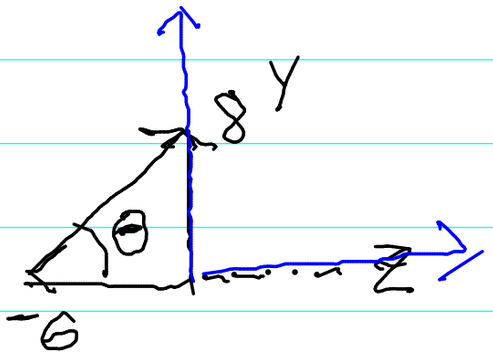
Chapter 4 5, 13, 18

5. a) $\vec{v} = \frac{d\vec{r}}{dt} = 2\hat{i} + (5+8t)\hat{j} + (-2-6t)\hat{k}$ (using Power Rule of Calc 1)

b) $\vec{a} = \frac{d\vec{v}}{dt} = 8\hat{j} - 6\hat{k}$

$|a| = \sqrt{8^2+6^2} = 10$

$\theta = \tan^{-1}\frac{8}{6} = 53^\circ$



13. $\vec{v} = \vec{v}_0 + \vec{a}t$ $\quad \vec{v}_0 = 0$ $\quad \vec{r}_0 = 0$

$\vec{v} = (3\hat{i} + 2\hat{j})t$

$\vec{r} = \vec{r}_0 + v_0 t + \frac{1}{2}at^2$

$\vec{r} = \frac{1}{2}(3\hat{i} + 2\hat{j})t^2$

18. when $v_y = 0$ $\quad y$ is max $\quad v_{oy} = 2$ $\quad a_y = -4$

$v_y = 0 = v_{oy} + at$ $\quad 0 = 2 - 4t$ $\quad t = .5\,s$

18 cont)

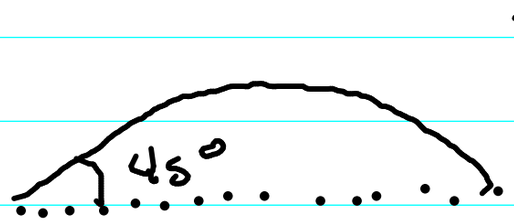
$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \tfrac{1}{2} a t^2$$

$$\vec{r} = 0 + (3\hat{i} + 2\hat{j})(.55) + \tfrac{1}{2}(\hat{i} - 4\hat{j})(.55)^2$$

