

## Midterm 71

1. Work : PE + KE =  $800 \frac{\text{kg}}{\text{min}} \times 9.80 \frac{\text{m}}{\text{s}^2} + 14.0 \text{ m} + 800 \frac{\text{kg}}{\text{min}} \times \frac{1}{2} (18.0 \frac{\text{m}}{\text{s}})^2$

$$\left[ \text{a) } = 109,760 \frac{\text{J}}{\text{min}} \right] + \left[ \text{b) } 129,600 \frac{\text{J}}{\text{min}} \right]$$

c) Power =  $\frac{\text{Work}}{\text{sec}} = \frac{\text{a) + b)}}{60 \frac{\text{sec}}{\text{min}}} = \left[ 3990 \text{ Watts} \right]$



at angle  $\theta$  :  $\frac{1}{2} m v^2 = \Delta PE = R(1 - \cos \theta) mg$

condition to leave :  $mg \cos \theta = \frac{m v^2}{R} = 2(1 - \cos \theta) mg$

$$\left[ \theta = \cos^{-1} \left( \frac{2}{3} \right) = 48.2^\circ \right]$$

3.  $P_{\text{initial}} = P_{\text{final}} \Rightarrow 24,000 \text{ kg} \times 4.0 \frac{\text{m}}{\text{s}} = (24,000 \text{ kg} + 3000 \text{ kg}) \cdot v \Rightarrow \left[ v = 3.56 \frac{\text{m}}{\text{s}} \right]$

4.  $v = 150 \text{ m/s}$   
 $v_{\text{up}} = 150 \frac{\text{m}}{\text{s}} \sin 55^\circ = 122.9 \frac{\text{m}}{\text{s}}$   
 $v_x = 150 \frac{\text{m}}{\text{s}} \cos 55^\circ = 86.0 \frac{\text{m}}{\text{s}}$

explosion conditions  
 and same landing time }  $\Rightarrow 9.0 \text{ kg has } v_x = -86 \frac{\text{m}}{\text{s}}$

$t_{\text{up}} - g t_{\text{up}} = 0 \Rightarrow t_{\text{up}} = \frac{122.9 \frac{\text{m}}{\text{s}}}{9.80 \frac{\text{m}}{\text{s}^2}} = 12.5 \text{ s}$

$P_x$  conserved:  $12.0 \text{ kg} (86.0 \frac{\text{m}}{\text{s}}) = 9.0 \text{ kg} (-86.0 \frac{\text{m}}{\text{s}}) + 3.0 \text{ kg } v_x'$

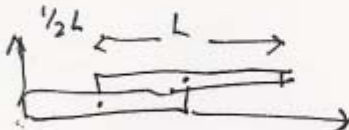
a)  $v_x' = 7v_x = 602 \frac{\text{m}}{\text{s}}$

b)  $E_{\text{exp}} = \frac{1}{2} 9.0 \text{ kg} (86.0 \frac{\text{m}}{\text{s}})^2 + \frac{1}{2} 3.0 \text{ kg} (602 \frac{\text{m}}{\text{s}})^2 - \frac{1}{2} 12.0 \text{ kg} (86.0 \frac{\text{m}}{\text{s}})^2$

$S = 86.0 \frac{\text{m}}{\text{s}} (12.5 \text{ s}) + 602 \frac{\text{m}}{\text{s}} (12.5 \text{ s})$   
 $= 8,628 \text{ m}$

$= 5.33 \times 10^5 \text{ J}$

5.  $\Delta z = 0 = 450 \text{ N} \times 2.0 \text{ m} - (80 \text{ N} + 9.80 \text{ M}) (0.7 \text{ m}) \Rightarrow M = 123.0 \text{ kg} (= 1206 \text{ N})$

6. a) 2 blocks  from left end  $2M x_{\text{cm}} = M \frac{L}{2} + ML$

$x_{\text{cm}} = \frac{3}{4} L$

overhang =  $\frac{3}{4} L$

b) 3 blocks  from left end:  $3M x_{\text{cm}} = M \frac{L}{2} + M \frac{L}{4} + M \frac{L}{6}$

$x_{\text{cm}} = \frac{5}{6} L$

overhang =  $\frac{L}{2} + \frac{L}{4} + \frac{L}{6} = \frac{11}{12} L$