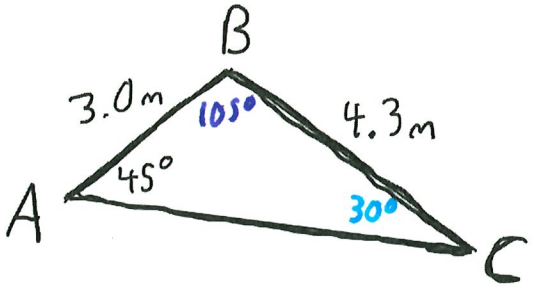
Use Sine Law to solve the following triangles:

1.



$\angle B$: 105°

$\angle C$: 30°

AC: 5.9m

$\angle C$

$$\frac{\sin C}{3.0} = \frac{\sin 45^\circ}{4.3}$$

$$\sin C = \frac{\sin 45^\circ}{4.3} \times 3.0 = 0.4933$$

$$C = \sin^{-1}(0.4933) = 29.56^\circ \approx 30^\circ$$

$\angle B$

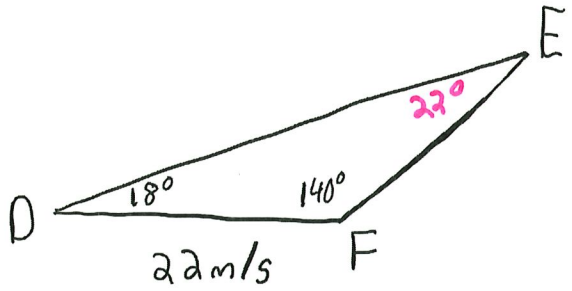
$\angle B = 180^\circ - 45^\circ - 29.56^\circ = 105.44^\circ \approx 105^\circ$ ← since angles in triangle add to 180°

AC

$$\frac{AC}{\sin 105.44^\circ} = \frac{4.3}{\sin 45}$$

$$AC = \frac{4.3}{\sin 45} \times \sin 105.44^\circ = 5.86\text{m} \approx 5.9\text{m}$$

2.



∠E: 22°

DE: 38m/s

EF: 18.15m/s

$\angle E = 180^\circ - 18^\circ - 140^\circ$

$= 22^\circ$

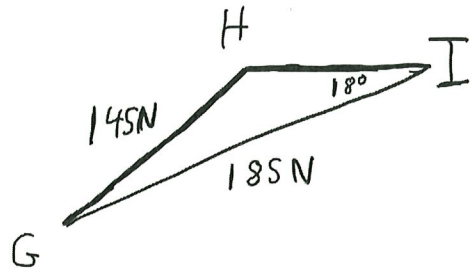
$$\frac{DE}{\sin 140^\circ} = \frac{22\,m/s}{\sin 22^\circ} \rightarrow DE = \frac{22\,m/s}{\sin 22^\circ} \times \sin 140^\circ$$

$$= 37.75\,m/s$$

$$\frac{EF}{\sin 18^\circ} = \frac{22\,m/s}{\sin 22^\circ} \rightarrow EF = \frac{22\,m/s}{\sin 22^\circ} \times \sin 18^\circ$$

$$= 18.15\,m/s$$

3.



∠G: 5.2°

∠H: 156.78° ≈ 157°

HI: 43N

∠H

$\frac{\sin H}{185N} = \frac{\sin 18}{145N} \rightarrow \sin H = \frac{\sin 18}{145} \times 185$

$\sin H = 0.3942$

$\sin^{-1}(0.3942) = 23.22°$

But ∠H is clearly more than 90°

so $\angle H = 180° - 23.22° = 156.78°$

∠G

$180° - 18° - 156.78° = 5.22°$

HI

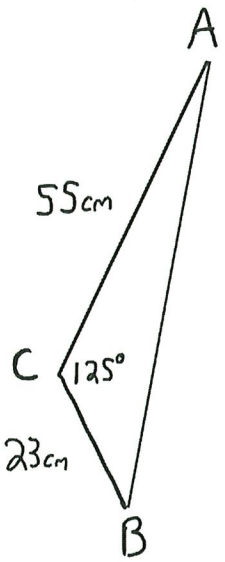
$\frac{HI}{\sin 5.22°} = \frac{145N}{\sin 18°} \rightarrow HI = \frac{145N}{\sin 18°} \times \sin 5.22°$

$= 42.69\,N$

$\approx 43\,N$

Use Cosine Law to solve the following triangles:

4.



