Understanding the planetary model

Given the following,

$$G = 6.674 \times 10^{-11}\ \frac{\mathrm{Nm}^2}{\mathrm{kg}^2}$$
$$\mathrm{m}_{\mathrm{earth}} = 5.97 \times 10^{24}\ \mathrm{kg}$$

$$\mathrm{m}_{\mathrm{sun}} = 1.98 \times 10^{30}\ \mathrm{kg}$$

$$R = 1.5 \times 10^{11}\ \mathrm{m}$$

Calculate both the attractive force and the centripedal force of the earth.

$$F_{\mathrm{attract}} = G\frac{\mathrm{m}_{\mathrm{earth}}\mathrm{m}_{\mathrm{sun}}}{R^2}\ \ and\ \ F_{\mathrm{centripedal}} = \mathrm{m}_{\mathrm{earth}}\omega^2 R$$

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First we use the universal law of gravitation to find the force of attraction between the earth and sun:

$$F_{\mathrm{attract}} = \left(6.674 \times 10^{-11}\ \frac{\mathrm{Nm}^2}{\mathrm{kg}^2}\right) \frac{(5.97 \times 10^{24}\ \mathrm{kg})(1.98 \times 10^{30}\ \mathrm{kg})}{(1.5 \times 10^{11}\ \mathrm{m})^2}$$

$$F_{\mathrm{attract}} = 3.5 \times 10^{22}\ \mathrm{N}$$

To obtain the centripedal force we need to know w. Since it takes the earth one year to revolve around the sun the frequency of revolution in seconds is the inverse of the number of seconds in a year.

$$\left(60\ \frac{\mathrm{sec}}{\mathrm{min}}\right)\left(60\ \frac{\mathrm{min}}{\mathrm{hr}}\right)\left(24\ \frac{\mathrm{hr}}{\mathrm{day}}\right)\left(365\,\frac{\mathrm{day}}{\mathrm{year}}\right) = 3.15 \times 10^{7}\ \frac{\mathrm{seconds}}{\mathrm{year}}$$

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Based on the value for the number of seconds per year we can obtain the frequency of revolution of the earth:

$$\nu = 3{,}17 \times 10^{-8}\ \mathrm{s}^{-1}$$

The angular frequency is

$$\omega = 2\pi\nu = 2 \times 10^{-7}\ \mathrm{s}^{-1}$$

and the centripedal force is:

$$F_{\mathrm{centripedal}} = (5.97 \times 10^{24}\ \mathrm{kg})(2 \times 10^{-7}\ \mathrm{s}^{-1})^2(1.5 \times 10^{11}\ \mathrm{m})$$

which computes to:

$$F_{\mathrm{centripedal}} = 3.5 \times 10^{22}\ \mathrm{N}$$

Understanding the planetary model

For the earth we find that

$$F_{\mathrm{attract}} = 3.5 \times 10^{22}\ \mathrm{N}$$

and

$$F_{\mathrm{centripedal}} = 3.5 \times 10^{22}\ \mathrm{N}$$

The balance of forces is a wonderful thing since without it we would either slide into the sun and burn up or fly out into space and freeze to death.