A Particle Makes 800 Revolution In 4 Minutes Of A Circle Of 5cm. Findi. It's Periodii. Angular Velocityiii.

A Particle Makes 800 Revolution In 4 Minutes Of A Circle Of 5cm. Findi. It's Periodii. Angular Velocityiii.

Understanding the motion of a particle moving along a circular path is fundamental in physics, especially in the study of rotational motion. When a particle completes a certain number of revolutions in a given time, we can determine key parameters such as its period and angular velocity. In this article, we will explore how to calculate these quantities step-by-step using the given data: the particle makes 800 revolutions in 4 minutes around a circle with a radius of 5 cm.

Understanding the Problem

Before diving into calculations, let's clearly understand what is being asked.

- The particle completes 800 revolutions in a total time of 4 minutes.
- The circle's radius is 5 cm.
- Our goals:
- Find the period (T) — the time taken for one complete revolution.
- Find the angular velocity (ω) — the rate at which the particle sweeps out an angle in radians per second.

Step 1: Convert Time to Appropriate Units

Since revolutions are given over minutes, and angular velocity is expressed in radians per second, the first step is to convert the total time into seconds.

Calculating Total Time in Seconds

1. Given time: 4 minutes
2. Convert minutes to seconds: 4 minutes × 60 seconds/minute = 240 seconds

---

Step 2: Calculate the Total Number of Revolutions

The total number of revolutions is already given as 800 revolutions.

Step 3: Find the Period (T)

The period (T) is the time taken for one complete revolution.

Formula for Period

- **T = Total Time / Total Number of Revolutions**

Applying the Formula

1. T = 240 seconds / 800 revolutions
2. T = 0.3 seconds

Therefore, the period of the particle's motion is 0.3 seconds.

Step 4: Calculate the Angular Velocity (ω)

The angular velocity (ω) measures how fast the particle rotates, expressed in radians per second.

Understanding Angular Displacement

- One complete revolution corresponds to an angle of 2π radians.
- Total revolutions: 800

Calculate Total Angular Displacement (θ)

- θ = Number of revolutions × 2π radians
- θ = 800 × 2π = 1600π radians

Formula for Angular Velocity

- **ω = Total angular displacement / Total time**

Applying the Formula

1. $\omega = 1600\pi$ radians / 240 seconds
2. $\omega \approx (1600 \times 3.1416) / 240$
3. $\omega \approx 5026.56 / 240$
4. $\omega \approx 20.94$ radians/second

Thus, the angular velocity of the particle is approximately 20.94 radians per second.

Step 5: Additional Calculations — Linear or Tangential Velocity

While the main focus is on period and angular velocity, understanding the linear velocity can provide a complete picture of the particle's motion.

Calculate the Circumference of the Circle

- Using the radius: $C = 2\pi r$
- $C = 2 \times 3.1416 \times 5$ cm ≈ 31.416 cm

Calculate the Linear Velocity (v)

- v = Circumference / Period = 31.416 cm / 0.3 s $\approx$ 104.72 cm/sec

This indicates the particle moves at approximately 1.047 meters per second along the circle.

Summary of Results

Parameter	Value	Explanation
Period (T)	0.3 seconds	Time for one complete revolution
Angular Velocity (ω)	20.94 radians/sec	Rate of change of angular displacement in radians/sec
Circumference of Circle	31.416 cm	Length of one complete lap around the circle
Linear Velocity (v)	104.72 cm/sec	Speed along the circular path

---

Conclusion

By analyzing the data that a particle makes 800 revolutions in 4 minutes around a circle of radius 5 cm, we've successfully calculated its period and angular velocity. The period is 0.3 seconds, meaning the particle completes a revolution every third of a second. The angular velocity is approximately 20.94 radians per second, indicating a rapid rotational motion. Additionally, understanding these parameters helps in various applications, such as designing rotating machinery, analyzing planetary motion, or studying oscillatory systems.

Understanding rotational motion through such calculations enhances our grasp of physics principles and provides practical insights into real-world dynamic systems. Whether you're a student preparing for exams or a professional analyzing mechanical systems, mastering these computations is essential for a comprehensive understanding of circular motion.

