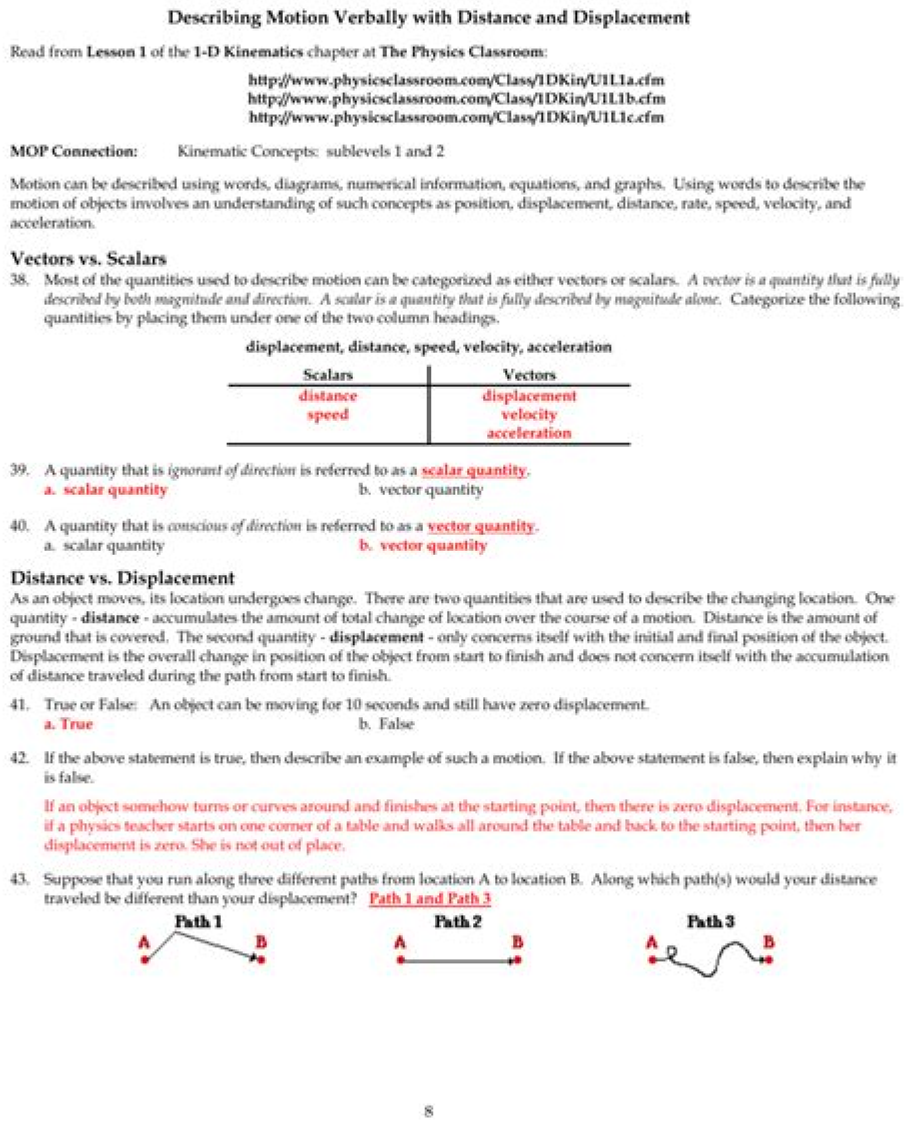
Lesson 1 Position And Motion Answer Key



Describing Motion Verbally with Distance and Displacement

Read from **Lesson 1** of the **1-D Kinematics** chapter at **The Physics Classroom**:

http://www.physicsclassroom.com/Class/1DKin/U1L1a.cfm
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MOP Connection: Kinematic Concepts: sublevels 1 and 2

Motion can be described using words, diagrams, numerical information, equations, and graphs. Using words to describe the motion of objects involves an understanding of such concepts as position, displacement, distance, rate, speed, velocity, and acceleration.

