15 6. Acar Moves With A Velocity Of 30m/s Is Accelerated In 6sec Find Final Velocity And The Distance

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Understanding the dynamics of motion is fundamental in physics, especially when analyzing how objects like cars accelerate. In this article, we will explore a specific problem: A car moves with an initial velocity of 30 m/s and is subjected to acceleration over a period of 6 seconds. The goal is to find the car's final velocity and the distance covered during this time. This problem involves applying basic kinematic equations, which are essential tools for solving motion-related questions.

Understanding the Given Data

Before diving into calculations, let's clearly outline the information provided:

Initial Velocity (u)

- The car's initial velocity is given as 30 m/s.

Time (t)

- The duration of acceleration is 6 seconds.

Acceleration (a)

- The acceleration value isn't directly provided and must be assumed or clarified. For the sake of this problem, we will consider the acceleration as an unknown to be calculated, or if given, we can proceed with it.
- If the problem states that the car accelerates uniformly, then the acceleration can be derived if additional data about final velocity or distance covered is provided.
- In the absence of specific acceleration data, a common approach is to assume a known acceleration or to analyze the problem in terms of variables.

Note: If the problem states an acceleration value, input that accordingly. If not, perhaps the problem involves calculating the final velocity assuming a specific acceleration or from other given data.

Applying Kinematic Equations

Kinematic equations describe the motion of objects under constant acceleration. The key formulas relevant here are:

Final velocity (v)

$$ v = u + a t $$

Distance traveled (s)

$$ s = ut + \frac{1}{2} a t^2 $$

Where:
- u = initial velocity
- v = final velocity
- a = acceleration
- t = time
- s = distance traveled

Calculating Final Velocity

To find the final velocity, we need the acceleration. If the acceleration is not given explicitly, we might need to make assumptions or derive it based on additional data. For this example, let's consider an acceleration value or analyze the problem in a generalized form.

Scenario 1: Constant acceleration is known

Suppose the acceleration a is 2 m/s^2 (a typical value in such problems). Then:

$$ v = u + a t = 30\, \text{m/s} + 2\, \text{m/s}^2 \times 6\, \text{s} = 30 + 12 = 42\, \text{m/s} $$

Scenario 2: Final velocity is given or needs to be calculated with known a

If, for example, the problem states the final velocity directly or provides the acceleration, you can substitute those values into the equation.

Calculating the Distance Covered

Using the initial velocity, acceleration, and time:

$$ s = ut + \frac{1}{2} a t^2 $$

With $u = 30\, \text{m/s}$, $a = 2\, \text{m/s}^2$, and $t = 6\, \text{s}$:

$$ s = 30 \times 6 + \frac{1}{2} \times 2 \times 6^2 $$
$$ s = 180 + 1 \times 36 $$
$$ s = 180 + 36 = 216\, \text{meters} $$

Thus, the car travels 216 meters during this acceleration period.

Real-World Application and Significance

Understanding how to calculate final velocity and distance covered during acceleration is crucial in various fields such as automotive engineering, safety analysis, and physics education. For example:

- Automotive Engineering: Engineers analyze acceleration to design safer and more efficient vehicles.
- Traffic Safety: Understanding how quickly a vehicle can accelerate or decelerate helps in accident reconstruction.
- Physics Education: These problems serve as fundamental exercises to grasp the principles of motion.

Additional Considerations in Kinematic Problems

While the above example provides a straightforward calculation, real-world problems may involve more variables and complexities.

Variable Acceleration

- Not all acceleration is constant. In such cases, calculus or more advanced physics techniques are required.

Negative Acceleration (Deceleration)

- If the car is slowing down, the acceleration value is negative, affecting the final velocity and distance calculations.

Multiple Phases of Motion

- Sometimes, a vehicle accelerates, then moves at constant speed, then decelerates. Each phase requires separate analysis.

Summary of Key Formulas

- Final velocity: $v = u + a t$
- Distance traveled: $s = ut + \frac{1}{2} a t^2$

Example Calculation Recap
Assuming an acceleration of 2 m/s^2:

- Final velocity after 6 seconds:

$$v = 30\, \text{m/s} + 2\, \text{m/s}^2 \times 6\, \text{s} = 42\, \text{m/s}$$

- Distance traveled during this period:

$$s = 30 \times 6 + \frac{1}{2} \times 2 \times 6^2 = 216\, \text{meters}$$

Final Notes
Always ensure to verify the acceleration value either from problem statements or given data. If the acceleration isn't specified, you might need to derive it or clarify the problem statement. The understanding of these principles allows for solving a wide range of motion-related questions, making them foundational in physics and engineering.

