12.1. **Model:** Model the sun (s), the earth (e), and the moon (m) as spherical.

Solve: **(a)** $F_{\text{s on e}} = \dfrac{Gm_{\text{s}}m_{\text{e}}}{r_{\text{s-e}}^2} = \dfrac{(6.67\times10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2)(1.99\times10^{30}\ \text{kg})(5.98\times10^{24}\ \text{kg})}{(1.50\times10^{11}\ \text{m})^2} = 3.53\times10^{22}\ \text{N}$

(b) $F_{\text{m on e}} = \dfrac{GM_{\text{m}}M_{\text{e}}}{r_{\text{m-e}}^2} = \dfrac{(6.67\times10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2)(7.36\times10^{22}\ \text{kg})(5.98\times10^{24}\ \text{kg})}{(3.84\times10^{8}\ \text{m})^2} = 1.99\times10^{20}\ \text{N}$

(c) The moon's force on the earth as a percent of the sun's force on the earth is

$$\left(\frac{1.99\times10^{20}\ \text{N}}{3.53\times10^{22}\ \text{N}}\right)\times100 = 0.56\%$$