$$= 1.5\hat{i} + \hat{j} + .125\hat{i} - .5\hat{j}$$

$$= 1.625\hat{i} + .5\hat{j}$$

22



$\Delta x = 1500\ m = v_{ox} t$ ①

$v_{ox} = v_0 \cos 45^\circ$

$\Delta y = 0 = v_{oy} t - \tfrac{1}{2} g t^2$ ②

$v_{oy} = v_0 \sin 45^\circ$

$\tan = \frac{\sin}{\cos}$

so ① $v_0 = \dfrac{1500\ m}{(\cos 45^\circ)t}$ stick in ②

② $0 = 1500\ m \tan 45^\circ - \tfrac{1}{2} g t^2$

$t = 17.5\ s$

plug t into ① $v_0 = 120\ m/s$

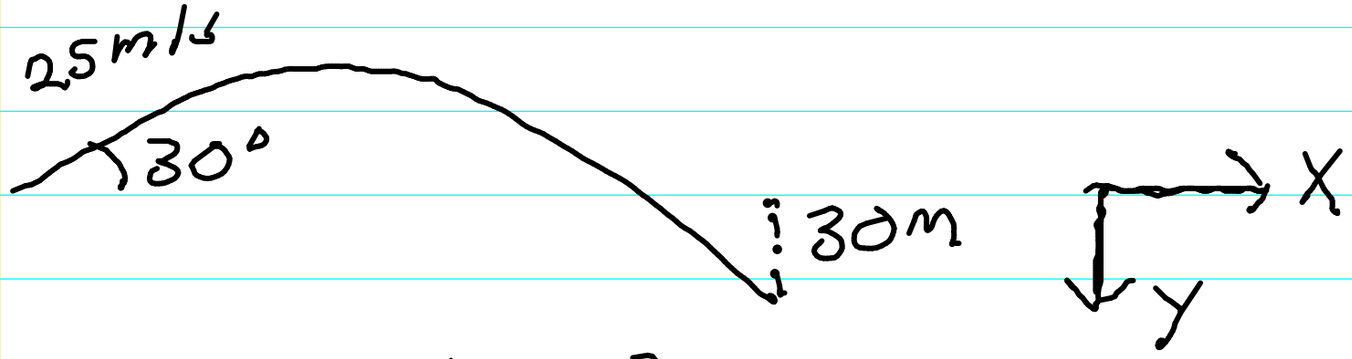
29) $x_{max} = y_{max}$

$$\frac{2v_0^2 \sin\theta\cos\theta}{g} = \frac{v_0^2 \sin^2\theta}{2g}$$

$$4\cos\theta = \sin\theta$$

$$\tan\theta = 4 \quad \text{so} \quad \theta = 76^\circ$$

36



$$\Delta y = v_{oy}t + \tfrac{1}{2}gt^2$$

$$30m = 25\,m/s \cos 30^\circ t + 4.9t^2$$

$$4.9t^2 + 21.6t - 30t = 0$$

$$t = \frac{-21.6 \pm \sqrt{(21.6)^2 + 4(30)(4.9)}}{9.8}$$

$$= 1.1\,s$$

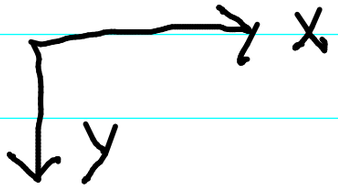
61) $a_c = \frac{v^2}{r}$ $\quad d = 2\pi r = 2\pi(6500\times10^3\,m) = 4.08\times10^7\,m$

$v = \frac{d}{t} = \frac{4.08\times10^7\,m}{87\,min\left(\frac{60\,s}{min}\right)} = 7820\,m/s$

So $a_c = \frac{(7820\,m/s)^2}{4.08\times10^7\,m} = 1.5\,m/s^2$

65 $a_c = \frac{v^2}{r} = \frac{(3\times10^8\,m/s)^2}{1000\,m} = 9\times10^{13}\,m/s^2$!

72. $\vec{V}_{RG} = \vec{V}_{RA} + \vec{V}_{AG}$



$V_{RGx} = V_{RAx} + V_{AGx}$ $\quad V_{AGx} = 30\,km/hr$

$V_{RGy} = V_{RAy} + V_{AGy}$ $\quad V_{RAy} = 10\,m/s$ →

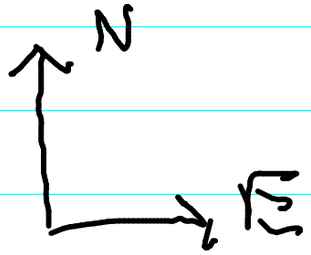
$$V_{RGx} = \frac{30\,km}{hr}\left(\frac{1000\,m}{km}\right)\left(\frac{1\,hr}{3600\,s}\right) = 8.3\,m/s$$

$V_{RGy} = 10\,m/s$ so $V_{RG} = \sqrt{10^2 + 8.3^2}$

$\simeq 13\,m/s$

$\theta = \tan^{-1}\frac{10\,m/s}{8.3\,m/s} = 50^\circ$

76)



$V_{SG} = V_{SA} + V_{AG}$

(like last problem)

$V_{AGx} = 30\,m/s \quad V_{AGy} = 0$

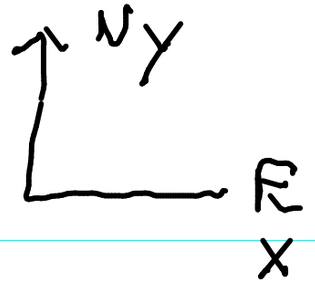
$V_{SAx} = 0\,m/s \quad V_{SAy} = 330\,m/s$

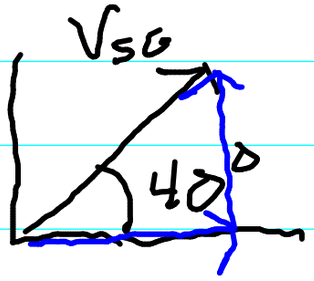
so speed $= |V| = \sqrt{V_{SGx}^2 + V_{SGy}^2}$

$= \sqrt{(330\,m/s)^2 + (30\,m/s)^2}$

$= 331\,m/s$

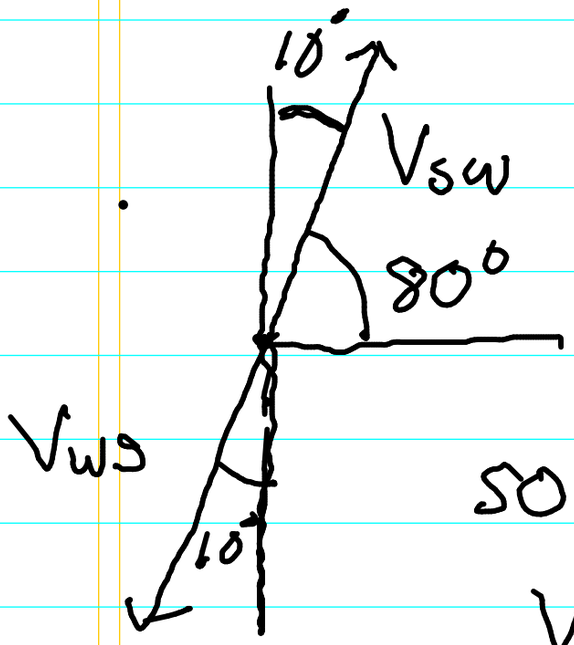
84) $\vec{V}_{SG} = \vec{V}_{SW} + \vec{V}_{WG}$





