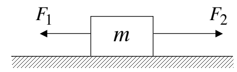
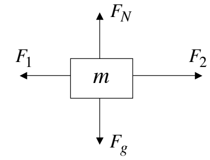
Example 1:

Two forces parallel to the ground act upon a box with a mass of 60 kg. One force is directed west and has a strength of 100 N. The other force is directed east and has a strength of 220 N. Find the acceleration of the box assuming the surface is frictionless.

Example 1:

$m = 60\text{ kg},\ \vec{F}_1 = 100\text{ N (west)},\ \vec{F}_2 = 220\text{ N (east)},\ a = ?$





Net force equations using Newton's 2nd Law:

$$\sum F_y = ma \qquad F_N - F_g = 0$$

$$\sum F_x = ma$$
$$F_2 - F_1 = ma$$
$$a = \frac{F_2 - F_1}{m}$$
$$a = \frac{220\text{ N} - 100\text{ N}}{60\text{ kg}} = \boxed{2.0\ \frac{\text{m}}{\text{s}^2}}$$
$$\vec{a} = 2.0\ \frac{\text{m}}{\text{s}^2}\text{ (east)}$$

Example 2:

A scale is fixed to the bottom of an elevator. A 50 kg box is on the scale. What is the scale reading when

a.) the elevator is at rest?

b.) the elevator accelerates upward at 2.0 m/s^2?

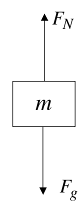
c.) the elevator accelerates downward at 1.5 m/s^2?

d.) the elevator moves at constant velocity?

Example 2:

a.) the elevator is at rest

$m = 50\text{ kg} \quad a = 0$

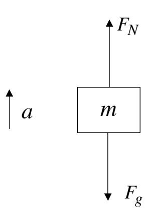


$$\sum F_y = ma$$
$$F_N - F_g = 0$$
$$F_N = F_g$$
$$F_N = mg = (50\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)$$
$$\boxed{F_N = 490\text{ N}}$$

Example 2:

b.) the elevator accelerates upward at 2.0 m/s^2

$m = 50\text{ kg} \quad a = 2.0\ \frac{\text{m}}{\text{s}^2}\text{ (upward)}$

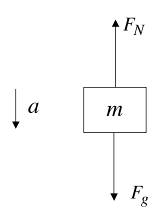


$$\sum F_y = ma$$
$$F_N - F_g = ma \quad \text{(direction is consistent with } a\text{)}$$
$$F_N = ma + F_g$$
$$F_N = ma + mg$$
$$F_N = (50\text{ kg})\left(2\ \frac{\text{m}}{\text{s}^2}\right) + (50\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)$$
$$\boxed{F_N = 590\text{ N}}$$

Example 2:

c.) the elevator accelerates downward at 1.5 m/s^2

$m = 50\text{ kg} \quad a = 1.5\ \frac{\text{m}}{\text{s}^2}\text{ (downward)}$

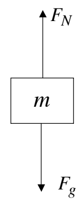


$$\sum F_y = ma$$
$$F_g - F_N = ma \quad \text{(direction is consistent with } a\text{)}$$
$$F_N = F_g - ma$$
$$F_N = mg - ma$$
$$F_N = (50\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right) - (50\text{ kg})\left(1.5\ \frac{\text{m}}{\text{s}^2}\right)$$
$$\boxed{F_N = 415\text{ N}}$$

Example 2:

d.) the elevator moves at constant velocity

$m = 50 \text{ kg} \quad a = 0$



(same as if the elevator was at rest)

$\sum F_y = ma$

$F_N - F_g = 0$

$F_N = F_g$

$F_N = mg = (50 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)$

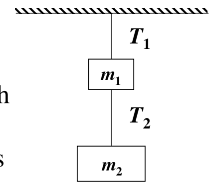
$\boxed{F_N = 490 \text{ N}}$

Example 3:

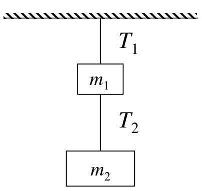
Two masses are suspended using cords with negligible mass.

a.) Draw force diagrams for each mass.

