Académie de Toulouse – sections européennes – session 2014

Sujet n°6

FUNCTIONS

Please do not write on the subject paper and don't forget to give back the examination paper at the end of the test.

Indroduction :

Gravity is a great real life application of the inverse (indirect) square law, or, 'y is inversely proportional to the square of x'. The gravity field of a body (comet, planet, star etc) is inversely proportional to the distance from the centre of the body, squared.

As an equation this is : $g = \frac{k}{r^2}$,

Where *g* is the gravity field of a body (acceleration due to gravity in $m.s^{-2}$), *r* is the distance from the centre of the body (in m) and k is a constant.

Questions :

1. For each of the bodies listed below, use the figures for surface gravity and radius to find the different values for *k*. Give your answers with scientific form using one decimal place. (Expect large *k* values!)

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn
Surface Gravity ($m.s^{-2}$)	3.70	8.87	9.81	3.69	24.79	3.69
Radius (km)	2,439	6,051	6,378	3,396	71,492	60,268

2. In each of your equations the constant k actually represents the mass m in kg of each planet multiplied by the gravitational constant (G), as discovered by Sir Isaac Newton. As an equation this is $k = G \times m$ and hence $g = \frac{G \times m}{r^2}$

   The gravitational constant is a very small number measured in Newtons or $kg.m.s^{-2}$ $G = 6.674 \times 10^{-11}$

   Find the mass of each given planet.

3. The Earth orbits the Sun at an average distance of 150 billion metres (from its centre). knowing that the mass in kg of ou Sun is 2×10^{30}, what is the gravitational acceleration *g* of the Earth towards the Sun as a result of the Sun's gravitational field ?

adapted from http://www.colmanweb.co.uk/spacemaths.htm