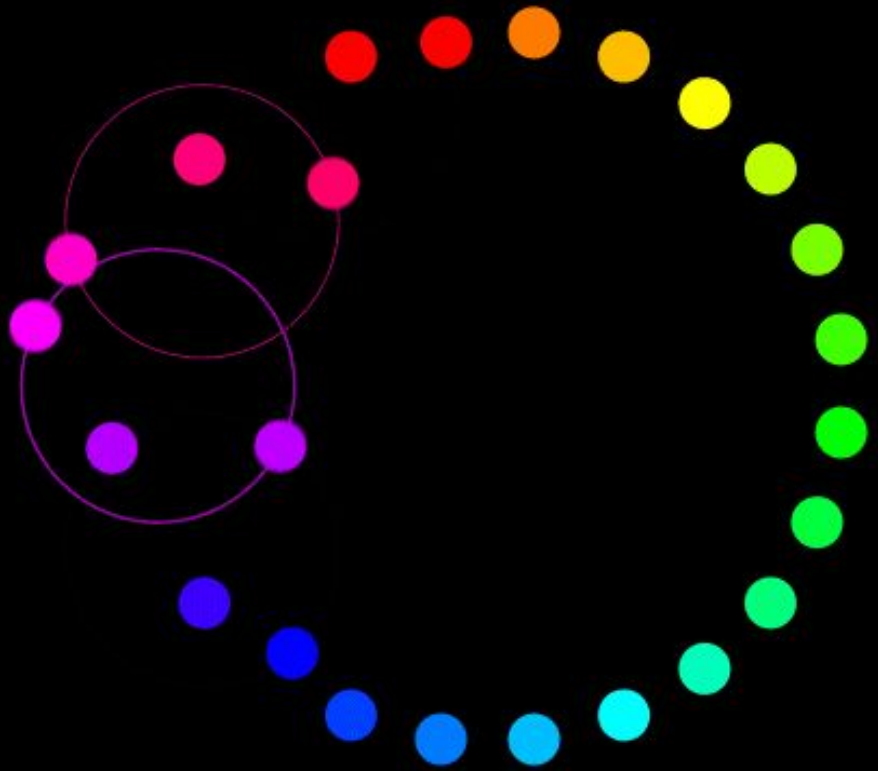
ENTHUSE

Circular Motion

Lets spin ! Circular Motion Kinetics

Lecture 01

SHREYAS SIR
HOD PHYSICS -VEDANTU



Vedantu Master Teacher

ENTHUSE

Shreyas_Vedantu

HOD Physics-JEE

Shreyas H

- B.Tech from NIT Nagpur
- Research from IIT Bombay

- 12+ Years Teaching Experience
- Produced top 100 AIRs

- Mentored 1,000s into IITs, BITs, NITs , IISER, IISC & premier institutes

- Foodie by heart , teacher by choice ...
  Techie by passion !

Not 1, not 2, not 3

20+ Vedantu students scored 98% and above in 12th Boards!

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Kerala Board

100%
Abhinav Pradeep
Kerala Board

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Aastha N Raj
ISC Board

99.4%
Bharat Kumar B
RBSE Board

99.3%
Krithika B
Karnataka Board

99.25%
Niranjana R
Kerala Board

99.2%
Vivek Mohan J
Kerala Board

99.16%
Kalidas Viswam
Kerala Board

99%
Devika V
Kerala Board

98.8%
Jatin Khatri
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Aatman Upreti
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98.4%
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J&K Board

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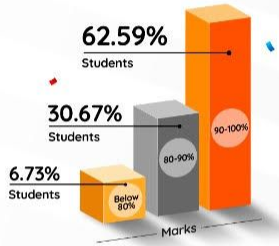
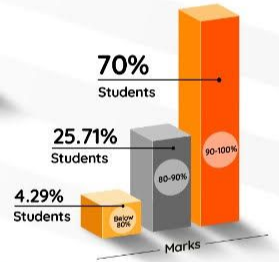
Our students have scored well across the board!

