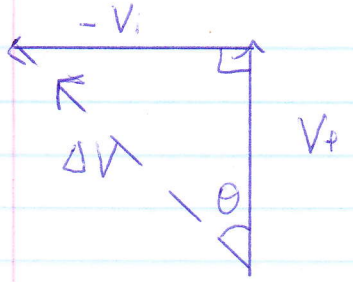
13. $V_i = 45\ km/h\ [E]$, $V_f = 50\ km/h\ [N]$

$\Delta V = V_f - V_i$



$\Delta V = \sqrt{(45\ km/h)^2 + (50\ km/h)^2}$

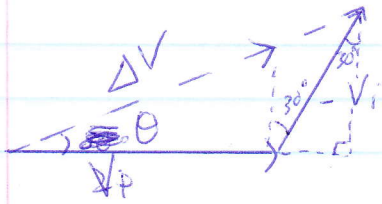
$= 67\ km$

$\tan\theta = \frac{V_i}{V_f} = \frac{45}{50}$

$\theta = \tan^{-1}\left(\frac{45}{50}\right) = 42°$

$\Delta V = 67 km\ [N\ 42°\ W]$

14. $V_i = 200\ km\ [S\ 30°\ W]$, $V_f = 200\ km\ [E]$



$V_{iy} = V_i \cos 30 = 200\ km\ (\cos 30°)$

$V_{iy} = 173.2\ km$

$V_{ix} = V_i \sin 30°$

$V_{ix} = 100\ km$

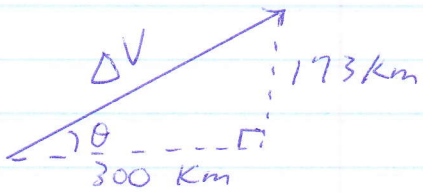
Add the horizontal and vertical components.

x: $200\ km + 100\ km = 300\ km$

y: $173.2\ km$

$\Delta V = \sqrt{(300\ km)^2 + (173.2\ km)^2}$

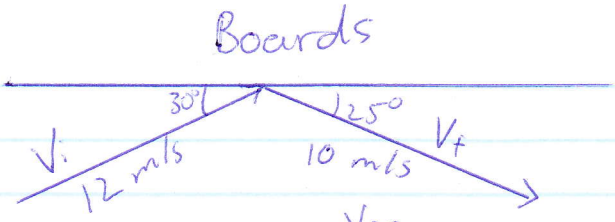
$\Delta V = 346\ km$



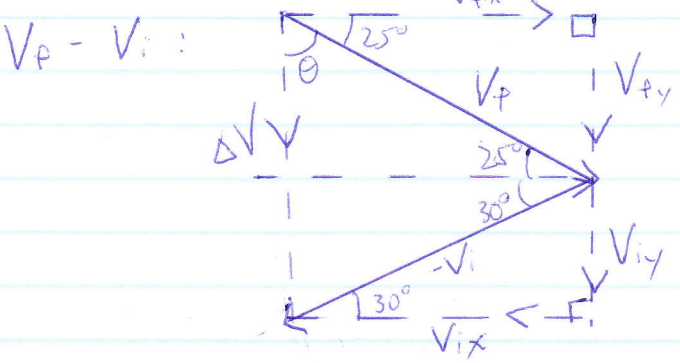
$\theta = \tan^{-1}\left(\frac{173\ km}{300\ km}\right) \Rightarrow \theta = 30°$

$\Delta V = 346 km\ [E\ 30°\ N]$

15.



$V_f - V_i$:

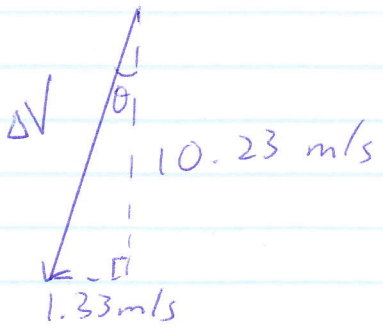


Separate V_f and V_i into components.

