p. 293 # 1-3, p. 295 # 1-2

1 $m_1 = 1.0\times10^{20}\ kg$

$m_2 = 3.0\times10^{20}\ kg$

$F_g = 2.2\times10^{9}\ N$

$r = ?$

$G = 6.67\times10^{-11}\ Nm^2/kg^2$

$$F_g = \frac{Gm_1m_2}{r^2} \Rightarrow r = \sqrt{\frac{Gm_1m_2}{F_g}}$$

$$r = \sqrt{\frac{(6.67\times10^{-11}\ Nm^2/kg^2)(1.0\times10^{20}\ kg)(3.0\times10^{20}\ kg)}{2.2\times10^{9}\ N}}$$

$r = 3.0159\times10^{10}\ m$

$r = 3.0\times10^{10}\ m$

2. $m_J = 1.9\times10^{27}\ kg$

$r = 7.0\times10^{7}\ m$

$G = 6.67\times10^{-11}\ Nm^2/kg^2$

$g = ?$

$$F_g = F_g$$

$$mg = \frac{Gmm_J}{r^2}$$

$$g = \frac{Gm_J}{r^2}$$

$$g = \frac{(6.67\times10^{-11}\ Nm^2/kg^2)(1.9\times10^{27}\ kg)}{(7.0\times10^{7}\ m)^2}$$

$g = 25.863\ N/kg$

$g = 26\ N/kg$

p. 293 # 1-3, p. 295 # 1,2

3a)

$m_A = 40.0\,kg$
$m_B = 60.0\,kg$
$m_C = 80.0\,kg$
$F_{netB} = ?$

$F_{netB} = F_{gA} - F_{gC}$ * Left is +ve

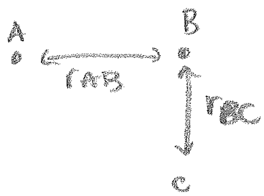
$$F_{netB} = \frac{G m_A m_B}{r_{AB}^2} - \frac{G m_{B} m_C}{r_{BC}^2}$$

$$F_{netB} = G m_B \left(\frac{m_A}{r_{AB}^2} - \frac{m_C}{r_{BC}^2} \right)$$

$$F_{netB} = (6.67\times10^{-11}\,Nm^2/kg^2)(60.0\,kg)\left(\frac{40.0\,kg}{(0.50\,m)^2} - \frac{80.0\,kg}{(0.75\,m)^2} \right)$$

$F_{netB} = 7.1\times10^{-8}\,N$ [left]

b)



$\vec{F}_{netB} = \vec{F}_{gA} + \vec{F}_{gC}$ * ~~East~~ West, North +ve

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

$$F_{gA} = \frac{(6.67\times10^{-11}\,Nm^2/kg^2)(40.0\,kg)(60.0\,kg)}{(0.50\,m)^2} = 6.4032\times10^{-7}\,N\,[W]$$

$$F_{gC} = \frac{(6.67\times10^{-11}\,Nm^2/kg^2)(80.0\,kg)(60.0\,kg)}{(0.75\,m)^2} = 5.69173\times10^{-7}\,N\,[S]$$

$$F_{netB} = \sqrt{(F_{gA})^2 + (F_{gC})^2}$$
$$= \left[(6.4032\times10^{-7}\,N)^2 + (5.69173\times10^{-7}\,N)^2\right]^{1/2}$$
$$= 8.6\times10^{-7}\,N$$

$\tan\theta = \frac{F_{gC}}{F_{gA}}$

$\theta = 42°$

$\therefore$ $F_{netB} = 8.6\times10^{-7}\,N$ [W42°S] p.293 # 1-3, p.295 # 1-2

1. $g = ?$
$m_s = 1.2 \times 10^{30}$ kg
$r = 7.0 \times 10^6$ m

$$F_g = F_g$$
$$\cancel{m}g = \frac{G\cancel{m}m_s}{r^2}$$
$$g = \frac{Gm_s}{r^2}$$

$$g = \frac{(6.67 \times 10^{-11}\ Nm^2/kg^2)(1.2 \times 10^{30} kg)}{(7.0 \times 10^6 m)^2}$$

$$g = 1.6 \times 10^6\ N/kg$$

Compared to Earth: $1.6 \times 10^6\ N/kg \div 9.8\ N/kg = 1.6 \times 10^5$ x bigger!

2 $g_s = \frac{Gm_s}{r_s^2}$

But with radius doubled:
$$g_s = \frac{Gm_s}{(2r_s)^2}$$
$$g_s = \frac{1}{4}\frac{Gm_s}{r_s^2}$$

∴ the new gravitational field strength will be $\frac{1}{4}g_s$.