12th Board Results

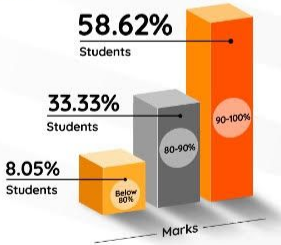
CBSE, ISC & State Boards



ISC and State Boards



CBSE



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For any queries
shreyas_vedantu


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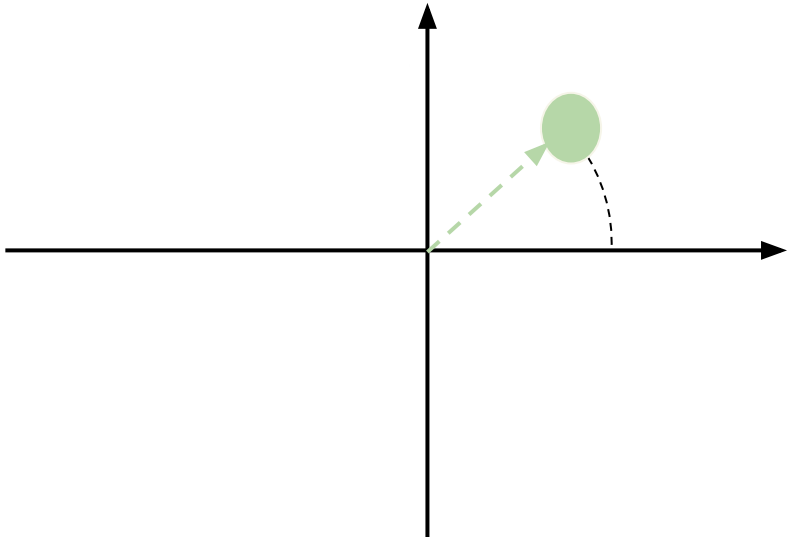
Angular Position

Angle made by position vector of a moving particle with respect to origin with reference line is known as angular position.



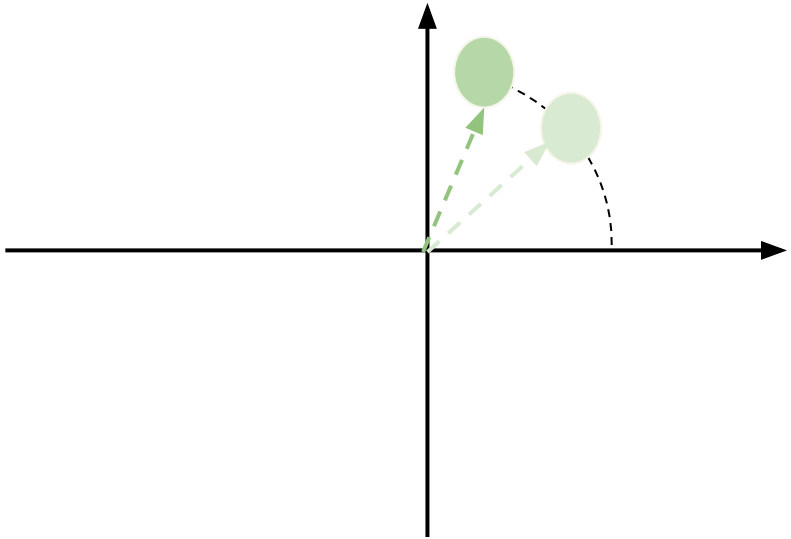
Angular Displacement

Angular displacement is the angle subtended by the position vector at the centre of the circular path.

Angular displacement $(\Delta\theta) = \frac{\Delta s}{r}$

Where, **Δs** is the linear displacement and **r** is the radius.

Its SI unit is radian.



Angular Velocity

Angular Velocity

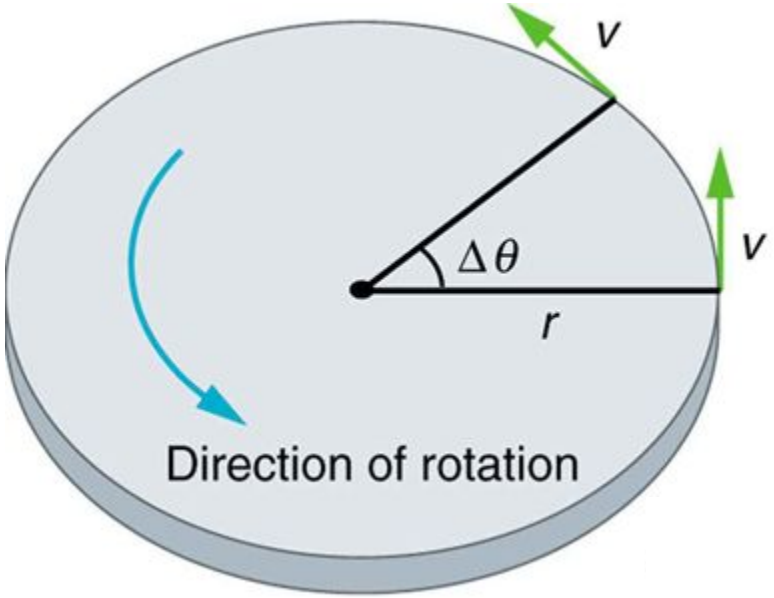
The time rate of change of angular displacement ($\Delta\theta$) is called angular velocity.