Keywords for SEO Optimization: Circular motion, angular velocity, period of rotation, revolutions per minute, rotational motion calculation, particle motion, physics problems, rotational kinematics, angular displacement, linear velocity, rotational dynamics.

Frequently Asked Questions

What is the total number of revolutions made by the particle in 4 minutes?

The particle makes 800 revolutions in 4 minutes.

What is the radius of the circle in which the particle is moving?

The radius of the circle is 5 cm.

How do you calculate the period of the particle's motion?

The period T is the time taken for one revolution, calculated as T = total time / number of revolutions, so T = 4 minutes / 800 = 0.005 minutes or 0.3 seconds.

What is the period of the particle's motion in seconds?

The period T is 0.3 seconds.

How is angular velocity related to the number of revolutions and time?

Angular velocity ω is given by ω = 2π × number of revolutions / total time in seconds.

What is the angular velocity of the particle in radians per second?

First, convert total time to seconds: 4 minutes = 240 seconds. Then, ω = 2π × 800 / 240 = (1600π) / 240 ≈ 20.94 radians/sec.

How do you find the linear velocity of the particle?

Linear velocity v = r × angular velocity ω. Using r = 5 cm = 0.05 m and ω ≈ 20.94 rad/sec, v ≈ 0.05 × 20.94 ≈ 1.05 meters/sec.

What is the significance of the period in circular motion?

The period represents the time taken for the particle to complete one full revolution around the circle.

How can you verify the angular velocity calculation?

By confirming that $\omega = 2\pi / T$, where T is the period in seconds. Using T = 0.3 sec, $\omega = 2\pi / 0.3 \approx 20.94$ rad/sec, matching previous calculation.

Additional Resources

A Particle Makes 800 Revolutions in 4 Minutes of a Circle of 5cm. Find i. Its Period ii. Angular Velocity iii.

Introduction

In the realm of classical mechanics, understanding the motion of particles along circular paths is fundamental. Such motion not only underpins many natural phenomena but also forms the basis for numerous engineering applications, from machinery to orbital dynamics. This investigative article delves into a specific problem involving a particle executing multiple revolutions along a circular path, with a focus on determining key parameters: the period, angular velocity, and other related quantities. The problem statement is as follows:

A particle makes 800 revolutions in 4 minutes along a circle with a radius of 5 cm.

This scenario offers an excellent case study to explore the interconnectedness of rotational kinematic quantities and to demonstrate methods for analyzing circular motion comprehensively.

Problem Restatement and Initial Observations

Understanding the problem begins with extracting the essential data:

- Number of Revolutions (N): 800 revolutions
- Time Duration (T): 4 minutes
- Radius of Circular Path (r): 5 cm

Our objectives are to find:

1. The period (T) — the time taken for one complete revolution.
2. The angular velocity (ω) — the rate at which the particle sweeps out angles in radians per second.
3. The linear (tangential) velocity (v) — the speed along the circular path.

Before delving into calculations, it's vital to understand the units involved and convert all measurements to SI units where appropriate.

Converting Units and Basic Calculations

Time Conversion

Since the time data is given in minutes, convert it to seconds:

$$
T = 4 \text{ minutes} = 4 \times 60 = 240 \text{ seconds}
$$

\]

Revolutions to Radians

One revolution corresponds to 2π radians. Therefore, total angular displacement over 800 revolutions:

$$
\theta_{\text{total}} = 800 \times 2\pi = 1600\pi \text{ radians}
$$

Radius in Meters

$$
r = 5 \text{ cm} = 0.05 \text{ m}
$$

Calculating the Period (T_p)

Definition

The period T_{p} is the time taken for one complete revolution:

$$
T_{p} = \frac{\text{Total Time}}{\text{Number of Revolutions}} = \frac{T}{N}
$$

Calculation

$$
T_{p} = \frac{240 \text{ s}}{800} = 0.3 \text{ seconds}
$$

Thus, the particle completes one revolution every 0.3 seconds.

