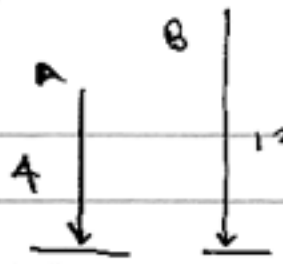
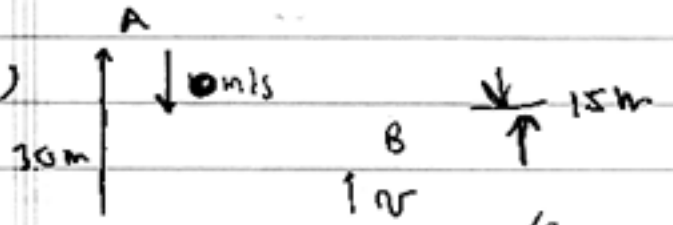
① 

$v_F^2 = 2gy$

$t = \frac{y}{\frac{1}{2}(v_I + v_F)} = \frac{2y}{0 + v_F} = \frac{2y}{\sqrt{2gy}} = \sqrt{\frac{2y}{g}}$

$t_A = \sqrt{\frac{2\times 4}{9.8}}\ s = 0.90\ s \qquad t_B = \sqrt{\frac{2\times 12}{9.8}}\ s = 1.56\ s$

$t_B - t_A = 0.66\ s$

② 

$y_{AF} = y_{AI} + v_{AI}t - \frac{1}{2}gt^2 = y_{BF} = y_{BI} + v_{BI}t - \frac{1}{2}gt^2$

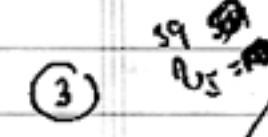
$y_{AI} + v_{AI}t = y_{BI} + vt$

$v = \frac{y_{AI} - y_{BI} + v_{AI}t}{t}$

$y_{AF} - y_{AI} = -15 = -\frac{1}{2}gt^2$

$t = \sqrt{30/g} = 1.75\ s$

$v = \frac{30 - 0}{1.75}\ m/s = 17.1\ m/s$

③ 

$y_F - y_I = v_{Iy}t - \frac{1}{2}gt^2$

$= 39\sin 60 \times 3 - \frac{1}{2} \times 9.8 \times 3^2\ m$

$= 101.3 - 44.1\ m$

$= 57.2\ m$

$y_F - y_I = v_{Iy}t - \frac{1}{2}gt^2$

$= 39\sin 60 \times 3 - \frac{1}{2} \times 9.8 \times (3)^2 = 57\ m$

(4)

$x_{AF} = x_{BF}$

$x_{AI} + \frac{1}{2} a_A t^2 = x_{BI} + v_{BI} t + \frac{1}{2} a_B t^2$

$x_{BI} - x_{AI} = \frac{1}{2} a_A t^2 - v_{BI} t = \frac{1}{2} \times 5 \times (6)^2 - (-40) \times 6$

$= 90 + 240\ m = \boxed{330\ m}$

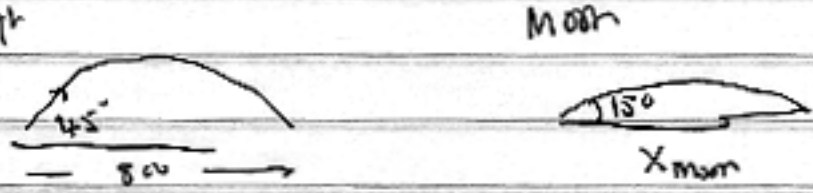
(5)

1st part $x_F - x_I = 0 + \frac{1}{2} 5 (5)^2 = 62.5\ m$ $\quad v_F = 5 \times 5 = 25\ m/s$

2nd part $x_F - x_I = \bar{v} t = (5 \times 5) \times 5\ m = 125\ m$

$x_{TOTAL} = 62.5 + 125 = \boxed{187.5\ m}$

(6)



$\frac{x_{moon}}{x_{Earth}} = \frac{v^2_{Earth\ moon}}{v^2_{Earth}} \times \frac{\sin 2\theta_{moon}}{\sin 2\theta_{Earth}} \times \frac{g_{Earth}}{g_{moon}}$

$\frac{x_{moon}}{800} = \frac{1}{1} \times \frac{\sin 30}{\sin 90} \times 6 = 3$

$\boxed{x_{moon} = 2400\ m}$

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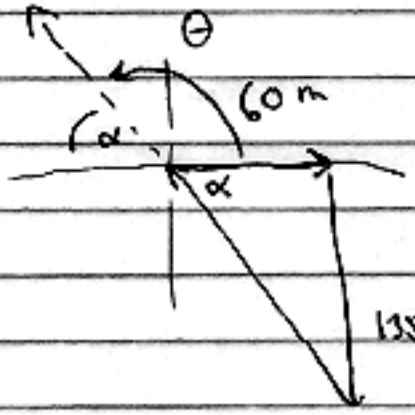
(9)



$\tan\alpha = \frac{135}{60} = 2.25 \Rightarrow \alpha = 66^\circ$

$\theta = 180^\circ - \alpha = 180^\circ - 66^\circ = \boxed{114^\circ}$

(8) $v_F^2 - v_I^2 = 2ax$

$a = -\frac{v_I^2}{2x} = \frac{-(40)^2 \frac{m}{s^2}}{2\times 100} = -8\ m/s^2$

$F = M|a| = 2\times10^3 \times 8\ N = \boxed{1.6\times10^4\ N}$