Science 10: Distance (d), Position ($\rightharpoonaccent{d}$) and Displacement (∆$\rightharpoonaccent{d}$)

In the physics of motion some of the most basic questions are “Where is an object”, “How far did an object travel?” and “How far is an object from where it started?”. These questions are answered with ***position, distance*** and ***displacement***.

* **Definitions**

*“Where is an object?”*

**Position** measures where an object is, including direction, from an **origin**. The size or ***magnitude*** of position is measured in meters (m), or any other length unit (cm, in, km, yd…). The symbol for position is or $\rightharpoonaccent{x}$ . Because position includes a magnitude and a direction it is a **vector**.

*“How far did an object travel?”*

**Distance** measures the length of the path travelled between two places (or positions). It is path dependent, meaning that the distance depends upon what path is taken. Distance does not have any direction. Like position, distance is measured in meters (m), or any other length unit. The symbol for distance is d. Because position includes magnitude only it is a **scalar**.

*“How far is an object from where it started?”*

**Displacement** measures the straight line distance, including direction, between a starting point (initial position, $\rightharpoonaccent{x}\_{0}$)and an ending point (final position,$\rightharpoonaccent{x}$). In other words, displacement is the change in position. The magnitude of displacement is measured in meters, or any other unit of length. The symbol for displacement is $\rightharpoonaccent{d} or ∆\rightharpoonaccent{x}$ . Because displacement includes both magnitude and direction it is a **vector**.

* **Examples**
* **Direction Conventions**

1. Usually left/right, or *horizontal* motion is described as “the x-direction”

2. Usually up/down, or *vertical* motion is described as “the y-direction”

3. Usually for horizontal motion LEFT IS NEGATIVE, RIGHT IS POSITIVE.

4. Usually for vertical motion UP IS POSITIVE, DOWN IS NEGATIVE.

5. Often direction is described using standard compass directions, NORTH, EAST, SOUTH and WEST.

* **Questions**

The following points are all on the x-axis.

**A**= -5.00m, **B**= -9.00m, **C**= 1.00m, **D**= 8.00m, **E**= 2.00m, **F**=-1.00m, **G**=4.44m, **H**=7.37m, **I**=-5.16m

1. Sketch a number line showing each of the points (USE A RULER).

2. Write the position vector for each point. I’ll give you the first 3.

 $\rightharpoonaccent{x}\_{A}= -5.00m$ $\rightharpoonaccent{x}\_{B}= -9.00m$ $\rightharpoonaccent{x}\_{C}= 1.00m$

 $\rightharpoonaccent{x}\_{D}= $ $\rightharpoonaccent{x}\_{E}=$ $\rightharpoonaccent{x}\_{F}=$

 $\rightharpoonaccent{x}\_{G}=$ $\rightharpoonaccent{x}\_{H}=$ $\rightharpoonaccent{x}\_{I}=$

3. Find the distance and displacement for the following motions:

 a. A to B

 b. B to A

 c. E to A to D

 d. C to E to A to C

 e. A to G

 f. H to I

 g. A to H to F

 h. B to C to H to I

 i. I to A to C to B to I

 j. C to E to D