Displacement vs Distance

Example #1:

A person rides their bike 6.0 km east [E] and then 8.0 km north [N].

$1 \text{ sq} = 1 \text{ km}$

Draw their path on the grid to the right.
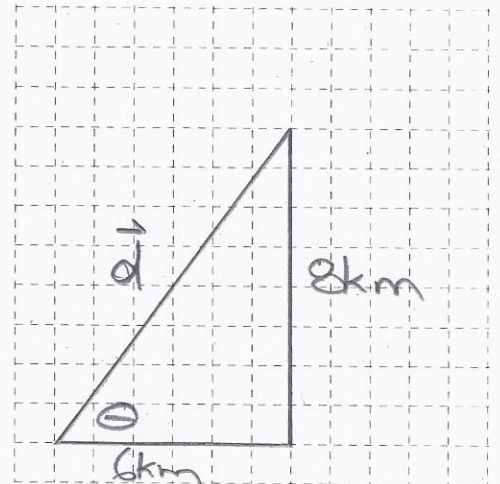
What is the total distance covered?

$$d = 6.0 \text{ km} + 8.0 \text{ km} = 14 \text{ km}$$

What is the displacement?

$$|\vec{d}| = \sqrt{6^2 + 8^2} = 10 \text{ km}$$

$$\theta = \tan^{-1}\left(\frac{8}{6}\right) = 53°$$

$$\vec{d} = 10 \text{ km } [E53°N]$$

What is the average speed if it took 2.0 hours to complete the journey?

$$V = \frac{d}{t} = \frac{14 \text{ km}}{2.0 \text{ hrs}} = 7.0 \text{ km/hr}$$

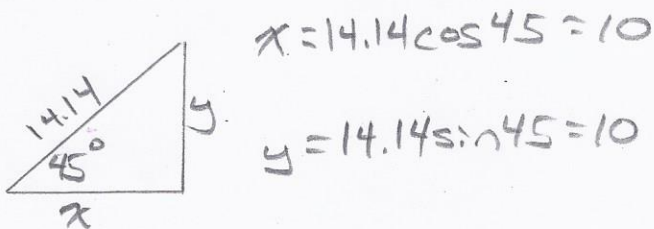What is the average velocity (assuming it took 2.0 hours to complete the journey).

$$\vec{v} = \frac{\vec{d}}{t} = \frac{10 \text{ km } [E53°N]}{2.0 \text{ hrs}} = 5.0 \text{ km/hr } [E53°N]$$

Example #2:

A person walks 14.14m northeast [NE] and then 5.00m east [E].

$1 \text{ sq} = 2 \text{ m}$

Draw their path on the grid to the right.

$$x = 14.14 \cos 45 = 10$$

$$y = 14.14 \sin 45 = 10$$
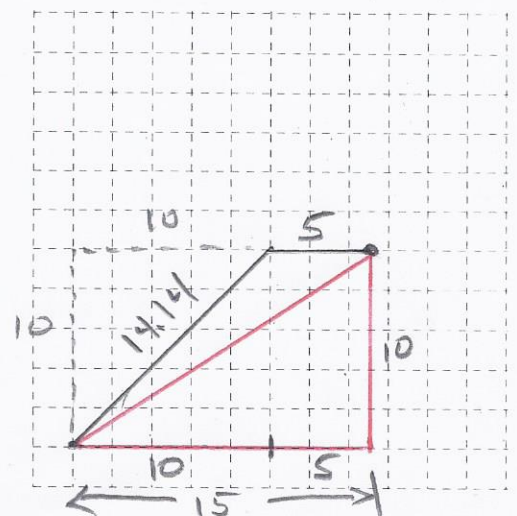
What is the total distance covered?

$$d = 14.14 \text{ m} + 5.00 \text{ m} = 19.1 \text{ m}$$

What is the displacement?

$$|\vec{d}| = \sqrt{15^2 + 10^2} = 18.03$$

$$\theta = \tan^{-1}\left(\frac{10}{15}\right) = 33.7°$$

$$\vec{d} = 18.0 \text{ m } [E 37°N]$$

What is the average speed if it took 12.5s to complete the journey?

$$V = \frac{d}{t} = \frac{19.14 \text{ m}}{12.5 \text{ s}} = 1.53 \text{ m/s}$$

What is the average velocity (assuming it took 12.5s to complete the journey).

$$\vec{v} = \frac{\vec{d}}{t} = \frac{18.03 \text{ m } [E37°N]}{12.5 \text{ s}} = 1.44 \text{ m/s } [E37°N]$$