- *I can use vectors to show displacement, velocity, and acceleration.* ***325-5***
- *I can use math to show the connections between, displacement, velocity, and time.* ***325-2***

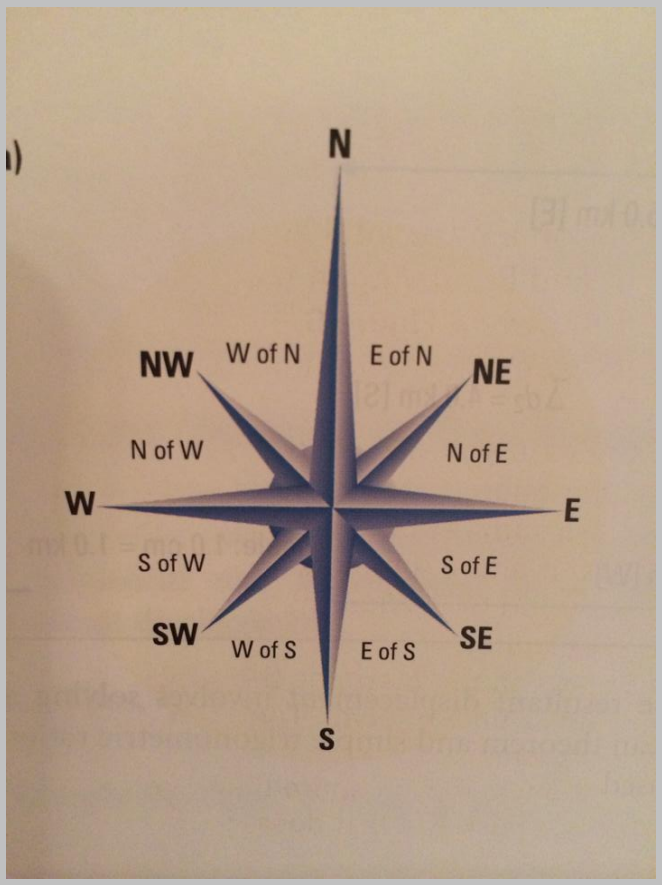
Two-Dimensional Motion

What are two characteristics that vectors have?

magnitude

direction

Vector quantities have both a magnitude and direction and so in two dimensions we need to be able to communicate this easily.

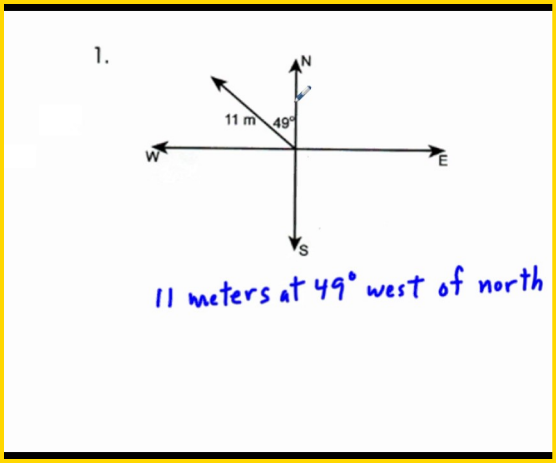


A protractor and ruler can be used to draw precise vector quantities with proper compass direction.

