PHYSICS

# SCALAR AND VECTOR QUANTITIES

## Learning Goals

**B2.1** - Use appropriate terminology related to kinematics.

**B2.5** - Solve problems involving distance, position, and displacement using a vector diagram.

**B3.2** - Distinguish between scalar and vector quantities as they relate to uniform and non-uniform motion.

## Success Criteria

- ☐ What is the difference between Scalars and Vectors?
- ☐ What is the difference between Distance and Displacement?
- ☐ What is the difference between Speed and Velocity?

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## SCALAR AND VECTOR QUANTITIES

A ***scalar*** quantity is one that does not have a direction associated with it.

*Ex:*

*A **vector*** quantity is one that does have a direction associated with it.

*Ex:*

A vector quantity is represented by an arrow that shows visually what the vector looks like:

*Ex:*

Note that a vector is represented by use of an arrow over top of the variable and the direction in square brackets.

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## Distance vs. Displacement

**Distance:**

**Displacement:**

*Ex 1. John goes for a walk.*
*He travels **3 km North**, then **4 km East**, then **3 km South**.*

***a)*** *Calculate the distance John travels.*

***b)*** *Calculate John's displacement.*

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## Speed vs. Velocity

**Speed:**

**Velocity:**

*Ex 2. In the previous example 1, it takes John **2 hours** to complete his walk.*

***a)*** *Calculate his speed.*

***b)*** *Calculate his velocity.*

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## Position vs. Displacement

**Position:**

**Displacement:** A vector quantity that measures the change in position from start to finish.

Displacement = Change in Position

Displacement = Final Position - Initial Position

$$\overrightarrow{\Delta d} = \overrightarrow{d_2} - \overrightarrow{d_1}$$

***NOTE:*** You can't ***subtract*** vector quantities.

In order to solve you must ***ADD the OPPOSITE***.

***Ex:*** *Jim (John's brother) also goes for a walk.*

*He starts at a position of 10 km [W] and ends at a position of 2 km [W]. What is John's displacement from his initial position?*

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HOMEWORK

# Displacement and Velocity Worksheet

**Show all work as you solve the following problems.**

1. Calculate the total displacement of a mouse walking along a ruler, if it begins at the location x = 5cm, and then does the following:
   - It walks to x = 12cm
   - It then walks a displacement of -8cm
   - Lastly, it walks to the location x = 7cm

2. Find the average velocity (in m/s) of a bicycler that starts 150 meters north of town and is 1200 meters north of town after 30.0 minutes.

3. Explain what is wrong with the following statement: A man walked at an average velocity of 5.2m/s.

4. A school bus takes 0.53 hours to reach the school from your house. If the average speed of the bus is 19km/h, what is the displacement of the bus during the trip?

5. A girl participating in cross-country spends the afternoon practicing, and ends the practice completely tired from her hard work, despite the fact that her average velocity during the practice was 0.0m/s. Explain how this situation is possible.

6. A hiker is at the bottom of a canyon facing the canyon wall closest to her. She is 280.5 meters from the wall and the sound of her voice travels at 340 m/s at that location. How long after she shouts will she hear her echo? (Be careful to consider why echoes happen.)

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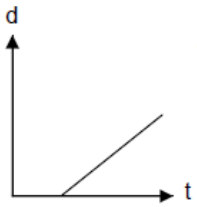
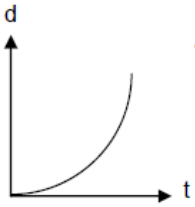
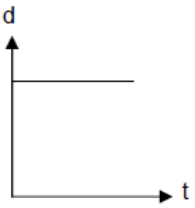
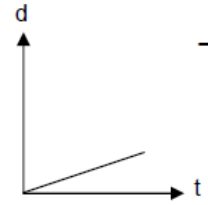
## HOMEWORK

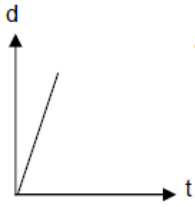
**Questions #7-12 all have to do with position-time graphs of different riders in a bicycle race. Match each graph with the explanation that makes the most sense, and write the letter of the explanation next to the appropriate number. (Some explanations will not be used.)**

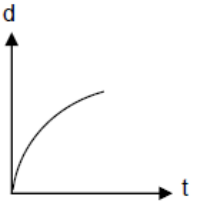
_____ 7. 


_____ 8. 


_____ 9. 


_____ 10. 


_____ 11. 


_____ 12. 


| | |
|---|---|
| A. slow, constant rate | E. fast constant rate |
| B. started late | F. gradually increasing speed |
| C. went back to take a picture | G. gradually decreasing speed |
| D. spectator standing still | H. leg cramp causes sudden drop in speed |

**13.** An object moves at a slow, constant speed, then sits at rest for a moment, then moves at a new faster, constant speed. Sketch a velocity-time graph of this motion on the given axes.


**14.** The following data was taken during a student's experiment with an object moving at a relatively constant velocity. Use the data to create a position-time graph (on the accompanying graph paper). Be sure to include a best-fit line. After the graph is completed, *use your best-fit line* to calculate the average speed of the object. Show speed calculations below.

| Time (s) | Position (cm) |
|---|---|
| 0.0 | 0.0 |
| 1.0 | 8.0 |
| 2.4 | 16.0 |
| 3.6 | 24.5 |
| 4.9 | 31.5 |
| 6.2 | 40.0 |