Angular velocity $(\omega) = \dfrac{\Delta\theta}{\Delta t}$

Angular velocity is a vector quantity
SI unit is rad/s.

Relation between linear velocity(v) and angular velocity(ω) is given by

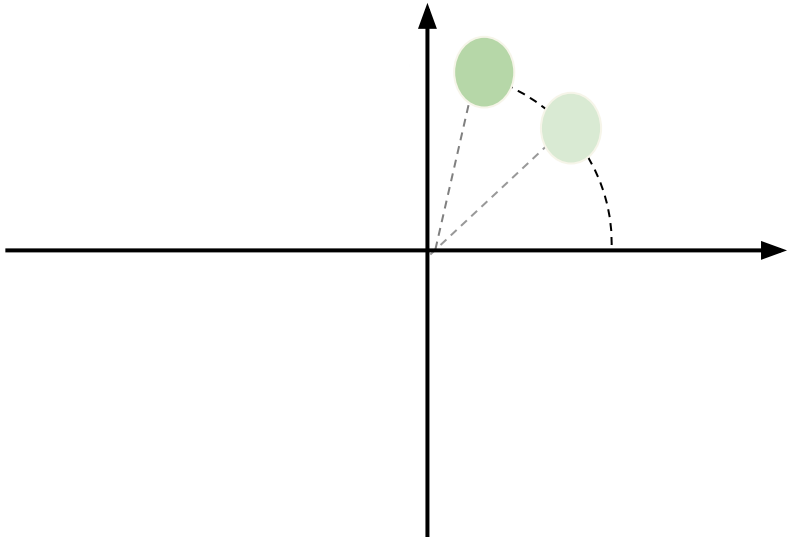
v = ω x r



Instantaneous Angular Velocity

The angular velocity of a particle at any instant is called instantaneous angular velocity.

$\omega = d\theta/dt$



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Circular Motion

Angular Acceleration

The rate of change of angular velocity is called angular acceleration.

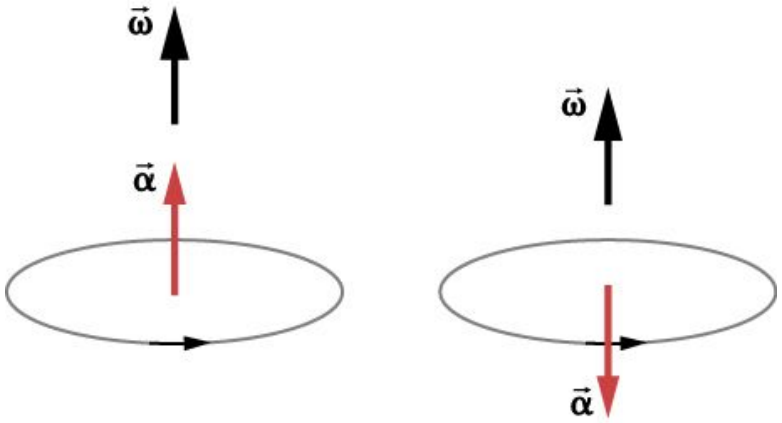
Angular acceleration $= \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$

Its SI unit is rad/s^2

Relation between linear acceleration(a) and angular acceleration(α)

$\mathbf{a = r\,\alpha}$

Where, r = radius.



