Days HW

Relative Velocity Part II: P 4, 6, 9 pg 48 S 6, 9 pg 49

1/4

4) $\Delta\vec{d}_{pG} = 450\text{ km [S]}$ Let p-plane, w-wind, g ground.

$\Delta t = 3.0\text{ h}$

$\vec{V}_{wG} = 500\text{ km/h [E]}$

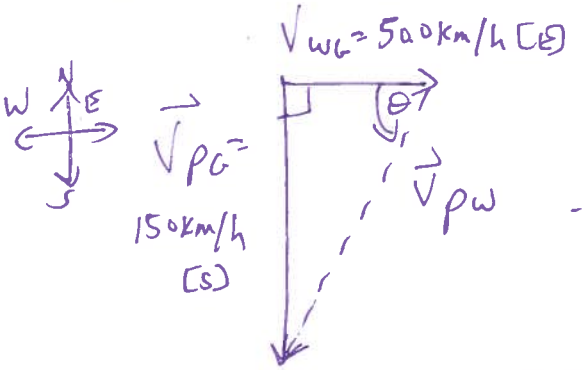
$\vec{V}_{pG} = ?$

$\vec{V}_{pw} = ?$

$$\vec{V}_{pG} = \frac{\Delta\vec{d}_{pG}}{\Delta t} = \frac{450\text{ km [S]}}{3.0\text{ h}} = 150.\text{ km/h [S]}$$

analysis: $\vec{V}_{pG} = \vec{V}_{pw} + \vec{V}_{wG}$

$$\vec{V}_{pw} = \vec{V}_{pG} - \vec{V}_{wG}$$



$$\therefore \vec{V}_{pw} = \sqrt{(150\text{ km/h})^2 + (500\text{ km/h})^2} = 158.1\text{ km/h}$$

$$\theta = \text{Tan}^{-1}\left(\frac{150.0}{50.0}\right) = 71.6^\circ$$

$$\therefore \boxed{\vec{V}_{pw} = 158\text{ km/h [W 72° S]}}$$

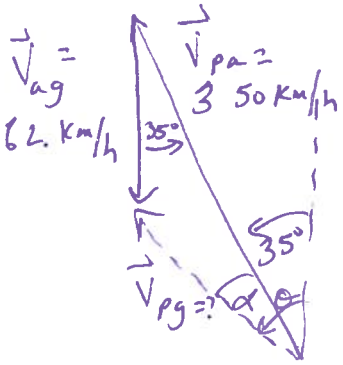
6) p-plane a-air g-ground

$\vec{V}_{pa} = 3.5\times10^2\text{ km/h [N35°W]}$

$\vec{V}_{ag} = 62.\text{ km/h [S]}$

$\vec{V}_{pg} = ?$

analysis: $\vec{V}_{pg} = \vec{V}_{pa} + \vec{V}_{ag}$



$$V_{pg} = \sqrt{62.^2 + 350^2 - 2(62.)(350)\cos 35^\circ}$$

$$= 301.3\text{ km/h}$$

b) $\Delta\vec{d}_{pG} = ?$ $\Delta t = 1.2\text{ h}$

$\Delta\vec{d}_{pG} = \vec{V}_{pG}\cdot\Delta t$

$= 361.6\text{ km [N42°W]}$

$\Delta d_{pG} = 3.6\times10^2\text{ km [N42°W]}$

$$\frac{\sin\alpha}{62} = \frac{\sin 35}{301.3} \rightarrow \alpha = \sin^{-1}\left(\frac{62\sin 35}{301.3}\right) = 6.78^\circ$$

