1) A river flows at a speed of $12 \mathrm{~m} / \mathrm{s}$ from north to south. A powerboat can move at a constant maximum speed of $23 \mathrm{~m} / \mathrm{s}$ in still water.
a. What is the maximum velocity of the boat upstream (upstream means traveling against the current)? $11 \mathrm{~m} / \mathrm{s} \mathrm{N}$
b. What is the maximum velocity of the boat downstream? $35 \mathrm{~m} / \mathrm{s} S$
c. If the boat were headed east across the river at its maximum speed, what would the resultant velocity of the boat be?


$$
\begin{aligned}
& a=12 \quad b=23 \quad c=? \\
& c=\sqrt{12^{2}+23^{2}}=26 \frac{m}{s} \\
& \tan \Theta=\frac{12}{23} \quad \Theta=28^{\circ}
\end{aligned}
$$

2) A plane is travelling toward the east with a velocity of $120 \mathrm{~km} / \mathrm{h}$. It encounters a wind blowing toward the east at $0.20 \mathrm{~km} / \mathrm{min}$. What is the velocity of the plane in $\mathrm{km} / \mathrm{h}$ ?

Both vectors are east, so they are added together; however, they must both be in identical units.

$$
\begin{aligned}
& ? \frac{\mathrm{~km}}{\mathrm{~h}}=0.20 \frac{\mathrm{~km}}{\mathrm{~min}} \times \frac{60 \mathrm{~min}}{1 \mathrm{~h}}=12 \frac{\mathrm{~km}}{\mathrm{~h}} \\
& 12 \frac{\mathrm{~km}}{\mathrm{~h}}+120 \frac{\mathrm{~km}}{\mathrm{~h}}=132 \frac{\mathrm{~km} \text { or } 130 \frac{\mathrm{~km}}{\mathrm{~h}}}{}
\end{aligned}
$$

3) A girl walks 26 m at an angle of $39^{\circ} \mathrm{W}$ of S .

a. How far west of her starting point is she?

$$
\begin{array}{ll}
\Theta=39^{\circ} \quad c=26 & a=\text { west }=? \quad b=\text { south }=? \\
\sin 39^{\circ}=\frac{\text { west }}{26} & \text { west }=16 \mathrm{~m} \tag{W}
\end{array}
$$

b. How far south of her starting point is she?

$$
\cos 39^{\circ}=\frac{\text { south }}{26} \quad \text { south }=20 . m
$$

4) A pitcher can throw a ball at a velocity of $125 \mathrm{~km} / \mathrm{h}$ straight ahead (draw this down on your paper). If he throws the ball straight when a cross-wind is blowing at $28 \mathrm{~km} / \mathrm{h}$ to the left,
a. What will be the magnitude of the ball's resultant velocity?

b. The direction of the ball will be off $13 \quad{ }^{\circ}$ to the (left, right).

Using the diagram above...

$$
\tan \Theta=\frac{28}{125} \quad \Theta=13^{\circ}
$$

5) A plane heads due north, but because of a wind blowing to the west, the plane flies at a resultant velocity of $620 \mathrm{mi} / \mathrm{h}, 22^{\circ} \mathrm{W}$ of N . What was the velocity of the wind?


$$
\begin{array}{ll}
\Theta=22^{\circ} \quad c=620 & a=\text { west }=? \\
\sin 22^{\circ}=\frac{\text { west }}{620} & \text { west }=230 \mathrm{mph} \mathrm{~W}
\end{array}
$$