In conclusion, by applying basic kinematic equations and understanding the initial conditions, you can accurately determine the final velocity and the distance traveled by a moving object under acceleration. Whether in academic exercises or real-world applications, mastering these calculations is essential for analyzing motion effectively.

Frequently Asked Questions

What is the initial velocity of Acar in the problem?

The initial velocity of Acar is 30 m/s.

How long does the acceleration last?

The acceleration lasts for 6 seconds.

How do you find the final velocity of Acar?

Use the formula $v = u + at$, where u is initial velocity, a is acceleration, and t is time. Since acceleration is not given, it must be calculated or assumed based on context.

What additional information is needed to find the final velocity?

The acceleration value is needed to calculate the final velocity, or it must be provided or derived from other data.

How do you calculate the distance traveled during acceleration?

Use the formula $s = ut + 0.5at^2$, where u is initial velocity, a is acceleration, and t is time.

What assumptions can be made if acceleration is not provided?

If acceleration is not given, one might assume constant acceleration or need to infer it from other parameters if available.

What is the general approach to solving for final velocity and distance in uniformly accelerated motion?

Apply kinematic equations such as $v = u + at$ for final velocity and $s = ut + 0.5at^2$ for distance, ensuring acceleration is known or calculated.

Additional Resources

Acar Moves With A Velocity Of 30m/s Is Accelerated In 6sec Find Final Velocity And The Distance is a fundamental physics problem that exemplifies the application of kinematic equations to real-world scenarios. This problem involves understanding key concepts such as initial velocity, acceleration, final velocity, and displacement—cornerstones in the study of motion. Analyzing such problems not only sharpens problem-solving skills but also provides insights into the physics governing everyday activities like driving, sports, and engineering designs. In this article, we will thoroughly explore the steps involved in solving this problem, break down the concepts, equations, and calculations, and discuss the practical significance of these physics principles.

Understanding the Problem

Before diving into calculations, it's essential to interpret what the problem states clearly:

- The initial velocity (u) of the car is 30 m/s.
- The car accelerates uniformly over a period of 6 seconds.
- The goal is to find:
- The final velocity (v) after 6 seconds.
- The total distance (displacement) traveled during this time.

This problem typifies a uniform acceleration scenario, a common topic in physics courses, and involves applying the basic equations of motion.

Key Concepts and Equations

To solve this problem, understanding the fundamental equations of uniformly accelerated motion is crucial.

Primary Equations of Motion

There are three main equations used when acceleration is constant:

1. $v = u + at$

- Relates initial velocity, acceleration, and time to find final velocity.
2. $s = ut + \frac{1}{2} a t^2$

- Calculates displacement based on initial velocity, acceleration, and time.
3. $v^2 = u^2 + 2as$

- Connects velocities, acceleration, and displacement without involving time directly.

Where:
- u = initial velocity
- v = final velocity
- a = acceleration
- t = time
- s = displacement

Step-by-Step Solution

The problem provides the initial velocity and the time over which acceleration occurs, but it does not specify the acceleration directly. Typically, such problems either give acceleration explicitly or require it to be deduced from additional data. Since the problem states the initial velocity and the acceleration duration, but not the acceleration itself, we need to clarify whether the acceleration is known or if the problem expects us to find the acceleration first.

If the assumption is that the car accelerates from initial velocity of 30 m/s to some unknown final velocity over 6 seconds, then:

- Step 1: Find the acceleration if any additional data is given.
- Step 2: Find the final velocity.
- Step 3: Find the distance traveled.

However, based on the problem statement, it seems that the initial velocity is 30 m/s, and the acceleration occurs over 6 seconds, but the acceleration value is not directly provided. To proceed, we need to make an assumption or interpret the problem as follows:

Scenario Assumption:
Suppose the car accelerates from an initial velocity of 30 m/s to a higher final velocity in 6 seconds, with the acceleration being constant. Without a specified final velocity or acceleration, the most logical interpretation is that the problem wants us to:

- Find the final velocity assuming a certain acceleration.
- Or, if acceleration is not specified, perhaps the problem is asking for the final velocity after a given acceleration.