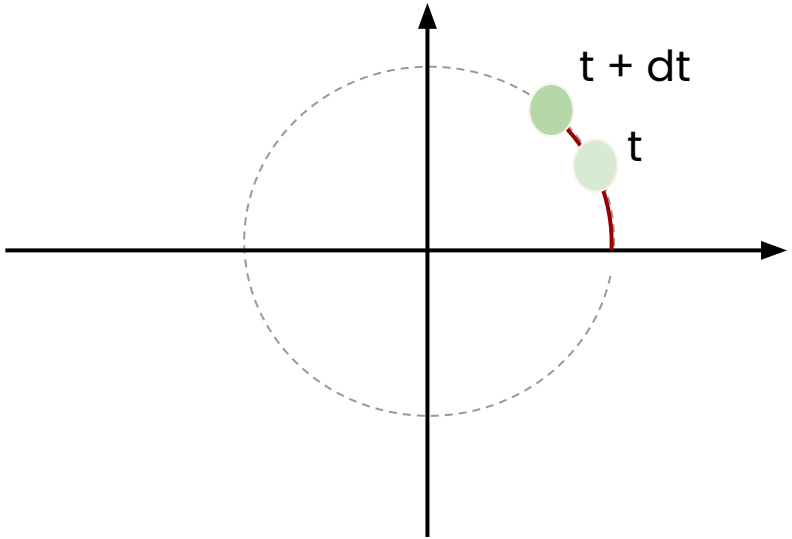
(a) Rotation rate counterclockwise and increasing

(b) Rotation rate counterclockwise and decreasing

Instantaneous Angular Acceleration

The angular Acceleration of a particle at any instant is called instantaneous angular Acceleration.

$\alpha = d\omega/dt$



The angular velocity of hour's hand in wall clock is (in($rads^{-1}$))

A $\frac{\pi}{3000}$

B $\frac{\pi}{3600}$

C $\frac{\pi}{21600}$

D $\frac{\pi}{1800}$

Let's Solve

Nurture 2023

Circular Motion

The angular velocity of hour's hand in wall clock is (in($rads^{-1}$))

A $\frac{\pi}{3000}$

B $\frac{\pi}{3600}$

C $\frac{\pi}{21600}$

D $\frac{\pi}{1800}$

A point on the rim of a wheel 2m in diameter has linear acceleration of $8ms^{-2}$. The angular acceleration of the wheel is

A $4\ rad\ s^{-2}$

B $8\ rad\ s^{-2}$

C $16\ rad\ s^{-2}$

D $10\ rad\ s^{-2}$

A point on the rim of a wheel 2m in diameter has linear acceleration of $8ms^{-2}$. The angular acceleration of the wheel is

A $4\ rad\ s^{-2}$

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D $10\ rad\ s^{-2}$

The angle turned by a body undergoing circular motion depends on time as $\theta = \theta_0 + \theta_1 t + \theta_2 t^2$. Then the angular acceleration of the body is

A θ_1

B θ_2

C $2\theta_1$

D $2\theta_2$

The angle turned by a body undergoing circular motion depends on time as $\theta = \theta_0 + \theta_1 t + \theta_2 t^2$. Then the angular acceleration of the body is

A θ_1

B θ_2

C $2\theta_1$

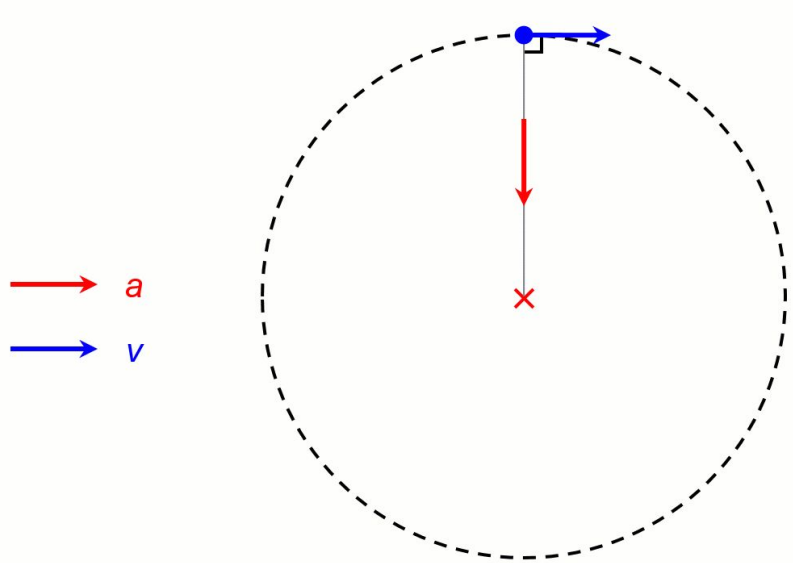
D $2\theta_2$

Centripetal Acceleration

In circular motion, an acceleration acts on the body, whose direction is always towards the centre of the path. This acceleration is called centripetal acceleration.

$$\text{Centripetal acceleration} = \frac{v^2}{r} = r\omega^2$$

Centripetal acceleration is also called radial acceleration as it acts along radius of circle.