$\angle A$: 15.44° ≈ 15°

$\angle B$: 40°

AB: 71cm

$$AB^2 = 23^2 + 55^2 - 2(23)(55)\cos 125^\circ$$

$$AB = 70.7471 \text{ cm}$$

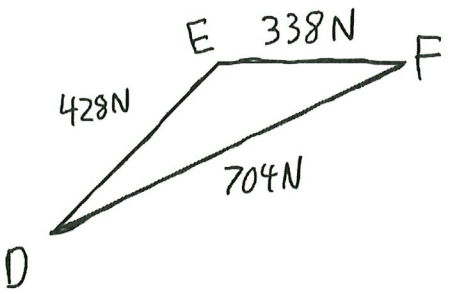
$$\cos A = \frac{23^2 - 70.7471^2 - 55^2}{-2(70.7471)(55)}$$

$$= 0.96389$$

$$\cos^{-1}(0.96389) = 15.44^\circ$$

$$\angle B = 180^\circ - 15^\circ - 125^\circ = 40^\circ$$

5.



$\angle D$: 20°

$\angle E$: 133°

$\angle F$:: 26°

$$\cos D = \frac{338^2 - 428^2 - 704^2}{-2(428)(704)}$$

$$= 0.9368$$

$$\angle D = 20.47°$$

$$\cos E = \frac{704^2 - 428^2 - 338^2}{-2(428)(338)}$$

$$\angle E = 133.24°$$

$$\angle F = 180° - 20.47° - 133.24°$$

$$= 26.29°$$

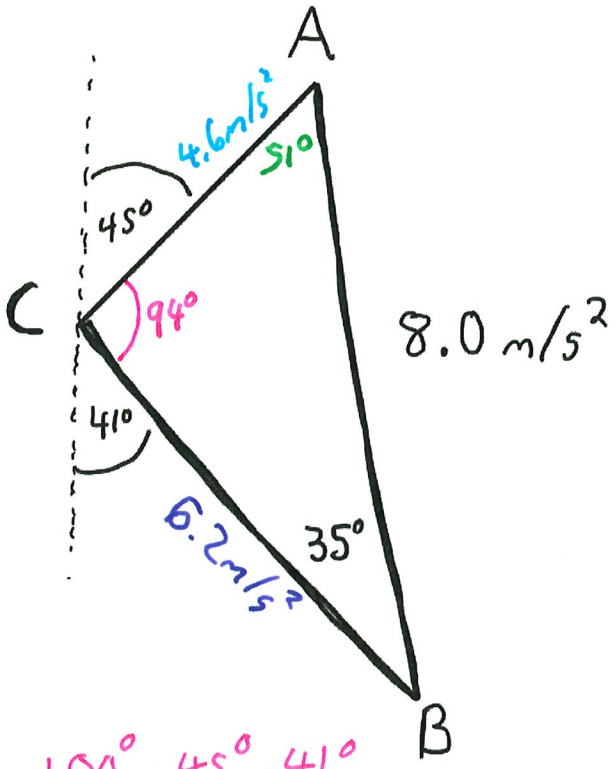
6 Solve the following triange:

$\angle A$: 51°

$\angle C$: 94°

AC: 4.6 m/s²

BC: 6.2 m/s²



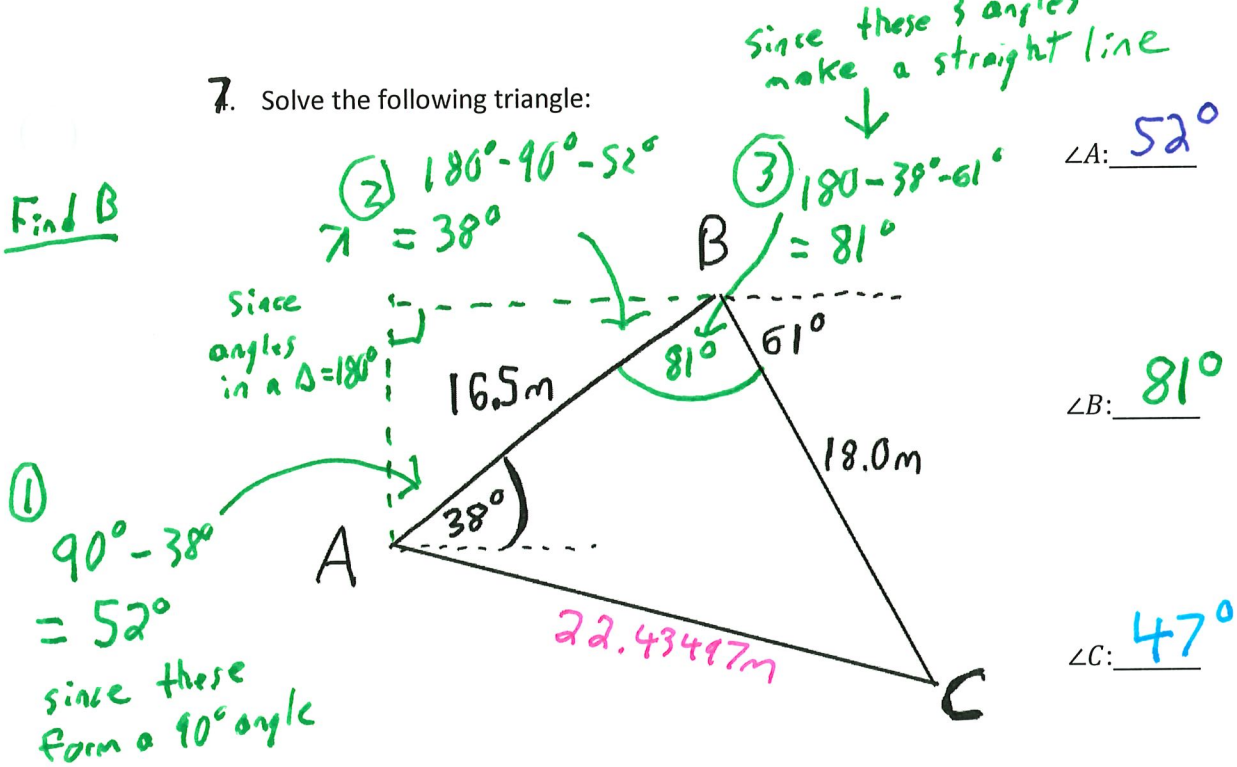
$\angle C = 180° - 45° - 41°$
$= 94°$ ← since angles together form a straight line

$\angle A = 180° - 35° - 94°$
$= 51°$ ← angles in a triangle add to 180°

$\frac{AC}{\sin 35°} = \frac{8.0 m/s^2}{\sin 94°} \rightarrow AC = \frac{8.0 m/s^2}{\sin 94°} \times \sin 35° = 4.5998 m/s^2$
$\approx 4.6 m/s^2$

$\frac{BC}{\sin 51°} = \frac{8.0 m/s^2}{\sin 94°} \rightarrow BC = \frac{8.0 m/s^2}{\sin 94°} \times \sin 51° = 6.2323 m/s^2$
$\approx 6.2 m/s^2$

7. Solve the following triangle:



$\angle A$: 52°

$\angle B$: 81°

$\angle C$: 47°

$AC^2 = 16.5^2 + 18.0^2 - 2(16.5)(18.0)(\cos 81°)$

$AC = 22.43497m$

AC: 22m

$\frac{\sin C}{16.5} = \frac{\sin 81}{22.43497} \rightarrow \sin C = \frac{\sin 81}{22.43497} \times 16.5$

