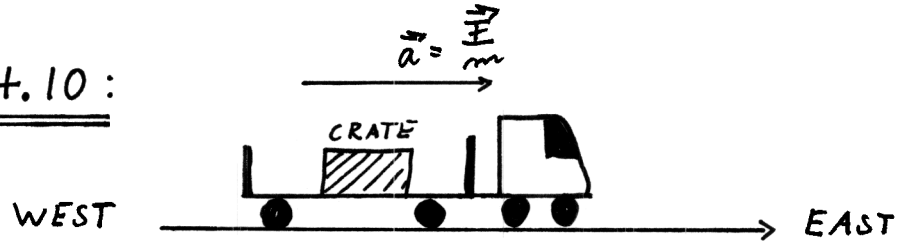
Homework Solutions to HW Set # 4, due 10 / 05 / 2003

By I.B.B.
On 09/23/2003

QQ 4.10:

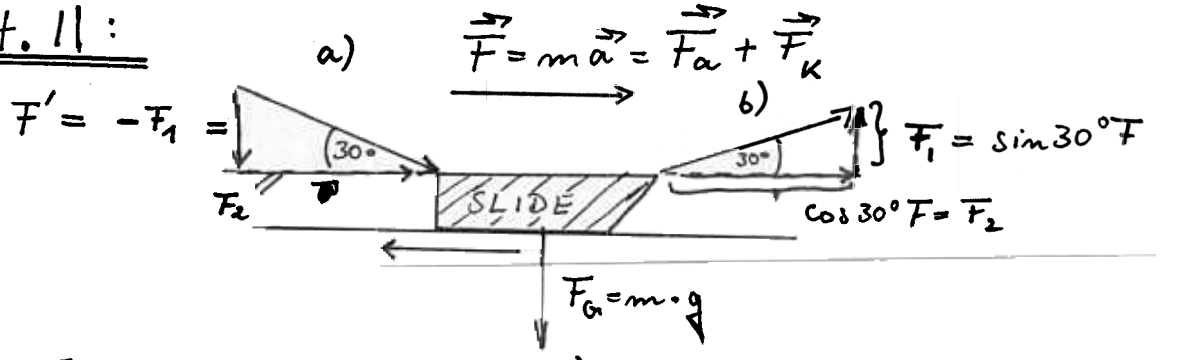


$\vec{F} = \vec{a}\, m$ = friction track bed on crate.

$\Rightarrow$ direction of force of the friction must be the same as the direction of $\vec{a}$.

$\Rightarrow$ Answer b), to the EAST.

QQ 4.11:



$$\text{Friction} = (m \cdot g + F')\,\mu_K$$

- for case a) F' has a minus sign

$\Rightarrow \left(-m\left(9.8\ \frac{m}{s^2}\right) - F_1\right)\mu_K = \text{Friction}.$

$\Rightarrow$ Friction gets bigger (larger negative value)

for case b)

$\left(-m\left(9.8\ \frac{m}{s^2}\right) + F_1\right)\mu_K = \text{Friction}.$

$\Rightarrow$ Friction gets smaller (smaller negative value). $\Rightarrow$ case b) is easier for you.

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CQ 6

- Weight = m · g

  You are interested in getting the maximum mass of gold. Death Valley is at sea level while Denver, Co, is much higher. The gravitational force reduces when you are further away from the center of the earth. $\left(g = G\frac{M_E}{r^2}.\right)$

  So the gravitation leads to a smaller acceleration in Denver than in Death Valley. Therefore the weight of the same mass is bigger in Death Valley than it is in Colorado. So you will get a bigger mass of gold when you buy it by weight in Denver.

- If it were sold by mass it doesn't matter where you buy it

CQ 9:

- the friction exerted by the road on the tires of a car causes the car to move
- (Newton's 3rd law) ("reaction = action")
  the propeller pushes the air backwards. The reaction of the air is a force pushing the plane forward.
- (Newton's 3rd law). ("reaction = action")
  rows push the water backward. ⇒ water pushes boat forward.

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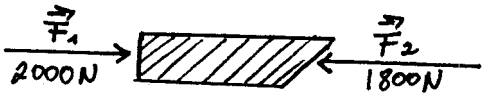
P 11:



$$\vec{F} = \vec{F}_1 + \vec{F}_2 = 2000N + (-1800N)$$
$$= 200N$$

$$\vec{F} = m\vec{a} \iff \vec{a} = \frac{\vec{F}}{m}$$

$$\vec{a} = \frac{200N}{1000kg} = 0.2\ \frac{kg\ \frac{m}{s^2}}{kg} = \underline{0.2\ \frac{m}{s^2}}$$

$$\boxed{x = v_0 t + \frac{1}{2} a t^2}$$

$v_0 = 0$, $a = 0.2\ \frac{m}{s^2}$, $t = 10\,s$

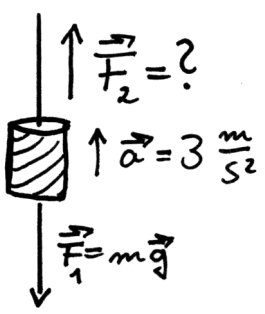
$$x = \frac{1}{2}\, 0.2\ \frac{m}{s^2}\ (10s)^2 = \underline{10\,m}$$

$$\boxed{v = a \cdot t + v_0}$$

$v_0 = 0$, $a = 0.2\ \frac{m}{s^2}$, $t = 10s$

$$v = 10s \times 0.2\ \frac{m}{s^2} = 2\ \frac{m}{s}$$

P 23:



$\vec{F}_2$ to be determined.

$$m\vec{a} = \vec{F} = \vec{F}_1 + \vec{F}_2$$

$\vec{a}$ and $\vec{g}$ have different signs, cause they act in opposite directions.