Let's Solve

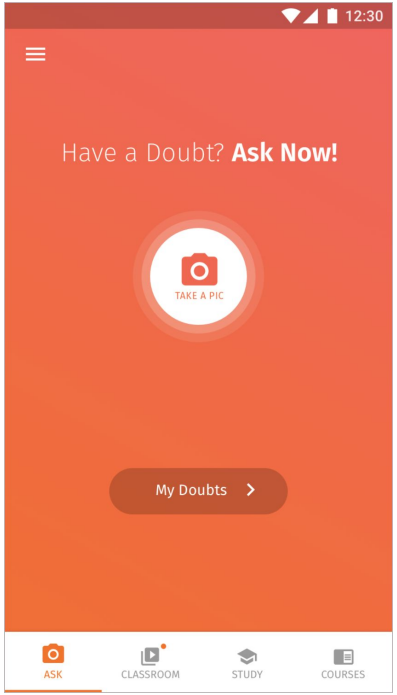
What is the magnitude of the centripetal acceleration of a car following a curve of radius 500 m at a speed of 90 kmph ?

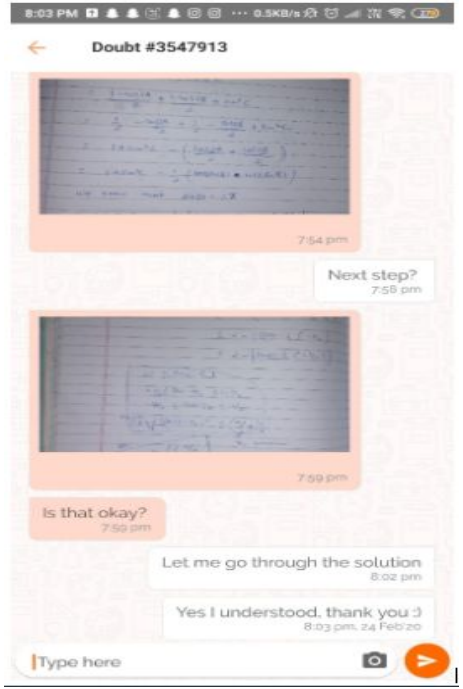
Let's Solve

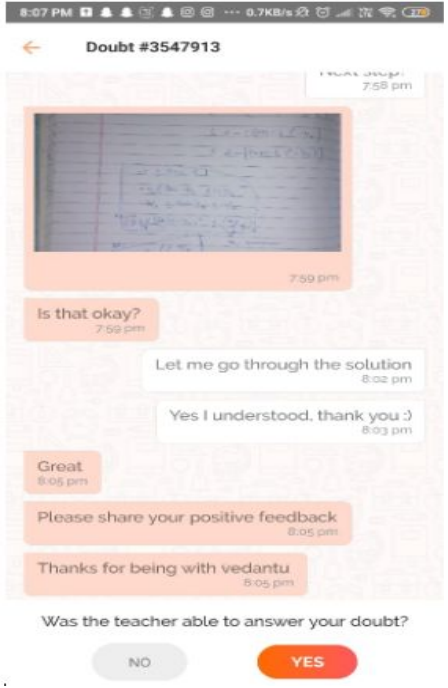
What is the magnitude of the centripetal acceleration of a car following a curve of radius 500 m at a speed of 90 kmph ?

