Chapter 3 Study Guide Accelerated Motion Answers

Date ________________ Period ______________ Name ______________________

CHAPTER 3 STUDY GUIDE

ACCELERATED MOTION

Vocabulary Review

Write the term that correctly completes the statement. Use each term once.

acceleration	**average acceleration**	**instantaneous acceleration**
free-fall acceleration	**free fall**	**velocity-time graph**

1. ________________ A ___ shows how velocity is related to time.
2. ________________ The change in velocity of an object at an instant of time is its ___ .
3. ________________ The rate at which an object's velocity changes is its ___ .
4. ________________ The motion of falling objects when air resistance is negligible is called ___ .
5. ________________ The ___ of an object is the change in velocity during some measurable time interval divided by that time interval.
6. ________________ The acceleration of an object in free fall that results from the influence of Earth's gravity is ___ .

Free Fall

For each statement below, write true or rewrite the italicized part to make the statement true.

1. ________________ A feather does not fall in the same way as a pebble because of *gravity*.
2. ________________ *Free fall* is the motion of a falling object when the air resistance is negligible.
3. ________________ Galileo concluded that objects in free fall have *different* accelerations.
4. ________________ Free-fall acceleration is *the same* for objects of different sizes.
5. ________________ Free-fall acceleration is always *downward*.
6. ________________ If you drop a rock, its speed after 3 s will be *19.6 m/s*.
7. ________________ The decision to treat free-fall acceleration as positive or negative depends on the *coordinate system* you use.
8. ________________ If you toss a ball up, it reaches its maximum height when its velocity is *zero*.

Chapter 3 Study Guide Accelerated Motion Answers is a critical resource for students delving into the fundamental concepts of motion in physics. Understanding accelerated motion is essential for grasping more complex topics in mechanics. This chapter focuses on how objects move when they experience a change in velocity, exploring the principles of acceleration, graphical representations, and mathematical formulations. This article will provide a comprehensive study guide to assist students in mastering the essential concepts of accelerated motion, including key definitions, equations, and practical examples.

Understanding Acceleration

Definition of Acceleration

Acceleration is defined as the rate of change of velocity of an object with respect to time. It is a vector quantity, meaning it has both magnitude and direction. The formula for calculating acceleration (a) can be expressed as:

$$ a = \frac{\Delta v}{\Delta t} $$

Where:
- Δv is the change in velocity (final velocity - initial velocity).
- Δt is the change in time.

Types of Acceleration

1. Constant Acceleration: Occurs when an object's velocity changes at a steady rate. An example is a car accelerating uniformly on a straight road.
2. Variable Acceleration: Occurs when the rate of acceleration changes over time. A roller coaster, for instance, experiences variable acceleration due to changing speeds and directions.
3. Negative Acceleration (Deceleration): Refers to a decrease in velocity. For example, a car coming to a stop exhibits negative acceleration.

Key Equations of Motion

For uniformly accelerated motion, several fundamental equations are derived from the definitions of acceleration and velocity. These equations are often referred to as the kinematic equations.

Kinematic Equations

1. First Equation of Motion:
$$ v = u + at $$
Where:
- v = final velocity
- u = initial velocity
- a = acceleration
- t = time

2. Second Equation of Motion:
$$ s = ut + \frac{1}{2} at^2 $$
Where:
- s = displacement

3. Third Equation of Motion:
$$ v^2 = u^2 + 2as $$

These equations are crucial for solving problems related to motion, allowing students to calculate unknown variables when given certain parameters.

Graphical Representation of Motion

Position vs. Time Graphs

Position vs. time graphs illustrate how the position of an object changes over time. The slope of the graph represents the object's velocity:
- Horizontal Line: Indicates constant position (zero velocity).
- Straight Line with Positive Slope: Indicates constant positive velocity.
- Straight Line with Negative Slope: Indicates constant negative velocity.
- Curved Line: Indicates changing velocity, suggesting acceleration.

