

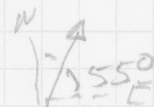
1. a $\vec{v} = 228 \text{ m/s} @ 160^\circ$

$$v_x = (228 \text{ m/s}) \cos 160^\circ$$

$$v_y = (228 \text{ m/s}) \sin(160^\circ)$$

$v_x = -214 \text{ m/s}$
$v_y = 78.0 \text{ m/s}$

b. $\vec{F} = 79 \text{ N} [35^\circ \text{ E of N}] \text{ or } @ 55^\circ$



$$F_x = (79 \text{ N}) \cos 55^\circ$$

$$F_y = (79 \text{ N}) \sin 55^\circ$$

$F_x = 45 \text{ N}$
$F_y = 65 \text{ N}$

c. $\vec{s} = (55 \text{ m}) @ -40^\circ \text{ or } @ 320^\circ$

$$s_x = (55 \text{ m}) \cos(320^\circ)$$

$$s_y = (55 \text{ m}) \sin(320^\circ)$$

$s_x = 42 \text{ m}$
$s_y = -35 \text{ m}$

d.

$$F_x = -40 \text{ N}$$

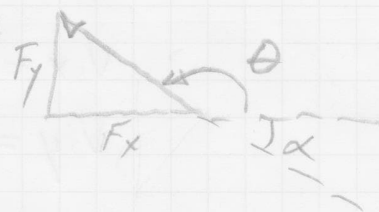
$$F_y = -20 \text{ N}$$

Read of the graph,
Each square
is $5 \text{ N} \times 5 \text{ N}$,

2. a. $F_x = -160.7\text{ N}$ $F_y = 191.5\text{ N}$

$$F = [(160.7\text{ N})^2 + (191.5\text{ N})^2]^{1/2}$$

$$F = 250\text{ N}$$



$$\alpha = \tan^{-1}\left(\frac{191.5}{-160.7}\right) = -50^\circ$$

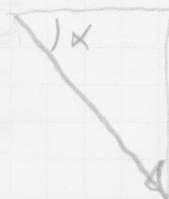
$$\theta = 180^\circ - 50^\circ$$

$$\boxed{\vec{F} = 250\text{ N @ } 130^\circ}$$

b. $v_x = 45\text{ m/s}$ $v_y = -62\text{ m/s}$ Assume
m/s

$$V = \sqrt{(45\text{ m/s})^2 + (-62\text{ m/s})^2}$$

$$V = 76.6\text{ m/s}$$



$$\alpha = \tan^{-1}\left(\frac{-62\text{ m/s}}{45\text{ m/s}}\right) = -54^\circ$$

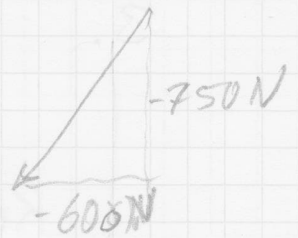
$$\theta = 360^\circ - 54^\circ = 306^\circ$$

$$\vec{V} = 76.6\text{ m/s @ } 306^\circ$$

$$2c \quad F_y = -750\text{ N} \quad F_x = -600\text{ N}$$

$$F = \sqrt{(750\text{ N})^2 + (-600\text{ N})^2}$$

$$F = 960\text{ N}$$



$$\alpha = \tan^{-1}\left(\frac{-750\text{ N}}{-600\text{ N}}\right) = 51.3^\circ$$

$$\theta = 180^\circ + 51.3^\circ = 231^\circ$$

$$\boxed{\vec{F} = 960\text{ N} @ 231^\circ}$$

d.