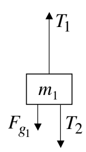
b.) Find the tensions in the cords if m_1 = 25 kg and m_2 = 55 kg.

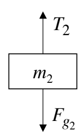


Example 3:



$m_1 = 25 \text{ kg},\ m_2 = 55 \text{ kg},\ \ T_1 = ?,\ T_2 = ?$





$\sum F_y = ma$

$T_1 - F_{g_1} - T_2 = 0 \qquad T_2 - F_{g_2} = 0$

$T_1 = F_{g_1} + T_2 \qquad T_2 = F_{g_2}$

$T_1 = m_1 g + m_2 g \qquad T_2 = m_2 g$

$T_1 = (25 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right) + (55 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right) \qquad T_2 = (55 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)$

$\boxed{T_1 = 784 \text{ N}} \qquad \boxed{T_2 = 539 \text{ N}}$

Example 4:

A 25 kg box is at rest on a rough horizontal surface. The coefficients of static and kinetic friction are 0.30 and 0.15 respectively.

a.) How much force is needed to just set the box in motion?

b.) What is the acceleration of the box if a horizontal force of 100 N is applied to it?

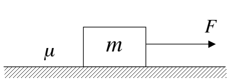
c.) How much force is needed to move the box at a constant velocity of 15 m/s?

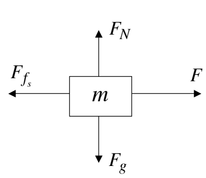
d.) How much force is needed to move the box with an acceleration of 1.5 m /s^2?

Example 4:

$m = 25 \text{ kg},\ \mu_s = 0.30,\ \mu_k = 0.15$

a.) Just to get the box moving, F = ?





$\sum F_y = ma$

$F_N - F_g = 0$

$F_N = F_g = mg$

$\sum F_x = ma$

$F - F_{f_s} = 0$

$F = F_{f_s} = \mu_s F_N = \mu_s mg$

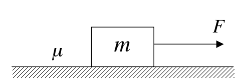
$F = 0.30(25 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)$

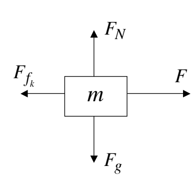
$\boxed{F = 73.5 \text{ N}}$

Example 4:

$m = 25 \text{ kg},\ \mu_s = 0.30,\ \mu_k = 0.15$

b.) $F = 100 \text{ N},\ a = ?$





$\sum F_y = ma$

$F_N - F_g = 0$

$F_N = F_g = mg$

$\sum F_x = ma$

$F - F_{f_k} = ma$

$a = \frac{F - F_{f_k}}{m} = \frac{F - \mu_k F_N}{m} = \frac{F - \mu_k mg}{m}$

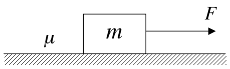
$a = \frac{100 \text{ N} - 0.15(25 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)}{25 \text{ kg}}$

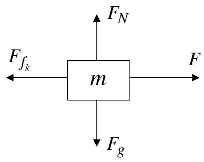
$\boxed{a = 2.53 \ \frac{\text{m}}{\text{s}^2}}$

Example 4:

$m = 25$ kg, $\mu_s = 0.30$, $\mu_k = 0.15$

c.) $v = 15\ \frac{\text{m}}{\text{s}}$, $a = 0$, $F = ?$





$\sum F_y = ma$

$F_N - F_g = 0$

$F_N = F_g = mg$

$\sum F_x = ma$

$F - F_{f_k} = 0$

$F = F_{f_k} = \mu_k F_N = \mu_k mg$

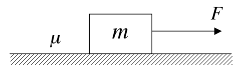
$F = 0.15(25\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)$

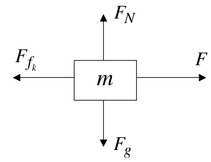
$\boxed{F = 36.75\text{ N}}$

Example 4:

