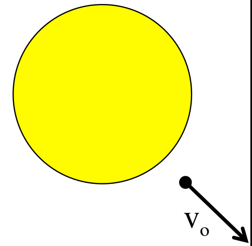
Problem 13.34



How fast will a satellite be moving if shot from the earth with a given initial speed?

As there is nothing out in space to produce much friction, energy is conserved. Using the "far out" potential energy function, the potential energy at the earth's surface is NOT zero, as it might be if we were using the "near in" function of "mgy." In any case, *conservation of energy* is the ticket.

As this is going to take the whole page, it is presented on the next page.

$$\sum KE_1 + \sum U_1 + \sum W_{ext} = \sum KE_2 + \sum U_2$$

$$\frac{1}{2}m(v_o)^2 + \left(-\frac{GmM}{R_{earth}}\right) + 0 = \frac{1}{2}m(v_{farAway})^2 + \left(-\frac{GmM}{R_{farAway}}\right)$$

$$\Rightarrow v_{farAway} = \left[\frac{2\left(\frac{1}{2}m(v_o)^2 + \left(-\frac{GmM}{R_{earth}}\right)\right)}{m}\right]^{1/2}$$

$$= \left[(v_o)^2 + 2\left(-\frac{GM}{R_{earth}}\right)\right]^{1/2}$$

$$= \left[(2.00\text{x}10^4 \text{ m/s})^2 + 2\left(-\frac{(6.67\text{x}10^{-11} \text{ N}\bullet\text{m}^2/\text{kg}^2)(5.98\text{x}10^{24} \text{ kg})}{(6.37\text{x}10^6 \text{ m})}\right)\right]^{1/2}$$

$$= 1.66\text{x}10^4 \text{ m/s}$$