Physics
Theory Part 27

Topics: Classical Mechanics/ Gravitational Theory

Course: B.Sc/ Physics

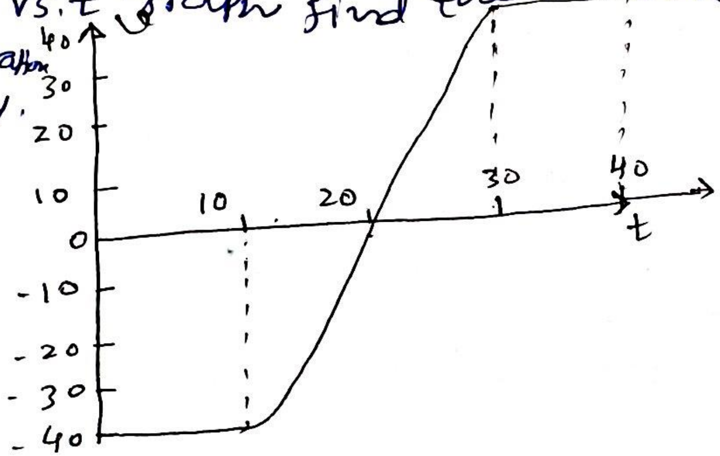
Dr. Rajesh Kumar Neogy

Assistant Professor, Physics

M. L. Arya College, Kasba

Purnea University, Purnia, Bihar

From the given v vs. t graph find the accleration of each segment and average Accleration for whole Journey.



$$\sqrt{0.06^2 + 1.75^2}$$
$$= \sqrt{0.0036 + 3.0625}$$
$$= \sqrt{3.0661} = 1.75\ m$$

(a) From time, $t = 0$ to $t = 10\,sec$

velocity at $t = 0$ is $v_0 = -40\ m/s$ $\therefore$ Avg. Acceleration $a_{(a)} = \dfrac{v_{10} - v_0}{t_{10} - t_0} = \dfrac{-40+40}{10} = \boxed{0\ m/s^2}$

" " $t = 10s$ is $v_{10} = -40\ m/s$

(b) From time, $t = 10s$ to $t = 30s$

velocity at $t = 10s$ is $v_{10} = -40\ m/s$ $\therefore$ Avg. Acceleration $a_{(b)} = \dfrac{v_{30} - v_{10}}{t_{30} - t_{10}} = \dfrac{40-(-40)}{30-10} = \dfrac{80}{20} = \boxed{4\ m/s^2}$

" $t = 30s$ is $v_{30} = 40\ m/s$

©neogyMLAC
rajesh.neogy@gmail.com

(c) from time $t = 0s$ to $t = 40s$

first we have to find Avg. Accl.

between $t = 30\,s$ to $t = 40\,s$

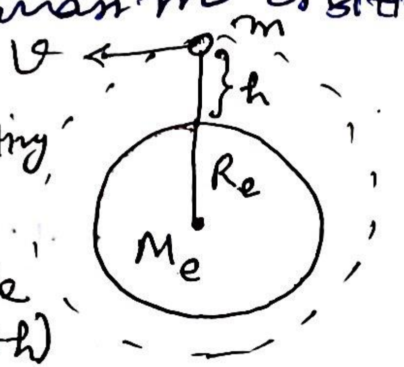
velocity at $t = 30$, $v_{30} = 40\ m/s$ $\therefore$ Avg. Accleration $a_{(c)} = \dfrac{v_{40} - v_{30}}{t_{40} - t_{30}} = \dfrac{40-40}{40-30} = 0\ m/s^2$

" " $t = 40$, $v_{40} = 40\ m/s$

Now overall avg. Acceleration between $t = 0$, $t = 40\,s$ is the Avg. of all Acclera

$$\therefore a_{Total} = \frac{a_{(a)} + a_{(b)} + a_{(c)}}{3} = \frac{0+4+0}{3} = \boxed{1.33\ m/s^2}$$

Find the Total Energy of a sattellite of mass m orbiting around Earth at height h



Satellite of mass m is orbitting around the earth at a height h above the surface of the earth. Let $r = (R_e + h)$

We know that acceleration due to gravity at a height h above earth is given by

$$g_h = \frac{GM_e}{(R_e+h)^2} = 0.233 \ m/s^2$$

$$\text{or, } (R_e+h) = \sqrt{\frac{GM_e}{0.233}} \quad \text{—(1)}$$

Centripetal force = Gravitational force

$$\therefore \frac{mv^2}{r} = \frac{GmM_e}{r^2} \Rightarrow v = \sqrt{\frac{GM_e}{r}}$$

rajesh.neogy@gmail.com

Now K.E of sattelite, $T = \frac{1}{2}mv^2 = \frac{GM_e m}{2r}$ (+ve)

& P.E " " , $V = -\frac{GM_e m}{r}$ (-ve)

$$\therefore \text{Total Energy, } E = T + V = \frac{GM_e m}{2r} - \frac{GM_e m}{r} = -\frac{GM_e m}{2r} = -\frac{GM_e m}{2(R_e+h)}$$

$$\text{or, } E = -\frac{GM_e m}{2 \times \sqrt{\frac{GM_e}{0.233}}} = -\frac{m\sqrt{GM_e \times 0.233}}{2} = -0.241 \times m\sqrt{GM_e}$$

$$= -0.241 \times 620 \times \sqrt{6 \times 10^{24} \times 6.67 \times 10^{-11}} = -149.63\sqrt{40.02 \times 10^{13}} = -149.63 \times 20 \times 10^{6}$$

$$= \boxed{-2993.3 \times 10^{6} \text{ J}}$$

FOR ANY QUERIES FEEL FREE TO CONTACT ME AT EMAIL: RAJESH.NEOGY@GMAIL.COM

These study materials are meant only for personal use by our own students and no commercial/ Publication use etc.

Thanksss