Name: ______________________

Period: ______________________

Position, Distance, Displacement

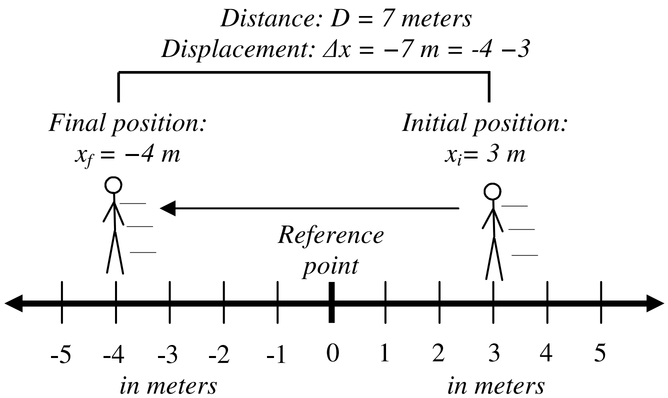
Position, distance, and displacement are all measured in meters, but they have different physical meanings.

Position (x) — *Position is where you are relative to a reference point. x_i is the initial position. x_f is the final position.*

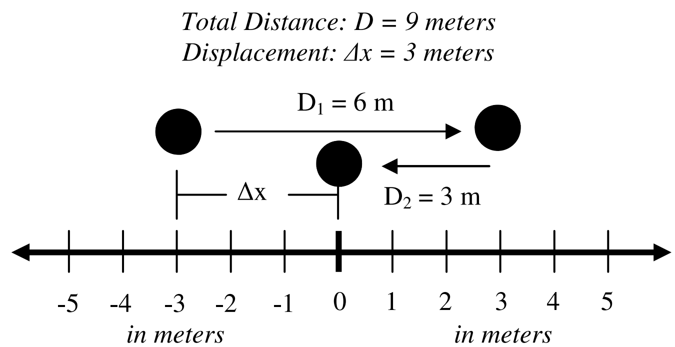
Distance (D) — *Distance is how far you have traveled between two positions. Distance is always positive.*

Displacement (Δx) — *Displacement is the straight line distance between the initial and final positions. $\Delta x = x_f - x_i$. Displacement can be positive or negative.*

In this example the displacement and distance are the same amount, but the displacement is negative, because they moved to the left.

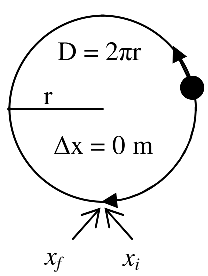


But what if an object turns around? The distance traveled would continue to increase, but the displacement would begin to decrease as the final position became closer to the initial position. If it were to return to its initial position, its displacement would be zero.

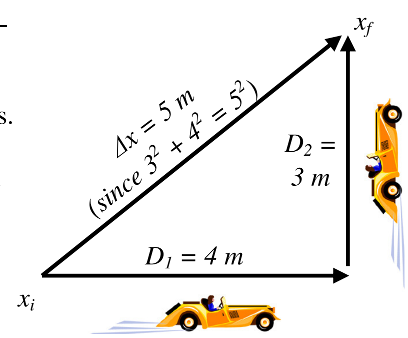


An object that travels a circular path and ends up at its starting point has a distance equal to the circumference of the circle: $D = 2\pi r$.

Yet the displacement is zero because it ended up where it started: its initial and final positions are the same.



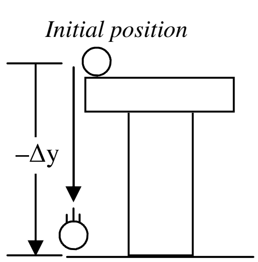
Remember that displacement is the straight line distance between the initial and final positions. In some cases you may need to use Pythagorean theorem to find Δx: $A^2 + B^2 = C^2$.



