

Motion

We can describe motion in three ways:

1. Sentences
2. Mathematical quantities
3. Graphs that show how these quantities change in time.

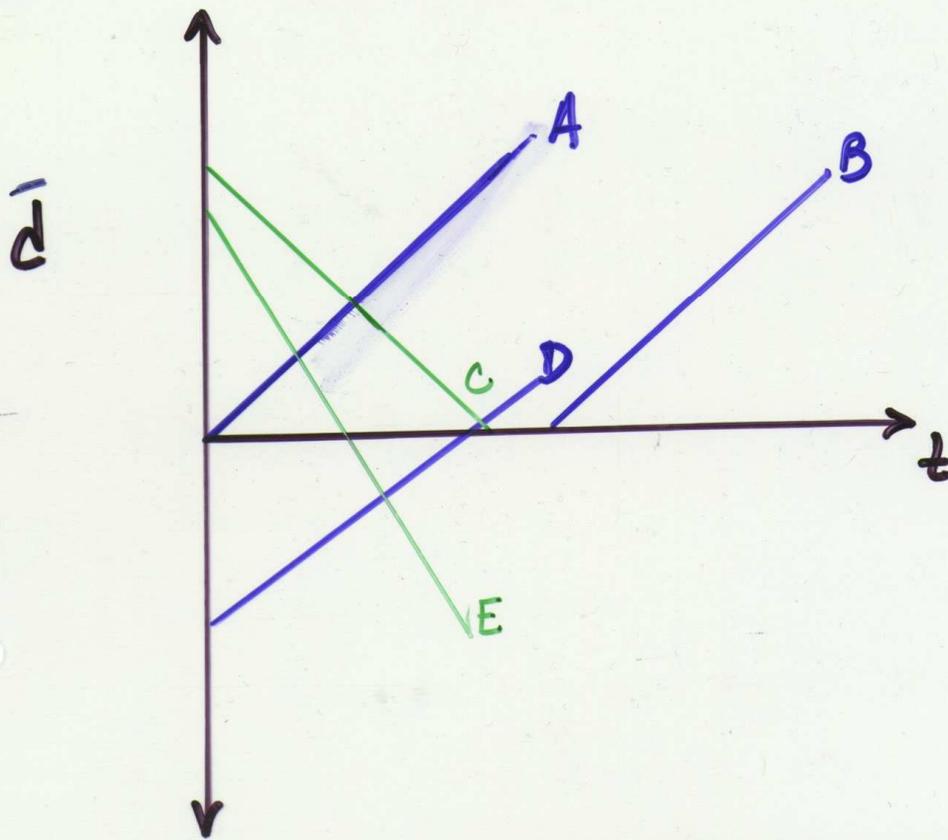
Position and Distance

- before you can study how something moves, we need to know where it is.
- describe position in terms of its relationship to some other point. Using a scale, 0 would become our reference point.
- when you make 0 the reference point, you have chosen a frame of reference.
- the position of an object is the separation between that object and a reference point.
- distance does not require a frame of reference (direction is not important).
- use +, - to describe position.

Scalar quantity - only magnitude
distance, work, mass

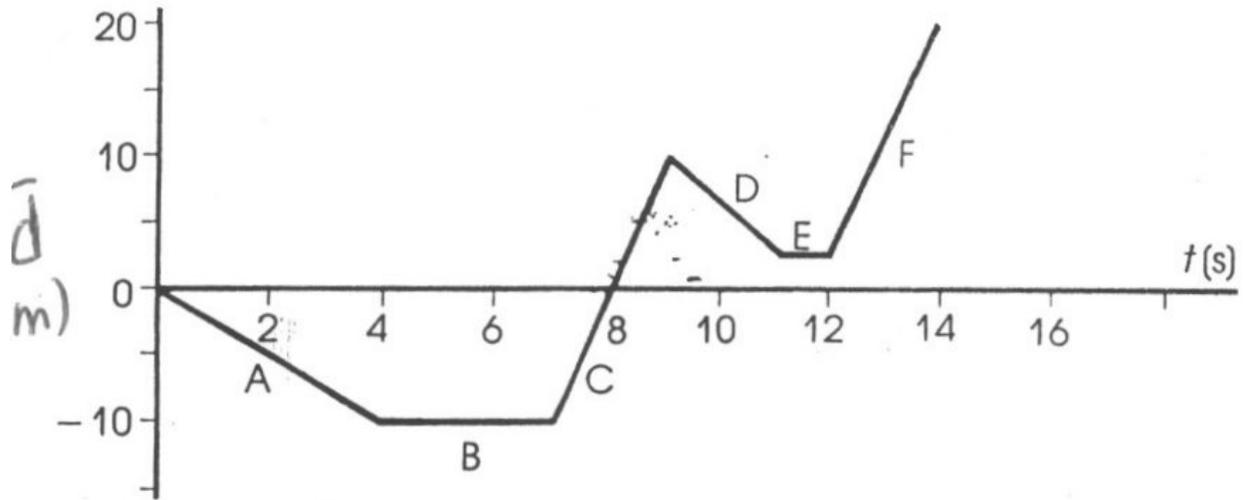
Vector quantity - magnitude and direction
displacement, velocity, acceleration, weight

