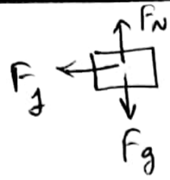
Q1.



$F_g = mg = F_N$

$F_f = \mu F_N = \mu mg$

Work kinetic energy theorem

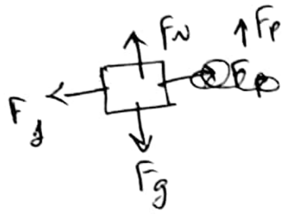
$W = \Delta KE$

$-F_f d = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$; $v_f = 0$

$-0.15 \times 0.16 \times 10 \times 20 = 0 - \frac{1}{2} \times 0.16\, v_i^2$

$\Rightarrow -\frac{24}{5} = -0.08\, v_i^2 \Rightarrow v_i = 7.75 \text{ m/s}$

Q2



$F_g = mg = F_N = F_p$

$F_f = \mu N = \mu F_p$

Work kinetic energy theorem.

$W = \Delta KE$

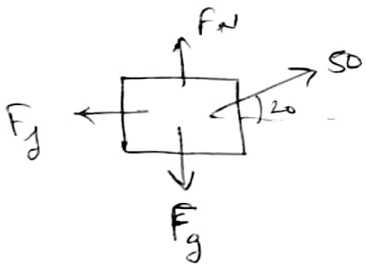
$F_f d = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

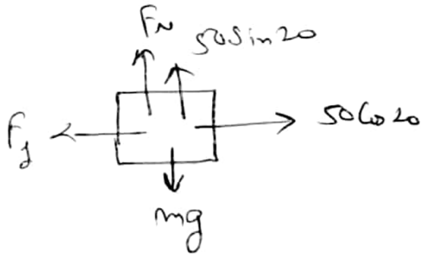
$\frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 = \mu F_p d$

$0.2 \times F_p \times 3 = \frac{1}{2}\, 12 \times 2^2 - \frac{1}{2} \times 12 \times 1^2$

$\Rightarrow 0.2 \times F_p \times 3 = 18 \Rightarrow F_p = 30N$

Q3





$\Sigma F_y = 0 \Rightarrow mg = F_N + 50 \sin 20$

$F_N = (8 \times 10) - (50 \sin 20^\circ) = 62.9N$

$\Sigma F_x \quad F_{Net} = 50 \cos 20^\circ - F_f = 50 \cos 20^\circ - \mu F_N$

$= [46.98 - \mu\, 62.9]\ N$

By Work Kinetic energy theorem.

$W = \Delta KE$

$F_{Net} \cdot d = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$\Rightarrow [46.98 - \mu 62.9] \times 3.4 = \frac{1}{2} 8 \times (1.8)^2 - \frac{1}{2} \times 8 \times (1.2)^2$

$\Rightarrow [46.98 - \mu 62.9]\, 3.4 = 7.2$

$\Rightarrow \mu = 0.71$

Q4. $E_i = E_f$

$\Rightarrow PE_i + KE_i = KE_f + PE_f$

$\Rightarrow \cancel{m} g h_i + \frac{1}{2} \cancel{m} v_i^2 = \frac{1}{2} \cancel{m} v_f^2 + \cancel{m} g h_f$

~~Ball hit the ground~~ $\Rightarrow g h_i + \frac{1}{2} v_i^2 = \frac{v_f^2}{2} + g h_f$

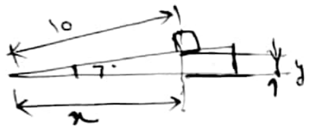
$h_f = 0$; Ball hit the ground

$v_i = 3\,m/s$; $v_f = 16\,m/s$; $h_i = ?$ = height of the building.

$\Rightarrow 10 h_i + \frac{(3)^2}{2} = \frac{(16)^2}{2} + 0$

$10 h_i = 123.5 \Rightarrow h_i = 12.35\,m.$

Q5. a)



$\frac{y}{10} = \sin 7^\circ \Rightarrow y = 1.22\,m.$

$\Rightarrow E_i = E_f$

$\Rightarrow PE_i + KE_i = PE_f + KE_f$

$\Rightarrow m g h_i + \frac{1}{2} m v_i^2 = m g h_f + \frac{1}{2} m v_f^2$

~~$\Rightarrow g h_i + \frac{v_i^2}{2}$~~ $\Rightarrow g h_i + \frac{v_i^2}{2} = g h_f + \frac{v_f^2}{2}$ — (1)

$h_i = y = 1.22$; $v_i = 0$ (released from rest)

$h_f = 0$; $v_f = ?$ = final velocity.

$(10 \times 1.22) + 0 = 0 + \frac{v_f^2}{2} \Rightarrow v_f = 4.94\,m/s$

b) We are given $v_i = 0.2\,m/s$; $v_f = 1.5\,m/s$; $h_f = 0$; h_i = distance along ramp vertically

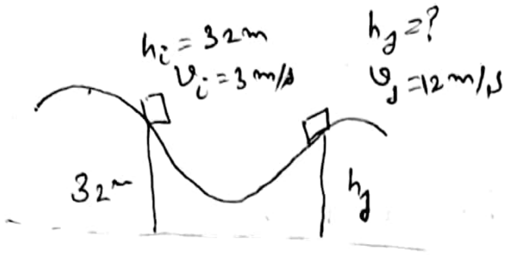
$10 h_i + \frac{(0.2)^2}{2} = 0 + \frac{(1.5)^2}{2} \Rightarrow 10 h_i = \frac{221}{200}$

$\Rightarrow h_i = y = 0.1105$

From triangle $\frac{0.1105}{ramp} = \sin 7^\circ \Rightarrow$ Distance along ramp $= \frac{0.1105}{\sin 7^\circ} = 0.90\,m$

~~300~~ ~~300.0~~

Q6.



By Conservation of energy $E_i = E_f$

$$PE_i + KE_i = PE_f + KE_f$$

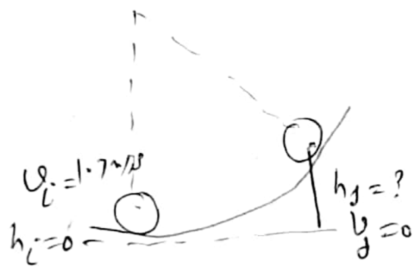
$$mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$$

$$gh_i + \frac{v_i^2}{2} = gh_f + \frac{v_f^2}{2}$$

$$(10 \times 32) + \frac{(3)^2}{2} = 10h_f + \frac{(12)^2}{2}$$

$$10h_f = \frac{505}{2} \Rightarrow h_f = 25.25\,m.$$

Q7.



By Conservation of energy $E_i = E_f$

$$PE_i + KE_i = PE_f + KE_f$$

$$mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$$

$$gh_i + \frac{v_i^2}{2} = gh_f + \frac{v_f^2}{2}$$

$$0 + \frac{(1.7)^2}{2} = 10h_f + 0$$

$$\Rightarrow h_f = 0.14\,m.$$