UNIT 8

16) $\Delta \vec{p} = \langle \vec{F}_{net} \rangle \Delta t$

$$\langle \vec{F}_{net} \rangle = \frac{\Delta \vec{p}}{\Delta t} = m\,\frac{\left(v_f\hat{j} - [-v_0\cos\theta\,\hat{i} - v_0\sin\theta\,\hat{j}]\right)}{\Delta t}$$

$$= \frac{m}{\Delta t}\left(v_0\cos\theta\,\hat{i} + (v_f + v_0\sin\theta)\hat{j}\right)$$

$$|\langle F_{net} \rangle| = \frac{m}{\Delta t}\sqrt{(v_0\cos\theta)^2 + (v_f + v_0\sin\theta)^2}$$

$$= \frac{0.30\,kg}{20\times10^{-3}\,s}\sqrt{\left(12\tfrac{m}{s}\cos 35^\circ\right)^2 + \left(10\,m/s + 12\,m/s\sin 35^\circ\right)^2}$$

$$= 2.9\times10^3\,N$$

17) $J = \int_{t_1}^{t_2} F_{net}\,dt$

$= 25\,N \cdot 4\,s = 100\,N\cdot s.$

$J = \Delta p = m(v_f - \cancel{v_i}^{\,0})$

$v_f = J/m = 100\,N\cdot s / 10\,kg = 10\,m/s$

18) a) $\rho = m/V$ /2

$$m = V\rho = \frac{4\pi r^3}{3}\rho = \frac{4\pi}{3}(0.92\,g/cm^3)\left(\frac{0.\text{[illegible]}\,cm}{2}\right)^3 = 0.48\,g.$$

$= 4.8\times10^{-4}\,kg$

b) $$\underbrace{|\langle F_{net} \rangle| = \left|\frac{\Delta p}{\Delta t}\right|}_{1pt.} = \left|\frac{(10\times20)m^2 \times \frac{120}{m^2} \times m(\cancel{v_f}^{\,0} - v_i)}{1m \times s/25m}\right| \quad \left(\Delta t = \frac{d}{v}\right)$$

$$= \frac{10\cdot20\cdot120\cdot4.8\times10^{-4}\,kg \cdot -25\,m/s}{1/25\,s}$$ /2.

$= 7.2\times10^3\,N.$

0.5 pts for something.

1

(SP8-2) from the Logger Pro graph, it looks like the ship comes to a pause at around $t = 9s$ before resuming its landing.

Selected data range $t = 0 - 9\,s$

Therefore, $\vec{F}_{thrust}$ before & after 9s can differ. For the curve fit, we assumed that $\vec{a}$ is constant w/in each time range.

fitted to parabola:

$$y = 0.1015t^2 - 2.340t + 18.59 \quad (m)$$

data range: $t = 9 - 16s$.

$$y = 0.06441t^2 - 2.432t + 22.56 \quad (m)$$

- It appears that the data fits well to these 2 parabolas. We thus infer that $\vec{F}_{thrust}$ (& $\vec{a}$) was constant w/in each time range.

at $t=0$, from the 1st parabola:

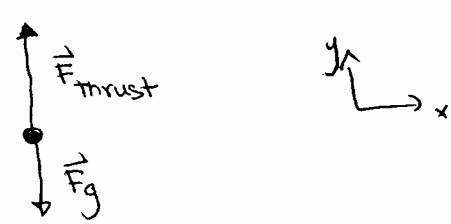
$$a = 2(0.1015) = 0.20\ m/s^2.$$

$$V_0 = -2.3\ m/s.$$

$$y_0 = \quad m.$$

b) $\vec{F}_g = \left(\frac{-9.8\,m/s^2}{5.8}\right)(4.5\times10^3\,kg)\hat{j} = -7.6\times10^3 N\,\hat{j}$ (down)

c)



d) $\vec{F}_{net} = m\vec{a} = \vec{F}_{thrust} + \vec{F}_g$

$$\vec{F}_{thrust} = m(a+g)\hat{j}$$

$t = 0 - 9s$: $\vec{F}_{thrust} = (4.5\times10^5 kg)\left(2(0.1015\,m/s^2) + \frac{9.8\,m/s^2}{5.8}\right)\hat{j} = 8.5\times10^5 N\hat{j}$

$t = 9 - 16s$: $\vec{F}_{thrust} = (4.5\times10^5\,kg)\left(2(0.06441\,m/s^2) + \frac{9.8\,m/s^2}{5.8}\right)\hat{j} = 8.2\times10^5 N\hat{j}$

thrust force is UPWARDS

(SP8-3)

a) $\vec{J} = \int_{t_1}^{t_2} \vec{F}_{net}\, dt = 12\ N\cdot s\ \hat{i}$

b) $\vec{J} = \Delta\vec{p}$

$= m(\vec{v}_f - \cancel{\vec{v}_i}^{\,0})$

$\vec{v}_f = \vec{J}/m = \dfrac{12\ N\cdot s\ \hat{i}}{2\,kg} = 6\ m/s\ \hat{i}$

c) $\vec{v}_f = \vec{J}/m + \vec{v}_i = 6\,m/s\,\hat{i} + (-1\,m/s)\,\hat{i} = 5\,m/s\ \hat{i}$

21) assume: spacecraft at rest, before detonation

$|\vec{J}| = 300\,N. = |\Delta\vec{p}| = |m\Delta\vec{v}| = |m(\vec{v}_f - \cancel{\vec{v}_i})|$

$|\vec{v}_f| = |\vec{J}|/m.$

since the 2 masses go in opp.. directions,

rel. speed $= |v_f|_1 + |v_f|_2$

$= |J|\left(\dfrac{1}{m_1} + \dfrac{1}{m_2}\right)$

$= 300\,N\cdot s\left(\dfrac{1}{1200\,kg} + \dfrac{1}{1800\,kg}\right)$

$= 0.42\,m/s.$

30) a) $m_1 = 1.20\,kg$ $m_2 = 1.80\,kg$.

$\Delta \vec{p} = 0$ (before bullet hits m_2 & after).

$m_b v_{b_i} = (m_2 + m_b) v_f$

$$v_{b_i} = \frac{m_b + m_2}{m_b} v_f$$

$$= \frac{3.5 \times 10^{-3} + 1.80\,kg}{3.5 \times 10^{-3}\,kg} (1.40\,m/s) = 721\,m/s.$$

b) $m_b v_{b_i} = m_b v_{b_f} + m_1 v_1$ (before bullet hits m_1 & after).

$$v_{b_i} = \frac{m_b v_{b_f} + m_1 v_1}{m_b} = \frac{(3.5 \times 10^{-3}\,kg)(721\,m/s) + (1.20\,kg)(0.630\,m/s)}{3.5 \times 10^{-3}\,kg}$$

$$= 937\,m/s.$$

SP8-1) SP8-2)
1/4 for very little
2/4 for something
4/4 for complete ans.