Position vs Time



- A: starts at ref. point ; moves in + direction \vec{v} + constant velocity.
- B: starts from ref point some time after A; moves in + direction \vec{v} + constant velocity
- C: starts from a + position away from ref. point; moves in - direction \vec{v} - constant velocity.
- D: starts from a - position away from ref point; moves in + direction \vec{v} + constant velocity
- E: +position from ref point; - direction \vec{v} - constant velocity.

Describe the motion of the object in sentences and quantify the position and velocity.



Velocity

- to determine velocity, we need to know the position of an object at a particular time (instantaneous position).
- a moving object will generate a series of pairs of instantaneous positions and clock readings
- displacement is the change in position of an object, d .
- the ratio $\Delta d/\Delta t$ is the average velocity of the object.
- if average velocity is the same for every time interval, the object moves with a constant velocity (uniform velocity). Therefore, the ratio $\Delta d/\Delta t$ is constant.
- for the special case of constant velocity, $v = d/t$

Position Time Graphs

What information can you find on a d-t graph?

- velocity

If the displacement is the vertical separation and time is the horizontal separation, the slope = $\Delta d / \Delta t$

Positive and Negative Velocities

- positions can be positive or negative.
- velocities can be positive or negative.

Ex. A player is on the +20. m line and runs 10 m/s.

Where will the player end up?

