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General Physics I, Quiz 3
PHYS1000AA, Class year104/2015
2015-11-12, Thursday

Quiz-3 Solution

1. Solution : ***(Similar to problem No.10, Chap.13, text book 9th edition)***

(a) Newton's law of gravity is defined by

$$F = \frac{GMm}{r^2},$$

Where G = Universal gravitational constant , M and m are the mass of two object in universe, r = distance between the objects, F = force between them.

(b) We know that , gravitational force

$$F = \frac{GM_{earth}m}{(R_{earth}+h)^2}$$, where m = mass of meteoroid , h = distance of mateoroid from earth surface

$$ma = \frac{GM_{earth}m}{(R_{earth}+h)^2}$$, where a = acceleration of meteoriod due to earth gravity

$$\therefore a = \frac{GM_{earth}}{(R_{earth}+h)^2} = \frac{6.67\times10^{-11}\times6.0\times10^{24}}{(R_{earth}+5R_{earth})^2} = \frac{6.67\times10^{-11}\times6.0\times10^{24}}{(6R_{earth})^2}$$

$$= \frac{6.67\times10^{-11}\times6.0\times10^{24}}{(6\times6.4\times10^{6})^2} = 0.30\ m/s^2$$

(c) For angular motion we can define the cetripetal force in our case as bellow

$$F = \frac{mv^2}{(R_{earth}+h)} \Rightarrow ma = \frac{mv^2}{(R_{earth}+h)} \Rightarrow a = \frac{v^2}{(R_{earth}+h)} \Rightarrow v = \sqrt{(R_{earth}+h)\times a}$$

$$\therefore v = \sqrt{(R_{earth}+5R_{earth})\times a} = \sqrt{(6\times6.4\times10^{6})\times0.3} = 3.5km/s$$

2. Solution: ***(Similar to problem No37, Chap.13, text book 9th edition)***

(a) Kepler's third law of planetary motion is

$T^2 = K_S a^3$, where T is period of planeatary revolution , a = The semimajor axis length of orbit

and K_S = constant of proportionality (with respect to Sun)

(b) From figure we can find the major axis length of the orbit is

$2a = 2.5 \quad \therefore a = 1.25$ AU

and a+c= 2.0 $\quad \therefore c = 0.75$ AU , where c is the distance between focus and the center of orbital axis

$\therefore$ ecentricity $e = \frac{c}{a} = \frac{0.75}{1.25} = 0.66$

(c)We know that $T^2 = K_S a^3$

So $\quad T = \sqrt{K_S a^3} = a\sqrt{K_S a} = 1.25 \text{ AU} \times \sqrt{2.97 \times 10^{-19} \times 1.25 \text{ AU}}$

$= 1.25 \times 1.496x10^{11} \times \sqrt{2.97 \times 10^{-19} \times 1.25 \times 1.496x10^{11}}$

$= 55165000 \text{ seconds} = \frac{55165000 \; days}{3600 \times 24} = 638.5 \; days = 1.78 years$