Q) The radius of earth's orbit around the sun, assumed to be circular, is $1.5 \times 10^8$ km and the earth travels around this orbit in 365 days.

(i) What is the magnitude of the orbital velocity of earth in ms$^{-1}$?

(ii) What is the radial acceleration of earth towards the sun in ms$^{-2}$?

Ans)Consider that in one year the Earth travels the entire circumference of the circle (ok, it should be an ellipse but let us assume it is a circle) of radius

$$r = 1.5 \times 10^{11} m$$

So :

in 1 year, 363 days, each day 24 hours, each hour 60 minutes and each minute 60 seconds, or:

$$365 \times 24 \times 60 \times 60 = 3.15 \times 10^7 m \approx 3 \times 10^7$$

seconds.

i) Describing a distance of

$$2\pi r 2.314.1.5 \times 10^{111} = 9.42 \times 10^{11}\,m \approx 9 \times 10^{11}\,m$$

Velocity will be:

$$v = \frac{distance}{time} = \frac{9 \times 10^{11}}{3 \times 10^7} = 3 \times 10^4\,\frac{m}{s}$$

ii) The radial acceleration of the earth toward the sun, in $m/s^2$, is

$$a_E = \frac{4\pi^2 R_E}{T^2} = \frac{4\pi^2(1.50 \times 10^{11} \text{ m})}{(3.15 \times 10^7 \text{ s})^2} = 5.97 \times 10^{-3} \text{ m/s}^2.$$