+30. m line

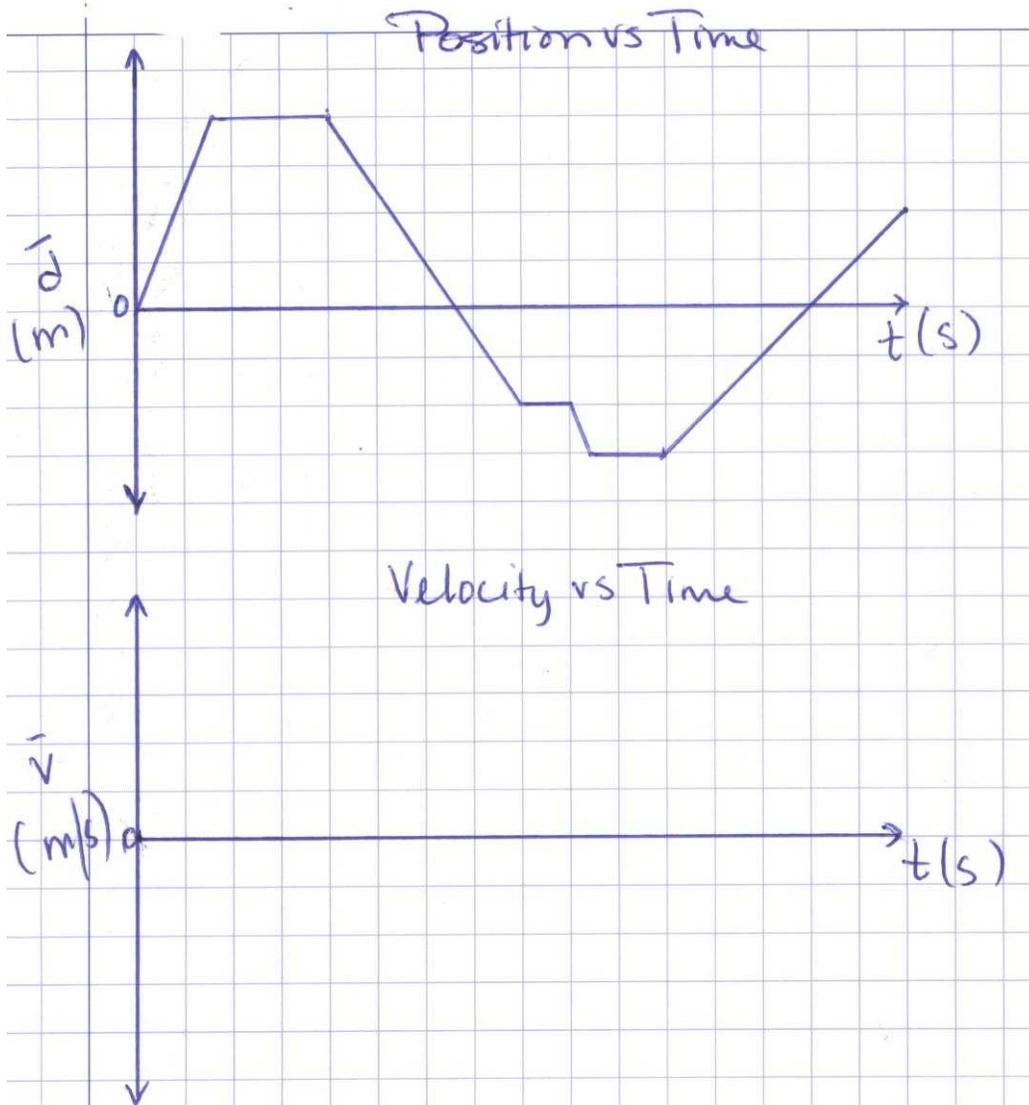
+10. m line

If the magnitude of the velocity is 10 m/s you need to assign a direction.

If the player runs - 10 m/s, they will end up on the + 10. m line.

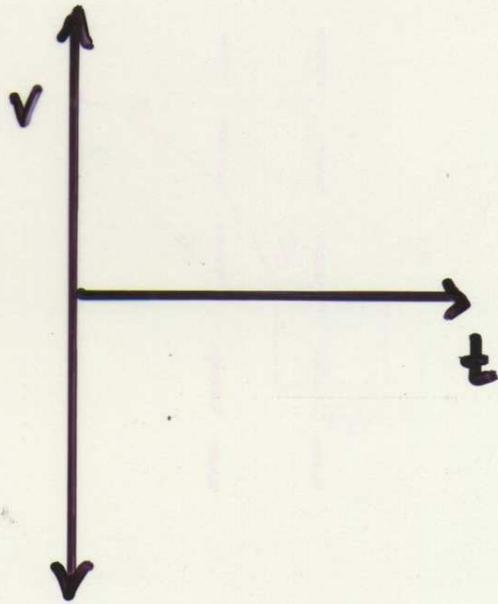
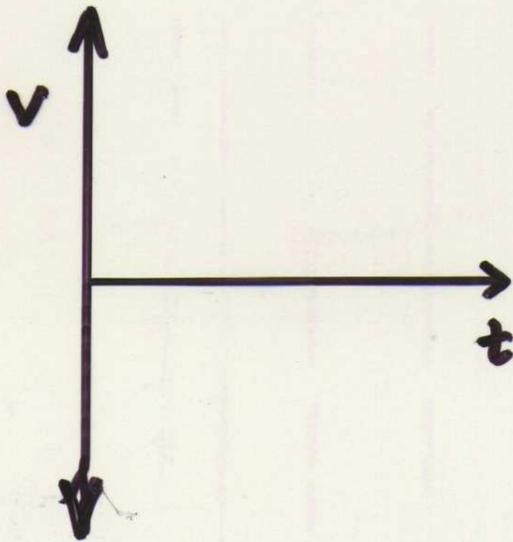
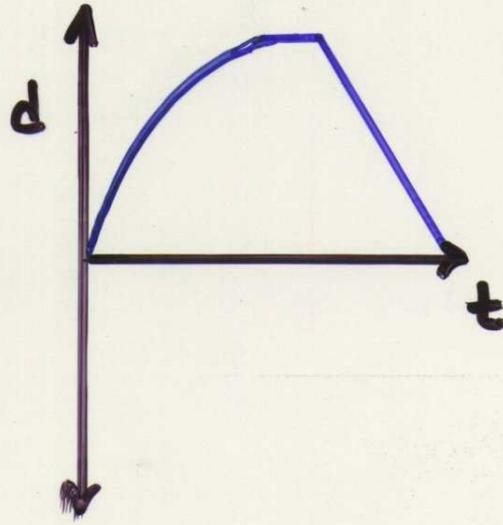
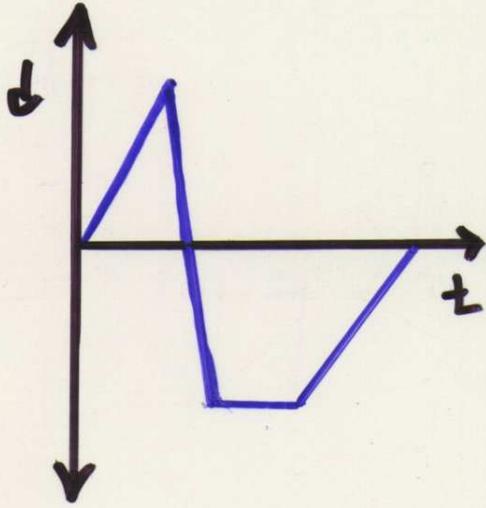
- negative velocity means DIRECTION not speeding up or down.

