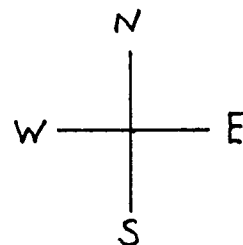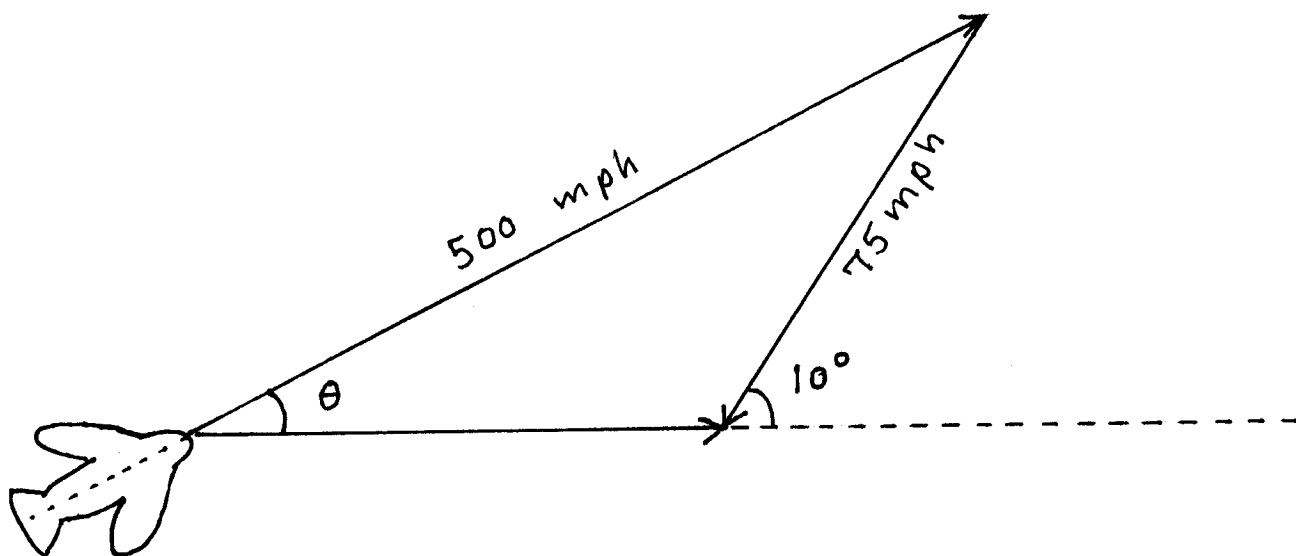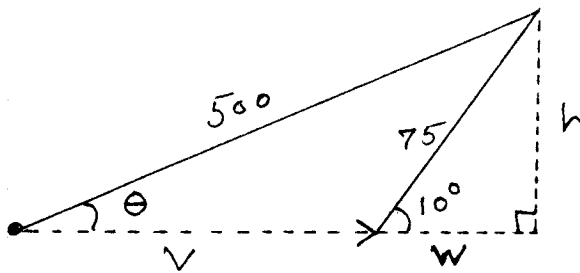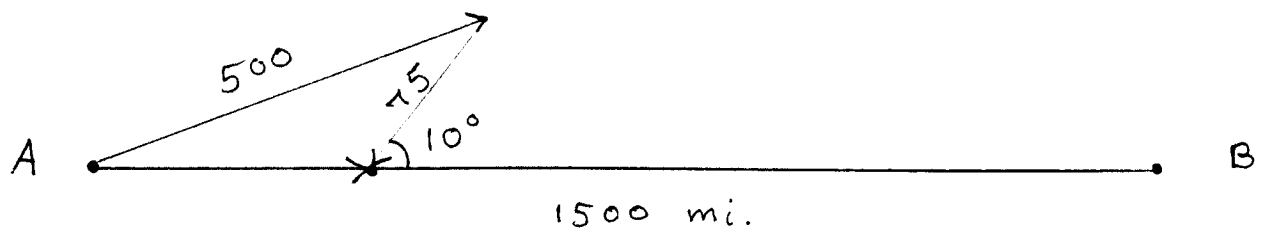Math 21C
Kouba
An Example Using Vectors

Example : A jet airplane wants to fly in a straight line from airport A directly East to airport B, which is 1500 miles away. The jet faces a headwind from $10°$ North of East at 75 mph. If the jet flies at a constant speed of 500 mph (relative to the surrounding air space),

     a.) in what direction should the jet fly ?
     b.) what is the jet's actual flying speed (relative to the ground) ?
     c.) how long will the flight take ?

A diagram: triangle with "500" and "75" labeled, angle 10°, from A to B along 1500 mi.

$$\cos 10° = \frac{w}{75} \longrightarrow$$

$$\boxed{w = 75 \cos 10°} \quad ;$$

$$\sin 10° = \frac{h}{75} \longrightarrow$$

$$\boxed{h = 75 \sin 10°} \quad ;$$

$$\sin \theta = \frac{h}{500} \longrightarrow \sin \theta = \frac{75 \sin 10°}{500} = \frac{3 \sin 10°}{20} \longrightarrow$$

$$\boxed{\theta = \arcsin\left(\frac{3}{20} \sin 10°\right)} \quad ; \quad \text{and}$$

$$(v+w)^2 + h^2 = 500^2 \longrightarrow v+w = \sqrt{500^2 - h^2} \longrightarrow$$

$$v = -w + \sqrt{500^2 - h^2} \longrightarrow$$

$$\boxed{v = -75 \cos 10° + \sqrt{500^2 - (75 \sin 10°)^2}} \quad ; \text{ then}$$

a.) direction $\theta \approx 1.49°$ North of East.

b.) speed $v \approx 426$ mph.

c.) flight time $T = \frac{1500}{426} \approx 3.52$ hrs.