The mass of the sun is 2e30 kg, and the mass of the Earth is 6e24 kg. The distance from the sun to the earth is 1.5ell m.

Calculate the magnitude of the gravatational force exerted by the Sun on the Earth.

$$|\vec{F}_g| = G\frac{m_s m_e}{|\vec{r}|^2}$$

$$= 6.7e{-}11\,\frac{2e30 \cdot 6e24}{1.5ell^2}$$

$$= 3.5733e22\ N$$

Calculate the magnitude of the gravatational force exerted by the Earth on the Sun.

Same magnitude

$$|\vec{F}_g| = 3.5733e22\ N$$

Calculate the magnitude of the gravatational force exerted by Mercury on a 60 kg human standing on the surface of Mercury. Mercury has a radius of 3.3e23 kg and a radius of 2.4e6 m.

$$|\vec{F}_g| = G\frac{m_1 m_2}{|\vec{r}|^2}$$

↳ $|\vec{r}| = 2.4e6\,m$

$$|\vec{F}_g| = 230.3125$$

A planet of mass 3e24 kg is at location $\langle 5e11, -5e11, 0 \rangle$. A star of mass 4e30 kg is at location $\langle -5e11, 5e11, 0 \rangle$.

What is the position vector from the planet to the star?

$$\vec{r}_{p\,to\,s} = \vec{r}_s - \vec{r}_p$$

$$= \langle -10e11, 10e11, 0 \rangle \text{ m}$$

What is the magnitude of this vector?

$$|\vec{r}_{p\,to\,s}| = \sqrt{-10e11^2 + 10e11^2}$$

$$= 1.4142e12 \text{ m}$$

What is the unit vector of this vector?

$$\hat{r}_{p\,to\,s} = \frac{\vec{r}}{|\vec{r}|}$$

$$= \langle -0.7071, 0.7071, 0 \rangle$$

What is the magnitude of force exerted on the planet by the star?

$$|\vec{F}_g| = G\frac{m_1 m_2}{|\vec{r}|^2}$$

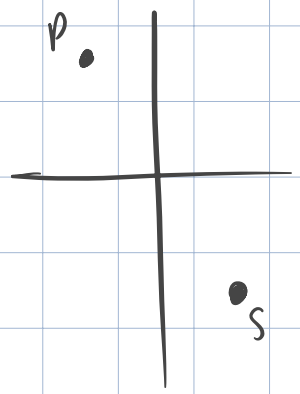
$$= 4.0326e20 \text{ N}$$

What is the force vector for the force exerted on the planet by the star?

$$\vec{F}_g = |\vec{F}_g|\hat{F}$$

$$= \langle -2.8155e20, 2.8155e20, 0 \rangle N$$

A planet of mass 7e24 kg is at location $\langle -3e11, 8e11, 0 \rangle$ m. A star of mass 9e30 kg is at location $\langle 5e11, -5e11, 0 \rangle$ m. What is the force exerted on the <u>planet</u> by the <u>star</u>?




$$\vec{F}_{\text{gravity on p by s}} = |\vec{F}_g| \cdot \hat{r}_{p\text{ to }s}$$

$$\hookrightarrow |\vec{F}_g| = G\frac{m_1 m_2}{|\vec{r}_{p\text{ to }s}|^2}$$

$$\hookrightarrow \vec{r}_{p\text{ to }s} = \vec{r}_s \text{ to } \vec{r}_p$$

$$= \langle 8e11, -13e11 \rangle m$$

$$\hookrightarrow |\vec{r}_{p\text{ to }s}| = 1.5264e12 \text{ m}$$

$$|\vec{F}_g| = 1.8116e21$$

$$\hookrightarrow \hat{r}_{p\text{ to }s} = \frac{\vec{r}}{|\vec{r}|}$$

$$= \langle 0.5241, -0.8517, 0 \rangle$$

$$\vec{F}_{\text{gravity on p by s}} = \langle 9.495e20, -1.543e21, 0 \rangle$$