PHY 2048
Test I – 13 Feb 2017

Solutions
— V. II —

(1) (a) $V_0 = 90.0$ m/s, $\theta = 60°$ $\Rightarrow V_{0y} = V_0 \sin\theta = 77.94$ m/s

At highest pt., $V_y = 0 \Rightarrow -V_{0y}^2 = -2gh \Rightarrow h = V_{0y}^2/2g$

$\rightarrow$ **$h = 310$ m**

(b) Since $\Delta y = 0$, d is given by the range formula.

$\rightarrow$ **$d = V_0^2 \sin(2\theta)/g = 716$ m**

$\Delta y = 0$ at pt B $\Rightarrow$ **$V_B = V_0 = 90.0$ m/s**

(c) $\Delta x = d + D = 915.8$ m and $\Delta x = V_{0x} t_{air}$

$V_{0x} = V_0 \cos\theta = 45.0$ m/s $\rightarrow$ **$t_{air} = 20.4$ s**

(d) $V_{Fx} = V_{0x} = 45.0$ m/s, $V_{Fy} = V_{0y} - g t_{air} = -121.5$ m/s

$\rightarrow$ **$V_F = (V_{Fx}^2 + V_{Fy}^2)^{1/2} = 130$ m/s**

$\tan\theta_F = \dfrac{V_{Fy}}{V_{Fx}} = -2.70 \rightarrow$ **$\theta_F = 69.7°$ below horiz.**

(2) (a) $f = 5.0$ rev/sec $\rightarrow$ **$T = 1/f = 0.200$ s**

(b) $r = 0.600$ m $\rightarrow T = 2\pi r/v \Rightarrow$ **$v = 2\pi r/T = 18.8$ m/s**

(c) centripetal acceleration $\rightarrow a_c = v^2/r = 592.2$ m/s$^2$

$m = 0.350$ kg $\rightarrow$ **$T = ma_c = 207$ N**

(d) double tension $\rightarrow$ double $a_c$

$$a_c = \frac{v^2}{r} = \frac{1}{r}\left(\frac{2\pi r}{T}\right)^2 = \frac{4\pi^2}{T^2} r$$

$\rightarrow$ same $T \Rightarrow$ **r must double**

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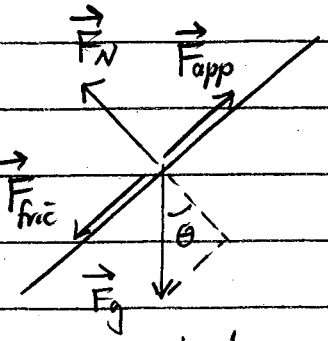
— V. II, p. 2 —

(3)(a) 1/1




$m = 4.00$ kg and $\theta = 53.1°$

$F_N = F_g \cos\theta = mg\cos\theta$

$\rightarrow \boxed{F_N = 23.5\ N}$

(b) 1/1 Forces balance if no motion $\Rightarrow F_s = F_{app} - F_g \sin\theta$

$F_{app} = 38.0\ N \rightarrow \boxed{F_s = 6.65\ N}$

(c) 1/1 $F_s^{max} = \mu_s F_N = 9.415\ N \rightarrow F_{app}^{max} = F_s^{max} + F_g \sin\theta$

$\rightarrow \boxed{F_{app}^{max} = 40.8\ N}$

(d) 1/1 Now $ma = F'_{app} - F_K - F_g \sin\theta$

$F'_{app} = 50.0\ N$ and $F_K = \mu_K F_N = 5.884\ N \Rightarrow ma = 12.77\ N$

$\rightarrow \boxed{a = 3.19\ m/s^2}$

(4)(a) 6/ Choose downward as positive direction

$d_1 = 150\ m \rightarrow d_1 = \frac{1}{2} g t_1^2 \Rightarrow \boxed{t_1 = \sqrt{2d_1/g} = 5.53\ s}$

$\rightarrow \boxed{v_1 = g t_1 = 54.2\ m/s}$

(b) 5/ Now $a_2 = -8.25\ m/s^2$ and $v_2 = 7.00\ m/s$

$\rightarrow \Delta v = v_2 - v_1 = -47.22\ m/s \rightarrow \boxed{t_2 = \Delta v / a_2 = 5.72\ s}$

(c) 4/ $d_2 = v_1 t_2 + \frac{1}{2} a_2 t_2^2 \rightarrow \boxed{d_2 = 175\ m}$

(d) 5/ $t_{tot} = 75.0\ s \Rightarrow t_3 = t_{total} - t_1 - t_2 = 63.74\ s$

$\rightarrow d_3 = v_2 t_3 = 446.2\ m \rightarrow \boxed{h = d_1 + d_2 + d_3 = 771\ m}$