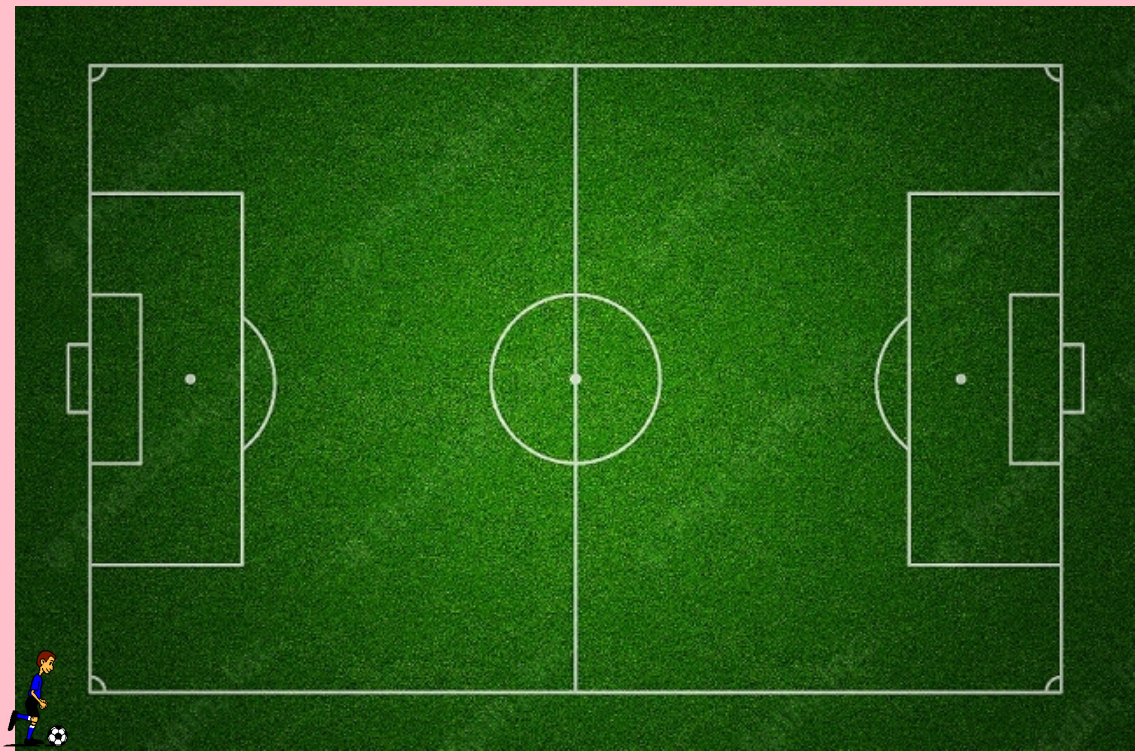
Example:

Use a ruler and a protractor to draw these vectors. For (c), make up a convenient scale.

a) $\Delta\vec{d}_1$ = 3.7 cm [25° S of E]
b) $\Delta\vec{d}_2$ = 41 mm [12° W of N]
c) $\Delta\vec{d}_3$ = 4.9 km [18° S of W]



Resultant Displacement in Two Directions



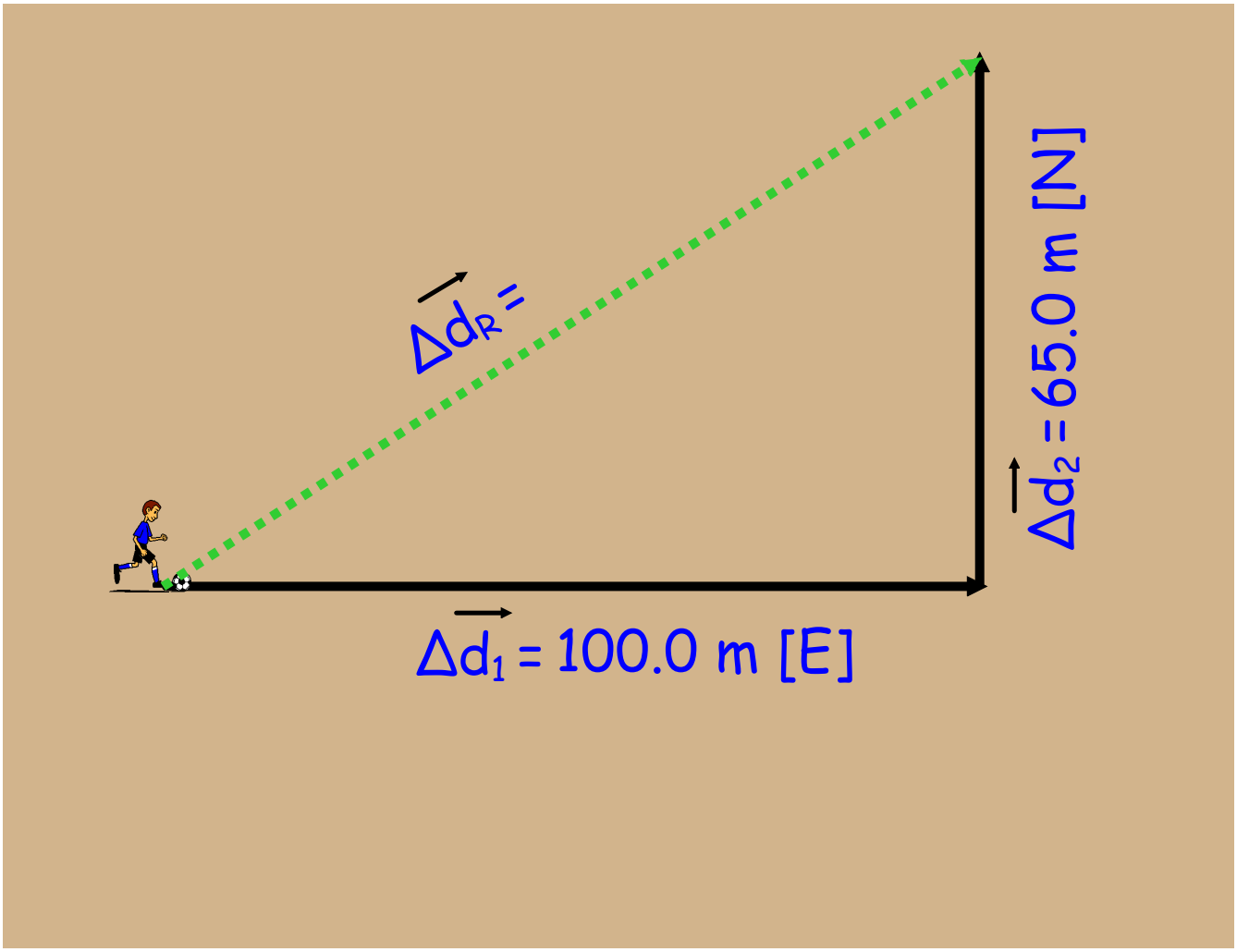
While a game is in progress, Jack has to run around the soccer field from corner to corner to relay a message to his coach. But during half-time Jack is able to run diagonally from one corner to the other.