But since the problem states "Acar moves with a velocity of 30 m/s" and "is accelerated in 6 seconds," it’s likely that the initial velocity is 30 m/s and the acceleration is uniform, but the acceleration value is missing.

Given the context, the most common approach is:

- Assume the acceleration is such that the initial velocity is 30 m/s, and the acceleration occurs uniformly over 6 seconds, resulting in a certain final velocity.
- Alternatively, if acceleration is not given, perhaps the problem expects us to find the final velocity assuming a certain acceleration.

In typical physics problems, unless specified, the acceleration is often given or can be deduced.

In this case, for a comprehensive explanation, let's assume a typical acceleration scenario:

Case 1: The acceleration is unspecified, and the problem asks for the final velocity assuming a certain acceleration

Suppose the car accelerates at a rate of a = 2 m/s^2 (a common acceleration value for illustrative purposes).

Calculating the Final Velocity (v)

Using the first equation:

$$
v = u + at
$$

Given:
- $u = 30\, \text{m/s}$
- $a = 2\, \text{m/s}^2$
- $t = 6\, \text{s}$

Substituting:

$$
v = 30 + (2)(6) = 30 + 12 = 42\, \text{m/s}
$$

Thus, the final velocity after 6 seconds is 42 m/s.

Calculating the Distance Traveled (s)

Now, using the second equation:

$$
s = ut + \frac{1}{2} a t^2
$$

Substituting the known values:

$$
s = (30)(6) + \frac{1}{2} (2)(6)^2
$$

Calculations:

$$
s = 180 + 0.5 \times 2 \times 36 = 180 + 1 \times 36 = 180 + 36 = 216\, \text{m}
$$

Distance traveled during this acceleration period is 216 meters.

Summary of Results

Parameter	Value
Initial velocity u	30 m/s
Acceleration a	2 m/s^2 (assumed)
Time t	6 s
Final velocity v	42 m/s
Distance traveled s	216 m

Note: The final velocity and distance are based on the assumed acceleration of 2 m/s^2. If the actual acceleration differs, the calculations will change accordingly.

Alternative Scenario: Finding Acceleration Given Final Velocity

Suppose the problem intends for us to find the acceleration if the final velocity is known or if the problem is more general.

Rearranged from the first equation:

$$
a = \frac{v - u}{t}
$$

If, for example, the final velocity after 6 seconds is observed or specified, say 42 m/s, then:

$$
a = \frac{42 - 30}{6} = 2\, \text{m/s}^2
$$

which aligns with our previous assumption.

Practical Applications and Significance

Understanding how to compute final velocity and displacement during acceleration has numerous real-world applications:

- Automotive Engineering: Designing acceleration profiles for vehicles to ensure safety and efficiency.
- Safety Analysis: Calculating stopping distances or acceleration during crashes.
- Sports Science: Analyzing athletes' acceleration and displacement during sprints.
- Robotics and Machinery: Programming robots to accelerate smoothly over specified distances and times.
- Aerospace: Calculating velocity changes during spacecraft maneuvers.

Features and Limitations

Features:

- Uses fundamental equations of motion applicable to a wide range of physics problems.
- Demonstrates the relationship between velocity, acceleration, and displacement.
- Suitable for both theoretical understanding and practical calculations.

Limitations:

- Assumes constant acceleration; not applicable for variable acceleration scenarios.
- Requires known or assumed acceleration to find specific parameters.
- Real-world factors such as friction, air resistance, or non-uniform acceleration are neglected.

Pros and Cons of Using Kinematic Equations

Pros:

- Straightforward calculations for uniform acceleration.
- Easily adaptable to various initial conditions.
- Provides clear relationships between key kinematic quantities.

Cons:

- Limited to idealized situations with constant acceleration.
- Cannot directly handle complex motion involving changing acceleration without modifications.
- Assumes perfect conditions, which are rarely met precisely in real life.

Conclusion

The problem involving an Acar moves with a velocity of 30 m/s and is accelerated over 6 seconds illustrates essential principles of kinematics. By applying basic equations of motion, we determined the final velocity and the distance traveled during acceleration, assuming a constant acceleration. Such problems serve as foundational exercises in physics education, helping students understand the dynamics of motion and prepare for more complex real-world applications. Whether in designing vehicles, analyzing sports performance, or exploring space travel, mastering these fundamental concepts is crucial for understanding how objects move and change velocity over time.

Remember: Always verify the given data and clarify assumptions when solving physics problems to ensure accurate and meaningful results.

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