

Prob 1 $t=0$ $L=250$ $V_B=55 \text{ km/h}$ $a_A=.3 \text{ m/s}^2$

$$V_{A,0} = 55 \text{ km/h} = 15.278 \text{ m/s}$$

$$V_B = 55 \text{ km/h} \cdot \frac{1000 \text{ m}}{1 \text{ km}} \cdot \frac{1 \text{ h}}{3600 \text{ s}} = 15.278 \text{ m/s}$$

$$X_A = 0 + 15.278 \text{ m/s} t + \frac{1}{2} (.3 \text{ m/s}^2) t^2$$

$$X_A = 15.278 t + .15 t^2$$

$$X_B = 250 + 15.278 t$$

$$\text{Q1. } X_A = X_B \quad 15.278 t + .15 t^2 = 250 + 15.278 t$$

$$.15 t^2 + 0 t - 250 = 0$$

$$t_{1,2} = \frac{- (0) \pm \sqrt{0^2 - 4 (.15) (-250)}}{2 \cdot .15} = \boxed{t_1 = 40.8248}$$

$$t_2 = -40.8248$$

$$\text{Q2. } X_B = 250 \text{ m} + (15.278 \text{ m/s} \cdot 40.8248 \text{ s}) = \boxed{873.72 \text{ m}}$$

$$\text{Q3. } V_A = 15.278 \text{ m/s} + (.3 \text{ m/s}^2 \cdot 40.8248 \text{ s}) = 27.52544 \text{ m/s}$$

$$27.52544 \text{ m/s} \cdot \frac{1 \text{ km}}{1000 \text{ m}} \cdot \frac{3600 \text{ s}}{1 \text{ hr}} = \boxed{99.09 \text{ km/h}}$$

Prob 2 $V_0 = 300 \text{ m/s}$ $\alpha = 60^\circ$ $h = 1500 \text{ m}$

$$V_{x,0} = V_0 \cos \alpha = 300 \cos 60 = 150 \text{ m/s}$$

$$V_{y,0} = V_0 \sin \alpha = 300 \sin 60 = 259.808 \text{ m/s}$$

$$\text{Q4. } X = X_0 + V_{x,0} t \quad X_0 = 0 \quad t = 6.59451 \text{ s}$$

$$V_{x,0} = 150 \text{ m/s}$$

$$X = 0 + (150 \text{ m/s} \cdot 6.59 \text{ s}) = \boxed{989.1765 \text{ m}}$$

$$Q5. y = y_0 + v_{y0} t + \frac{1}{2} a t^2$$

$$y_0 = 0 \quad a = -g = -9.8 \text{ m/s}^2$$

$$1500 = 0 + 259.808 t + \frac{1}{2} (-9.81) t^2$$

$$v_{y0} = 259.808 \text{ m/s}$$

$$y = 1500 \text{ m}$$

$$-4.905 t^2 + 259.808 t - 1500 = 0$$

$$t_1, t_2 = \frac{-(259.808) \pm \sqrt{(259.808)^2 - 4(-4.905)(-1500)}}{2(-4.905)}$$

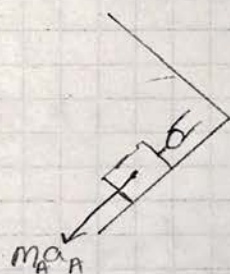
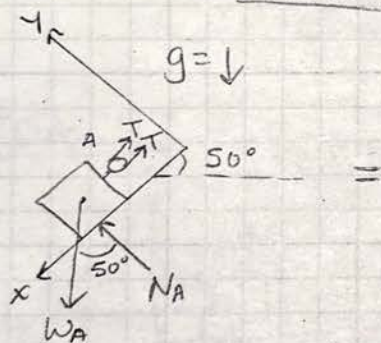
$$t_1 = \boxed{6.59451 \text{ s}}$$

$$t_2 = 46.3735 \text{ s}$$

Prob 3

FBD of A

$$W_A = 600 \text{ lb}$$



$$\sum F_y: -W_A \cos 50 + N_A = 0$$

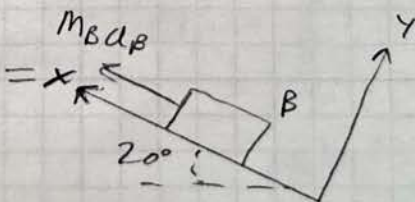
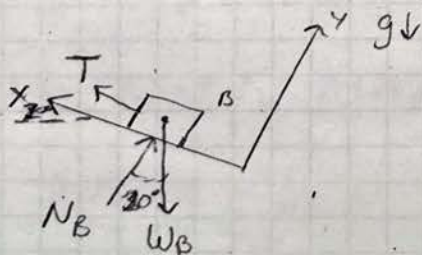
$$\sum F_x: W_A \sin 50 - T = m_A a_A$$

