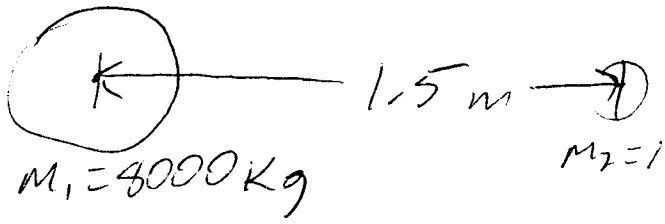
Gravitation Problems G-15

(6)

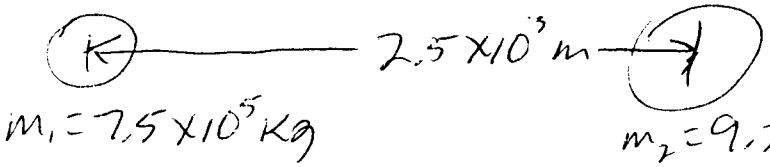


what is F_g?

$$F_g = \frac{G m_1 m_2}{r^2} = \frac{\left(6.67\times10^{-11}\frac{N\cdot m^2}{Kg^2}\cdot 8000\,Kg\cdot 1500\,Kg\right)}{(1.5\,m)^2}$$

$$= 3.56\times10^{-4}\,N$$

(7)



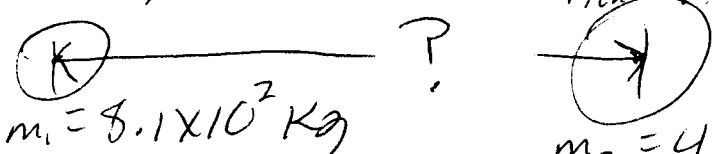
$$F_g = \frac{G m_1 m_2}{r^2} = \frac{\left(6.67\times10^{-11}\frac{N\cdot m^2}{Kg^2}\cdot 7.5\times10^{5}\,Kg\cdot 9.2\times10^{7}\,Kg\right)}{(2.5\times10^{3}\,m)^2} =$$

$F_g =$ [illegible]

$$F_g = 7.36\times10^{-4}\,N$$

$\vec{F}_{2on1} = 1.9\times10^{-3}\,N$ $\quad$ $\vec{F}_{1on2} = 1.9\times10^{-3}\,N$

(8)

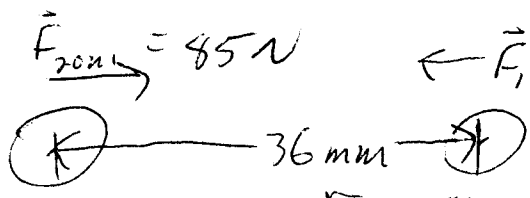


$r = 113.1\,m$

$$F = \frac{G m_1 m_2}{r^2} \quad \text{solve for } r \;\therefore\; r^2 \cdot F = G m_1 m_2$$

$$r^2 = \frac{G m_1 m_2}{F} \;\therefore\; r = \sqrt{\frac{G m_1 m_2}{F}} = \sqrt{\frac{6.67\times10^{-11}\frac{N m^2}{Kg^2}\cdot 8.1\times10^{2}\,Kg\cdot 4.5\times10^{8}\,Kg}{1.9\times10^{-3}\,N}} =$$

(9)



make sure to convert to m.

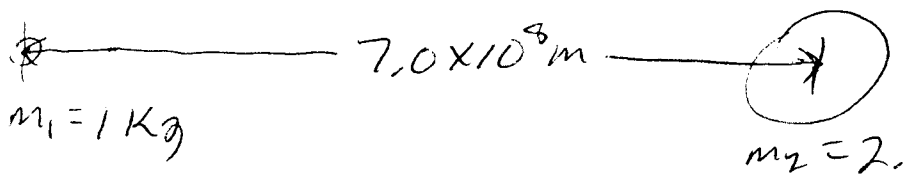
$m_1 = m_2$ what are masses? $36\,mm\left(\frac{1\,m}{1000\,mm}\right) = 0.036\,m$

$F_g = \frac{G m_1 m_2}{r^2}$ Since $m_1 = m_2$, we can simplify as m^2

$F_g = \frac{G m^2}{r^2}$ $\therefore$ $m^2 = \frac{F_g \cdot r^2}{G}$ $\therefore$ $m = \sqrt{\frac{F_g \cdot r^2}{G}}$

$m = \sqrt{\frac{85\,\frac{Kgm}{s^2} \cdot (0.036m)^2}{6.67 \times 10^{-11}\,\frac{N \cdot m^2}{Kg^2}}} = 40640\,Kg$

(10)



a) what is magnitude of Force on smaller object?

$F_g = \frac{G m_1 m_2}{r^2} = \frac{\left(6.67 \times 10^{-11}\,\frac{N \cdot m^2}{Kg^2} \cdot 1\,Kg \cdot 2.0 \times 10^{30}\,Kg\right)}{(7.0 \times 10^8 m)^2}$

$= 272\,N$

b) what is magnitude of Force on larger object?

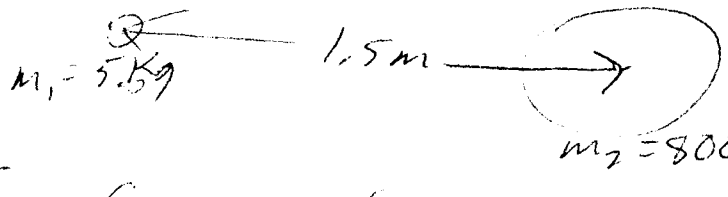
According to Newton's 3rd Law, the force of mass 1 on mass 2 is equal in magnitude, but opposite in direction to the force of mass 2 on mass 1.