$$s_x = (6)(20\text{ m}) = 120\text{ m} \quad s_y = (11)(20\text{ m}) = 220\text{ m}$$

$$s = \sqrt{(120\text{ m})^2 + (220\text{ m})^2}$$

$$s = 251\text{ m}$$



$$\theta = \tan^{-1}\left(\frac{220\text{ m}}{120\text{ m}}\right) = 61.4^\circ$$

$$\boxed{\vec{s} = 251\text{ m} @ 61.4^\circ}$$

$$3. \quad AB_x = 11\text{m} \quad AB_y = 3\text{m}$$

$$CD_x = 9\text{m} \quad CD_y = -6\text{m}$$

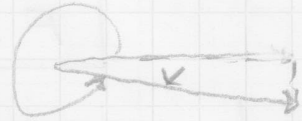
Reading off the graph.

$$\vec{s} = AB_x + CD_x = 11\text{m} + 9\text{m} = 20\text{m}$$

$$AB_y + CD_y = 3\text{m} - 6\text{m} = -3\text{m}$$

$$\text{let } \vec{s} = \vec{AB} + \vec{CD}$$

$$s = \sqrt{(20\text{m})^2 + (-3\text{m})^2}$$



$$s = 20.2\text{m}$$

$$\alpha = \tan^{-1}\left(\frac{-3\text{m}}{20\text{m}}\right) = -8.5^\circ$$

$$\theta = 360^\circ - 8.5^\circ$$

$$\theta = 351.5^\circ$$

$$\boxed{\vec{s} = 20.2\text{m} @ 351.5^\circ}$$

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4.

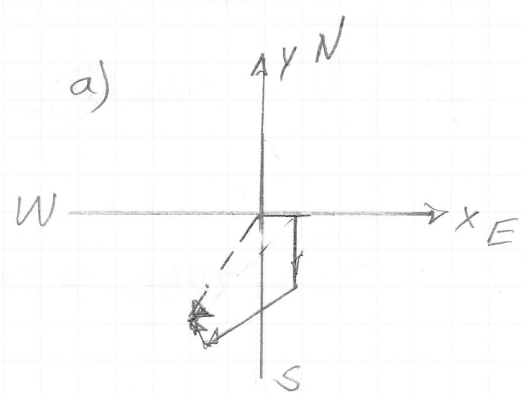
b) ①

$$S_{1x} = 150 \text{ m} \quad S_{1y} = 0$$

$$\textcircled{2} \quad S_{2x} = 0 \quad S_{2y} = -300 \text{ m}$$

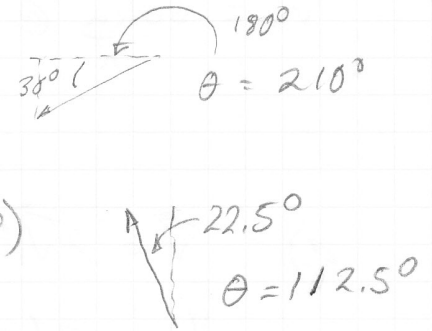
$$\textcircled{3} \quad S_{3x} = 450 \text{ m} \cos 210^\circ \quad S_{3y} = 450 \text{ m} \sin 210^\circ$$

$$S_{3x} = -389 \text{ m} \quad S_{3y} = -225 \text{ m}$$



$$\textcircled{4} \quad S_{4x} = 100 \cos(112.5^\circ) \quad S_{4y} = 100 \sin(112.5^\circ)$$

$$S_{4x} = -38.3 \text{ m} \quad S_{4y} = 92.4 \text{ m}$$



Add x-components

$$\begin{array}{r} 150 \text{ m} \\ 0 \text{ m} \\ -389 \text{ m} \\ -38.3 \text{ m} \\ \hline -277.3 \text{ m} \end{array}$$