$$\Rightarrow \vec{F}_2 = m\vec{a} - \vec{F}_1 = m\vec{a} - (-9.8\ \tfrac{m}{s^2} \cdot 5kg)$$

$$\vec{F}_2 = 5kg\ 3\ \tfrac{m}{s^2} + 9.8\ kg\ \tfrac{m}{s^2} \cdot 5 = \underline{64N}$$

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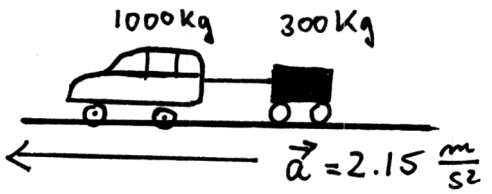
P33:



Net force on the car = mass × acceleration

$\vec{F} = 1000\,kg \times 2.15 \frac{m}{s^2} = 2150\,N$

Net force on the trailer = mass × acceleration

$\vec{F} = 300\,kg \times 2.15 \frac{m}{s^2} = 645\,N$

Newton's law: $\vec{F}_{12} = -\vec{F}_{21}$ (3rd Law)

$\vec{F}_{21}$ = force trailer exerting on car

$\vec{F}_{21} = 300\,Kg \times 2.15 \frac{m}{s^2} = 645N$

d) Force car exerting on road is the force that leads through the equal force the road is exerting on the car to the acceleration of the whole system.

$F = 1300\,kg \times 2.15 \frac{m}{s^2} = 2795N.$

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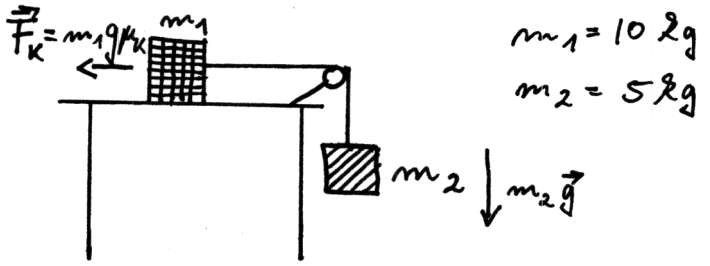
P45



$m_1 = 10\,kg$

$m_2 = 5\,kg$

$$F = m_2 g - m_1 g \mu_K = a\,(m_1 + m_2)$$

$$y = v_0 t + \frac{1}{2} a t^2 \qquad v_0 = 0;\ y = -1m;\ t = 1.20s$$

$$a = \frac{F}{m_1 + m_2} = \frac{m_2 g - m_1 g \mu_K}{m_1 + m_2}$$

$$y = \frac{1}{2} \frac{m_2 g - m_1 g \mu_K}{m_1 + m_2} t^2$$

$$\Leftrightarrow \quad \frac{2(m_1 + m_2) y}{t^2} = m_2 g - m_1 g \mu_K$$

$$\Leftrightarrow \left(\frac{2(m_1 + m_2) y}{t^2} - m_2 g \right) \frac{1}{-m_1 g} = \mu_K$$

$$\left(\frac{2(15kg)(-1m)}{(1.2s)^2} + 5kg\ 9.8 \frac{m}{s^2} \right) \frac{1}{10kg\ 9.8 \frac{m}{s^2}} = 0.287$$

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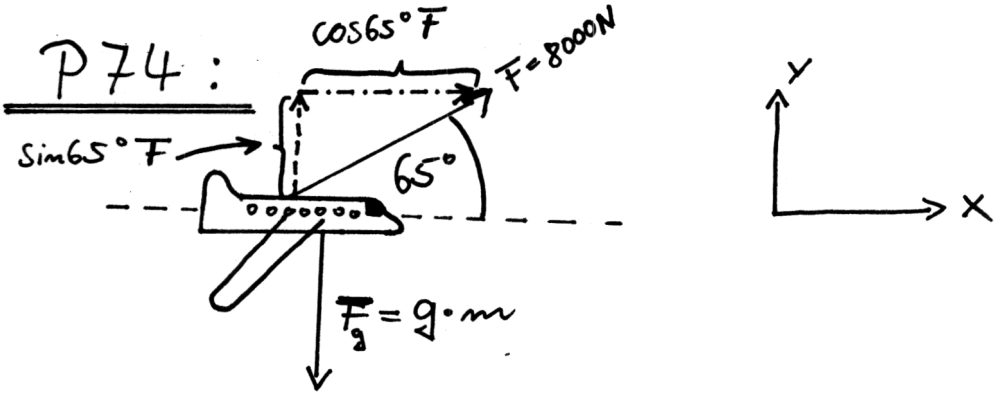
P59:

Newton's first law says that bodies at rest tend to stay at rest. Therefore there has to be a force acting on the box when it is accelerated.
In this case it is the friction between the box and the truck bed that accelerates the box.

$$F = m a = -m g \mu$$
$$\Leftrightarrow a = -g\mu = -0.3 \times \left(-9.8 \tfrac{m}{s^2}\right)$$
$$= 2.94 \tfrac{m}{s^2}$$

P74:



a) velocity constant in y direction. ⇒ NO acceleration in y-direction.

⇒ no Net Force in y direction

⇒ $\sin 65° F + F_g = 0$

$\sin 65° 8000N + g m = 0 \Rightarrow m = \dfrac{-\sin 65° 8000N}{g}$

$m = 739.84 kg$

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to P74

b) horizontal force = $\cos 65° \, 8000N$ = net force in x-direction

$\Rightarrow \cos 65° \, 8000N = m \, a_x$

$$a_x = \frac{\cos 65° \, 8000N}{739.84 \, kg} = 4.6 \, \frac{m}{s}$$