Name:_____ Block:_____ Date:_____/_____/_____

Introduction to Position, Distance, and Displacement

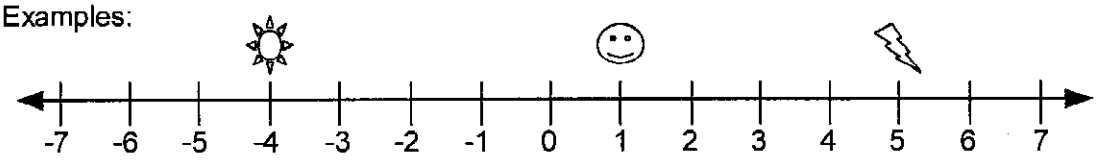
A. Reading Positions:

When objects start moving, it is useful to be able to describe an object's location.

To describe location, imagine a meterstick is placed next to the object. The meterstick acts like a number line.

- ✓ Objects to the right of the zero (0) have positive positions
- ✓ Objects to the left of the zero (0) have negative positions

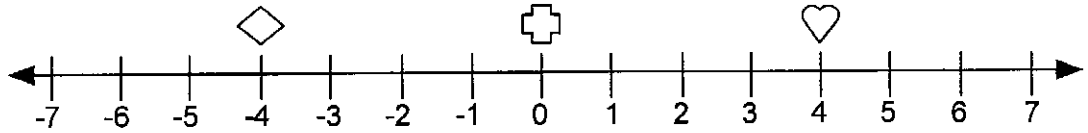
Examples:



Meters

A. What is the position of the lightning bolt?
B. What is the position of the happy face?
C. What is the position of the sun?

Use the number line below to give the positions of the objects (Don't forget units!):

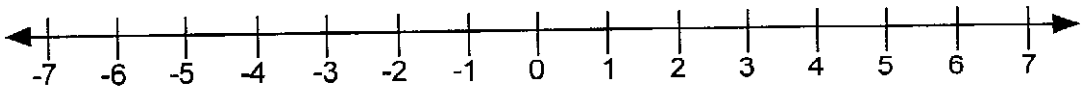


Meters

1. What is the position of the heart? _____
2. What is the position of the diamond? _____
3. What is the position of the cross? _____

B. Locating Positions:

Draw the object at the indicated locations:

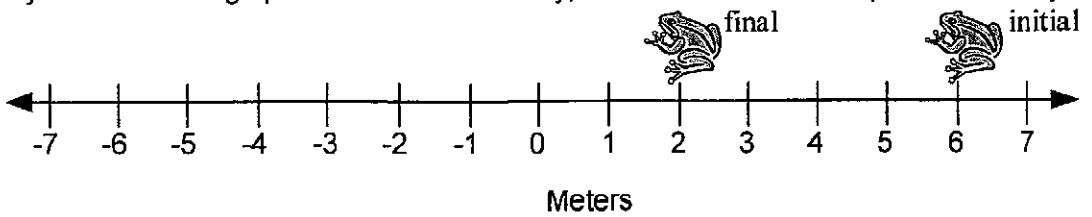


Meters

4. Put an "s" at the 2 m mark.
5. Put a "d" at the -6 m mark.
6. Put a "k" at the 7 m mark.
7. Put an "e" at the –1 m mark.

C. Changing positions:

Objects often change positions. In this activity, find the initial and final positions of objects.



8. What is the initial position of the frog? _____

9. What is the final position of the frog? _____

10. If the frog traveled in a straight line from the initial position to the final position, what distance did it travel? _____

D. Distance and Displacement:

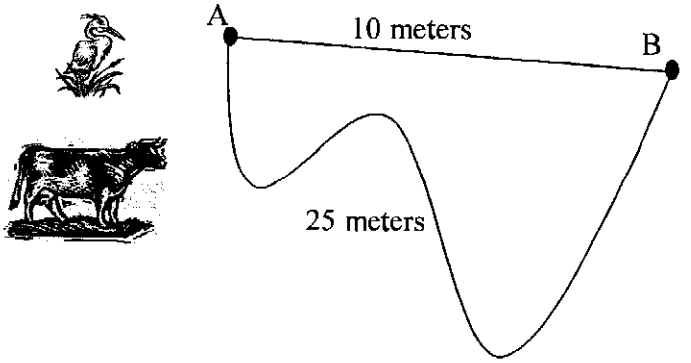
Now we will learn about two words that seem similar, but have different meanings in physics.

Distance: measurement of the actual path traveled
Displacement: the straight-line distance between 2 points

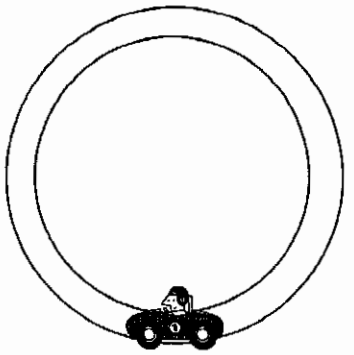
- If an object travels in one direction in a straight line, distance traveled is EQUAL to the displacement.
- Often, objects do not travel in straight lines (or they move back and forth), so distance and displacement are NOT EQUAL.

Examples:

Bessie the cow and Sally the bird both traveled from point "A" to point "B." Sally traveled in a straight line and Bessie did not.



A. What distance does Bessie the cow travel? *25 meters*
B. What distance does Sally the bird travel? *10 meters*
C. What is Bessie the cow's displacement? *10 meters*
D. What is Sally the bird's displacement? *10 meters*



the track is 100 meters around

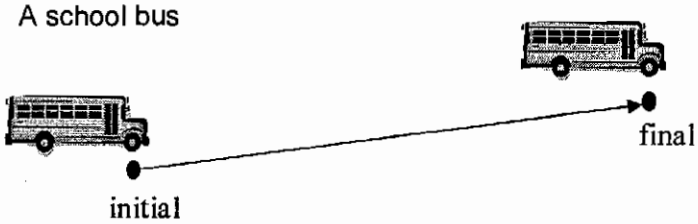
11. If the car travels once around the racetrack, what distance does it travel? _____

12. If the car travels twice around the racetrack, what distance does it travel? _____

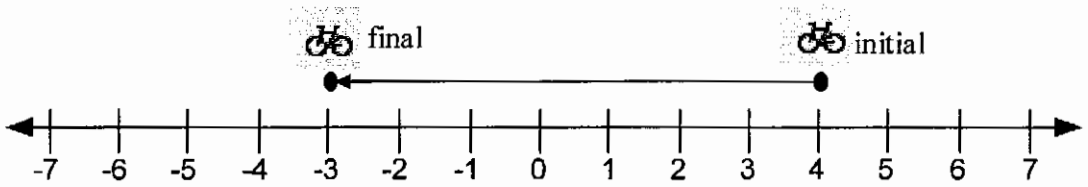
13. If the car travels once around the racetrack, what is its displacement? _____

E. <u>Showing Displacement</u>:

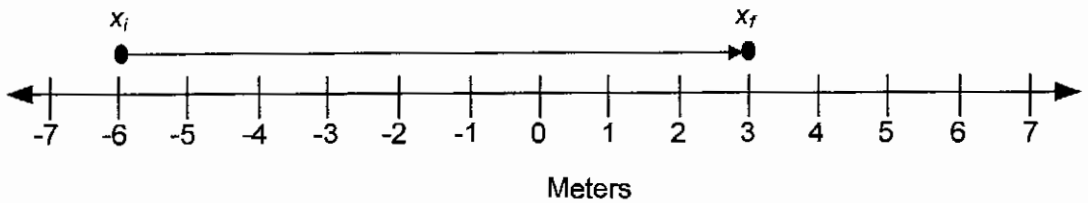
- ❖ When an object moves, an arrow can be drawn to show the displacement
- ❖ The arrow points in the direction of motion
  - ✓ The arrow should start (non-arrow side) at the starting position and end (arrow side) at the ending position
  - ✓ The arrow should be <u>straight</u>
- ❖ <u>Examples</u>:
  - ✓ A school bus



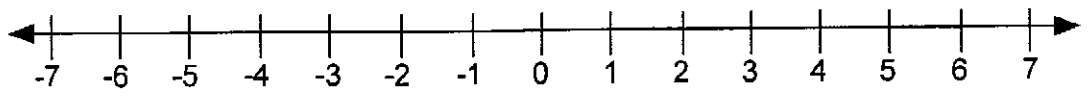
  - ✓ A bike moving along a number line, from a position of 4 m to –3m



  - ✓ Any object, using "x_i" to represent the initial position and "x_f" to represent the final position. (In this case, the object moves from the –6 m position to the 3 meter position.)

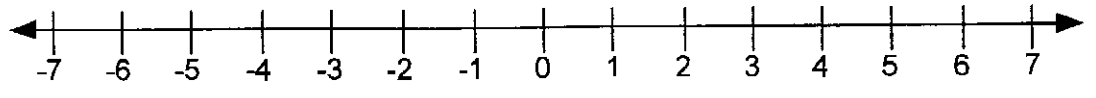


14. Draw an arrow showing an object that moves from the –4 m position to the 5 m position.



Meters

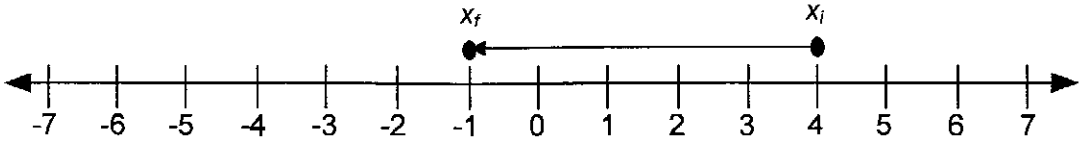
15. Draw an arrow showing an object that moves from the 7 m position to the 1 m position.