So, $F = 272\,N$

c) $a_1 = \frac{F}{m_1} = \frac{272\,\frac{Kgm}{s^2}}{1\,Kg} = 272\,\frac{m}{s^2}$

d) $a_2 = \frac{F}{m_2} = \frac{272\,\frac{Kgm}{s^2}}{2.0 \times 10^{30}\,Kg} = 1.36 \times 10^{-28}\,\frac{m}{s^2}$

(11)

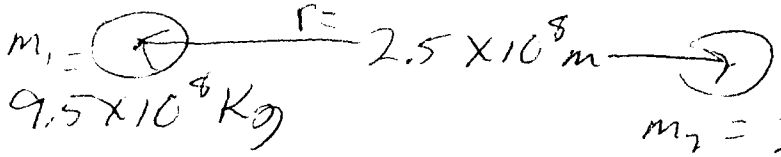


$$F_g = \frac{G m_1 m_2}{r^2} = \frac{\left(6.67 \times 10^{-11} \frac{N \cdot m^2}{Kg^2} \cdot 5.0\,Kg \cdot 8000\,Kg\right)}{(1.5\,m)^2}$$

$F_g = 7.1 \times 10^{-5}\,N$

$F_g = 1.2 \times 10^{-6}\,N$

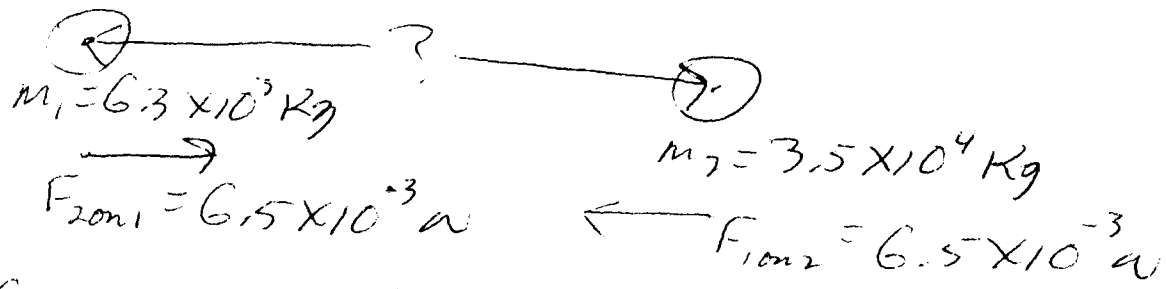
(12)



$$F_g = \frac{G m_1 m_2}{r^2} = \frac{\left(6.67 \times 10^{-11} \frac{N m^2}{Kg^2} \cdot 9.5 \times 10^8\,Kg \cdot 2.5\,Kg\right)}{(2.5 \times 10^8\,m)^2}$$

$F_g = 2.5 \times 10^{-18}\,N$

(13)



$F_g = \frac{G m_1 m_2}{r^2}$ what is r?

$F_g \cdot r^2 = G m_1 m_2$

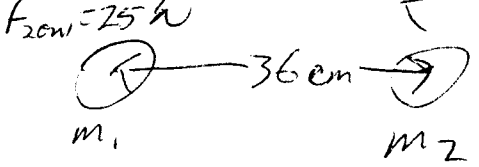
$r^2 = \frac{G m_1 m_2}{F_g}$

$r = \sqrt{\frac{G m_1 m_2}{F_g}} =$

$$r = \sqrt{\frac{\left(6.67 \times 10^{-11} \frac{N m^2}{Kg^2} \cdot 6.3 \times 10^3\,Kg \cdot 3.5 \times 10^4\,Kg\right)}{6.5 \times 10^{-3}\,N}}$$

$r = 1.5\,m$

(14)



Convert 36 cm to m.

$36\,cm \left/ \frac{1\,m}{100\,cm} \right. = 0.36\,m$

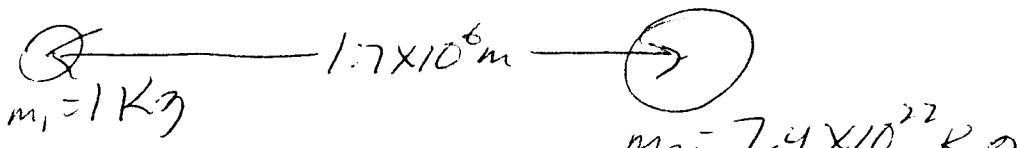
since m_1 & m_2 are equal:

$F_g = \frac{G m_1 m_2}{r^2} \therefore F_g = \frac{G m^2}{r^2}$

$m^2 = \sqrt{\frac{F_g r^2}{G}} = \sqrt{\frac{(25\,N \cdot (0.36\,m)^2)}{6.67 \times 10^{-11} \frac{N \cdot m^2}{Kg^2}}}$

$m = 2.2 \times 10^5\,Kg$

(15)



a) what is force on m_1?

$F_g = \frac{G m_1 m_2}{r^2} = \frac{\left(6.67 \times 10^{-11} \frac{N \cdot m^2}{Kg^2} \cdot 1\,Kg \cdot 7.4 \times 10^{22}\,Kg\right)}{(1.7 \times 10^6\,m)^2}$

$F_g = 1.7\,N$

b) Because of Newton's 3rd Law, Force on m_2 is also 1.7 N.

c) $a_1 = \frac{F}{m_1} = \frac{1.7\,N}{1\,Kg} = 1.7 \frac{m}{s^2}$

d) $a_2 = \frac{F}{m_2} = \frac{1.7 \frac{Kg\,m}{s^2}}{7.4 \times 10^{22}\,Kg} = 2.3 \times 10^{-23} \frac{m}{s^2}$