$$600 \sin 50 - T = \frac{600}{32.2} a_A$$

$$18.63 a_A + T = 459.62$$

FBD of B

$$W_B = 150 \text{ lb}$$



$$\sum F_y: -W_B \cos 20 + N_B = 0$$

$$\sum F_x: -W_B \sin 20 + T = m_B a_B$$

$$-150 \sin 20 + T = \frac{150}{32.2} a_B$$

$$Q6. t - 4.658 a_B = 51.303 \quad 2a_A = a_B$$

$$(t - 9.3167 a_A = 51.303) \times 2$$

$$2t - 18.633 a_A = 102.606$$

$$-(2t + 18.63 a_A = 459.62)$$

$$0 - 37.267 a_A = -357.014$$

$$a_A = 9.58 \text{ ft/s}^2$$

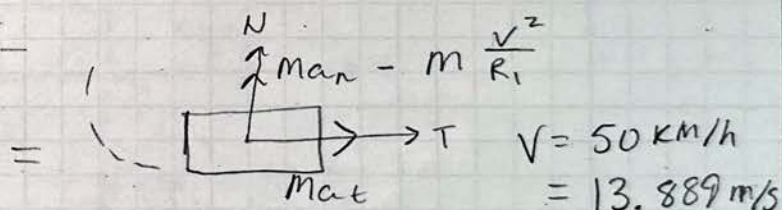
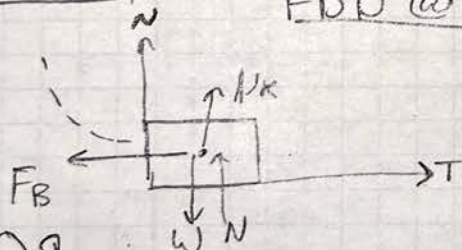
$$Q7. a_B = 2a_A = 2 \cdot 9.58 \text{ ft/s}^2 = 19.16 \text{ m/s}^2$$

$$Q8. t - 4.658 (19.16) = 51.303$$

$$t = 140.55 \text{ lb}$$

Prob 4

FBD @ A



$$v = 50 \text{ km/h} = 13.889 \text{ m/s}$$

Q9.

$$t: -F_B = m a_t$$

$$F_B = \mu_k N$$

$$N: N - W = m a_n$$

$$a_n = \frac{v^2}{R_1}$$

$$m a_t = -\mu_k N$$

$$|a| = \sqrt{a_t^2 + a_n^2}$$

$$m a_t = -\mu_k (W + m a_n)$$

$$|a| = \sqrt{\left(-\mu_k \left(g + \frac{v^2}{R_1}\right)\right)^2 + \left(\frac{v^2}{R_1}\right)^2}$$

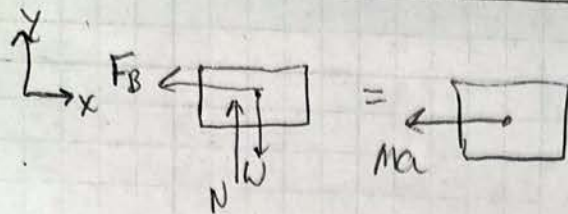
$$m a_t = -\mu_k \left(mg + m \frac{v^2}{R_1}\right)$$

$$|a| = \sqrt{\left(-0.2 \left(-9.81 + \frac{50^2}{20}\right)\right)^2 + \left(\frac{50^2}{20}\right)^2}$$

$$a_t = -\mu_k \left(g + \frac{v^2}{R_1}\right)$$

$$= 9.645 \text{ m/s}^2$$

Q10. FBD Between A + B



$$x: -F_B = -ma$$

$$F_B = \mu_k \cdot N$$

$$y: N - W = 0$$

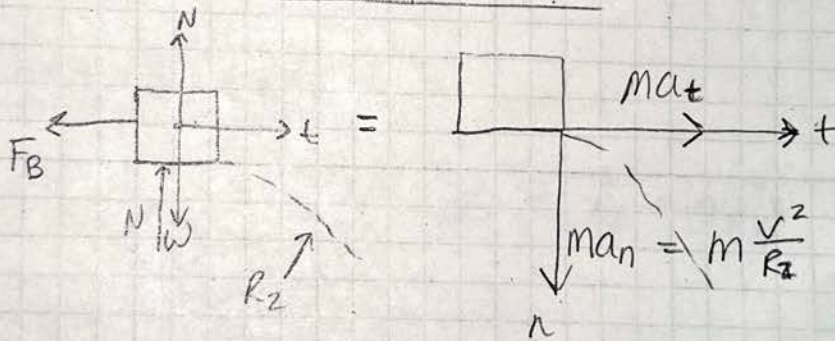
$$N = W$$

$$\mu_k W = ma$$

$$ma = \mu_k m \cdot g$$

$$|a| = \mu_k \cdot g = .2 \cdot -9.81 = \boxed{1.9 \text{ m/s}^2}$$

Q11. Just after B FBD



$$t: -F_B = ma_t$$

$$F_B = \mu_k N$$

$$N: N - W = -ma_n$$

$$a_n = \frac{v^2}{R_2}$$

$$-\mu_k N = ma_t$$

$$|a| = \sqrt{a_t^2 + a_n^2}$$

$$-\mu_k (W - ma_n) = ma_t$$

$$= \sqrt{(.2 \left(\frac{13.889^2}{60} - (9.81) \right))^2 + \left(\frac{13.889^2}{60} \right)^2}$$

