S = 6t + 3t + 7, 0 T 2 Find The Body's Displacement And Average Velocity For The Given Time Interval.

S = 6t + 3t + 7, 0 T 2 Find The Body's Displacement And Average Velocity For The Given Time Interval.

Understanding the concepts of displacement and average velocity is fundamental in kinematics, the branch of physics that deals with the motion of objects. When analyzing an object’s motion, it is essential to interpret the position function, often expressed as a function of time, and derive meaningful quantities such as displacement and average velocity. In this article, we will explore how to determine the displacement and average velocity of a body moving along a straight path, given the position function $S(t) = 6t + 3t + 7$ over the time interval $0 \leq T \leq 2$.

Understanding the Position Function

Before diving into calculations, it’s important to understand what the position function represents.

Position Function $S(t)$

- The position function $S(t)$ gives the position of the body at any time t.
- In this specific case, the function is:

$$
S(t) = 6t + 3t + 7
$$

- Simplifying this, we get:

$$
S(t) = (6 + 3)t + 7 = 9t + 7
$$

This linear function indicates a constant rate of change of position with respect to time, characteristic of uniform motion.

Significance of the Function Components

- The coefficient 9 before t signifies the velocity (since the position function is linear, the coefficient is the velocity).
- The constant term 7 indicates the initial position at $t = 0$.

Calculating Displacement

Displacement refers to the change in position of the body from the initial point to the final point over a specific time interval.

Definition of Displacement

$$
\text{Displacement} = S(t_{final}) - S(t_{initial})
$$

Given the time interval $0 \leq t \leq 2$:

- $t_{initial} = 0$
- $t_{final} = 2$

Step-by-Step Calculation

1. Find the initial position $S(0)$:

$$
S(0) = 9(0) + 7 = 0 + 7 = 7
$$

2. Find the final position $S(2)$:

$$
S(2) = 9(2) + 7 = 18 + 7 = 25
$$

3. Calculate the displacement:

$$
\text{Displacement} = S(2) - S(0) = 25 - 7 = 18
$$

Result: The body's displacement over the interval $0 \leq t \leq 2$ is 18 units.

Calculating Average Velocity

Average velocity is a measure of the overall rate of change of position with respect to time between two points.

Definition of Average Velocity

$$
v_{avg} = \frac{\text{Displacement}}{\text{Time Interval}} = \frac{S(t_{final}) - S(t_{initial})}{t_{final} - t_{initial}}
$$

Using the values from above:

$$
v_{avg} = \frac{18}{2 - 0} = \frac{18}{2} = 9
$$

Result: The average velocity of the body over the interval $0 \leq t \leq 2$ is 9 units per second.

Interpreting the Results

The calculated displacement and average velocity reveal key aspects of the body's motion:

- The displacement of 18 units indicates the net change in position over 2 seconds.
- The average velocity of 9 units/sec signifies a uniform motion, consistent with the linear position function.

Since the position function is linear, the body's velocity remains constant throughout the interval. This simplifies analysis and confirms that the body moves with a steady speed.

Additional Insights and Related Concepts

Understanding displacement and average velocity forms the foundation of kinematic analysis. Here are some related ideas and concepts for a comprehensive understanding:

Instantaneous Velocity

- Unlike average velocity, instantaneous velocity refers to the velocity of the body at a specific moment.
- For linear functions, the instantaneous velocity is constant and equal to the slope of the position function.

Graphical Representation

- Plotting $S(t)$ versus t yields a straight line with slope 9.
- The slope of the line represents the velocity.
- The change in the vertical axis between $t=0$ and $t=2$ visually shows displacement.

Application in Real-World Scenarios

- Calculating displacement and average velocity is essential in vehicle motion analysis, projectile physics, and even in tracking objects in space.
- These calculations help in predicting future positions and understanding the motion pattern of objects.

Summary of Key Points

- The position function $S(t) = 9t + 7$ describes the linear motion of a body.
- Displacement over the interval $0 \leq t \leq 2$ is 18 units.
- The average velocity during this period is 9 units/sec.
- The constant velocity indicates uniform motion, simplifying calculations and interpretations.
- Understanding these concepts is fundamental in physics and engineering disciplines.

Conclusion

Analyzing the motion of a body using its position function provides valuable insights into its displacement and average velocity. In the given case, the linear nature of $S(t) = 9t +$

7 \) makes it straightforward to compute these quantities. Recognizing the relationship between the position function, velocity, and displacement allows scientists and engineers to design, predict, and analyze motion effectively. Whether in theoretical physics or practical applications like vehicle navigation and space exploration, mastering these fundamental concepts is crucial for advancing understanding and innovation.

FAQs

1. **What is displacement?** Displacement is the change in position of an object from its initial to final point over a given time interval.

2. **How is average velocity different from instantaneous velocity?** Average velocity considers the overall change over a time interval, whereas instantaneous velocity is the velocity at a specific moment.

3. **Why is the position function \(S(t) \) important?** It provides a mathematical description of an object's location over time, enabling calculation of motion parameters.

4. **Can the same approach be used for non-linear functions?** Yes, but calculations may be more complex, often involving derivatives to find instantaneous velocity and displacement.

By mastering these concepts and methods, learners can effectively analyze various types of motion, enhancing their understanding of physics and engineering principles.

Frequently Asked Questions

What is the given displacement function in the problem?

The displacement function is S = 6t + 3t + 7.

How do you simplify the displacement function S = 6t + 3t + 7?

Combine like terms to get S = (6t + 3t) + 7 = 9t + 7.

What is the displacement of the body at t = 0 seconds?