Interpreting Position-Time Graphs in order to construct Velocity Time Graphs



What if I put a scale on the axis?

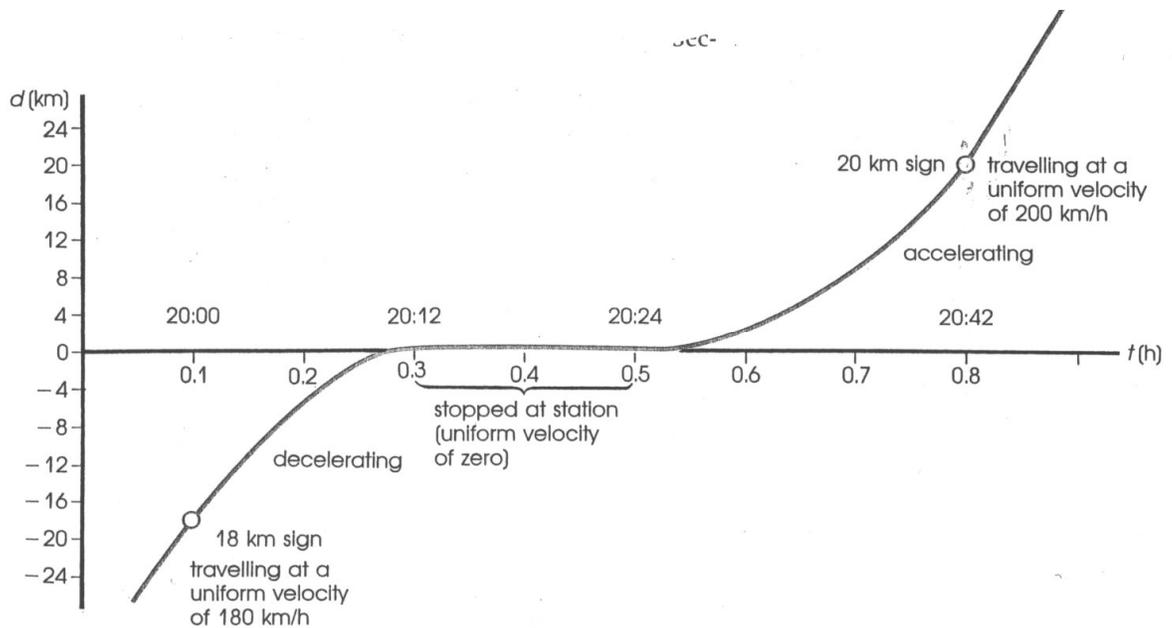
Given the following graphs, construct v-t graphs.



Instantaneous Velocity

- an object does not always move at a constant speed.
- you may speed up or slow down.
- when you are driving on the highway and you look down at your speedometer, you are traveling at + 55 km/h. At that instant in time, + 55 km/h is your **instantaneous velocity**.

To find instantaneous velocity on a position - time graph, draw a line that is tangent to the curve at that point. The slope is the instantaneous velocity (take the two points on the tangent from each side of the point).



Velocity - Time Graphs

- from a v-t graph, the displacement can be calculated.

$$d = vt$$

This is the area under the curve.