$$ma_t = \mu_k (ma_n - mg)$$

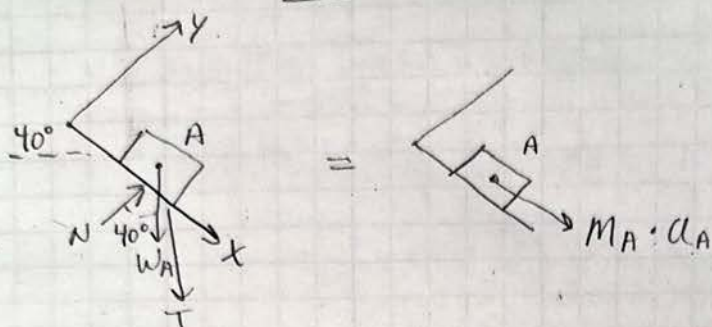
$$= \boxed{3.475 \text{ m/s}^2}$$

$$a_t = \mu_k (a_n - g)$$

$$a_t = \mu_k \left(\frac{v^2}{R_2} - g \right)$$

Prob 5

FBD cart A



$$\sum F_x = M_A a_A$$

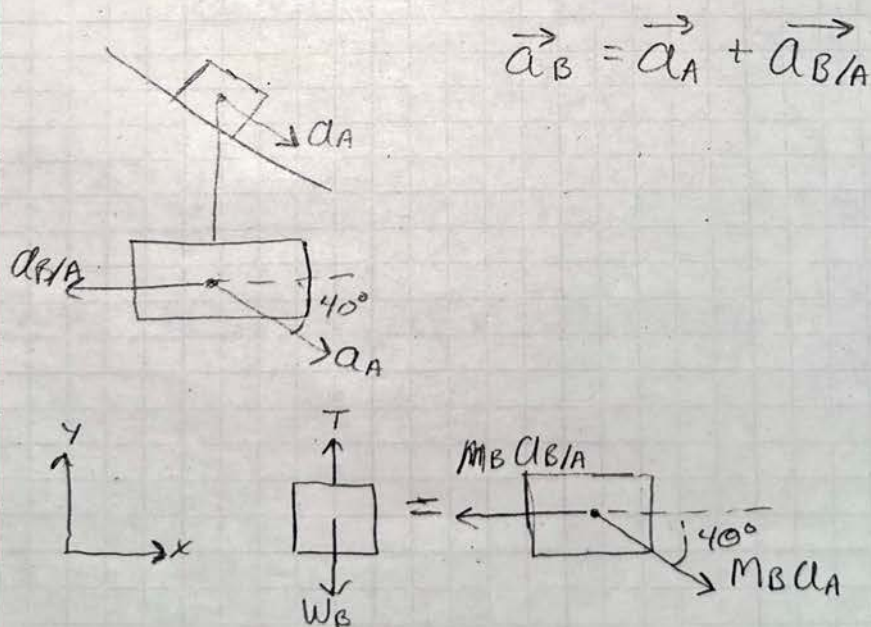
$$(T + W_A) \sin 40^\circ = M_A a_A$$

$$(T + m \cdot g) \sin 40 = M_A a_A$$

$$(T + (10 \cdot 9.81)) \sin 40 = 10 a_A$$

$$T + 98.1 = 15.557 a_A$$

Block B FBD



$$\sum F_x = m_B a_B$$

$$0 = -m_B a_{B/A} + m_B a_A \cdot \cos 40^\circ$$

$$a_{B/A} = a_A \cdot \cos 40^\circ$$

$$= .766 a_A$$

$$\sum F_y = m_B a_B$$

$$T - W_B = -m_B a_A \cdot \sin 40^\circ$$

$$T - (30 \cdot 9.81) = -30 a_A \sin 40^\circ$$

$$T - 294.3 = -19.284 a_A$$

$$T = 294.3 - 19.284 a_A$$

Q12.

$$294.3 - 19.284 a_A + 98.1 = 15.557 a_A$$

$$34.841 a_A = 392.4$$

$$a_A = 11.263 \text{ m/s}^2$$

Q13. $T = 294.3 - 19.284 (11.263) = 77.112 \text{ N}$

Q14. $a_{B/A} = \frac{7.228}{\sin 40^\circ} (11.263) = 7.23 \text{ m/s}^2$

$$7.228$$