Meters

F. <u>What about direction?</u>:

- Displacement also includes direction!
- Possible directions include:
  - ✓ positive or negative
  - ✓ left or right
  - ✓ up or down
  - ✓ north, south, east, or west
- In this class, we will often use positive and negative to show direction.
  - ✓ A displacement is <u>negative</u> if the arrow points to the <u>left</u> or <u>down</u>
  - ✓ A displacement is <u>positive</u> if the arrow points to the <u>right</u> or <u>up</u>

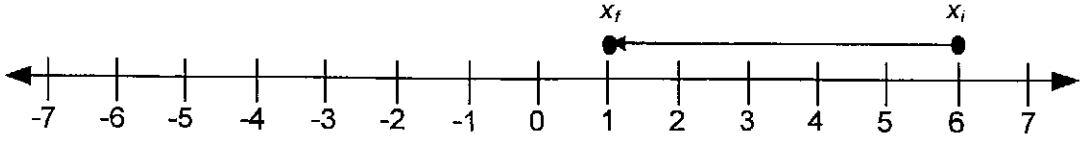


Meters

16. Is the above displacement positive or negative? _____

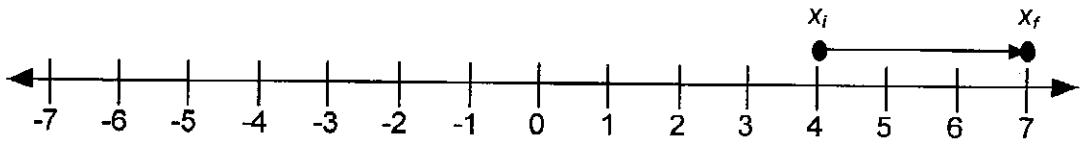
G. <u>Calculating Displacement</u>:

- Remember: Displacement is the straight-line distance between 2 points.
- To give a displacement we should give both the <u>size</u> and the <u>direction</u>.
- To find the <u>size</u> of the displacement, <u>count</u> the number of spaces from the initial to the final position.
- The following shows a displacement of <u>–5 m</u>

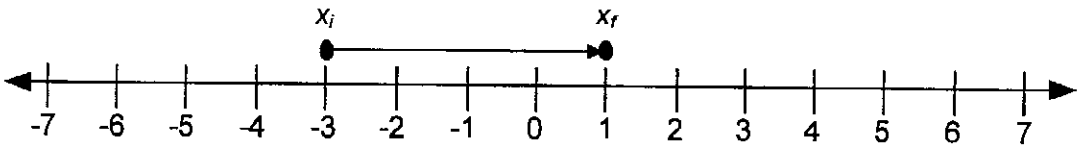


Meters

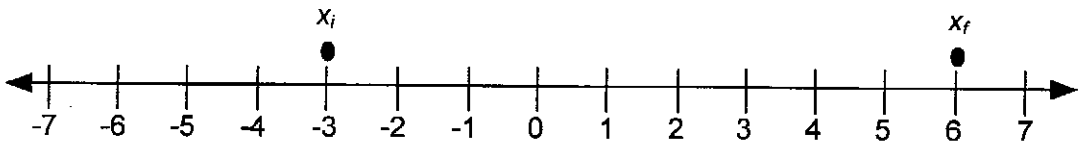
❖ The following shows a displacement of +3 m



❖ The following shows a displacement of +4 m



Use the number line below to answer the following questions:



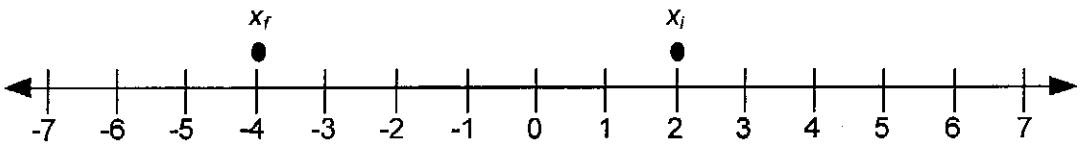
17. Draw an arrow to show the displacement.
18. Is the initial position positive or negative? _____