$m = 25$ kg, $\mu_s = 0.30$, $\mu_k = 0.15$

d.) $a = 1.5\ \frac{\text{m}}{\text{s}^2}$, $F = ?$





$\sum F_y = ma$

$F_N - F_g = 0$

$F_N = F_g = mg$

$\sum F_x = ma$

$F - F_{f_k} = ma$

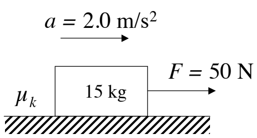
$F = ma + F_{f_k} = ma + \mu_k F_N$

$F = ma + \mu_k mg$

$F = (25\text{ kg})\left(1.5\ \frac{\text{m}}{\text{s}^2}\right) + 0.15(25\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)$

$\boxed{F = 74.25\text{ N}}$

Example 5:



A 50 N force is applied to a 15 kg box causing it to accelerate at a rate of 2.0 m/s^2.

a.) Draw a force diagram for the box.

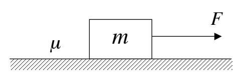
b.) Find the frictional force.

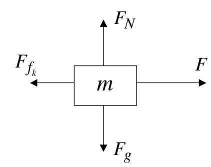
c.) Find the coefficient of kinetic (sliding) friction.

Example 5:

$F = 50$ N, $m = 15$ kg, $a = 2.0\ \frac{\text{m}}{\text{s}^2}$

a.) Force diagram





b.) $F_{f_k} = ?$

$\sum F_x = ma$

$F - F_{f_k} = ma$

$F_{f_k} = F - ma$

$F_{f_k} = 50\text{ N} - (15\text{ kg})\left(2.0\ \frac{\text{m}}{\text{s}^2}\right)$

$\boxed{F_{f_k} = 20\text{ N}}$

c.) $\mu_k = ?$

$\sum F_y = ma$

$F_N - F_g = 0$

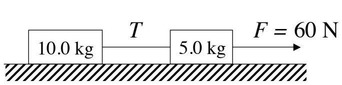
$F_N = F_g = mg$

$F_{f_k} = \mu_k F_N$ so $\mu_k = \frac{F_{f_k}}{F_N} = \frac{F_{f_k}}{mg}$

$\mu_k = \frac{20\text{ N}}{(15\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)} = \boxed{0.14}$

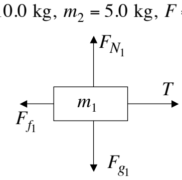
Example 6:

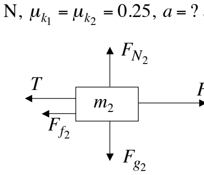
Two boxes are connected by a cord with negligible mass, as shown in the figure below. A force of 60 N is applied horizontally to the 5.0 kg box causing the boxes to accelerate to the right. The coefficient of kinetic friction between the boxes and the surface is 0.25. Find the magnitude of the acceleration of the boxes and the tension in the cord that connects them.



Example 6:

$m_1 = 10.0$ kg, $m_2 = 5.0$ kg, $F = 60$ N, $\mu_{k_1} = \mu_{k_2} = 0.25$, $a = ?$ and $T = ?$





$\sum F_y = ma$ (1) $F_{N_1} - F_{g_1} = 0$, $F_{N_1} = F_{g_1} = m_1 g$ (2) $F_{N_2} - F_{g_2} = 0$, $F_{N_2} = F_{g_2} = m_2 g$

$\sum F_x = ma$ (3) $T - F_{f_1} = m_1 a$ (4) $F - T - F_{f_2} = m_2 a$

(3)+(4) $F - F_{f_1} - F_{f_2} = m_1 a + m_2 a = (m_1 + m_2)a$

$$a = \frac{F - F_{f_1} - F_{f_2}}{m_1 + m_2} = \frac{F - \mu_{k_1} F_{N_1} - \mu_{k_2} F_{N_2}}{m_1 + m_2} = \frac{F - \mu_{k_1} m_1 g - \mu_{k_2} m_2 g}{m_1 + m_2}$$