Set up 2 displacement vectors for Jacks run around the soccer field

$\Delta\vec{d}_1 =$

$\Delta\vec{d}_2 =$

How could we find the resultant direction? Draw this event using a ruler and protractor. What would be an appropriate scale?

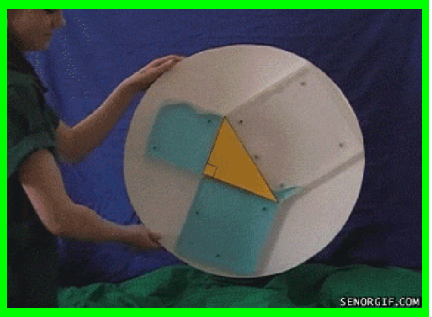

$\vec{\Delta d_R}$ =
$\vec{\Delta d_2}$ = 65.0 m [N]
$\vec{\Delta d_1}$ = 100.0 m [E]

Example:

A cyclist travels 5.0km [E], then 4.0km [S], and then 8.0km [W]. Use a scale diagram to determine the resultant displacement and a protractor to measure the angle of displacement.

Example 2

Determine the resultant displacement from the previous example using Pythagorean theorem and trigonometric ratios.



We can also use vector displacement to show average velocity (V_{av}) in two-dimensions

Example 3: After leaving a huddle, a receiver on a football team runs 8.5m [E] waiting for the ball to be snapped, then he turns abruptly and runs 12.0m [S], suddenly changes directions, catches a pass, and runs 13.5m [W] before being tackled. If the entire motion takes 7.0 seconds, determine the receivers:

a) resultant displacement (using trigonometry ratios or a scale diagram)
b) average speed
c) average velocity

Relative Motion

Terminology

frame of reference: coordinate system relative to which a motion can be observed.

relative velocity: velocity of a body relative to a particular frame of reference.

Suppose a cruise ship is moving 5.0m/s [S] relative to the coast and a passenger is jogging at a velocity of 3.0 m/s [S] relative to the cruise ship.

Relative to the coast, how fast is the passenger going?

Example:

Suppose the passenger in the previous example was jogging at a velocity of 3.0 m/s [E] relative to the ship as the ship is traveling at a velocity of 5.0 m/s [S] relative to the coast. Determine the joggers velocity relative to the coast.