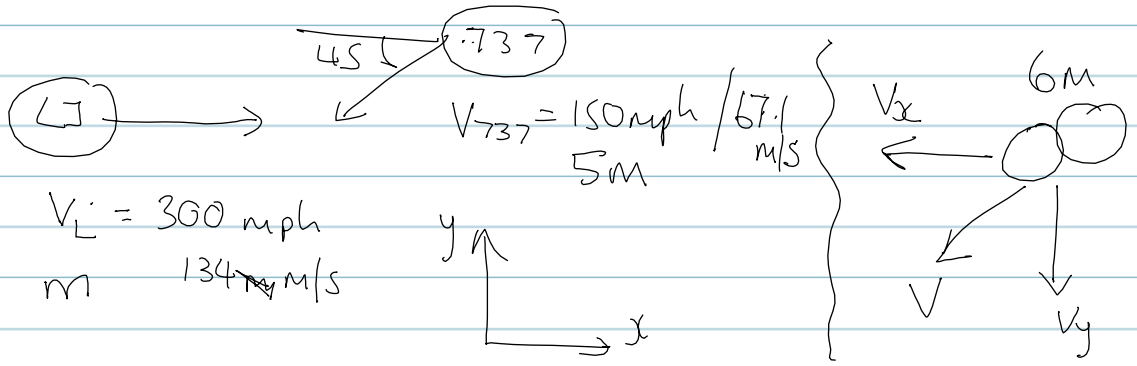
Momentum cons. tutorial problems

(1)

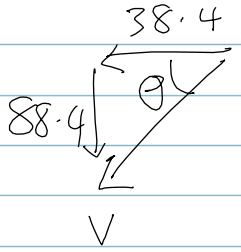


Conserve p_x $\quad 300m - \frac{750m}{\sqrt{2}} = 6mV_x$

Conserve p_y $\quad -\frac{750m}{\sqrt{2}} = 6mV_y$

$V_x = -38.4$ mph

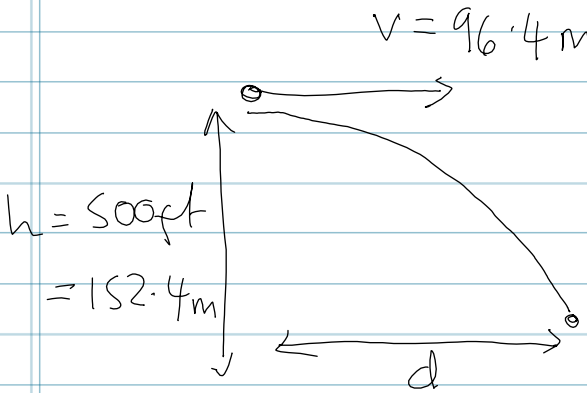
$V_y = -88.4$ mp.



$\theta = 66.6°$

$V = 96.4$ mph

$= 43.1$ m/s



$s = \frac{1}{2}gt^2 \rightarrow t = \sqrt{\frac{2s}{g}} = 5.58$s

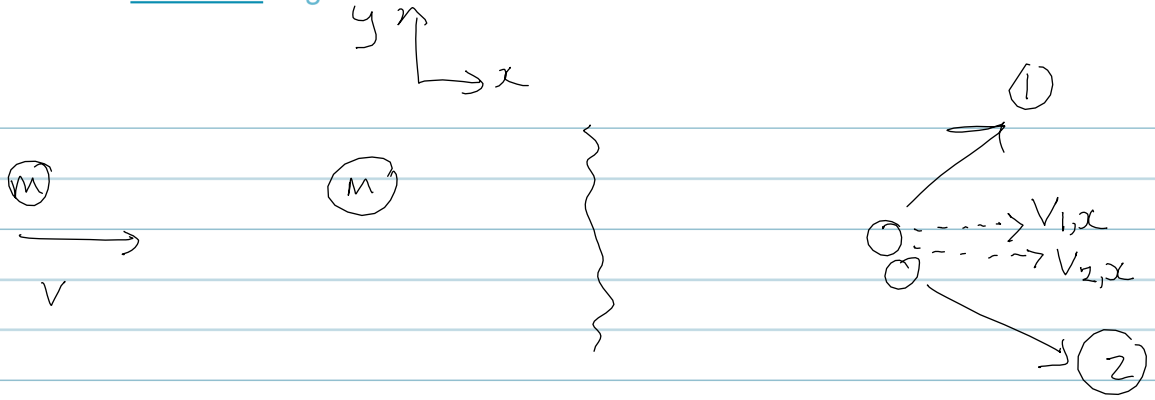
$d = 43.1 \times 5.58 = 240$m

b) Initial KE $= \frac{1}{2}mV_L^2 + \frac{1}{2}5m \times V_{737}^2 = 202.3$ MJ

Final KE $= \frac{1}{2} \times 6M \times V^2 = 55.7$ MJ

$\Delta KE = 146.6$ MJ

2



P_x $\quad mv = m\,0.1v + M V_{2x}$

$V_{2x} = 0.9v$

P_y $\quad 0 = m V_{1y} + M V_{2,y}$

$V_{1y} = -V_{2,y}$

Cons of Energy $\quad \frac{1}{2}mv^2 = \frac{1}{2}m\underbrace{(V_{1x}^2 + V_{1y}^2)}_{V_1^2} + \frac{1}{2}M\underbrace{(V_{2x}^2 + V_{2y}^2)}_{V_2^2}$

$\frac{1}{2}v^2 = (0.1v)^2 + V_{1y}^2 + (0.9v)^2 + V_{2y}^2$

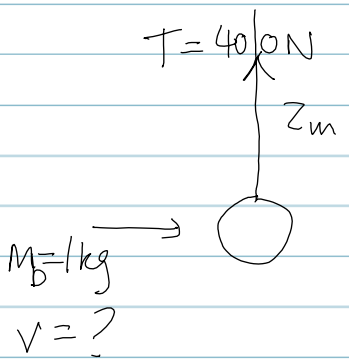
$v^2 - 0.01v^2 - 0.81v^2 = 2V_{2y}^2$

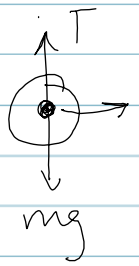
$0.18v^2 = 2V_{2y}^2$

$V_{2y} = 0.3v$

$V_{1y} = -0.3v$

3





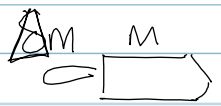
$$T - mg = \frac{m + m_b}{r} V_f^2$$

$$V_f = 4.3 \text{ m/s}$$

Conserve p $\quad m_b V = (m + m_b) V_f$

$$V = 21 V_f = 92 \text{ m/s}$$

4



Before combustion $\quad (m + \Delta m) V$

After $\quad m(V + \Delta v) + \Delta m (V - V_e)$

$(m + \Delta m) V = mV + m\Delta v + \Delta m V - \Delta m V_e$ $\quad$ Speed of rocket

$m \Delta v = \Delta m V_e$ $\quad$ Speed of ex. gas

$$\Delta v = \frac{\Delta m}{m} V_e$$

$$\int_{V_i}^{V_f} dV = \int_{m_i}^{m_f} -\frac{1}{m} dm \; V_e$$

$$V_f - V_i = \Delta V = \ln\left(\frac{m_i}{m_f}\right) V_e$$

$$\Delta V = V_e \ln\left(\frac{m_i}{m_f}\right) \qquad m_i = 743 kg$$

$m_f = 150 kg$ $\quad m_{fuel} = 593 kg$.