Example 6:

$m_1 = 10.0 \text{ kg},\ m_2 = 5.0 \text{ kg},\ F = 60 \text{ N},\ \mu_{k_1} = \mu_{k_2} = 0.25,\ a = ? \text{ and } T = ?$

$$a = \frac{F - \mu_{k_1} m_1 g - \mu_{k_2} m_2 g}{m_1 + m_2} = \frac{60 \text{ N} - 0.25(10 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right) - 0.25(5 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)}{10 \text{ kg} + 5 \text{ kg}}$$

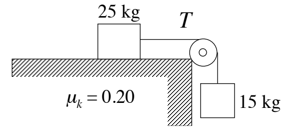
$$\boxed{a = 1.55 \ \frac{\text{m}}{\text{s}^2}}$$

$$(3)\ T - F_{f_1} = m_1 a \qquad (4)\ F - T - F_{f_2} = m_2 a$$

$$\text{using (3) } T = m_1 a + F_{f_1} = m_1 a + \mu_{k_1} F_{N_1} = m_1 a + \mu_{k_1} m_1 g$$

$$T = (10 \text{ kg})\left(1.55 \ \frac{\text{m}}{\text{s}^2}\right) + 0.25(10 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)$$

$$\boxed{T = 40 \text{ N}}$$



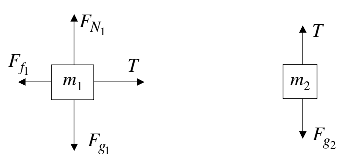
Example 7:

Assuming that the system above is initially at rest and that the pulley is frictionless and of negligible mass

a.) Find the acceleration of both boxes and the tension in the cord that connects them.

b.) How much horizontal force must be applied to the 25 kg box to move both boxes at a constant velocity of 15 m/s to the left?

Example 7a: $m_1 = 25 \text{ kg},\ m_2 = 15 \text{ kg},\ \mu_{k_1} = 0.20,\ a = ? \text{ and } T = ?$



$\sum F_y = ma$ (1) $F_{N_1} - F_{g_1} = 0$, $F_{N_1} = F_{g_1} = m_1 g$ (2) $F_{g_2} - T = m_2 a$

$\sum F_x = ma$ (3) $T - F_{f_1} = m_1 a$ no x - forces

$$(2) + (3)\ F_{g_2} - F_{f_1} = m_1 a + m_2 a = (m_1 + m_2) a$$

$$a = \frac{F_{g_2} - F_{f_1}}{m_1 + m_2} = \frac{m_2 g - \mu_{k_1} F_{N_1}}{m_1 + m_2} = \frac{m_2 g - \mu_{k_1} m_1 g}{m_1 + m_2}$$

Example 7a: $m_1 = 25 \text{ kg},\ m_2 = 15 \text{ kg},\ \mu_{k_1} = 0.20,\ a = ? \text{ and } T = ?$

$$a = \frac{m_2 g - \mu_{k_1} m_1 g}{m_1 + m_2} = \frac{(15 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right) - 0.20(25 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)}{15 \text{ kg} + 25 \text{ kg}}$$

$$\boxed{a = 2.45 \ \frac{\text{m}}{\text{s}^2}}$$

$$(3)\ T - F_{f_1} = m_1 a \qquad (2)\ F_{g_2} - T = m_2 a$$

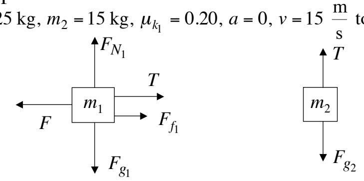
$$\text{using (3) } T = m_1 a + F_{f_1} = m_1 a + \mu_{k_1} F_{N_1} = m_1 a + \mu_{k_1} m_1 g$$

$$T = (25 \text{ kg})\left(2.45 \ \frac{\text{m}}{\text{s}^2}\right) + 0.20(25 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)$$

$$\boxed{T = 110.25 \text{ N}}$$

Example 7b:

