

13-4

Vector Applications

Due North \uparrow 90° Due West \leftarrow 180° East = ?
South = ?

Ex1) A boat is travelling @ 9 knots per hour (kph) at an \angle of 110° . The current is flowing due east @ 4 kph. Find the resulting velocity. (speed & direction)

$$\text{Boat: } 9 \text{ kph } \angle 110^\circ \quad \langle 9 \cos 110^\circ, 9 \sin 110^\circ \rangle = \langle -3.08, 8.46 \rangle \text{ reasonable?}$$

$$\text{Current: } \frac{4}{\rightarrow} \quad \langle 4 \cos 0^\circ, 4 \sin 0^\circ \rangle = \langle 4, 0 \rangle$$

$$\text{Boat + current} = \langle -3.08, 8.46 \rangle + \langle 4, 0 \rangle = \langle .92, 8.46 \rangle$$

$$\text{Speed} = \sqrt{(.92)^2 + (8.46)^2} \approx \boxed{8.51 \text{ kph}} \quad \theta = \tan^{-1}\left(\frac{8.46}{.92}\right) \approx \boxed{83.79^\circ}$$

Ex2) A plane is travelling 500 mph and is headed $N 30^\circ W$. It encounters a wind blowing 70 mph at $N 45^\circ E$. What is the resulting velocity?

$$\text{Plane: } \begin{array}{c} \uparrow 30^\circ \\ \text{---} \\ \downarrow 120^\circ \end{array} \quad \langle 500 \cos 120^\circ, 500 \sin 120^\circ \rangle = \langle -250, 433.01 \rangle$$

$$\text{Wind: } \begin{array}{c} \uparrow 45^\circ \\ \text{---} \\ \downarrow 135^\circ \end{array} \quad \langle 70 \cos 45^\circ, 70 \sin 45^\circ \rangle = \langle 49.50, 49.50 \rangle$$

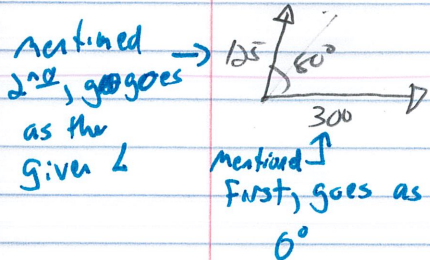
$$\text{Plane + Wind} = \langle -200.5, 482.51 \rangle$$

$$\text{Speed} = \sqrt{(-200.5)^2 + (482.51)^2} \approx \boxed{522.51 \text{ mph}}$$

$$\theta = \tan^{-1}\left(\frac{482.51}{-200.5}\right) + 180 \approx \boxed{112.56^\circ}$$

(cont)

(Ex 3) A 300 newton force and a 125 newton force are acting on the same object. The \angle between the forces is 80° . Find the magnitude & direction of the resultant force.



$$\langle 300 \cos 0^\circ, 300 \sin 0^\circ \rangle = \langle 300, 0 \rangle$$

$$= \langle 321.71, 123.10 \rangle$$

$$\langle 125 \cos 80^\circ, 125 \sin 80^\circ \rangle = \langle 21.71, 123.10 \rangle$$

$$\text{Magnitude} = \sqrt{(321.71)^2 + (123.10)^2} \approx \boxed{344.46 \text{ newtons}}$$

$$\theta = \tan^{-1} \left(\frac{123.10}{321.71} \right) = \boxed{20.94^\circ}$$

cw/HW - wkshet 7.4