19. Is the final position positive or negative? _____

20. Is the displacement positive or negative? _____

21. What is the displacement [size (with units) and direction (+ or -)]? _____

Use the number line below to answer the following questions:

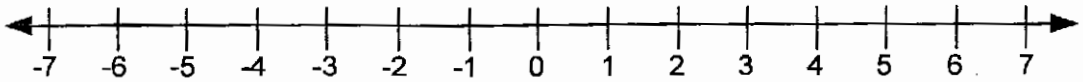


22. Draw an arrow to show the displacement.
23. Is the initial position positive or negative? _____

24. Is the final position positive or negative? _____

25. Is the displacement positive or negative? _____

26. What is the displacement [size (with units) and direction (+ or -)]? _____



27. Use the above number line to help answer the following question: Freddy the cat started at the –3 meter position. He then walked to other locations. Mark each new location with the letter for that part.
    a. Freddy started at the –3 m position. (mark this position with an "a")
    b. First, Freddy walked 2 meters in the positive direction (right).
    c. Second, Freddy walked 5 meters in the positive direction.
    d. Third, Freddy walked 1 meter in the negative direction.
    e. Finally, Freddy walked 8 meters in the negative direction.

    f. Draw a displacement arrow that starts at Freddy's initial position (-3 m) and ends at Freddy's final position (-5 m).

    g. What was Freddy's total displacement? (for this, you only need to look at his initial and final position) (be sure to include sign, number, and units)

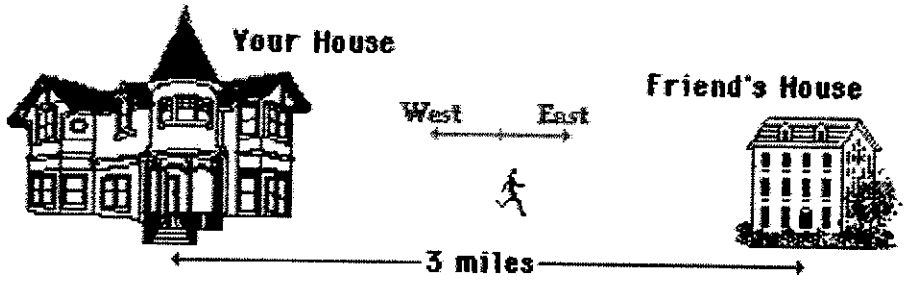
    _____

    h. To get the distance Freddy traveled, add up all the distances:

    2m + 5m + 1m + 8m = _____ meters

    i. Is Freddy's total displacement equal in size to Freddy's total distance traveled?

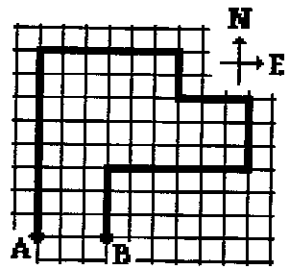
28. You run from your house to a friend's house that is 3 miles away. You then walk home.



a. What distance did you travel? _____

b. What was the displacement for the entire trip? _____

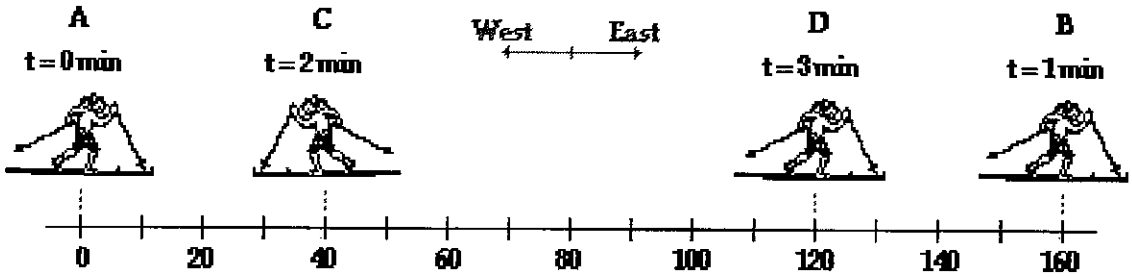
29 Observe the diagram below. A person starts at A, walks along the bold path and finishes at B. Each square is 1 km along its edge. Use the diagram in answering the next two questions.



A. This person walks a distance of _____ km.

B. This person has a displacement of _____.

30 A cross-country skier moves from location A to location B to location C to location D. Each leg of the back-and-forth motion takes 1 minute to complete; the total time is 3 minutes. (The unit is meters.)



a. What is the distance traveled by the skier during the three minutes of recreation?

b. What is the net displacement of the skier during the three minutes of recreation?

c. What is the displacement during the second minute (from 1 min. to 2 min.)?

d. What is the displacement during the third minute (from 2 min. to 3 min.)?