Velocity vs. Time Graphs

Velocity vs. time graphs show how the velocity of an object changes over time. The slope of this graph indicates acceleration:
- Horizontal Line: Indicates constant velocity (zero acceleration).
- Straight Line with Positive Slope: Indicates constant positive acceleration.
- Straight Line with Negative Slope: Indicates constant negative acceleration (deceleration).
- Area Under the Curve: Represents displacement over a time interval.

Example Problems and Solutions

To solidify the understanding of accelerated motion, it is essential to work through example problems. Here are a few common types of problems, along with their solutions.

Example Problem 1: Calculating Acceleration

Problem: A car accelerates from 20 m/s to 50 m/s in 5 seconds. Calculate the acceleration.

Solution:
- Initial velocity (u) = 20 m/s
- Final velocity (v) = 50 m/s
- Time (t) = 5 s

Using the first equation of motion:

$$ a = \frac{v - u}{t} = \frac{50 \, \text{m/s} - 20 \, \text{m/s}}{5 \, \text{s}} = \frac{30 \, \text{m/s}}{5 \, \text{s}} = 6 \, \text{m/s}^2 $$

Thus, the acceleration is 6 m/s^2.

Example Problem 2: Displacement Calculation

Problem: A cyclist starts from rest and accelerates at a uniform rate of 2 m/s^2 for 10 seconds. Calculate the displacement.

Solution:
- Initial velocity (u) = 0 m/s (starts from rest)

- Acceleration (a) = 2 m/s^2
- Time (t) = 10 s

Using the second equation of motion:

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

$$ s = 0 \cdot 10 + \frac{1}{2} \cdot 2 \cdot (10)^2 $$

$$ s = 0 + 1 \cdot 100 = 100 \, \text{m} $$

Thus, the displacement is 100 meters.

Applications of Accelerated Motion

Understanding accelerated motion is vital in various real-life applications. Here are some scenarios where these principles are essential:

1. Automobile Safety: Engineers design cars to utilize principles of acceleration for features like anti-lock braking systems (ABS), which control deceleration to prevent skidding.
2. Sports: Athletes, such as sprinters, need to understand how to maximize acceleration to improve performance during races.
3. Space Exploration: Rocket scientists apply concepts of accelerated motion to calculate launch trajectories and speeds to reach orbital velocity.

Conclusion

In conclusion, Chapter 3 Study Guide Accelerated Motion Answers is an invaluable tool for mastering the concepts of motion in physics. By focusing on the definitions, equations, graphical representations, and practical applications of accelerated motion, students can develop a strong foundation for understanding more advanced topics in mechanics. Utilizing example problems and solutions allows learners to apply theoretical knowledge to practical scenarios, reinforcing their comprehension and problem-solving skills. As students continue their studies in physics, the principles of accelerated motion will serve as a cornerstone for their future learning.

Frequently Asked Questions

What is accelerated motion and how does it differ from uniform motion?

Accelerated motion refers to the change in velocity of an object over time, while uniform motion indicates that an object moves at a constant speed in a straight line. In accelerated motion, the object's speed increases, decreases, or changes direction.

What are the key formulas used to calculate acceleration in chapter 3?

The key formulas include: 1) Acceleration (a) = (final velocity (v_f) - initial velocity (v_i)) / time (t), and 2) $v_f = v_i + at$, where 'a' is the acceleration, 'v_f' is final velocity, 'v_i' is initial velocity, and 't' is time.

How can graphs be used to represent accelerated motion?

Graphs such as velocity-time graphs can illustrate accelerated motion. A straight line indicates constant acceleration, while a curve can show varying acceleration. The slope of the line represents acceleration, and the area under the curve can indicate displacement.

What real-life examples illustrate concepts of accelerated motion?

Real-life examples include a car speeding up at a stoplight, a roller coaster descending a hill, or an object in free fall, such as a dropped ball, which accelerates due to gravity.

What role does gravity play in accelerated motion as discussed in chapter 3?

Gravity is a constant force that causes objects to accelerate towards the Earth at approximately 9.81 m/s^2 when in free fall. This acceleration due to gravity is a fundamental example of accelerated motion.

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