At t = 0, S = 9(0) + 7 = 7 units.

What is the displacement of the body at t = 2 seconds?

At t=2, S = 9(2) + 7 = 18 + 7 = 25 units.

How do you calculate the body's displacement over the time interval from 0 to 2 seconds?

Displacement over the interval is S(2) - S(0) = 25 - 7 = 18 units.

How is the average velocity calculated for the given time interval?

Average velocity = (Displacement) / (Time interval) = 18 / 2 = 9 units per second.

What are the final answers for displacement and average velocity over the interval 0 to 2 seconds?

Displacement is 18 units and the average velocity is 9 units per second.

Additional Resources

S = 6t + 3t + 7, 0 T 2 Find The Body's Displacement And Average Velocity For The Given Time Interval

Understanding the motion of objects is fundamental in physics, especially when analyzing how far a body travels and how quickly it moves over a specific period. In this context, we are presented with a position function $S(t) = 6t + 3t + 7$ over the interval from $t=0$ to $t=2$. Our goal is to determine the body's displacement and average velocity within this timeframe, shedding light on the body's motion characteristics.

Clarifying the Position Function

Before diving into calculations, let's clarify the position function provided. The expression is:

$$S(t) = 6t + 3t + 7$$

which, when simplified, becomes:

$$S(t) = (6t + 3t) + 7 = 9t + 7$$

This linear function describes the position of the body at any time t. The coefficient of t (which is 9) represents the velocity component, while the constant term (7) indicates the initial position at $t=0$.

The Fundamentals: Displacement and Average Velocity

Displacement is a vector quantity that measures the change in position of an object during a time interval. It considers the initial and final positions:

$$\text{Displacement} = S(t_{final}) - S(t_{initial})$$

Average velocity describes the rate at which an object changes its position over a period:

$$v_{avg} = \frac{\text{Displacement}}{\text{Time Interval}} = \frac{S(t_{final}) - S(t_{initial})}{t_{final} - t_{initial}}$$

In our case, the interval is from $t=0$ to $t=2$.

Calculating the Displacement

To find the displacement, we first evaluate the position function at the initial and final times:

1. Position at $t=0$:

$$S(0) = 9 \times 0 + 7 = 0 + 7 = 7$$

2. Position at $t=2$:

$$S(2) = 9 \times 2 + 7 = 18 + 7 = 25$$

Displacement is then:

$$\text{Displacement} = S(2) - S(0) = 25 - 7 = 18$$

This means the body has moved 18 units in the positive direction over the 2-second interval.

Calculating the Average Velocity

Using the displacement and the time interval:

$$
v_{avg} = \frac{S(2) - S(0)}{2 - 0} = \frac{18}{2} = 9
$$

Thus, the average velocity over the interval from 0 to 2 seconds is 9 units per second.

This indicates that, on average, the body moved at a steady rate of 9 units/sec in the positive direction during this period.

Deep Dive: Interpreting the Results

While the calculations seem straightforward, interpreting these results involves understanding the nuances of motion:

- Constant velocity: The position function $S(t) = 9t + 7$ is linear, implying uniform motion. The body moves at a constant velocity of 9 units/sec throughout the interval, which aligns with the average velocity calculation.

- Implication of initial position: The initial position at $t=0$ is 7 units, meaning the body started 7 units away from some reference point.

- Significance of displacement: The displacement of 18 units confirms a movement in the positive direction, consistent with the positive coefficient in the position function.

Broader Context: Application in Physics and Engineering

Understanding displacement and average velocity is vital across various fields:

- Kinematics: These fundamental concepts describe how objects move, whether in free fall, vehicle motion, or robotic arms.

- Engineering: Designing systems requires precise knowledge of object movement over time to ensure safety and efficiency.

- Navigation and GPS: Displacement calculations help determine how far a vehicle or person has traveled.

- Sports science: Analyzing an athlete's movement relies on these principles to optimize performance.

Limitations and Further Considerations

While the current analysis assumes a linear position function, real-world motion often involves acceleration, non-linear paths, or variable velocities. To capture such complexities, calculus becomes essential:

- Instantaneous velocity: Derived from the derivative of the position function.

- Acceleration: The second derivative indicates how velocity changes over time.

For instance, if the position function were quadratic or more complex, the calculations would involve derivatives and integrals to find instantaneous velocities and more detailed displacement analysis.

Summary and Final Thoughts

In conclusion, analyzing the motion described by the position function $S(t) = 9t + 7$ over the interval from 0 to 2 seconds yields:

- Displacement: 18 units
- Average velocity: 9 units/sec

This straightforward scenario exemplifies uniform motion, where the body's displacement and average velocity are directly proportional to time. Such analyses serve as foundational tools in physics, enabling scientists and engineers to understand, predict, and optimize the movement of objects in various contexts.

By mastering these calculations, professionals can interpret motion data accurately, design better systems, and deepen their understanding of the physical world. Whether in academic research or practical applications, the principles of displacement and average velocity remain central to the study of motion.

S 6t 3t 7 0 T 2 Find The Body S Displacement And Average Velocity For The Given Time Interval

S 6t 3t 7 0 T 2 Find The Body S Displacement And Average Velocity For The Given Time Interval

Related Articles

- Muscle Cells Make Up Muscle Tissues, Which Are Attached To Each Other And To Bones. The Main Function
- Provide An Appropriate Response. Express Your Answer As A Simplified Fraction Unless Otherwise Noted.
- Percy Corporation Was Formed On January 1. The Corporate Charter Authorized 100,000 Shares Of $10 Par

Back to Home