Vertical Displacement (Δy)

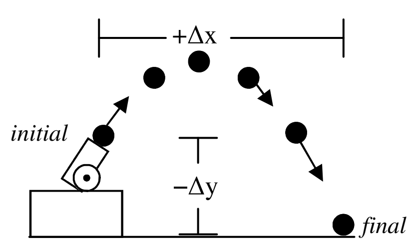
Δy is just like Δx except it is up or down..
+Δy means the final position is above the initial.
−Δy means the final position is below the initial.

If an object moves up or down we use Δy, not Δx. Remember that down is negative, so a falling object will have a negative displacement.



Δx and Δy

When an object moves at an angle we can find both the x and y displacements independently.



In this example, the object has a positive x-displacement (because it moved to the right) and a negative y-displacement (because it fell).

Name: ____________________

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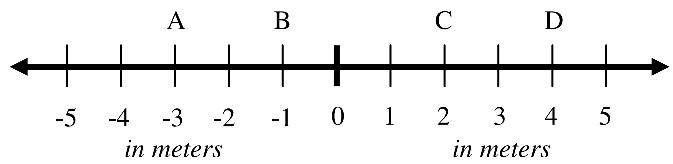
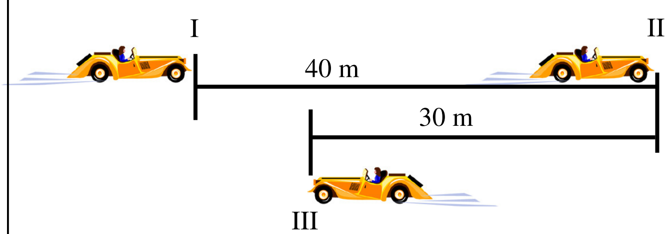
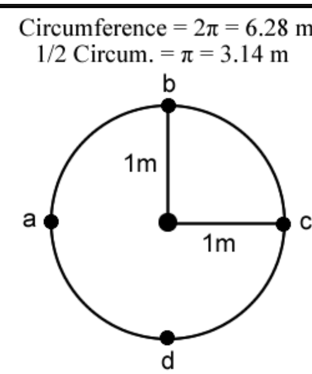
1. Use the number line at the right to answer the following questions.
   A. What is the position of letter A? x_A =
   B. What is the position of letter C? x_C =
   C. What is the distance from A to C?
   D. What is the distance from D to A?
   E. What is the displacement from D to A?

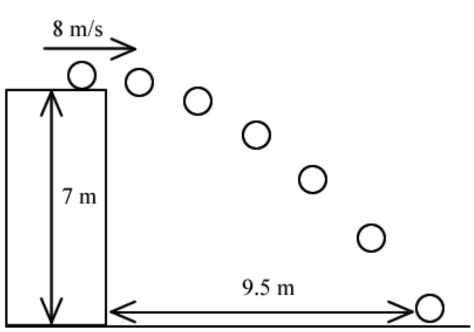




2. A. If II is the reference point, what is the position of the car at I?
   B. What is the total distance the car traveled? D =
   C. What is the car's first displacement from I to II?
   D. What is the total displacement of the car from I to III: Δx =

3. A. What is the curved distance from a to c?
   B. What is Δx from a to c?
   C. What is the curved distance from c to a?
   D. What is Δx from c to a?
   E. What is the distance 1 time around the circle?
   F. What is the displacement 1 time around?





4. A ball is thrown horizontally from the top of a 7 m tall ledge.
   A. What is its vertical displacement during the fall? Δy =
   B. What is its horizontal displacement? Δx =
   C. What is the total displacement (straight line) from start to finish?

5. The grid at the right is 1 m between each of the horizontal and vertical rows.
   A. From D to E: Δx = Δy =
   B. From A to M: Δx = Δy =
   C. From B to O: Δx = Δy =
   D. Draw this path: D to B to J to L:
      i. Δx = ii. Δy = iii. D_{total} =
   E. What is the total displacement (straight line) from B to P?