so $V_{SGx} = (14\,km/hr)\cos 40^\circ$

$V_{SGy} = (14\,km/hr)\sin 40^\circ$



$V_{SWx} = 32\,km/hr \cos 80^\circ$

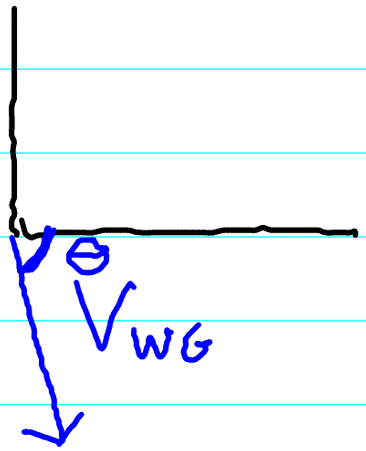
$V_{SWy} = 32\,km/hr \sin 80^\circ$

so $\vec{V}_{WG} = \vec{V}_{SG} - \vec{V}_{SW}$

$V_{WGx} = V_{SGx} - V_{SWx} = 5.2\,km/hr$

$V_{WGy} = V_{SGy} - V_{SWy} = -22.5\,\frac{km}{hr}$

so $V_{WG} = \sqrt{5.2^2 + 22.5^2} = 23\,km/hr$



$\tan\theta = \frac{-22.5}{5.2} = 77^\circ$

south of east

5-4) Same Force

$F = ma$ so $m_B a_B = m_G a_G$

$$m_G = \frac{m_B a_B}{a_G} = 43\,kg$$

13) $\bar{a} = \frac{30\,m/s}{.065} = 500\,m/s^2$

so $F = (.030)(500\,m/s^2) = 15\,N$

19) first .3 sec $\bar{a} = -63\,m/s^2$

last .3 sec $\bar{a} = -40\,m/s^2$

$F = ma$ $\quad m = \frac{100\,lbs}{2.2\,kg/lb} = 45.4\,kg$

on earth

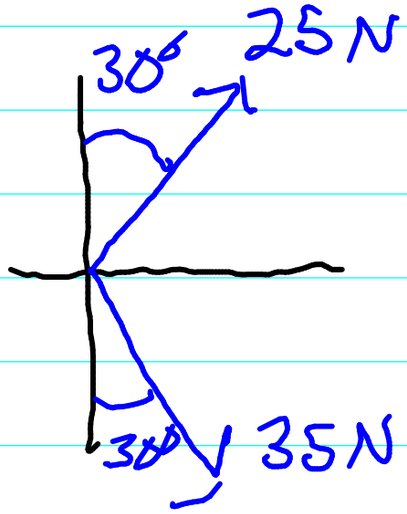
so $F_1 = -2.86 \times 10^3\,N$

$F_2 = -1.82 \times 10^3\,N$

22) $F_{Tot} = ma = 9360\,N$

Each **wheel** feels a fourth $= 2340\,N$

26.



$F_x = 25N\cos60° + 35N\cos60°$

$F_y = 25N\sin60° - 35N\sin60°$

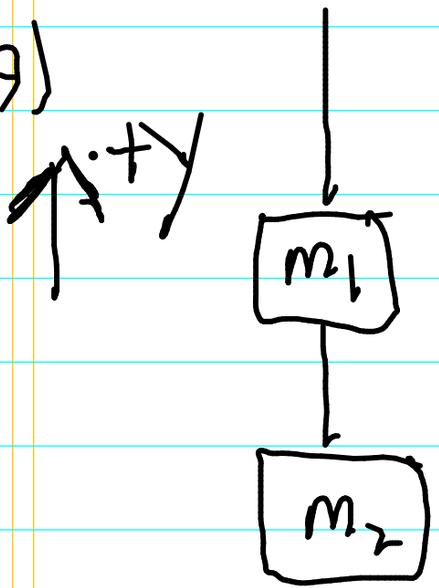
$F_x = 27.5N \quad F_y = -8.66\,N$

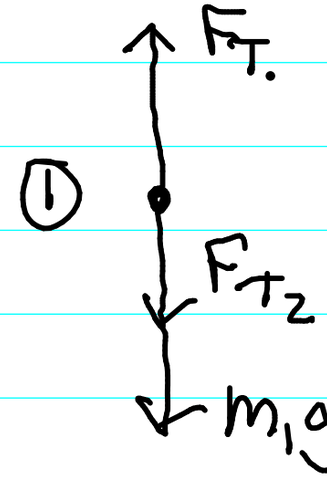
$|F| = 28.8\,N$

$\theta = \tan^{-1}\left(\frac{-8.66\,N}{27.5\,N}\right)$

$= 17.5°$

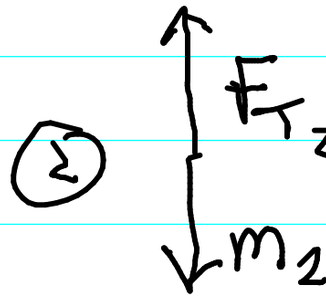
39)





$0 = F_{T_1} - F_{T_2} - m_1g$

$F_{T_1} = 127\,N$



$0 = F_{T_2} - m_2g$

$F_{T_2} = 29N$