Vectors vs. Scalars

38. Most of the quantities used to describe motion can be categorized as either vectors or scalars. *A vector is a quantity that is fully described by both magnitude and direction. A scalar is a quantity that is fully described by magnitude alone.* Categorize the following quantities by placing them under one of the two column headings.

displacement, distance, speed, velocity, acceleration

Scalars	Vectors
distance **speed**	**displacement** **velocity** **acceleration**

39. A quantity that is *ignorant of direction* is referred to as a **scalar quantity**.
    a. scalar quantity
    b. vector quantity

40. A quantity that is *conscious of direction* is referred to as a **vector quantity**.
    a. scalar quantity
    b. vector quantity

Distance vs. Displacement

As an object moves, its location undergoes change. There are two quantities that are used to describe the changing location. One quantity - **distance** - accumulates the amount of total change of location over the course of a motion. Distance is the amount of ground that is covered. The second quantity - **displacement** - only concerns itself with the initial and final position of the object. Displacement is the overall change in position of the object from start to finish and does not concern itself with the accumulation of distance traveled during the path from start to finish.

41. True or False: An object can be moving for 10 seconds and still have zero displacement.
    a. True
    b. False

42. If the above statement is true, then describe an example of such a motion. If the above statement is false, then explain why it is false.

    If an object somehow turns or curves around and finishes at the starting point, then there is zero displacement. For instance, if a physics teacher starts on one corner of a table and walks all around the table and back to the starting point, then her displacement is zero. She is not out of place.

43. Suppose that you run along three different paths from location A to location B. Along which path(s) would your distance traveled be different than your displacement? **Path 1 and Path 3**

Lesson 1 Position and Motion Answer Key is an essential tool for students and educators alike, providing clarity and understanding in the foundational concepts of physics. Position and motion are fundamental topics that help students grasp how objects move and interact within their environment. This article will delve into the key concepts, problems, and solutions associated with this lesson, ensuring an in-depth understanding for learners at all levels.

Understanding Position

Position refers to an object's location in space at a given time. It is typically defined in relation to a reference point, which can be anything from a fixed landmark to a coordinate system.

Reference Points

- Definition: A reference point is a stationary object or location used to determine the position of another object.
- Importance: It provides a basis for comparison, making it easier to describe the position of moving objects.
- Examples:
1. A tree in a yard can serve as a reference point for a dog running around.
2. A classroom can be used as a reference point when discussing the position of students around the room.

Coordinate Systems

Coordinate systems use numbers to describe positions in space. The most common systems include:

- Cartesian Coordinate System:
- Consists of an x-axis (horizontal) and a y-axis (vertical).
- Positions are defined by ordered pairs (x, y).

- Polar Coordinate System:
- Positions are defined by a distance from a reference point and an angle from a reference direction.
- Uses the format (r, θ), where 'r' is the radius and 'θ' is the angle.

Exploring Motion

Motion is the change in position of an object over time. It can be described using various parameters, including speed, velocity, and acceleration.

Types of Motion

1. Translational Motion: Movement from one location to another without rotation.
2. Rotational Motion: Movement around a central axis.
3. Periodic Motion: Motion that repeats at regular intervals, such as the swinging of a pendulum.

Speed and Velocity

- Speed:
- Defined as the distance traveled over time.
- Formula: Speed = Distance / Time

- It is a scalar quantity and does not have a direction.

- Velocity:
- Defined as the displacement over time.
- Formula: Velocity = Displacement / Time
- It is a vector quantity, meaning it has both magnitude and direction.

Acceleration

- Definition: The rate of change of velocity over time.
- Formula: Acceleration = (Final Velocity - Initial Velocity) / Time
- Types of Acceleration:
1. Uniform Acceleration: Constant rate of change of velocity.
2. Non-uniform Acceleration: Variable rate of change of velocity.

