Two branches in physics examine the motion of objects:

• Kinematics: describes the motion of objects, without looking at the cause of the motion
(kinematics is the first unit of Physics 20).

• Dynamics: relates the motion of objects to the forces which cause them
(dynamics is the second unit of Physics 20).

Together these are known as Mechanics.

Important Vocabulary

If the velocity of an object is always the same, we say it has a constant velocity. We can also call this uniform motion.

Instantaneous velocity is the velocity of an object at one moment of time.

scalar: scalars have magnitude (a number value), but no direction.
Examples: time, mass, distance. Mass is a great example, since it has a number value (like 58 kg), but we don't give it a direction (like "East").
• **vector**: have magnitude and direction
Examples: velocity, force, displacement. Force has a magnitude (like 37 N) and a direction (like "pushed to the left").

Scalars...

The distance between two objects is scalar, since it doesn't matter which direction you measure it from. e.g. "We are standing 2.3m apart."
Distance is used to calculate speed.

Vectors...

• The displacement of an object is a vector, since you have to state the direction the object has traveled. e.g. "The car moved 2.56km east."
Displacement is used to calculate velocity.

Example 1: You start walking home from school. After walking 1.3 km North, you get a phone call on your cell from your mom asking if you can meet her at the mall. You will have to turn around and walk 2.5 km South. Determine your distance and displacement to get from home to the mall.

A positive velocity means you are moving forward , to the right, or up, while negative means you are going backwards, to the left, or down.

Example 2: A train is moving backwards at a velocity of 13.5 km/h for 6.40 minutes. Determine the train's displacement.

Average Velocity

It is called average velocity because it looks at your overall velocity for the entire trip, not at any one particular velocity you might have been traveling at during the trip.
• What you have to measure is the total displacement (not distance) divided by the total time.

Example 3: I try to run the 100m race to break the world's record. Unfortunately, it takes me 16.83s to complete the run. Determine my average velocity.

Example 4: A car drives along the highway at 115 km/h for 2.50 h. Once in the city, the car drives at 60.0 km/h for the next 0.500 h. Determine the average velocity of the car.

Warning!
You MUST resist the temptation to just add the two velocities and divide by 2!

Example 5: Look back at Example 2. Determine your speed and velocity if the walk took you one hour and ten minutes.
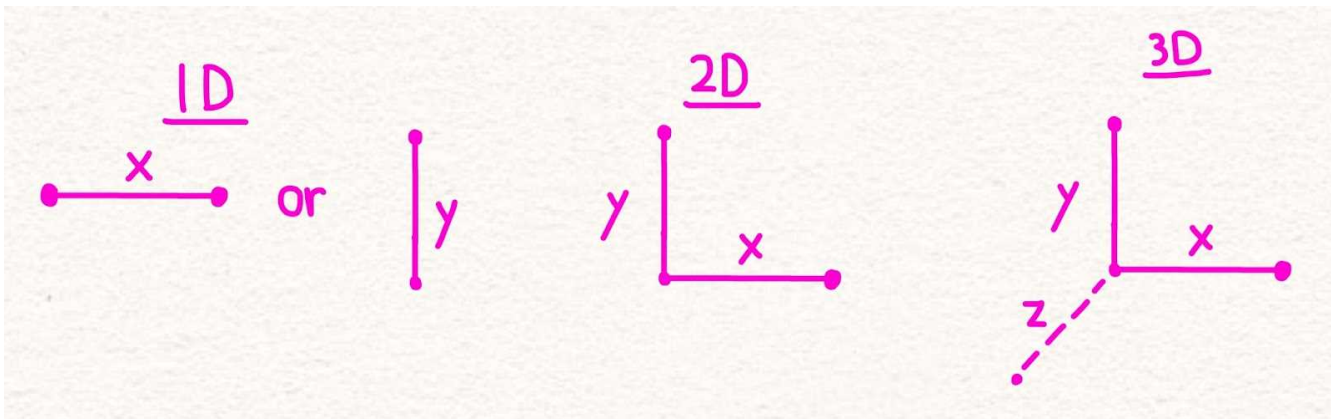
***First thing you should do is change the time into seconds.

***Since I wrote out the time in the question in words, I basically have as many sig digs for the time measurement as I want....

Vectors in One Dimension
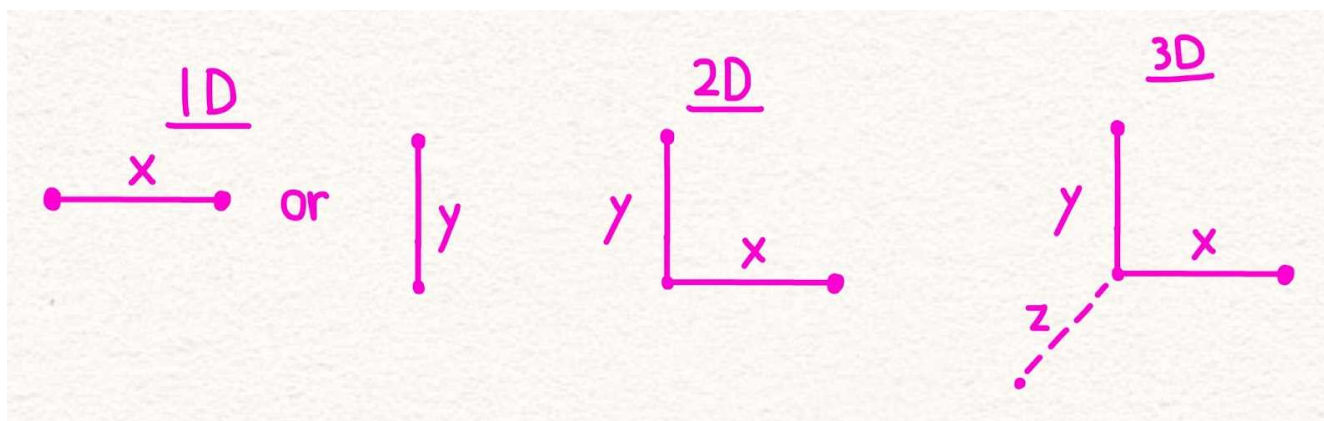
Vectors in One Dimension

Vector Drawing Rules

1. The vector is drawn pointing in the direction of the vector. This is probably the key feature of what makes a vector a vector... direction. If an object is moving East, you better make sure that the arrow points East. Always remember that when a direction is written down with the magnitude of a measurement, the direction should appear in square brackets.

10 km [East]   →

Vector Drawing Rules

2. The length of a vector is proportional to the magnitude of the measurement. This just means that the bigger your measurement, the bigger your vector. If I wanted to show you a vector for a car moving at 10km/h [East], and another one moving at 20km/h [East], the second vector would be twice as big.

10km/h [East]

20km/h [East]

Vector Drawing Rules

3. A vector can be picked up and moved around in a vector diagram, as long as when you place it in its new location it is still the same size and pointing in the same direction. If you are extremely careful, you can even use the rules to draw all your vector diagrams to scale and solve them by measuring stuff without using physics formulas.

● I would caution you that calculations will usually give you more accurate answers than a diagram.

No Problem
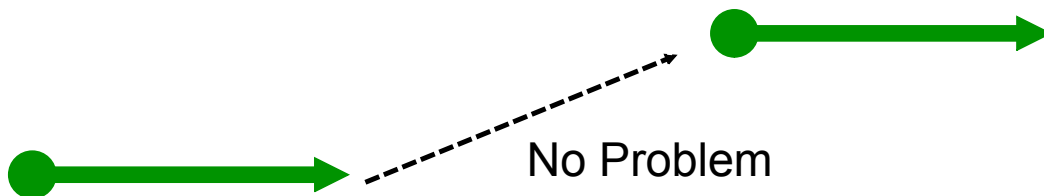
Adding Vectors In One Dimension

One dimensional vector diagrams are the easiest ones to solve.
● The only thing you have to really watch out for is how you touch the vectors to each other in the diagram.

● To add vectors , the vectors much touch with the head of one (the pointy tip) touching the tail (nothing there) of the next vector.

$$A + B$$
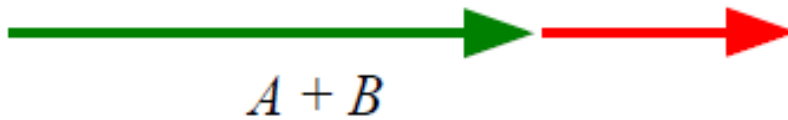
Example 1: a) **Sketch** a diagram that shows how you wold add the following two vectors, **A** and **B**.

b) Sketch the resultant of the addition of the two vectors
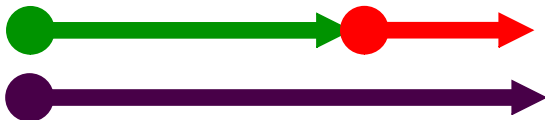
Subtracting Vectors in One Dimension

This is where things get a bit more interesting.

● What we need to remember here is that in Physics a negative sign simply means "in the opposite direction."

● We can take A - B and simply change it into A + -B.

● The negative sign on the B just means that we will need to take the original vector B and point it in exactly the opposite direction (180° from where it's pointing right now.

● Then we will simply add them just like we did in the previous diagrams (touching head to-tail of course!) to get our resultant.

● The reason you may have to do subtraction of vectors is because some physics formulas require you to subtract vectors. For example, Δv = vf – vi.

Example 3: Sketch a vector diagram of **A** – **B**.
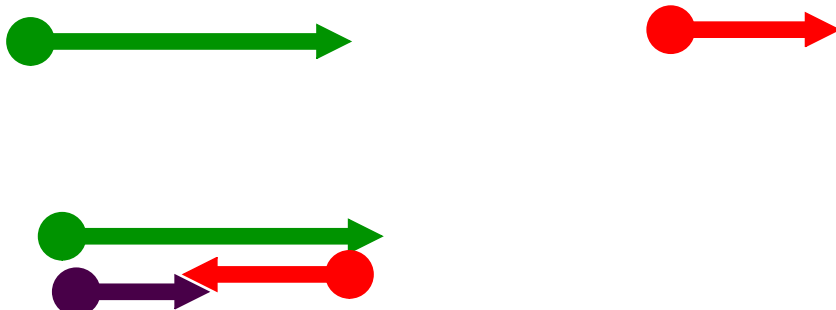
Be careful since subtraction is not commutative (that just means that A - B ≠ B - A).

Homework

Velocity
P. 145 # 1, 2, 5-7