Add y-components

$$\begin{array}{r} 0 \text{ m} \\ -300 \text{ m} \\ -225 \text{ m} \\ 92.4 \text{ m} \\ \hline -432.6 \text{ m} \end{array}$$

$$S_x = -277 \text{ m}$$

$$S_y = -433 \text{ m}$$

$$S = \sqrt{(-277)^2 + (-433)^2} = 514 \text{ m}$$

$$\alpha = \tan^{-1}\left(\frac{-433}{-277}\right) = 57.4^\circ$$

$$\theta = 180^\circ + 57.4^\circ = 237.4^\circ$$

$$\boxed{\vec{S} = 514 \text{ m} @ 237.4^\circ}$$

- c) Distance by course $150 \text{ m} + 300 \text{ m} + 450 \text{ m} + 100 \text{ m} = 1000 \text{ m}$
 Distance by direct route 514 m

$$5. \quad \vec{V}_1 = 20 \frac{\text{km}}{\text{h}} @ 50^\circ \quad V_{1x} = \frac{20 \text{ km}}{\text{h}} \cos 50^\circ \quad V_{1y} = \frac{20 \text{ km}}{\text{h}} \sin 50^\circ$$

$$V_{1x} = 12.9 \frac{\text{km}}{\text{h}} \quad V_{1y} = 15.3 \frac{\text{km}}{\text{h}}$$

$$\vec{V}_2 = 40 \frac{\text{km}}{\text{h}} @ 200^\circ \quad V_{2x} = \frac{40 \text{ km}}{\text{h}} \cos 200^\circ \quad V_{2y} = \frac{40 \text{ km}}{\text{h}} \sin 200^\circ$$

$$V_{2x} = -37.6 \frac{\text{km}}{\text{h}} \quad V_{2y} = -13.7 \frac{\text{km}}{\text{h}}$$

$$\vec{V}_3 = 30 \frac{\text{km}}{\text{h}} @ 310^\circ \quad V_{3x} = \frac{30 \text{ km}}{\text{h}} \cos 310^\circ \quad V_{3y} = \frac{30 \text{ km}}{\text{h}} \sin 310^\circ$$

$$V_{3x} = 19.3 \frac{\text{km}}{\text{h}} \quad V_{3y} = -23.0 \frac{\text{km}}{\text{h}}$$

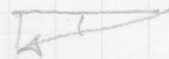
$$a) \quad \vec{V} = 2\vec{V}_1 + 3\vec{V}_2$$

$$V_x = 2(12.9 \text{ km/h}) + 3(-37.6 \text{ km/h}) = -87.0 \text{ km/h}$$

$$V_y = 2(15.3 \text{ km/h}) + 3(-13.7 \text{ km/h}) = -10.5 \text{ km/h}$$

$$V = \sqrt{(-87 \text{ km/h})^2 + (-10.5 \text{ km/h})^2} = 87.6 \text{ km/h}$$

$$\alpha = \tan^{-1}\left(\frac{-10.5}{-87.0}\right) = 6.88^\circ$$



$$\theta = 186.9^\circ$$

$$\boxed{\vec{V} = 87.6 \text{ km/h} @ 186.9^\circ}$$

$$b) \quad \vec{V} = 5\vec{V}_3 - \vec{V}_1$$

$$V_x = 5(19.3 \text{ km/h}) - 12.9 \text{ km/h} = 83.6 \text{ km/h}$$

$$V_y = 5(-23 \text{ km/h}) - 15.3 \text{ km/h} = -130.3 \text{ km/h}$$

$$\alpha = \tan^{-1}\left(\frac{-130.3}{83.6}\right) = -57.3^\circ$$

$$\theta = 360^\circ - 57.3^\circ = 303^\circ$$



5. (cont'd)

$$b) v = \sqrt{(83.6 \text{ km/h})^2 + (-130.3 \text{ km/h})^2} = 155 \text{ km/h}$$

$$\boxed{\vec{v} = 155 \text{ km/h @ } 303^\circ}$$

$$c) \vec{v} = \vec{v}_2 + 4(\vec{v}_1 - \vec{v}_3) = \vec{v}_2 + 4\vec{v}_1 - 4\vec{v}_3$$

$$v_x = -37.6 \frac{\text{km}}{\text{h}} + 4\left(12.9 \frac{\text{km}}{\text{h}}\right) - 4\left(19.3 \frac{\text{km}}{\text{h}}\right) = -63.2 \text{ km/h}$$