Key Concepts from Lesson 1

Several concepts are crucial to understanding position and motion, including displacement, distance, and the relationship between speed and velocity.

Displacement vs. Distance

- Distance:
- The total path length traveled by an object, regardless of direction.
- Always a positive value.

- Displacement:
- The straight line distance from the initial position to the final position.
- Can be positive, negative, or zero, depending on direction.

Graphing Motion

Graphing is an effective way to visualize motion. The two most common graphs used in this context are:

1. Position vs. Time Graphs:
- The slope of the graph represents velocity.
- A horizontal line indicates that the object is at rest.
- A straight diagonal line shows constant velocity.

2. Velocity vs. Time Graphs:
- The slope of the graph indicates acceleration.
- A horizontal line shows constant velocity.

- Areas under the curve can represent displacement.

Sample Problems and Solutions

To reinforce the concepts learned in this lesson, here are some sample problems with their solutions.

Problem 1: Calculating Speed

A car travels 150 kilometers in 3 hours. What is its speed?

- Solution:
- Speed = Distance / Time
- Speed = 150 km / 3 hrs = 50 km/h

Problem 2: Finding Displacement

A person walks 3 km north and then 4 km east. What is their displacement?

- Solution:
- Use the Pythagorean theorem to find the resultant displacement:
- Displacement = $\sqrt{(3^2 + 4^2)} = \sqrt{(9 + 16)} = \sqrt{25} = 5$ km
- The direction can be calculated using $\tan^{-1}(4/3)$.

Problem 3: Understanding Velocity

A cyclist moves 20 meters east in 4 seconds. What is the cyclist's velocity?

- Solution:
- Velocity = Displacement / Time
- Velocity = 20 m (east) / 4 s = 5 m/s (east)

Common Misconceptions

Understanding position and motion can be challenging, particularly for beginners. Here are some common misconceptions:

- Misconception 1: Speed and velocity are the same.
- Clarification: Speed is a scalar quantity, while velocity is a vector and includes direction.

- Misconception 2: Distance and displacement are interchangeable.

- Clarification: Distance is the total length traveled, while displacement is the shortest path between two points.

- Misconception 3: An object can be in motion and at rest at the same time.
- Clarification: An object is considered in motion relative to a reference point, while it can appear at rest from another reference point.

Conclusion

The Lesson 1 Position and Motion Answer Key serves as a vital resource for understanding the basic principles of motion and the significance of position. Through concepts such as reference points, displacement, speed, and velocity, students can develop a foundational knowledge that will aid them in more advanced studies of physics. By practicing problems and recognizing common misconceptions, learners can strengthen their grasp of these crucial concepts, paving the way for further exploration into the fascinating world of motion.

Frequently Asked Questions

What is the main focus of Lesson 1 on position and motion?

The main focus is to understand the concepts of position, motion, and how they relate to each other in a physical context.

How is position defined in the context of motion?

Position is defined as an object's location in relation to a reference point or coordinate system.

What are the different types of motion discussed in Lesson 1?

The lesson discusses linear motion, rotational motion, and periodic motion.

What is the significance of a reference point in understanding motion?

A reference point is crucial as it allows us to determine an object's position and understand how it moves in relation to that point.

What units are commonly used to measure position and motion?

Common units include meters for distance, seconds for time, and kilometers per hour for speed.

How do speed and velocity differ according to Lesson 1?

Speed is a scalar quantity that measures how fast an object is moving, while velocity is a vector quantity that includes both speed and direction.

What role does acceleration play in motion?

Acceleration describes the rate of change of velocity, indicating how quickly an object is speeding up or slowing down.

Can you explain the concept of displacement?

Displacement is the shortest distance from the initial position to the final position of an object, along with the direction.

What graphical representations are used to illustrate motion in Lesson 1?

Position-time graphs and velocity-time graphs are commonly used to illustrate different aspects of motion.

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