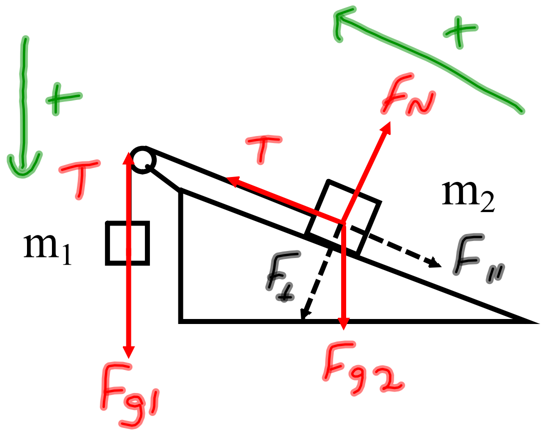
Section 5: Strings and Pulleys on Incline Planes

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
$\theta = 30.0^\circ$

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

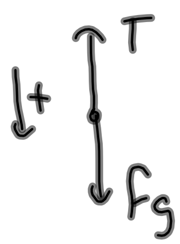
$$F_{net} = F_{g1} - F_{\parallel}$$

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

$$(5\,\text{kg})a = (2\,\text{kg})(9.8\,\text{m/s}^2) - (3\,\text{kg})(9.8\,\text{m/s}^2)\sin 30^\circ$$

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

Tension: Use Block 1



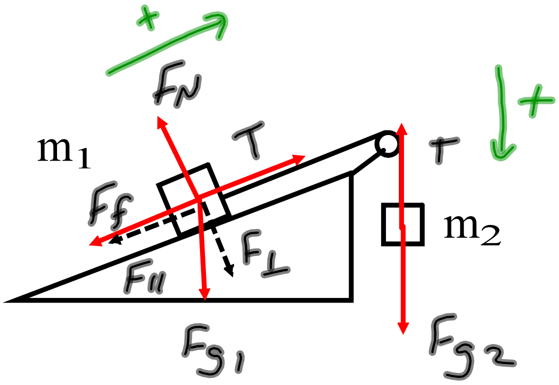
$$F_{net} = T + F_g$$

$$m_1 a = T + m_1 g$$

$$(2\,\text{kg})(0.98\,\text{m/s}^2) = T + (2\,\text{kg})(9.8\,\text{m/s}^2)$$

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

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



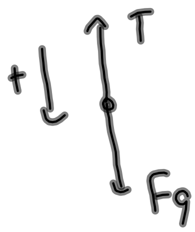
$m_1 = 2.0$ kg
$m_2 = 3.0$ kg
$\theta = 30.0$
$\mu = 0.15$

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

$$F_f = \mu F_N$$
$$F_f = \mu F_\perp$$
$$F_f = \mu m g \cos\theta$$

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

Tension:

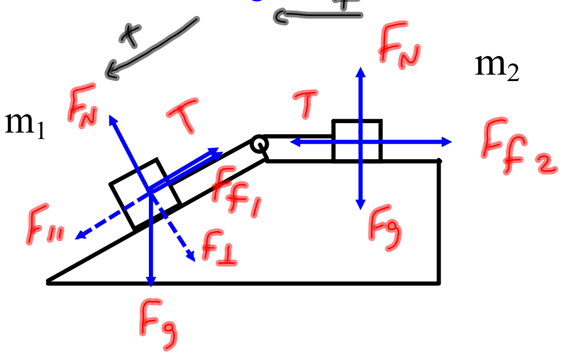


$$F_{net_2} = T + F_{g2}$$
$$m_2 a = T + m_2 g$$
$$(3\,kg)(3.4\,m/s^2) = T + (3\,kg)(9.8\,m/s^2)$$
$$-19\,N = T$$

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

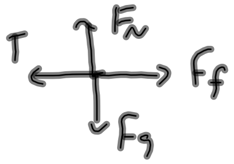
Direction of motion: m_1 is moving down and m_2 is moving left.

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



$$F_{netsys} = F_{\parallel} - F_{f1} - F_{f2}$$
$$m_T a = m_1 g \sin\theta - \mu F_N - \mu F_N \quad *$$
$$m_T a = m_1 g \sin\theta - \mu F_{\perp} - \mu F_{g2} \quad *$$
$$m_T a = m_1 g \sin\theta - \mu m_1 g \cos\theta - \mu m_2 g$$
$$(80)a = (45)(9.8)\sin 40° - (0.2)(45)(9.8)\cos 40° - (0.2)(35)(9.8)$$
$$a = 1.8\ m/s^2$$

M_2



$$F_{net2} = T - F_{f2}$$
$$m_2 a = T - \mu m_2 g$$
$$(35\,kg)(1.8\,m/s^2) = T - (0.20)(35\,kg)(9.8\,m/s^2)$$
$$130\,N = T$$

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

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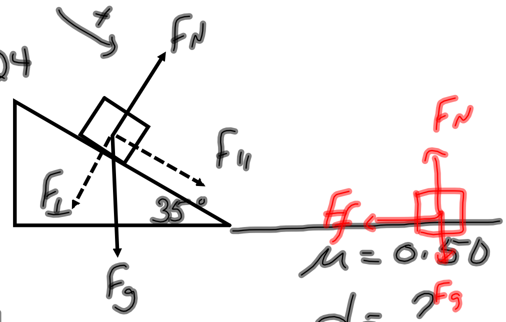
P.224



$\mu = 0.50$

$d_{hill} = 50.0\text{m}$

$d = ?$

$V_2 = 0$

Hill: $V_1 = 0$
$a = ?$
$V_2 = ?$ — same → V_1:

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

$ma = mg\sin\theta$

$a = 9.8\,\text{m/s}^2 \sin 35°$

$a = 5.62\,\text{m/s}^2$

Bottom of Hill: $V_2^2 = V_1^2 + 2ad$

$V_2^2 = 2(5.62\,\text{m/s}^2)(50\,\text{m})$

$V_2 = 23.7\,\text{m/s}$

This is V_1 on the horizontal part.

Horizontal:
need "a":

$F_{net} = -F_f$

$ma = -\mu mg$

$a = -0.50(9.8\,\text{m/s}^2)$

$a = -4.9\,\text{m/s}^2$

Horizontal: $d = \dfrac{V_2^2 - V_1^2}{2a}$

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

Jest

$d = 57\,\text{m}$