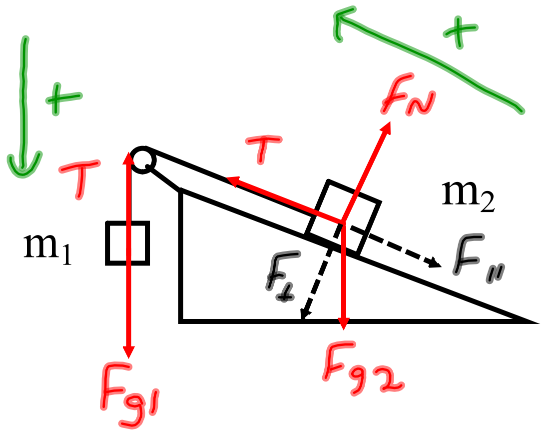
Section 5: Strings and Pulleys on Incline Planes

1. For the frictionless system shown, determine the acceleration of the blocks and the tension in the string.



$m_1 = 2.0$ kg
$m_2 = 3.0$ kg
$\theta = 30.0°$

Direction of motion: m_1 is moving down and m_2 is moving up the plane.

$$F_{net} = F_{g1} - F_{\parallel}$$

$$m_T a = m_1 g - m_2 g \sin\theta$$

$$(5 kg)a = (2 kg)(9.8 m/s^2) - (3 kg)(9.8 m/s^2)\sin 30°$$

$$\underline{a = 0.98 m/s^2}$$

Tension: Use Block 1

↓+ ↑T ↓F_g

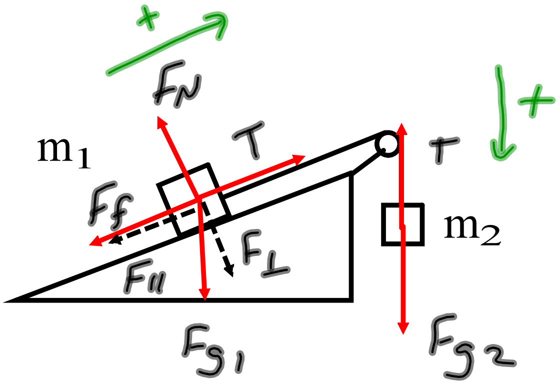
$$F_{net} = T + F_g$$

$$m_1 a = T + m_1 g$$

$$(2 kg)(0.98 m/s^2) = T + (2 kg)(9.8 m/s^2)$$

$$\underline{-18 N = T}$$

2. For the system shown, determine the acceleration of the blocks and the tension in the string.



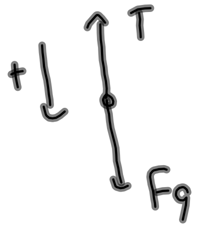
$m_1 = 2.0$ kg
$m_2 = 3.0$ kg
$\theta = 30.0$
$\mu = 0.15$

Direction of motion: m_1 is moving up the incline and m_2 is moving down.

$F_f = \mu F_N$
$F_f = \mu F_{\perp}$
$F_f = \mu mg\cos\theta$

$F_{netsys} = F_{g2} - F_{\parallel} - F_f$
$m_T a = m_2 g - m_1 g\sin\theta - \mu m_1 g\cos\theta$
$5a = (3)(9.8) - (2)(9.8)\sin 30^\circ - (0.15)(2)(9.8)\cos 30^\circ$
$a = 3.4\ m/s^2$

Tension:

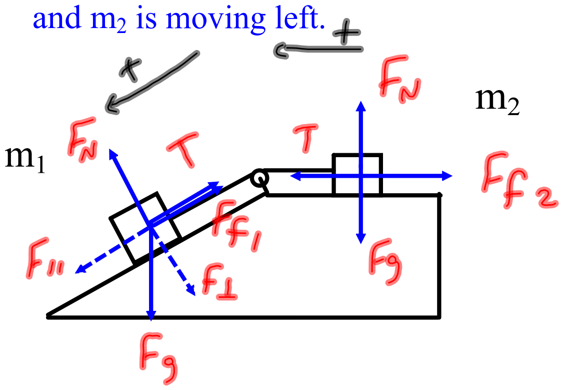


$F_{net_2} = T + F_{g2}$
$m_2 a = T + m_2 g$
$(3kg)(3.4\ m/s^2) = T + (3kg)(9.8\ m/s^2)$
$-19N = T$

3. For the system shown, determine the acceleration of the blocks and the tension in the string.

Direction of motion: m_1 is moving down and m_2 is moving left.

$m_1 = 45$ kg
$m_2 = 35$ kg
$\theta = 40.0°$
$\mu = 0.20$



$$F_{netsys} = F_{\parallel} - F_{f1} - F_{f2}$$

$$m_T a = m_1 g \sin\theta - \mu F_N - \mu F_N \quad *$$

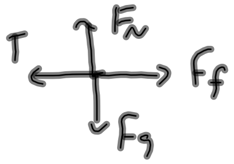
$$m_T a = m_1 g \sin\theta - \mu F_{\perp} - \mu F_{g2} \quad *$$

$$m_T a = m_1 g \sin\theta - \mu m_1 g \cos\theta - \mu m_2 g$$

$$(80)a = (45)(9.8)\sin 40° - (0.2)(45)(9.8)\cos 40° - (0.2)(35)(9.8)$$

$$a = 1.8 \text{ m/s}^2$$

$\underline{m_2}$



$$F_{net2} = T - F_{f2}$$

$$m_2 a = T - \mu m_2 g$$

$$(35\text{ kg})(1.8\text{ m/s}^2) = T - (0.20)(35\text{ kg})(9.8\text{ m/s}^2)$$

$$130\text{ N} = T$$

Questions: 1(b) p. 202
11 (a) and (b) for diagram C, p. 225

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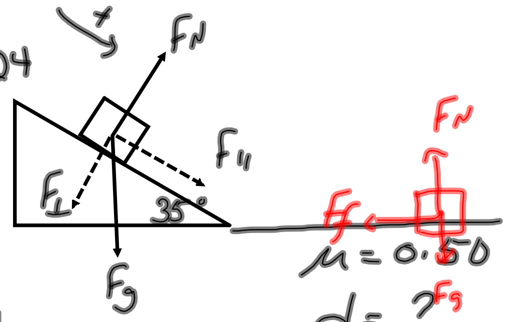
P.224



$\mu = 0.50$

$d = ?$

$v_2 = 0$

$d_{hill} = 50.0m$

Hill: $v_1 = 0$, $a = ?$, $v_2 = ?$ — same → v_1 :

Hill: $F_{net} = F_{\parallel}$

$ma = mg\sin\theta$

$a = 9.8 m/s^2 \sin 35°$

$a = 5.62 m/s^2$

Bottom of Hill: $v_2^2 = v_1^2 + 2ad$

$v_2^2 = 2(5.62 m/s^2)(50 m)$

$v_2 = 23.7 m/s$

This is v_1 on the horizontal part.

Horizontal:
need "a":

$F_{net} = -F_f$

$ma = -\mu mg$

$a = -0.50(9.8 m/s^2)$

$a = -4.9 m/s^2$

Horizontal: $d = \dfrac{v_2^2 - v_1^2}{2a}$

$d = \dfrac{0 - (23.7 m/s)^2}{2(-4.9 m/s^2)}$

Test

$d = 57m$