Ans $1.25\ m/s^2$

Doubts



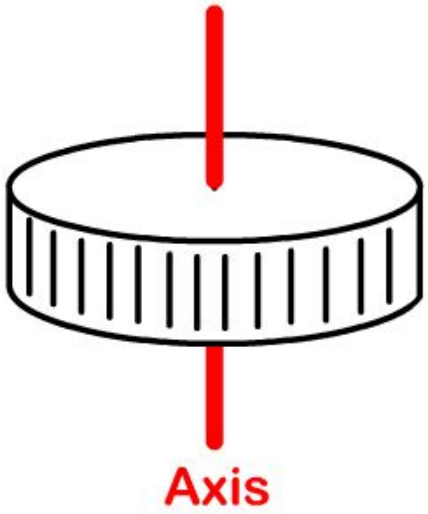




More than 2 Million doubts solved

Uniform Circular Motion

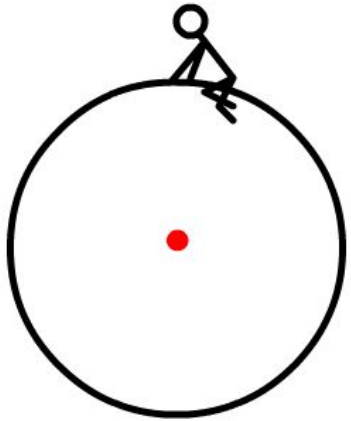
If the magnitude of the velocity *(=speed)* of the particle in circular motion remains constant, then it is called uniform circular motion.



Time Period

The time required to complete one rotation is called time period (T).

$T = 2\pi/\omega$



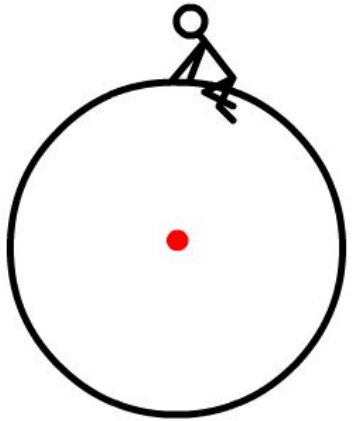
Revolution

Frequency

Number of rotations in one second is called frequency f .

$f = 1/T$

Angular frequency $\omega = 2\pi f$



Revolution

Let's Solve

A point on the rim of a wheel 2m in diameter has linear velocity of 8m/s. What will be the angular velocity of the wheel in RPM ? What is the time period of revolution ?

Let's Solve

A point on the rim of a wheel 2m in diameter has linear velocity of 8m/s. What will be the angular velocity of the wheel in RPM ? What is the time period of revolution ?

Ans $240/\pi$ RPM , $\pi/4$ s

Let's Solve

What will be the average acceleration of a car travelling at 36 kmph to take a turn by 180° ,while travelling along an arc of length 314 m ? What would its instantaneous acceleration be ?

Let's Solve

What will be the average acceleration of a car travelling at 36 kmph to take a turn by 180° ,while travelling along an arc of length 314 m ? What would its instantaneous acceleration be ?

Ans $2/\pi \text{ m/s}^2$

1 m/s^2

The angular displacement of a particle is given by $\theta = t^3 + t^2 + t + 1$ where 't' is time in seconds. Its angular velocity after 3s is

A. 34 radius^{-1}

B. 24 radius^{-1}

C. 15 radius^{-1}

D. 6 radius^{-1}

The angular displacement of a particle is given by $\theta = t^3 + t^2 + t + 1$ where 't' is time in seconds. Its angular velocity after 3s is

A. 34 radius^{-1}

B. 24 radius^{-1}

C. 15 radius^{-1}

D. 6 radius^{-1}

$$\theta = t^3 + t^2 \times t + 1$$

$$T = 3 \text{ sec}$$

$$\omega = \frac{d\theta}{dt} = 3t^2 + 2t + 1$$

$$3(9) + 2t + 1$$

$$=27 + 6 + 1$$

Homework

A particle moves in a circle of radius 100 m with constant speed of 20 m/s. What is its angular velocity in radians per second about the centre of the circle? What is the centripetal acceleration ?

Homework

A particle moves in a circle of radius 100 m with constant speed of 20 m/s. What is its angular velocity in radians per second about the centre of the circle? What is the centripetal acceleration ?

Ans 0.2 rad /s , $4 m/s^2$

$\omega = 20 / 100 = 0.2$ rad/s

$a_c = \omega^2 r = 0.2^2 (100) = 4 \, m/s^2$

Homework

A particle moves in a circle of radius 100 m with constant speed of 20 m/s. What is the frequency ?

Homework

A particle moves in a circle of radius 100 m with constant speed of 20 m/s. What is the frequency ?

Ans 1/10π Hz

$f = \omega / 2\pi = v/2\pi r = 20 / 2\pi (100) = 1/10\pi$ Hz

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