$m_1 = 25 \text{ kg},\ m_2 = 15 \text{ kg},\ \mu_{k_1} = 0.20,\ a = 0,\ v = 15 \ \frac{\text{m}}{\text{s}} \text{ to the left},\ F = ?$



$\sum F_y = ma$ (1) $F_{N_1} - F_{g_1} = 0$, $F_{N_1} = F_{g_1} = m_1 g$ (2) $T - F_{g_2} = 0$

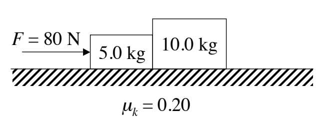
$\sum F_x = ma$ (3) $F - T - F_{f_1} = 0$ no x - forces

$$(2) + (3)\ F - F_{g_2} - F_{f_1} = 0$$

$$F = F_{g_2} + F_{f_1} = m_2 g + \mu_{k_1} F_{N_1} = m_2 g + \mu_{k_1} m_1 g$$

$$F = (15 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right) + 0.20(25 \text{ kg})\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)$$

$$\boxed{F = 196 \text{ N}}$$

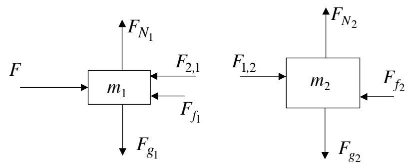


Example 8:

A force of 80 N is applied to a 5.0 kg block that is in contact with a 10 kg block. Both blocks are initially at rest on a horizontal surface and the coefficient of kinetic friction for both blocks is 0.20 on this surface. Find the force that the 10 kg block exerts on the 5.0 kg block.

Example 8:

$m_1 = 5.0$ kg, $m_2 = 10.0$ kg, $\mu_{k_1} = \mu_{k_2} = 0.20$, $F = 80$ N, $a = ?$ and $F_{2,1} = ?$



$\sum F_y = ma$ (1) $F_{N_1} - F_{g_1} = 0$, $F_{N_1} = F_{g_1} = m_1 g$ (2) $F_{N_2} - F_{g_2} = 0$, $F_{N_2} = F_{g_2} = m_2 g$

$\sum F_x = ma$ (3) $F - F_{f_1} - F_{2,1} = m_1 a$ (4) $F_{1,2} - F_{f_2} = m_2 a$

(3) + (4) $F - F_{f_1} - F_{f_2} = m_1 a + m_2 a$ $(F_{1,2} = F_{2,1})$

$$F - F_{f_1} - F_{f_2} = (m_1 + m_2)a \text{ so } a = \frac{F - F_{f_1} - F_{f_2}}{m_1 + m_2} = \frac{F - \mu_{k_1} F_{N_1} - \mu_{k_2} F_{N_2}}{m_1 + m_2}$$

25

Example 8:

$m_1 = 5.0$ kg, $m_2 = 10.0$ kg, $\mu_{k_1} = \mu_{k_2} = 0.20$, $F = 80$ N, $a = ?$ and $F_{2,1} = ?$

$$a = \frac{F - \mu_{k_1} F_{N_1} - \mu_{k_2} F_{N_2}}{m_1 + m_2} = \frac{F - \mu_{k_1} m_1 g - \mu_{k_2} m_2 g}{m_1 + m_2}$$

$$a = \frac{80\text{ N} - 0.20(5.0\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right) - 0.20(10.0\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)}{5.0\text{ kg} + 10.0\text{ kg}}$$

$$\boxed{a = 3.37\ \frac{\text{m}}{\text{s}^2}}$$

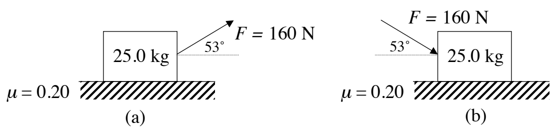
(3) $F - F_{f_1} - F_{2,1} = m_1 a$ (4) $F_{1,2} - F_{f_2} = m_2 a$

using (4) $F_{1,2} = m_2 a + F_{f_2} = m_2 a + \mu_{k_2} F_{N_2} = m_2 a + \mu_{k_2} m_2 g$

$$F_{1,2} = (10\text{ kg})\left(3.37\ \frac{\text{m}}{\text{s}^2}\right) + 0.20(10\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)$$

$$\boxed{F_{2,1} = F_{1,2} = 53.3\text{ N}}$$

26



Example 9:

A 25 kg box is being pulled by a force that makes a 53° angle above the horizontal as shown in figure (a).

i.) Find the normal force acting on the box.

