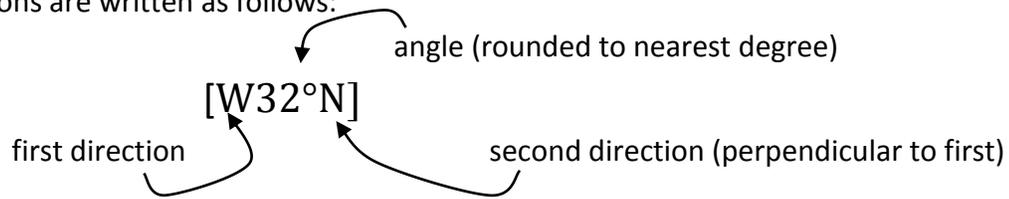


**2-D Vectors**

Vector directions are written as follows:


 The above direction can be read as: *“starting West, rotate 32° towards the North”*

Examples:

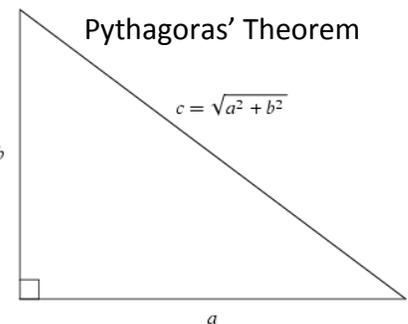
Vector				
Direction (option 1)	[N20°E]	[E25°S]	[N52°W]	[S84°W]
Direction (option 2)	[E70°N]	[S65°E]	[W38°N]	[W6°S]

Practice:

Vector				
Direction (option 1)				
Direction (option 2)				

**2-D Displacement Problems:**

- a) Sketch and calculate the total displacement of
  - Ms. Reichling who travels 250 m [E] and then 450 m [S]
  - Ms. McTague who travels 450 m [S] and then 250 m [E].
 b) If Ms. McTague were to turn around and head directly back to where she started from, in what direction would she be travelling?
- Find the total displacement of a cyclist who travels 3.5 km [W], 2.3 km [S], then 6.1 km [N].
- Find the total displacement of a bird that travels 12 km [E], 15 km [W], 11 km [S], then 17 km [N].
- Find the total displacement of a fish that swims 320 m [N], 85 m [down], 110 m [N], then 45 m [up].



SOH CAH TOA

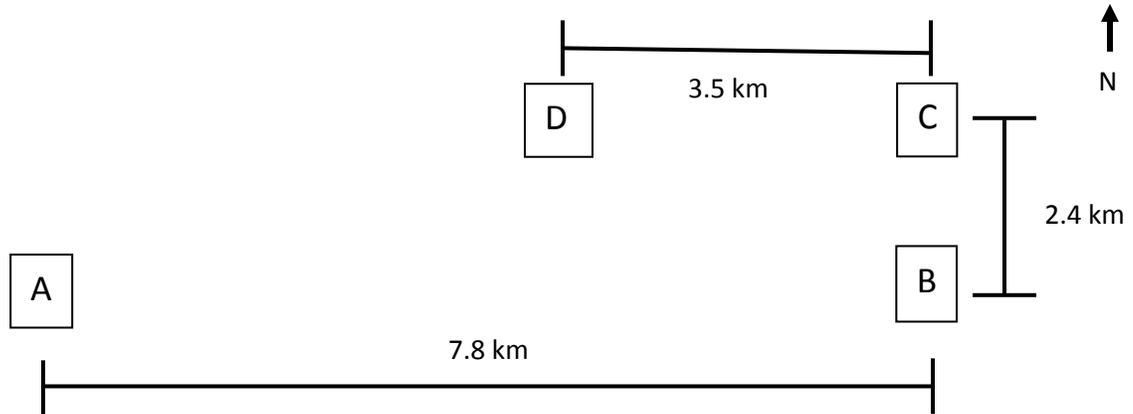
$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

**2-D Vector Problems:**

5. A group of hikers sets out from point **A**, proceeds to **B**, then to **C**, and finally to **D**. The entire trip takes 6.0 h.



- Determine the hikers' average speed for the trip.
  - If the hikers release a homing pigeon upon their arrival at point **D** and the bird returns to point **A** 30 min later, what is the bird's average velocity during the flight?
  - Determine the hikers' average velocity for the trip.
6. A boat that can travel at 14 m/s in still water is crossing a river that is moving at 3.5 m/s [S]. If the boat always points itself west, in what direction will the boat appear to be moving to a person standing on the shore?
7. A plane leaves Toronto and flies with an airspeed of  $2.20 \times 10^2$  km/h always pointing due east. A wind is blowing from the north at  $8.0 \times 10^1$  km/h.
- What is the plane's velocity relative to the ground?
  - What is the plane's displacement from Toronto after flying for 2.5 h?
8. A boat sets out from the north shore of a 200 m wide east-flowing river. The boat always faces due south but the current carries it 300 m downstream while crossing. The trip takes 2.0 min. Assume three significant digits.
- What is the boat's displacement during the trip?
  - What is the boat's average velocity during the trip?
  - If the boat's velocity relative to the water is 1.7 m/s [S], what is the velocity of the current?