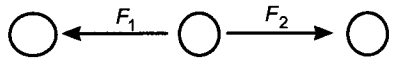
12.



$$F_1 = \frac{Gm_1m_2}{r^2}$$
$$= \frac{\left(6.67\times10^{-11}\ \frac{\text{N}\cdot\text{m}^2}{\text{kg}^2}\right)(10.0\text{ kg})(10.0\text{ kg})}{(5.00\times10^{-1}\text{ m})^2}$$
$$= 2.67 \times 10^{-8}\text{ N}$$

$$F_2 = \frac{Gm_1m_2}{r^2}$$
$$= \frac{\left(6.67\times10^{-11}\ \frac{\text{N}\cdot\text{m}^2}{\text{kg}^2}\right)(10.0\text{ kg})(15.0\text{ kg})}{(5.00\times10^{-1}\text{ m})^2}$$
$$= 4.00 \times 10^{-8}\text{ N}$$

$$F_{net} = F_2 - F_1$$
$$= 4.00 \times 10^{-8}\text{ N} - 2.67 \times 10^{-8}\text{ N}$$
$$= 1.33 \times 10^{-8}\text{ N}$$

13.
$$F_g = \frac{Gm_1m_2}{r^2}$$
$$F_g \propto \frac{m_1m_2}{r^2}$$
$$\propto \frac{(2)(2)}{(3)^2}$$
$$\propto 0.444$$
$$F_g = (3.24 \times 10^{-7}\text{ N})(0.444)$$
$$= 1.44 \times 10^{-7}\text{ N}$$

Lesson 4–Force Due to Gravity (Weight)

1. $F_g = mg$
$= (25.0\text{ kg})(9.80\text{ m/s}^2)$
$= 245\text{ N}$

2. $F_g = mg$

$$m = \frac{F_g}{g}$$
$$= \frac{80.0\text{ N}}{9.80\text{ m/s}^2}$$
$$= 8.16\text{ kg}$$

3. $F_g = mg$

$$g = \frac{F_g}{m}$$
$$= \frac{36.0\text{ N}}{22.0\text{ kg}}$$
$$= 1.64\text{ m/s}^2$$

4. $F_g = mg$
$= (72.0\text{ kg})(9.80\text{ m/s}^2)$
$= 706\text{ N}$

5. $F_g = mg$

$$m = \frac{F_g}{g}$$
$$= \frac{127\text{ N}}{9.80\text{ m/s}^2}$$
$$= 13.0\text{ kg}$$

Lesson 5–Normal and Frictional Forces

1. $F_N = F_g$
$= mg$
$= (14.0\text{ kg})(9.80\text{ m/s}^2)$
$= 137\text{ N}$

2. $F_N = mg$
$= (9.6\text{ kg})(9.80\text{ m/s}^2)$
$= 94\text{ N}$

$F_f = \mu F_N$
$= (0.11)(94\text{ N})$
$= 1.0 \times 10^1\text{ N}$

3. $F_f = \mu F_N$

$$\mu = \frac{F_f}{F_N}$$
$$= \frac{3.0\text{ N}}{20.0\text{ N}}$$
$$= 0.15$$

4. $F_N = mg$
$= (16.2\text{ kg})(9.80\text{ m/s}^2)$
$= 159\text{ N}$