$V_{fx} = V_f \cos 25 = 9.06$ m/s
$V_{fy} = V_f \sin 25 = -4.23$ m/s (because it's pointing down)

$V_{ix} = V_i \cos 30 = -10.39$ m/s (pointing left)
$V_{iy} = V_i \sin 30 = -6.00$ m/s (pointing down)

x : 9.06 m/s + (-10.39 m/s) = -1.33 m/s
y : -4.23 m/s + (-6.00 m/s) = -10.23 m/s

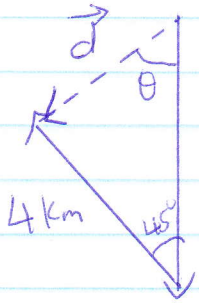


$\Delta V = \sqrt{(10.23 \text{ m/s})^2 + (-1.33 \text{ m/s})^2} = 10.32$ m/s
$\theta = \tan^{-1}\left(\frac{1.33}{10.23}\right) = 7.41°$

$\Delta V = 10.32$ m/s [S 7.41° W]

Page 102

17.



Assume 45° for "Northwest"

Use cosine law for $\vec{d}$, and sine law for θ.

$c^2 = a^2 + b^2 - 2ab\cos C$

$\vec{d}^2 = (6\text{ km})^2 + (4\text{ km})^2 - 2(6\text{ km})(4\text{ km})\cos(45°)$

$\vec{d}^2 = 18.0589\text{ km}^2$

$\vec{d} = 4.25\text{ km}$

$$\frac{\sin 45°}{4.25\text{ km}} = \frac{\sin\theta}{4\text{ km}} \Rightarrow \sin\theta = \frac{(4\text{ km})\sin 45°}{4.25\text{ km}}$$

$\theta = 41.7°$

$$\vec{V} = \frac{\vec{d}}{t} = \frac{4.25\text{ km}}{45\text{ min}} = 0.094\overline{4}\text{ km/min} = 5.\overline{6}\text{ km/h}$$

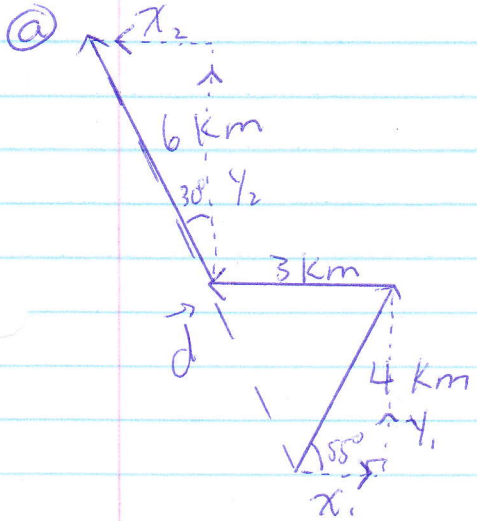
$\vec{V} = 0.094\overline{4}\text{ km/min}\quad [S\ 41.7°\ W]$

20. $(5.0\text{ km/h})\left(48\text{ min}\times\frac{1\text{ h}}{60\text{ min}}\right) = 4\text{ km}\ [N\ 35°\ E]$ ①

$(4.5\text{ km/h})\left(40\text{ min}\times\frac{1\text{ h}}{60\text{ min}}\right) = 3\text{ km}\ [W]$ ②

$6\text{ km}\ [N\ 30°\ W]$ ③

@



Break into components.

①: $x_1 = 4\cos 55 = 2.29\text{ km}$

$y_1 = 4\sin 55 = 3.28\text{ km}$

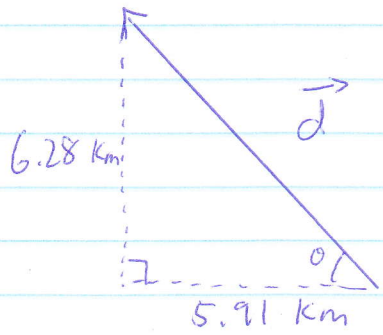
②: $x_2 = 6\cos 30° = -5.20\text{ km}$ (direction)

$y_2 = 6\sin 30° = 3\text{ km}$

Add all components:

x: $2.29\ km + (-3\ km) + (-5.20\ km) = -5.91\ km$

y: $3.28\ km + 3\ km = 6.28\ km$



$\vec{d} = \sqrt{(6.28)^2 + (5.91)^2} = 8.6\ km$

$\theta = \tan^{-1}\left(\frac{6.28}{5.91}\right)$

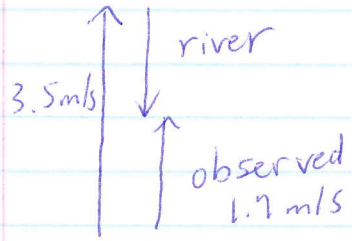
$\theta = 46.74°$

(b) $\vec{V} = \frac{\vec{d}}{t}$, total time $= 0.8\ h + \frac{2}{3}\ h + 1.5\ h$

$= 2.9\overline{6}\ h$

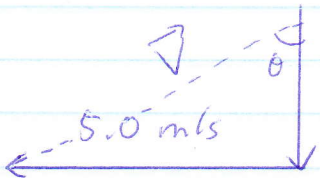
$\vec{V} = 8.6\ km \div 2.9\overline{6}\ h = 2.9\ km/h\ [W46°N]$

Page 110

21. 