Calculating the Angular Velocity (ω)

Definition

Angular velocity ω is the rate of change of angular displacement with respect to time:

$$
\omega = \frac{\theta}{t}
$$

where:

- θ is the total angle in radians
- t is the total time in seconds

Calculation

$$
\omega = \frac{1600 \pi}{240 \text{ s}} = \frac{1600 \pi}{240} \text{ rad/sec}
$$

Simplify:

$$
\omega = \frac{1600}{240} \pi = \frac{20}{3} \pi \text{ rad/sec}
$$

Numerically:

$$
\omega \approx 6.6667 \times 3.1416 \approx 20.943 \text{ rad/sec}
$$

Therefore, the angular velocity is approximately 20.943 rad/sec.

Calculating the Linear (Tangential) Velocity (v)

Relationship

Linear velocity v relates to angular velocity via:

$$
v = r \omega
$$

Calculation

$$
v = 0.05 \text{ m} \times 20.943 \text{ rad/sec} \approx 1.047 \text{ m/sec}
$$

The particle's tangential velocity is approximately 1.047 meters per second.

Summary of Findings

Quantity	Calculation / Value
Period (T)	0.3 seconds
Angular Velocity (ω)	20.943 rad/sec
Linear Velocity (v)	1.047 m/sec

Deep Dive: The Physics and Implications

The Significance of the Period and Angular Velocity

The period of 0.3 seconds indicates rapid completion of each revolution, illustrating high-frequency motion. This is typical in systems where particles or objects rotate swiftly, such as in centrifuges or high-speed machinery. The angular velocity, approximately 21 rad/sec, confirms that the particle completes over 20 radians each second—a significant rate of rotation, emphasizing the importance of understanding the associated centripetal forces and energy considerations.

Energy and Force Considerations

While the problem does not specify forces or energy, it is useful to consider the implications:

- Centripetal Force (F_c): For a particle moving at velocity v:

$$
F_{c} = \frac{m v^{2}}{r}
$$

- Kinetic Energy (K): Total kinetic energy:

$$
K = \frac{1}{2} m v^{2}
$$

These quantities are vital in analyzing the stability of the motion, potential energy losses, or the design of systems involving such particle motion.

Extended Applications and Contextual Relevance

Engineering Applications

Understanding these parameters is essential for designing rotating machinery, such as turbines, disc brakes, or centrifuges, where precise control of rotational speed and timing is critical.

Natural Phenomena

Natural systems, such as electrons orbiting an atomic nucleus or celestial bodies revolving around a star, can be modeled with similar principles, albeit with quantum or gravitational considerations.

Educational Significance

This problem exemplifies core concepts in rotational kinematics, offering students practical insights into how to analyze circular motion quantitatively.

Conclusion

This investigation elucidates the fundamental parameters of a particle undergoing multiple revolutions along a circular path. By systematically converting units, applying basic kinematic formulas, and interpreting the results, we find that:

- The particle completes each revolution in 0.3 seconds.
- It exhibits an angular velocity of approximately 20.943 rad/sec.
- It maintains a tangential speed of about 1.047 m/sec.

These insights reinforce the interconnectedness of rotational parameters and serve as a foundation for more complex analyses in physics and engineering. Understanding such motion is crucial for designing systems that harness or withstand rapid rotational dynamics, making this problem a quintessential example of applied rotational kinematics in both academic and real-world contexts.

End of Article

A Particle Makes 800 Revolution In 4 Minutes Of A Circle Of 5cm Findi It S Periodii Angular Velocityiii

A Particle Makes 800 Revolution In 4 Minutes Of A Circle Of 5cm Findi It S Periodii Angular Velocityiii

Related Articles

- What Should The Representative Consider Prior To A Mutual Fund Transfer?A) The Performance Of The Existing
- Assume The Random Variable X Has A Binomial Distribution With The Given Probablity Of Obtainirig A Success.
- The Ethical Standard That States That Wages Paid For A Standard Work Week Must Meet The Legal And Industry

Back to Home