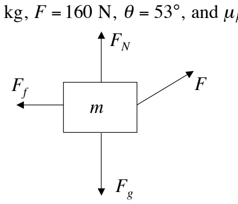
ii.) Find the acceleration of the box.

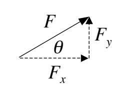
Repeat part (i) and (ii) if the force is applied below the horizontal as shown in figure (b).

Forces 27

Example 9a:

$m = 25$ kg, $F = 160$ N, $\theta = 53°$, and $\mu_k = 0.20$





$F_x = F\cos\theta$

$F_y = F\sin\theta$

i.) $F_N = ?$

$\sum F_y = ma$ (1) $F_N + F_y - F_g = 0$

$F_N = F_g - F_y$

$F_N = mg - F\sin\theta$

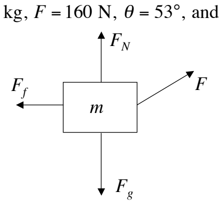
$$F_N = (25\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right) - (160\text{ N})\sin 53°$$

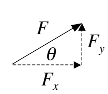
$$\boxed{F_N = 117\text{ N}}$$

28

Example 9a:

$m = 25$ kg, $F = 160$ N, $\theta = 53°$, and $\mu_k = 0.20$





$F_x = F\cos\theta$

$F_y = F\sin\theta$

ii.) $a = ?$

$\sum F_x = ma$ (2) $F_x - F_f = ma$

$$a = \frac{F_x - F_f}{m} = \frac{F\cos\theta - \mu_k F_N}{m}$$

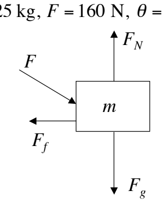
$$a = \frac{(160\text{ N})\cos 53° - 0.20(117\text{ N})}{25\text{ kg}}$$

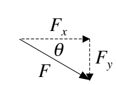
$$\boxed{a = 2.92\ \frac{\text{m}}{\text{s}^2}}$$

29

Example 9b:

$m = 25$ kg, $F = 160$ N, $\theta = 53°$, and $\mu_k = 0.20$





$F_x = F\cos\theta$

$F_y = F\sin\theta$

i.) $F_N = ?$

$\sum F_y = ma$ (1) $F_N - F_y - F_g = 0$

$F_N = F_g + F_y$

$F_N = mg + F\sin\theta$

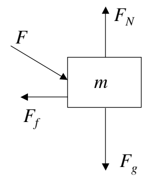
$$F_N = (25\text{ kg})\left(9.8\ \frac{\text{m}}{\text{s}^2}\right) + (160\text{ N})\sin 53°$$

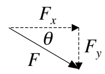
$$\boxed{F_N = 373\text{ N}}$$

30

Example 9b:

$m = 25 \text{ kg}$, $F = 160 \text{ N}$, $\theta = 53°$, and $\mu_k = 0.20$





$F_x = F\cos\theta$

$F_y = F\sin\theta$

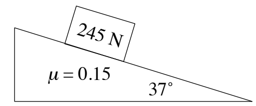
ii.) $a = ?$

$\sum F_x = ma$ $\quad$ (2) $F_x - F_f = ma$

$$a = \frac{F_x - F_f}{m} = \frac{F\cos\theta - \mu_k F_N}{m}$$

$$a = \frac{(160 \text{ N})\cos 53° - 0.20(373 \text{ N})}{25 \text{ kg}}$$

$$\boxed{a = 0.87 \ \frac{\text{m}}{\text{s}^2}}$$



Example 10:

A box with a weight of 245 N held at rest on a 37° incline. The coefficient of kinetic friction between the box and the inclined surface is 0.15.

a.) Find the acceleration of the box if it is allowed to slide down the incline.

b.) What force (parallel to the incline) should be applied to the box if the block is to slide down the incline at a constant velocity?

