PHY 2048 — Solutions —

Test I – 1 June 2016 V. I

(1) (a) Height of incline → $h = L\sin\theta$

6/ $L = 5.0$ m, $\theta = 45°$ ⇒ $h = 3.54$ m

Energy conserv → $E_A = E_{top}$ ⇒ $\frac{1}{2}mv^2 = mgh$

⇒ $\boxed{v = \sqrt{2gh} = 8.32 \text{ m/s}}$

5/ (b) $E_B = 0$ ⇒ $W_{fric} = E_A = \frac{1}{2}mv^2$ ⇒ $\boxed{W_{fric} = 1390 \text{ J}}$

(c) $F_K = W_{fric}/d = 115$ N for $d = 12.0$ m

9/ $F_N = Mg = 392$ N for $M = 40.0$ kg

⇒ $\boxed{\mu_K = F_K/F_N = 0.29}$

(2) (a) $V_0 = 120.0$ m/s and $\theta_0 = 36.9°$

6/ ⇒ $V_{0x} = V_0\cos\theta_0 = 96.0$ m/s, $V_{0y} = V_0\sin\theta_0 = 72.0$ m/s

At highest pt, $V_y = 0$ ⇒ $-2gh = -V_{0y}^2$

⇒ $\boxed{h = V_{0y}^2/2g = 265 \text{ m}}$

4/ (b) $x = V_{0x}t_{air}$ ⇒ $\boxed{t_{air} = x/V_{0x} = 8.86 \text{ sec}}$ for $x = 850$ m/s

(c) $V_y = V_{0y} - gt_{air} = -14.8$ m/s and $V_x = V_{0x} = 96.0$ m/s

6/ ⇒ $\boxed{V_F = (V_x^2 + V_y^2)^{1/2} = 97.1 \text{ m/s}}$

and $\tan\theta_F = V_y/V_x = -0.154$ → $\boxed{|\theta_F| = 8.7°}$

(d) $H = V_{0y}t_{air} - \frac{1}{2}gt_{air}^2$ → $\boxed{H = 254 \text{ m}}$

4 Alternatively, $H = x\tan\theta_0 - gx^2/2V_{0x}^2$ → same result

(3) (a) $a = -g$ and $v = 0$ at the highest point

8/

$\Rightarrow -2gh = -v_0^2 \Rightarrow \boxed{h = v_0^2/2g = 29.4\ m}$ for $v_0 = 24.0\ m/s$

Also, $0 = v_0 - g t_{up} \Rightarrow \boxed{t_{up} = v_0/g = 2.45\ s}$

(b) During descent, $v_0 = 0$ and $\Delta y = -h$

7/

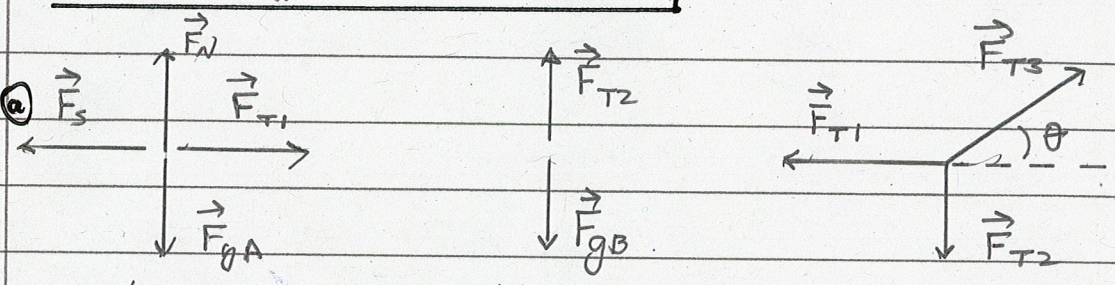
$\Rightarrow -h = \frac{1}{2} a t_{down}^2 \Rightarrow a = -2h/t_{down}^2$

$t_{total} = 7.50\ sec \Rightarrow t_{down} = t_{total} - t_{up} = 5.05\ s \Rightarrow \boxed{a = -2.30\ m/s^2}$

5/ (c) $\boxed{v_F = a t_{down} = -11.6\ m/s}$

(4) (a)

5/



block A block B

(b) block B $\rightarrow F_{T2} = F_{gB} = m_B g$

8/

point P $\rightarrow F_{T2} = F_{T3} \sin\theta \Rightarrow F_{T3} = F_{T2}/\sin\theta$

and $F_{T1} = F_{T3}\cos\theta = F_{T2}/\tan\theta$

$m_B = 25\ kg \Rightarrow \boxed{F_{T2} = 245\ N,\ F_{T3} = 306\ N,\ F_{T1} = 184\ N}$

5/ (c) block A $\rightarrow \boxed{F_s = F_{T1} = 184\ N}$

(d) $F_s = F_s^{max} = \mu_s F_N$ and $F_N = m_A g \Rightarrow \mu_s = F_s/m_A g$

4/

$m_A = 150\ kg \Rightarrow \boxed{\mu_s = 0.125}$