

1)

$$s = vt$$

$$t = \frac{1.5 \times 10^8 \text{ miles}}{2.998 \times 10^8 \text{ m/s}}$$

$$t = \frac{s}{v}$$

$$= \frac{1609.3 \text{ m}}{1 \text{ mile}} = 805.2 \text{ sec}$$

2)

a)

$$v = v_0 + at$$

$$a = \frac{v - v_0}{t} = \frac{-4 \text{ m/s} - 7 \text{ m/s}}{7.5} = -1.57 \text{ m/s}^2$$

b)

at top

$$v = v_0 + at$$

$$0 = v_0 + at_m$$

$$t_m = \frac{-v_0}{a} = \frac{-7 \text{ m/s}}{-1.57 \text{ m/s}^2}$$

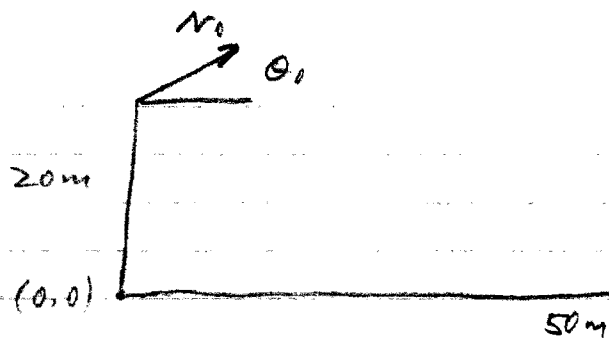
$$= 4.46 \text{ sec}$$

$$y = 0 + v_0 t_m + \frac{1}{2} at^2$$

$$= 7 \frac{\text{m}}{\text{s}} \cdot 4.46 \text{ sec} - \frac{1.57}{2} (4.46)^2$$

$$= 15.6 \text{ m}$$

3)



$$a = -g = -9.8 \text{ m/s}^2$$

a) $\theta_0 = 0$

$$v_0 \cos \theta_0 = v_0 ; v_0 \sin \theta_0 = 0$$

$$x = v_0 t = 50$$

$$y = 20 + \frac{1}{2} a t^2 = 0$$

$$t = \frac{50}{v_0}$$

$$20 = -\frac{1}{2} a t^2$$

$$40 = -a t^2 = 9.8 \cdot \left(\frac{50}{v_0} \right)^2 = \frac{2.45 \times 10^4}{v_0^2}$$

$$v_0^2 = \frac{2.45 \times 10^4}{40} = 6.125 \times 10^2$$

$$v_0 \approx 25 \text{ m/s}$$

b) $\theta_0 = 45^\circ$

$$v_0 \cos \theta_0 = \frac{v_0}{\sqrt{2}} ; v_0 \sin \theta_0 = \frac{v_0}{\sqrt{2}}$$

$$x = \frac{v_0}{\sqrt{2}} t = 50 \rightarrow t = \frac{50 \sqrt{2}}{v_0}$$

$$y = 20 + \frac{v_0}{\sqrt{2}} t + \frac{1}{2} a t^2 = 0$$

$$= 20 + 50 - \frac{1}{2} 9.8 \left(\frac{50 \sqrt{2}}{v_0} \right)^2 = 0$$

$$70 - \frac{2.45 \times 10^4}{v_0^2} = 0$$

$$70 = \frac{2.45 \times 10^4}{v_0^2}$$

$$v_0^2 = \frac{2.45 \times 10^4}{70}$$

$$v_0 = 18.7 \text{ m/s} \quad (t = 3.8 \text{ s})$$

c) $v_{x_0} = v_0 \cos \theta_0 = 13.2 \text{ m/s}$

$$\frac{d}{dt}(t^N) = N t^{N-1}$$

4)

$$m = 2.0 \text{ kg}$$

$$F = ma$$

$$A = 0.030 \frac{\text{m}}{\text{s}^{3/4}}$$

$$x(t) = A t^{3/4}$$

$$v(t) = \frac{dx}{dt} = \frac{3}{4} A t^{-1/4}$$

$$a(t) = \frac{dv}{dt} = -\frac{1}{4} \left(\frac{3}{4}\right) A t^{-5/4}$$

$$F = 2 \text{ kg} \cdot a(t) = -2 \cdot \frac{1}{4} \cdot \frac{3}{4} A t^{-5/4} \text{ N}$$

$$= -\frac{3}{8} A t^{-5/4} = -1.125 \times 10^{-2} t^{-5/4} \text{ N}$$

Check Dimensions $[a] = \frac{\text{m}}{\text{s}^{3/4}} \cdot \frac{1}{\text{s}^{5/4}} = \frac{\text{m}}{\text{s}^2} \text{ OK}$

5)

a)

$$F = ma$$

$$F_0 = ma$$

$$a_0 = F_0/m \quad ; \quad m = F/a$$

$$a_{2F} = 2F_0/m = 2a_0$$

$$a_{\text{con}} = 0.40 \text{ m/s}^2$$

$$a_{\text{box}} = 0.20 \text{ m/s}^2$$

b)

$$a = \frac{F}{m}$$

$$a_m = \frac{F}{m_m}$$

$$a_{T_0} = \frac{F_0}{F_0/15} = 0.067 \text{ m/s}^2$$

$$a_{2T} = \frac{2F_0}{F_0/15} = 0.133 \text{ m/s}^2$$

$$m_{\text{TP}} = m_{\text{con}} + m_{\text{box}}$$

$$m_c = \frac{F_0}{a_c}$$

$$m_b = \frac{F_0}{a_b}$$

$$m_{\text{TP}} = \frac{F_0}{a_c} + \frac{F_0}{a_b}$$

$$= F_0 \left(\frac{a_b + a_c}{a_b a_c} \right)$$

$$= F_0 \left(\frac{0.10 + 0.20}{0.10 \times 0.20} \right)$$

$$= F_0 \cdot 15$$

c)

$$F_0 = m_c a_c = m_b a_b$$

$$\frac{m_b}{m_c} = \frac{a_c}{a_b}$$

$$m_b = m_c \cdot \frac{a_c}{a_b}$$

$$= 4.39 \cdot \frac{0.2}{0.1} = 8.69$$