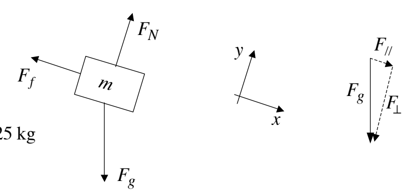
c.) What force (parallel to the incline) should be applied to the box if the block is to move up the incline with an acceleration of 3.0 m/s²?

Example 10a $\quad \theta = 37°$, $F_g = 245 \text{ N}$, and $\mu_k = 0.15$

Sliding down the incline $a = ?$

$F_g = mg$

$$m = \frac{F_g}{g} = \frac{245 \text{ N}}{9.8 \ \frac{\text{m}}{\text{s}^2}} = 25 \text{ kg}$$



$\sum F_x = ma$

$F_{//} - F_f = ma$

$F_g\sin\theta - \mu_k F_N = ma$

$mg\sin\theta - \mu_k mg\cos\theta = ma$

$a = g\sin\theta - \mu_k g\cos\theta$

$\sum F_y = ma$

$F_N - F_\perp = 0$

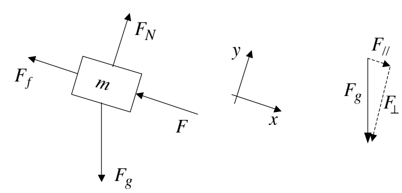
$F_N = F_\perp = F_g\cos\theta$

$F_N = mg\cos\theta$

$$a = \left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)\sin(37°) - 0.15\left(9.8 \ \frac{\text{m}}{\text{s}^2}\right)\cos(37°) = \boxed{4.72 \ \frac{\text{m}}{\text{s}^2}}$$

Example 10b $\quad \theta = 37°$, $F_g = 245 \text{ N}$, $m = 25 \text{ kg}$, and $\mu_k = 0.15$

Force needed to slide down incline with constant velocity. $F = ?$



$\sum F_x = ma$

$F_{//} - F - F_f = 0$

$F = F_{//} - F_f$

$F = F_g\sin\theta - \mu_k F_N$

$F = F_g\sin\theta - \mu_k F_g\cos\theta$

$F = (245 \text{ N})\sin(37°) - 0.15(245 \text{ N})\cos(37°)$

$\boxed{F = 118.1 \text{ N (up the incline)}}$

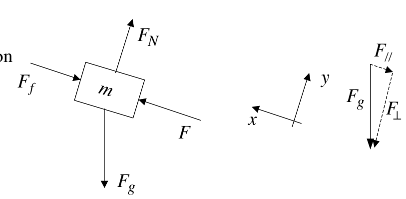
$\sum F_y = ma$

$F_N - F_\perp = 0$

$F_N = F_\perp = F_g\cos\theta$

Example 10c $\quad \theta = 37°$, $F_g = 245 \text{ N}$, $m = 25 \text{ kg}$, and $\mu_k = 0.15$

Force needed to move up incline with an acceleration of 3.0 m/s². $F = ?$



$\sum F_x = ma$

$F - F_{//} - F_f = ma$

$F = ma + F_{//} + F_f$

$F = ma + F_g\sin\theta + \mu_k F_N$

$F = ma + F_g\sin\theta + \mu_k F_g\cos\theta$

$$F = (25 \text{ kg})\left(3.0 \ \frac{\text{m}}{\text{s}^2}\right) + (245 \text{ N})\sin(37°) + 0.15(245 \text{ N})\cos(37°)$$

$\boxed{F = 252 \text{ N (up the incline)}}$

$\sum F_y = ma$

$F_N - F_\perp = 0$

$F_N = F_\perp = F_g\cos\theta$