$= 0.7264$

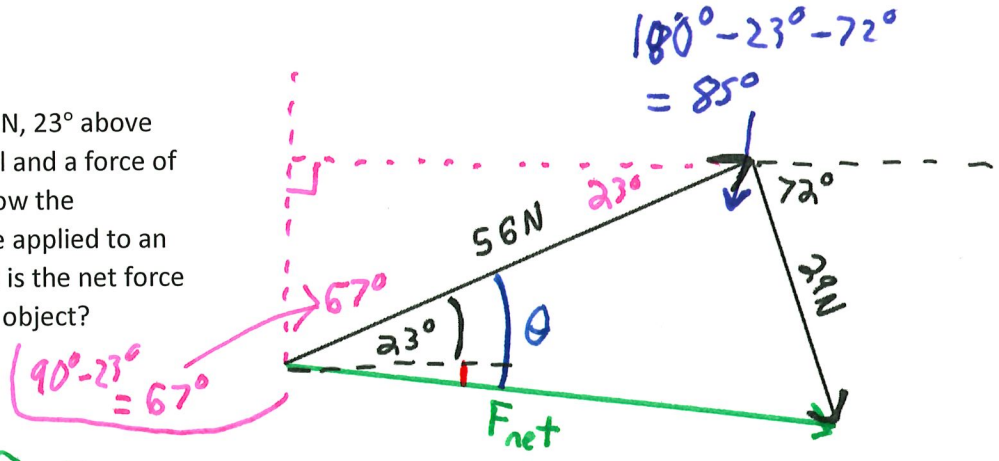
$C = 46.5858°$

$\approx 47°$

$\angle A = 180° - 81° - 46.5858°$

$= 52°$

8. A force of 56 N, 23° above the horizontal and a force of 29 N, 72° below the horizontal are applied to an object. What is the net force acting on the object?



F_{net} is sum of forces

Need to find an angle in triangle

Magnitude can be found with cosine law

$$F_{net}^2 = 56^2 + 29^2 - 2(56)(29)(\cos 85°)$$

F_{net} magnitude = 60.78 N

Use sine law to find θ shown

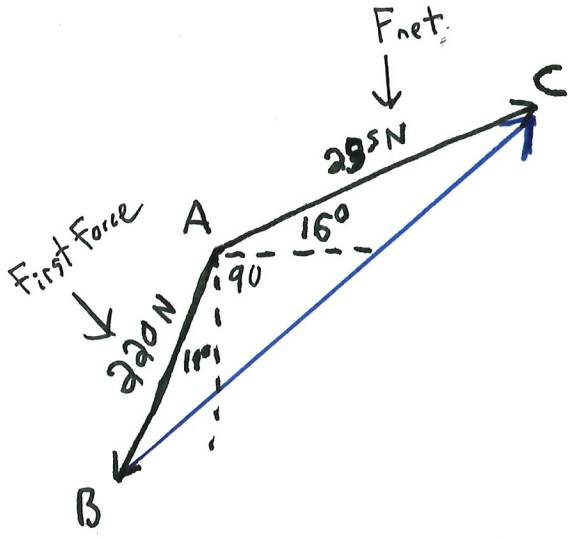
$$\frac{\sin\theta}{29\,N} = \frac{\sin 85°}{60.78\,N} \rightarrow \theta = 28.4°$$

θ is the angle between F_{net} and the 56°N force, we need to get the angle with reference to the horizontal

it is 28.4° − 23° = 5.4° below the horizontal

F_{net} = 61 N, 5.4° below horizontal

9. The net force acting on an object is 255 N, 16° North of East. There is a 220 N force acting 19° West of South and another force acting on the object. What is the magnitude and direction of the second force?



