

1. A car travels 50.0 km [35° N of E], then 45.0 km [12° E of S] and finally 22.0 km [15° S of W] in a time of 112 minutes.

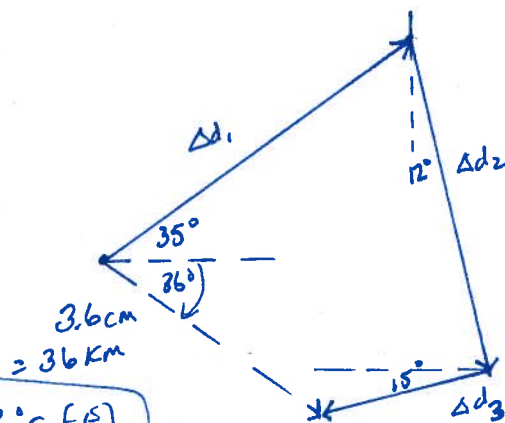
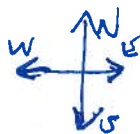
- a) Use the scale diagram method to find the car's resultant displacement.  
 b) Find the car's average velocity over the trip in km/h.  
 c) Find the car's average speed over the trip in km/h.

$$\Delta \vec{d}_1 = 50.0 \text{ km [35° N of E]}$$

$$\Delta \vec{d}_2 = 45.0 \text{ km [12° E of S]}$$

$$\Delta \vec{d}_3 = 22.0 \text{ km [15° S of W]}$$

Scale: 1 cm = 10 km



$$\Delta \vec{d}_R = 36 \text{ km [36° S of E]}$$

$$\vec{v}_{av} = ?$$

$$\Delta t = \frac{112 \text{ min}}{60 \text{ min/h}} = 1.867 \text{ h}$$

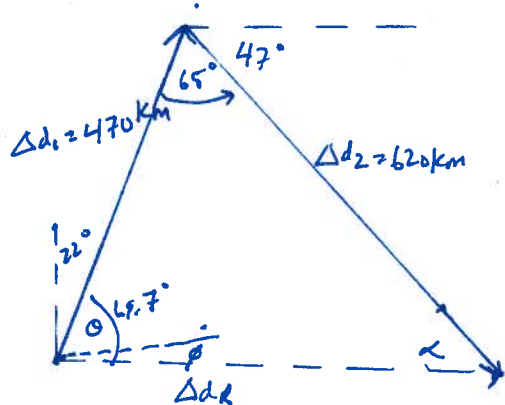
$$\vec{v}_{av} = \frac{\Delta \vec{d}_R}{\Delta t} = \frac{36 \text{ km}}{1.867 \text{ h}} = 19.3 \frac{\text{km}}{\text{h}} [36° \text{ S of E}]$$

$$c) \vec{v}_{av} = ?$$

$$\Delta d_T = ?$$

$$\vec{v}_{av} = \frac{\Delta d_T}{\Delta t} = \frac{50.0 \text{ km} + 45.0 \text{ km} + 22.0 \text{ km}}{1.867 \text{ h}} = 62.7 \frac{\text{km}}{\text{h}}$$

2. An airplane flies 470 km [22° E of N] and then flies 620 km [47° S of E] in a time of 3.0 hours. Use the "relastic sketch cosine/sine law" method to find the plane's resultant displacement.



$$\Delta d_R = \sqrt{470^2 + 620^2 - 2(470)(620) \cos 65^\circ}$$

$$= 599.2 \text{ km}$$

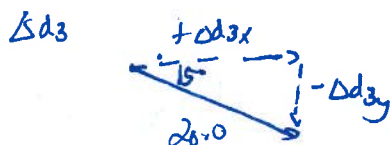
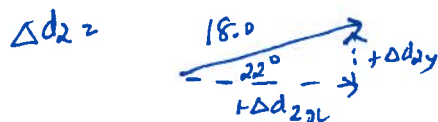
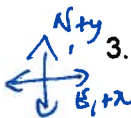
$$\frac{\sin \alpha}{470} = \frac{\sin 65^\circ}{599.2} \rightarrow \alpha = \sin^{-1} \left( \frac{470 \cdot \sin 65^\circ}{599.2} \right) = 45.3^\circ$$

$$\theta = 180^\circ - 65^\circ - 45.3^\circ = 69.7^\circ$$

$$\theta = 22^\circ + 69.7^\circ - 90^\circ = 1.7^\circ$$

$$\Delta \vec{d}_R = 599 \text{ km [1.7° S of E]}$$

3. A sailboat travels 12.0 km [37° N of W], 18.0 km [22° N of E] and finally 20.0 km [15° S of E]. Use the component method to find the sailboat's resultant displacement.



$$\Delta d_{Rx} = \Delta d_{1x} + \Delta d_{2x} + \Delta d_{3x}$$

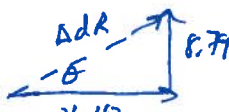
$$= -12.0 \cos 37^\circ + 18.0 \cos 22^\circ + 20.0 \cos 15^\circ$$

$$= 26.42 \text{ km}$$

$$\Delta d_{Ry} = \Delta d_{1y} + \Delta d_{2y} + \Delta d_{3y}$$

$$= 12.0 \sin 37^\circ + 18.0 \sin 22^\circ - 20.0 \sin 15^\circ$$

$$= +8.79 \text{ km}$$



$$\Delta d_R = \sqrt{26.42^2 + 8.79^2}$$

$$= 27.8 \text{ km}$$

$$\theta = \tan^{-1} \left( \frac{8.79}{26.42} \right) = 16.4^\circ$$

$$\Delta \vec{d}_R = 27.8 \text{ km [16° N of E]}$$