$$v_y = -13.7 \frac{\text{km}}{\text{h}} + 4\left(15.3 \frac{\text{km}}{\text{h}}\right) - 4\left(-23.0 \frac{\text{km}}{\text{h}}\right) = 139.5 \text{ km/h}$$

$$v = \sqrt{(-63.2 \text{ km/h})^2 + (139.5 \text{ km/h})^2} = 153 \text{ km/h}$$

$$\alpha = \tan^{-1}\left(\frac{139.5}{-63.2}\right) = -65.6^\circ$$



$$\theta = 180^\circ - 65.6^\circ = 114^\circ$$

$$\boxed{\vec{v} = 153 \text{ km/h @ } 114^\circ}$$

$$6. \vec{F}_1 = (5 \text{ N}, -3 \text{ N}) \quad \vec{F}_2 = (-8 \text{ N}, 12 \text{ N}) \quad \vec{F}_3 = (-6 \text{ N}, -7 \text{ N})$$

$$\vec{F} = -4\vec{F}_3 + 3\vec{F}_2 - \vec{F}_1 = -4(-6 \text{ N}, -7 \text{ N}) + 3(-8 \text{ N}, 12 \text{ N}) - (5 \text{ N}, -3 \text{ N})$$

$$= (24 \text{ N}, 28 \text{ N}) + (-24 \text{ N}, 36 \text{ N}) + (-5 \text{ N}, 3 \text{ N})$$

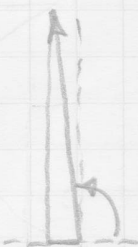
$$\boxed{\vec{F} = (-5 \text{ N}, 67 \text{ N})}$$

$$F = \sqrt{(-5 \text{ N})^2 + (67 \text{ N})^2} = 67.2 \text{ N}$$

$$\alpha = \tan^{-1}\left(\frac{67 \text{ N}}{-5 \text{ N}}\right) = -85.7^\circ$$

$$\theta = 180^\circ - 85.7^\circ = 94.3^\circ$$

$$\boxed{\vec{F} = 67.2 \text{ N @ } 94.3^\circ}$$



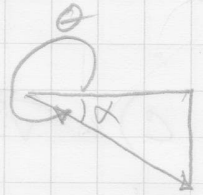
6 (contd)

$$b) \vec{F} = 7.5\vec{F}_1 - 2\vec{F}_2$$

$$F_x = 7.5(5N, -3N) - 2(-8N, 12N)$$

$$= (37.5N, -22.5N) + (16N, -24N)$$

$$\boxed{\vec{F} = (53.5N, -46.5N)}$$



$$F = \sqrt{(53.5N)^2 + (-46.5N)^2} = 70.9N$$

$$\alpha = \tan^{-1}\left(\frac{-46.5}{53.5}\right) = -41^\circ \quad \theta = 360^\circ - 41^\circ = 319^\circ$$

$$\boxed{\vec{F} = 70.9N @ 319^\circ}$$

$$c) \vec{F} = 4(\vec{F}_1 - \vec{F}_3) - (6\vec{F}_2 - \vec{F}_1) = 4\vec{F}_1 - 4\vec{F}_3 - 6\vec{F}_2 + \vec{F}_1$$

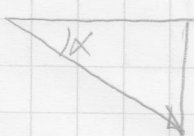
$$\vec{F} = 5\vec{F}_1 - 6\vec{F}_2 - 4\vec{F}_3 = 5(5N, -3N) - 6(-8N, 12N) - 4(-6N, -7N)$$

$$= (25N, -15N) + (48N, -72N) + (24N, 28N)$$

$$\boxed{\vec{F} = (97N, -59N)}$$

$$F = \sqrt{(97N)^2 + (-59N)^2}$$

$$F = 113.5N$$



$$\alpha = \tan^{-1}\left(\frac{-59N}{97N}\right)$$

$$\alpha = -31.3^\circ$$

$$\theta = 360^\circ - 31.3^\circ$$

$$\theta = 329^\circ$$

$$\boxed{\vec{F} = 114N @ 329^\circ}$$