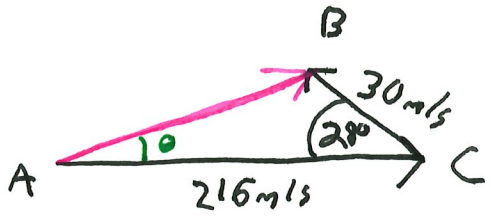
$\angle A = 18° + 90° + 16° = 124°$

Magnitude BC can be found with cosine law

$BC^2 = 220^2 + 255^2 - 2(220)(255)\cos 124°$

$BC = 419.72\ N$

10. A plane is flying with airspeed of 216 m/s due East, a 30 m/s wind is blowing at 28° N of W. What is the resultant velocity of the plane?



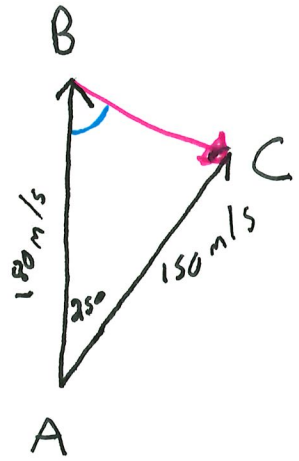
$AB^2 = 30^2 + 216^2 - 2(216)(30)\cos 28°$

$AB = 190.03$

$\frac{\sin\theta}{30\,m/s} = \frac{\sin 28}{190.03} \rightarrow \theta = 4.25°$

Velocity is 190 m/s, 4.3° North of East

11. A plane with airspeed of 180m/s, pointed due North is deflected from its bearing by 25° to the East by a strong wind. Due to the wind the plane travels with a ground speed of 150 m/s. What is the speed and direction of the wind?



magnitude BC

$$BC^2 = 180^2 + 150^2 - 2(180)(150)\cos 25°$$

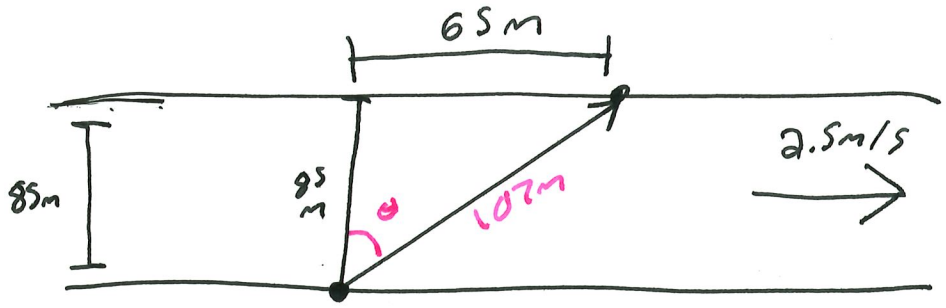
$$BC = 77.20 \text{ m/s}$$

$\angle B$

$$\frac{\sin B}{150} = \frac{\sin 25}{77.20} \rightarrow \angle B = 55°$$

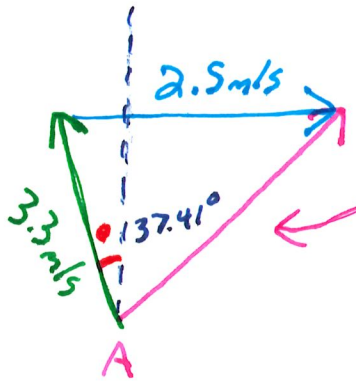
Wind blows 77m/s, 55° East of South

12. A boat which can travel at 3.3 m/s in calm water is attempting to cross an 85 m wide river which flows at 2.5m/s and hopes to end up at a dock 65 m downstream. What direction should the boat be pointed?



Resultant direction is $\tan^{-1}\left(\frac{65}{85}\right) = 37.41°$

distance travelled $= \sqrt{65^2+85^2} = 107\,m$



$V = \frac{107\,m}{28\,sec} = 3.8214\,m/s$

$$\cos A = \frac{2.5^2 - 3.3^2 - 3.8214^2}{-2(3.3)(3.8214)}$$

$$A = 40.27°$$

$$\theta = 40.27° - 37.41° = 2.9° \text{ upstream}$$