$\therefore \theta = 35 + 6.78^\circ = 41.8^\circ \cong 42^\circ$

$$\therefore \boxed{\vec{V}_{pg} = 301\text{ km/h [N 42° W]}}$$

9) p-plane, a-air, g-ground

$\vec{V}_{pa} = 630\ km/h\ [N]$

$\Delta\vec{d}_{pg} = 750\ km\ [N]$

$\vec{V}_{ag} = 35.\ km/h\ [S]$ Let N = +

$\vec{V}_{pg} = ?$

analysis: $\vec{V}_{pg} = \vec{V}_{pa} + \vec{V}_{ag}$

$= 630\ km/h - 35.\ km/h$

$= 595\ km/h\ [N]$

$\Delta t = \dfrac{\Delta\vec{d}_{pg}}{\vec{V}_{pg}}$

$= \dfrac{750\ km\ [N]}{595\ km/h\ [N]}$

$= 1.26\ h$

$\simeq 1.3\ h$

b) $\vec{V}_{ag} = 35.\ km/h\ [N]$ $\vec{V}_{pg} = 630\ km/h + 35\ km/h$

$= 665\ km/h\ [N]$

$\Delta t = \dfrac{750\ km\ [N]}{665\ km/h\ [N]}$

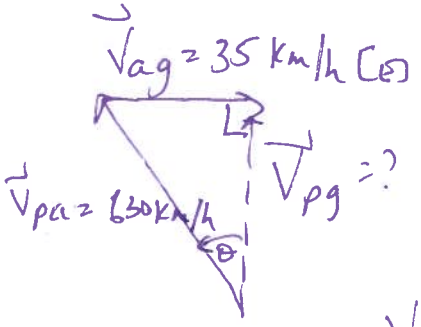
$= 1.13\ h$

$\simeq 1.1\ h$

c) $\vec{V}_{ag} = 35\ km/h\ [E]$

$\vec{V}_{pa} = 630\ km/h\ [?]$

$V_{pg} = ?\ [N]$



$\theta = \sin^{-1}\left(\dfrac{35}{630}\right) = 3.18°$

$V_{pg} = \sqrt{630^2 - 35^2} = 629.03\ km/h$

$\therefore \Delta t = \dfrac{\Delta\vec{d}_{pg}}{|\vec{V}_{pg}|} = \dfrac{750.\ km}{629.03\ km/h} = 1.19\ h$

$\simeq 1.2\ h$

$\therefore$ the pilot must head [N 3.2° W] to compensate for the easterly wind. The trip will take 1.2 h

S6 | pg 49

p-plane, w-wind, g-ground

$\Delta\vec{d}_{pg} = 220\,km\,[N]$

$\vec{V}_{wg} = 42\,km/h\,[N36°E]$

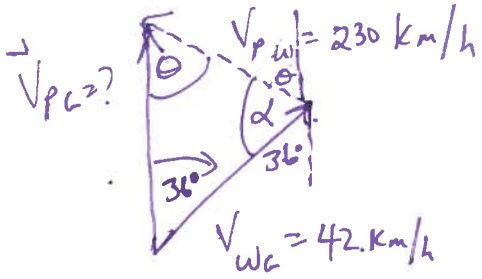
$\vec{V}_{pw} = 230\,km/h\,[?]$

$\vec{V}_{pg} = ?\,[N]$

$\Delta t = ?$

analysis: $\vec{V}_{pg} = \vec{V}_{pw} + \vec{V}_{wg}$

$\vec{V}_{pw} = \vec{V}_{pg} - \vec{V}_{wg}$



Solve for angle θ:

$$\frac{\sin\theta}{42} = \frac{\sin 36}{230}$$

$$\theta = \sin^{-1}\left(\frac{42 \cdot \sin 36}{230}\right)$$

$$= 6.16°$$

Solve for α:

$$\alpha = 180° - 36° - 6.16°$$

$$= 137.8°$$

a) ∴ the heading of the plane is [N 6.2° W].

* { Note that alternate angles (Z pattern) was used to find the heading  }

b) Solve for V_{pg} $\quad \frac{V_{pg}}{\sin\alpha} = \frac{V_{pw}}{\sin 36°}$

$$\therefore V_{pg} = \frac{(\sin 137.8°)(230\,km/h)}{(\sin 36°)}$$

$$= 262.6\,km/h$$

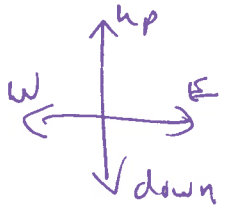
$$\therefore \Delta t = \frac{\Delta d_{pg}}{V_{pg}} = \frac{220\,km}{262.6\,km/h} = 0.838h \doteq 0.84\,hours$$

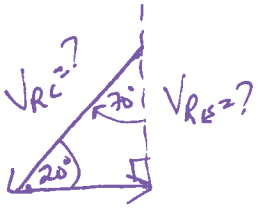
4. r-raindrops, c-car, E-Earth

$\vec{V}_{rE}$ = ? [down]

$\vec{V}_{rc}$ = ? [Down 70° West]

$\vec{V}_{cE}$ = 60.0 km/h [E]





V_{CE} = 60.0 km/h

analys: $\vec{V}_{rE} = \vec{V}_{rc} + \vec{V}_{cE}$

a) $\cos 20° = \frac{V_{cE}}{V_{RC}}$

$\therefore V_{RC} = \frac{V_{cE}}{\cos 20°} = \frac{60.0 km/h}{\cos 20°} = 63.85 km/h$

OR 17.7 m/s

$\therefore \vec{V}_{RC}$ = 17.7 m/s [Down 70.0° W]

b) $\tan 70° = \frac{V_{cE}}{V_{RE}}$

$V_{RE} = \frac{V_{cE}}{\tan 70°}$

$= \frac{60.0 km/h}{\tan 70°}$

$= 21.84 km/h$

OR 6.07 m/s

$\therefore \vec{V}_{RE}$ = 6.07 m/s [Down]