$3.5\ m/s + V_{river} = 1.7\ m/s$

$V_{river} = -1.8\ m/s$

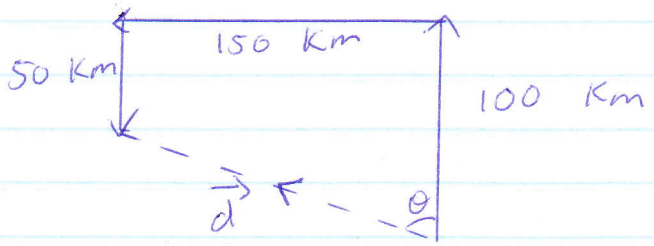
22. 

$\vec{V} = \sqrt{(11)^2 + (5)^2}$

$\vec{V} = 12.08\ m/s$

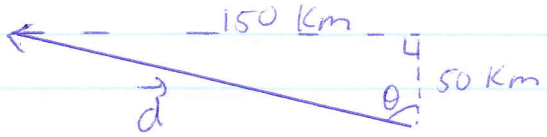
$\theta = \tan^{-1}\left(\frac{5}{11}\right) \Rightarrow \theta = 24°$

$\vec{V} =$ 12 m/s [S24° W]

24. 

(a) x : 150 km [W]

y : 100 km + (-50 km) = 50 km [N]



$\vec{d} = \sqrt{(150)^2 + (50)^2} = 158\ km$

$\theta = \tan^{-1}\left(\frac{150}{50}\right) = 71.57° = 71.6°$

$\vec{d} = 158\ km\ [N\ 71.6°\ W]$

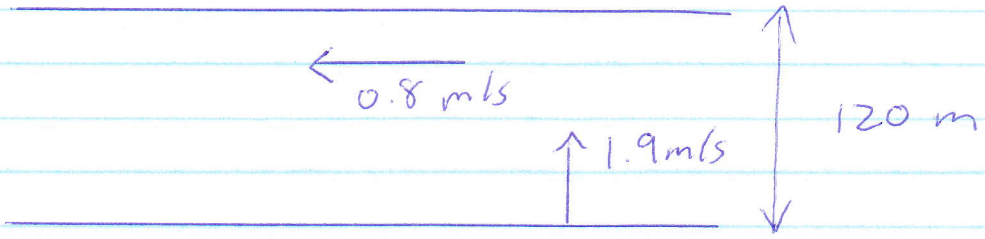
(b) Total time = 72 min

Segment 1 : 100 km ÷ 20 min = 5 km/min [N]

Segment 2 : 150 km ÷ 40 min = 3.75 km/min [W]

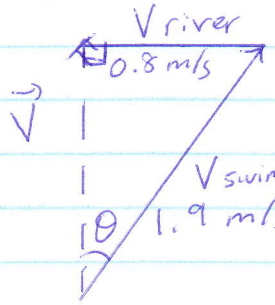
Segment 3 : 50 km ÷ 12 min = $4.1\overline{6}$ km/min [S]

25.



$24\ m \div 30.0\ s = 0.8\ m/s$

(a) We want a $\vec{V}$ that is directly North.



$\vec{V} = \sqrt{(1.9)^2 - (0.8)^2}$

$\vec{V} = 1.72\ m/s\ [N]$ (for part (b))

We need to find θ. $\sin\theta = \left(\frac{0.8}{1.9}\right)$

$\theta = \sin\left(\frac{0.8}{1.9}\right) = 24.9°$

He needs to swim at $[N\ 28.9°\ E]$

(b) $\vec{V} = 1.72\ m/s\ [N]$

$\vec{V} = \frac{\vec{d}}{t} = \frac{120\ m}{t}$, so $t = \frac{120\ m}{1.72\ m/s} = 69.8\ s$