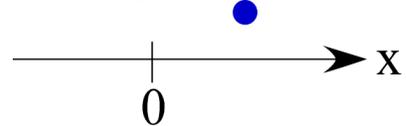
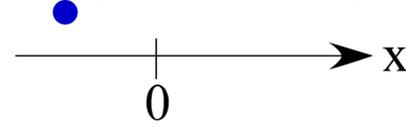
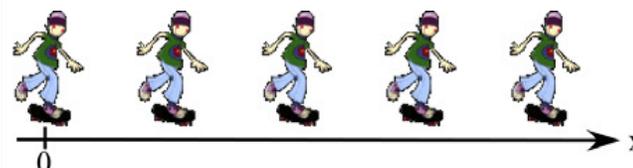
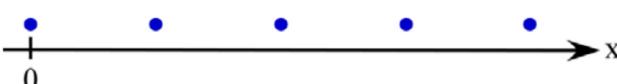


A motion diagram is like a composite photo that shows the position of an object at several equally spaced time intervals, like a stroboscopic photograph. We model the position of the object with a small dot or point with reference to a coordinate axis. The origin of the coordinate axis may be arbitrary.

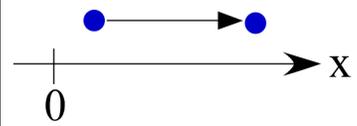
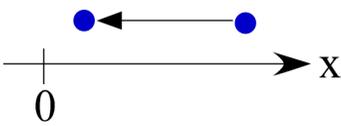
| | |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Position to right of origin, position(x) is positive</p>  | <p>Position to left of origin, position(x) is negative</p>  |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|

Examples of motion diagrams:

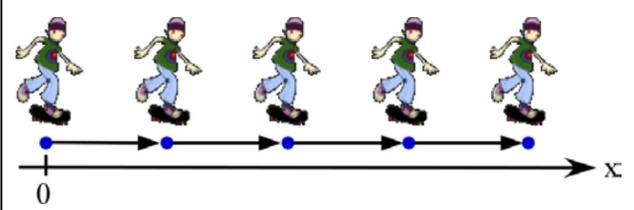
| | |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A stationary ball on the ground</p>  | <p>An object that is at rest occupies only a single position in a motion diagram</p>  |
| <p>A skateboarder rolling down a sidewalk</p>  | <p>An object that moves with constant speed produces images that are equally spaced (since it travels equal distances in equal time intervals). Its motion diagram is a series of equally spaced dots.</p>  |

Motion diagrams for objects moving with constant speed

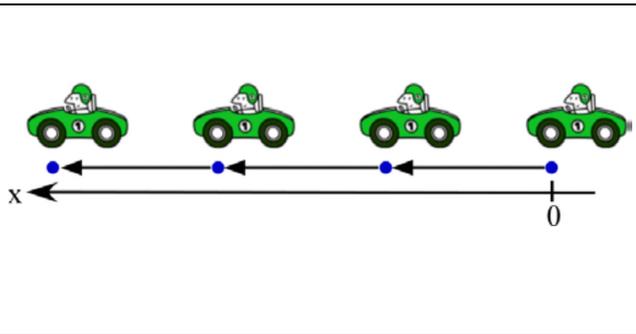
In addition to the position, we can also represent the speed of the object on the motion diagram. A **velocity arrow** is associated with each position dot; the length of the arrow represents the amount of speed (longer arrow, larger speed) and the direction of the arrow indicates the direction of motion.

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Direction of motion is to the right, in the positive direction, v is positive</p>  | <p>Direction of motion is to the left, in the negative direction, v is negative</p>  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

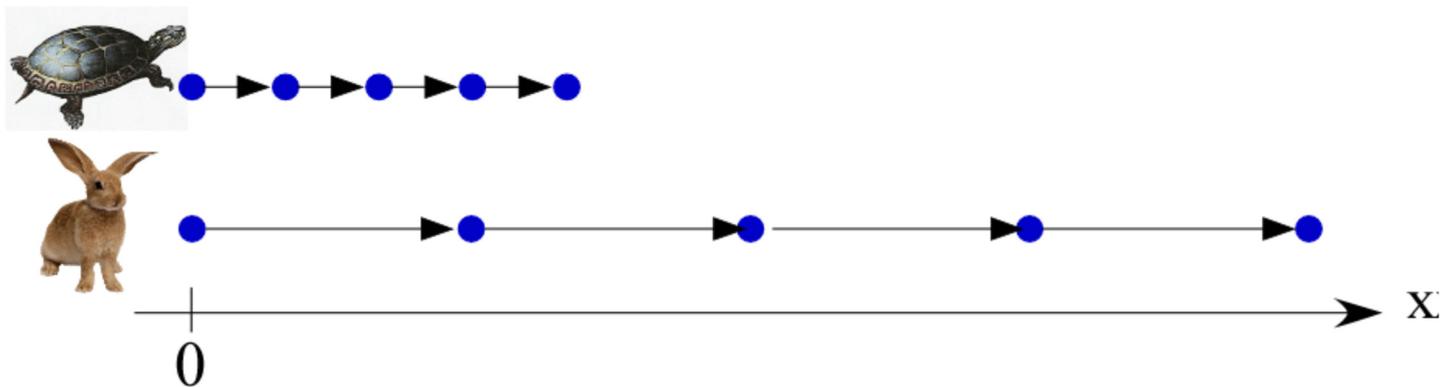
Examples:

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <p>Example 1: A skateboarder is rolling down the side walk with a constant speed. The distance between the points is the same, and the length of the arrows is the same, indicating that the object moves with constant speed. The arrows are oriented in the direction of motion of the skater.</p> |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|

Example 2: A car is moving at a constant speed to the left. The distance between the points is the same, and the length of the arrows is the same, indicating that the object moves with constant speed. The arrows are oriented along the direction of motion of the car. **The positive direction of motion can be chosen to the right or to the left.** In this case is chosen to be to the left.



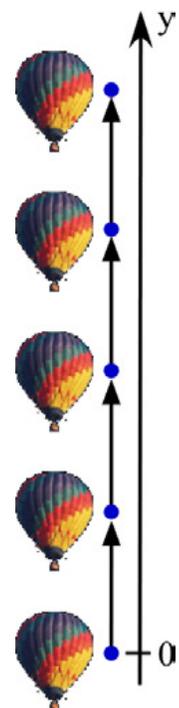
Example 3: A tortoise and a rabbit are having a race. Both run with a constant speed but the rabbit runs 4 times faster than the tortoise.



The dots for the position of the rabbit and for the tortoise are drawn for the same time intervals. The arrow for the rabbit's speed is four times longer than that for the tortoise's speed -which implies that the rabbit runs four times faster. The fact that for one position along the x-axis the dots align *does not* mean that at that time the two objects have the same speed. It means that the rabbit reached that position after one time interval, and the tortoise reached the same position after 4 time intervals have passed.

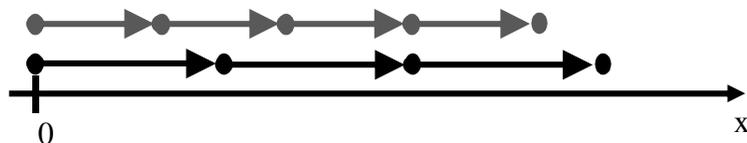
Example 4: A balloon is ascending (moving up) at constant speed.

The distance between the points is the same (position points are equally spaced), and the length of each arrow is the same, indicating the balloon rises at a constant speed. The direction of the arrow indicates the direction of motion of the balloon.



Questions over reading:

- a. Can you show more than one object moving on a motion diagram?
- b. Look at the motion diagram below.
- c. Is there a common position for both objects? _____
- d. Do they occupy the same position at the same time? _____
How can you tell?



Note: the axis is named the "y-axis" because vertical positions are usually designated as y, not x. However, the symbol for position is always "x".

Summary of Motion Diagrams

- A motion diagram is a series of snapshots of the motion of the object, taken at **regular time intervals**.
- A motion diagram shows only the **POSITION** of the object on the position axis.
- A motion diagram depicts the motion of the object over a chosen time period
- A motion diagram should specify the direction of **+x (positive position)**
- A motion diagram should specify the **starting point**
- If the object stands still, indicate it with a single dot: 
- If the object stands still for several clock ticks, indicate it with several dots one above another: 
- If the object stands still for a long time, draw a circle around the dot. 
- If an object moves upward, the motion diagram is drawn vertically
- If an object moves horizontally to the left, the motion diagram is drawn to show motion to the left.
- If the object moves on a slope, the motion diagram is drawn on a slope.
- In a motion diagram you need at least three positions to determine the type of motion.

QUALITATIVE MOTION DIAGRAM PRACTICE

NAME _____

1. On a motion diagram, the dots mark the object's _____.
2. On a motion diagram, the arrows show the object's _____ and _____.
3. For all motion diagrams, an axis is drawn underneath to define where _____ is and which way is _____.
4. Draw a motion diagram for this description. *Starting at a positive position, the car drove at a slow constant speed in the negative direction for 5 minutes.*

5. Draw a motion diagram for the biker.



6. Write a description of the biker's motion. (4 points).⁰

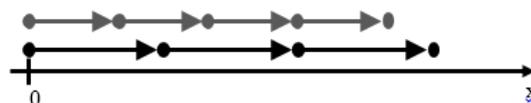
7. Can you show more than one object moving on a motion diagram?

8. Look at the motion diagram below.

a. Is there a common position for both objects? _____ Circle it on the motion diagram.

b. Do they occupy the same position at the same time? _____

How can you tell?



Motion Diagrams Describe the motion of the cars below and draw the motion diagram in each case
A picture was taken of each car every 30 seconds. Assume the positive direction is to the right for all.

A.



Description:

Motion Diagram:



B.



Description:

Motion Diagram:



C.

Description:



Motion Diagram:



D.



Description:

Motion Diagram: