Packet C: Distance/Displacement
Level 1
Prerequisites: None
Points to:

Objectives:
- Know the difference between **vectors** and **scalars**
- Recognize the difference between *distance* and *displacement*
- Be able to calculate *distance* and *displacement*
- Always write displacement with a *direction*
- did I mention you need to know the difference between vectors and scalars?

Part A: Vectors vs. Scalars

Definition	*Examples*
Magnitude An amount of something Includes both a number and a unit	 45 kilograms 24 seconds 14 m/s
Direction [I don't try to define the word "direction," but I think people have an intuitive sense of what it means]	 North, south, east, west Up, down To the left, to the right

Quantity A number, in physics a number we care about	Speed, distance, time, velocity, displacement, mass, force
Scalar A quantity with only *magnitude*.	Speed, distance, time, mass
Vector A quantity with both *magnitude* and *direction.*	Velocity, displacement, force, momentum

Word Bank

Number	Unit	magnitude
direction	vector	scalar

A.1 A magnitude always has two parts, a _____and a _____

A.2 A quantity that has only magnitude and no direction is called a _____.

A.3 A quantity that has both magnitude and direction is called a _____

A.4 Both vectors and scalars have _____, but only vectors have _____.

True or False:

A.5 Scalars have both direction and magnitude.

A.6 Scalars have only magnitude.

A.7 Vectors have both direction and magnitude.

A.8 Vectors have only magnitude.

A.9 When writing a magnitude, you only need to write a number.

A.10 When writing a magnitude, you can include a number and a unit.

A.11
Each sentence describes a physics quantity. Write whether the quantity is a vector or a scalar. Give the magnitude, and, if the quantity is a vector, also give its direction.

	Vector or Scalar?	**Magnitude**	**Direction (if vector)**
I ran the 100 meter dash.			
I walked 100 meters to the north.			
I jumped 6 feet up in the air.			
I have a mass of 60 kilograms.			
I push my friend to the right with 50 pounds of force.			
The speed limit is 60 miler per hour.			
I am driving from Boston to New York at 55 miles per hour.			

Part D: Distance vs. Displacement

Distance How far you move in total	**Symbol** *d*	**Vector or Scalar?** Scalar
Displacement How far you are from where you started. Change in position.	**Symbol** Δx	**Vector or Scalar?** Vector

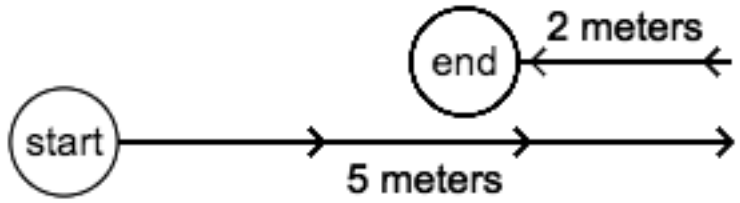
Vector Addition (1-dimensional)

A mathematical procedure for adding two vectors:
If the two vectors are in *the same* direction, *add* the magnitudes.
If the two vectors are in *different* directions, *subtract* the magnitudes

Same direction = ADD
different directions = SUBTRACT

Calculate displacement using vector addition.

D.1 Mr. Kuncik walks 5 m to the right, then back 2 m to the left.
Find his distance.
Find his displacement. For displacement, make sure to write magnitude and direction.



distance =

displacement =

D.2 Mr. Kuncik walks 5 km to the right, then another 2 m to the right. Find his distance and displacement.

distance =

displacement =

3. You drive 5 km east, then 10 km west, then 2 km back east.
a) Draw this situation:

b) What is your distance?

c) What is your displacement?

4. You drive 9 miles east to the store. Then, you drive 5 miles west to your grandparents' house.
a) Draw this situation:

b) What is your distance?

c) What is your displacement?

5. You throw a baseball up in the air. It travels 5 m up, then 5 m back down, and you catch it right where it started:
a) Draw this situation:

b) What is the baseball's distance?

c) What is the baseball's displacement?

6. A soccer ball moves back and forth:
4 m to the left
8 m to the right
2 m to the left
3 m to the right.
What is the distance?

What is the displacement?

7.When finding DISPLACEMENT in one dimension, we need to add two vectors. If they are in the same direction, we _____. If they are in opposite directions, we _____. This procedure is called _____.

Part E: Conceptual Questions about distance and displacement

E.1 A track star runs a lap around a track. The track is 400 m long. He ends in the same place he started.
What is his distance?

What is his displacement?

E.2 You wake up in the morning in your bed. You go downstairs, eat breakfast, and ride all the way to school. You walk around school all day. Then you leave school and go to a friend's house, where you walk around all day. In the evening you ride home, eat dinner, do your homework, go upstairs, and get into bed.
What is you *displacement* for the entire day?

E.3 In football, team has four chances to move the ball 10 yards from where they started. If not, they need to give the ball to the other team.
Is it *distance* or *displacement* that matters? How do you know?

E.4 When is the magnitude of distance the same as displacement? [hint: look at problem **D.2**]