

## The Sun and Solar Rotation

The Sun makes up about 99% of the mass of our solar system. Without it we wouldn't survive, so let's learn some more about it by applying what you know about rotational kinematics.

The outer layers of the Sun exhibit differential rotation: at the equator the surface rotates once every 25.4 days; near the poles it's as much as 36 days. This odd behavior is due to the fact that the Sun is not a solid body like the Earth. We also know that its diameter at the equator is about 1,390,000 km.

(<http://www.nineplanets.org/sol.html>)

1. What is the Sun's radius in  $m$ ?

$$\left(\frac{1,390,000 \text{ km}}{2}\right)\left(\frac{1,000 \text{ m}}{1 \text{ km}}\right) = 695,000,000 \text{ m}$$

2. What is the Sun's circumference in  $m$ ?

$$C = 2\pi r = (2)(3.14)(695,000,000 \text{ m}) = 4,364,600,000 \text{ m}$$

3. What is the Sun's rotation period at the equator in  $s$ ?

$$(25.4 \text{ days})\left(\frac{24 \text{ hr}}{1 \text{ day}}\right)\left(\frac{60 \text{ min}}{1 \text{ hr}}\right)\left(\frac{60 \text{ s}}{1 \text{ min}}\right) = 2,194,560 \text{ s}$$

4. What is the Sun's tangential velocity  $v_T$  at the equator in  $m/s$ ?

$$\frac{4,364,600,000 \text{ m}}{2,194,560 \text{ s}} = 1,989 \text{ m/s}$$

5. What is the Sun's angular velocity  $\omega$  at the equator in  $rad/s$ ?

$$\left(\frac{1 \text{ revolution}}{25.4 \text{ days}}\right)\left(\frac{2\pi \text{ radians}}{1 \text{ revolution}}\right)\left(\frac{25.4 \text{ days}}{2,194,560 \text{ s}}\right) = 2.86 \times 10^{-6} \text{ rad/s}$$

6. What is the Sun's centripetal acceleration  $a_c$  at the equator in  $m/s^2$ ?

$$a_c = \frac{v_T^2}{r} = \frac{(1,989 \text{ m/s})^2}{695,000,000 \text{ m}} = 5.69 \times 10^{-3} \text{ m/s}^2$$