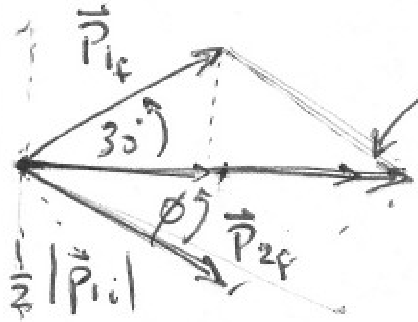
Exam 2

(9) momentum is conserved — (Energy is not necessarily conserved) {If $m_2 = 0.41 m_1$ then it is}



$|\vec{P}_{1f}| = \frac{1}{2}|\vec{P}_{1i}|$

$|P_{2f}| = (P_{2x}^2 + P_{2y}^2)^{1/2} = 0.62\, p_{1i}$

$P_{1y} = \frac{1}{2} P_{1i} \sin 30 = \frac{1}{4} P_{1i} = P_{2y}$

$\phi = \tan^{-1} \frac{\frac{1}{4}P_{1i}}{0.57 P_{1i}} = 24°$

$P_{2x} = P_{1i} - \frac{1}{2} P_{1i} \cos 30 = 0.57 p_{1i}$

$\cos 30 = \frac{\sqrt{3}}{2}$ so $P_{2x} = (1 - \frac{\sqrt{3}}{4}) P_{1i}$

units ✓

(10) Want to launch a 2kg object

$PE_{ground} = -\frac{GMm}{R_E}$ $PE_{space} = 0$ $(r = \infty)$ units ✓

$KE_{ground} = \frac{1}{2} m v_{esc}^2$ $KE_{space} = 0$

$E_i = E_f$ so $\frac{1}{2} m v_{esc}^2 - \frac{GMm}{R_E} = 0$

$$KE = \frac{GMm}{R_E} = \frac{(6.67\times10^{-11} Nm^2/kg^2)(6\times10^{24} kg)(2kg)}{6.4\times10^6 m}$$

$KE = 125$ MJ $(1.25\times10^8 J)$

Note: $v_{esc} = \left(\frac{2GM_E}{R_E}\right)^{1/2} = 1.1\times10^4 m/s$

... for all objects ...

(11) $m = 0.149\,kg$ $\quad \xrightarrow{+x}$

(a) $\longrightarrow$

$v = 40\,m/s \qquad V_f = 0$

Ball is stopped so $v_f = 0$ $\quad$ Impulse $= \Delta p = -5.96\ Ns$

$W = \Delta KE = KE_f - KE_i = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = -\frac{1}{2}(0.149\,kg)(40\,m/s)^2 = -119.2\,J$

$W = \int \vec{F} \cdot d\vec{x}$ (Assume force (average) acted along 2cm stopping distance

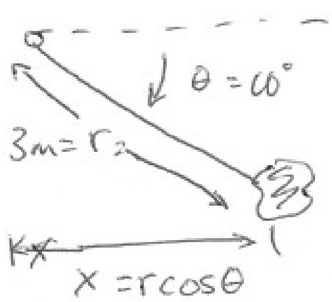
$W = F\Delta x \qquad F_{AVG} = \frac{W}{\Delta x} = \frac{-119.2\,J}{0.02\,m} = -5960\,N$

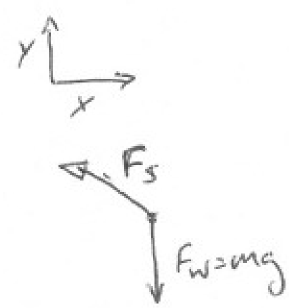
$\Delta \vec{p} = \int \vec{F} \cdot dt \qquad$ Impulse $= \int \vec{F}\,dt \qquad \frac{\Delta p}{F_{AVG}} = \Delta t = \frac{-5.96\,Ns}{-5960\,N} = 0.001\,s$

units ✓

Alt $v_f^2 - v_i^2 = 2ad$ ✓

(12)





$\sum \vec{F} = m\vec{a}$

$\sum F_y = 0 = F_s \sin\theta - F_w = 0$

$\sum F_x = m a_c = \frac{mv^2}{x}$

$F_s \cos\theta = \frac{mv^2}{x}$

$y: \; F_s = \frac{F_w}{\sin\theta} = \frac{mg}{\sin\theta}$

$x: \left(\frac{mg}{\sin\theta}\right)\cos\theta = \frac{mv^2}{x}$ $\quad$ so $\quad g(\tan\theta)^{-1} = \frac{v^2}{r\cos\theta}$ $\qquad$ units ✓

$\theta \uparrow \; v \downarrow$ ✓

$v = \left(g r \frac{\cos^2\theta}{\sin\theta}\right)^{1/2} = \left(\frac{gr}{\sin\theta}\right)^{1/2} \cos\theta$

$v = 12.8\,m/s$