Suppose we want a satellite to revolve around Erath 7.5 times a day. What should the radius of its orbit be ?

For Earth $R^3/T^2 = 10{*}10^{12}\ m^3/s^2 = \frac{GM_E}{4\pi^2}$

Now we want T = 24 h/ 7.5 times = 11520 s

$$R^3 = (10{*}10^{12}).(11520)^2$$

$$R = \sqrt[3]{10{*}10^{12}(11520)^2}$$

$$= 1.09 * 10^7\ m$$

Find the orbital speed of as satellite orbiting about a planet, if the mass of the planet is 5.67 x 10^{26} kg and the radius of the orbit is 250,000 km.

Note: G = 6.67x 10^{-11} $N.m^2/kg^2$

$$\frac{mv^2}{r} = F_g = G\frac{mM}{r^2}$$

Centripetal Force = $m_{Sat} . V^2/R_{Orbit}$ = Gravitational Force = G .$M_{Planet} . m_{Sat}/R^2_{(orbit)}$

$$V^2 = \frac{G . M_{PLANET}}{R}$$

$$V = \sqrt{\frac{G . M_{PLANET}}{R}}$$

$$= \sqrt{\frac{(6.67 \times 10^{-11})\ 5.67 \times 10^{26}}{250000 \times 10^3 m}}$$

$$= 1.22 \times 10^3 \frac{m}{s}$$

$M_{Mars} = 6.42 \times 10^{23}$ kg, $R_{Mars} = 3.37 \times 10^{6}$ m

$v_{esc_{Mars}} = ?$

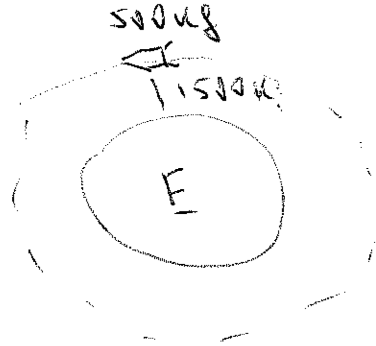
68. ORGANIZE AND PLAN The escape speed from the surface of Mars can be found using Eq. 9.6, replacing the Earth's mass and radius with the mass and radius of Mars.

Known: $M_{Mars} = 6.42 \times 10^{23}$ kg, $R_{Mars} = 3.37 \times 10^{6}$ m.

SOLVE The escape speed from the surface of Mars is [Eq. 1]

$$v_{esc} = \sqrt{\frac{2GM_{Mars}}{R_{Mars}}} = \sqrt{\frac{2(6.67 \times 10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2)(6.42 \times 10^{23}\ \text{kg})}{3.37 \times 10^{6}\ \text{m}}} = 5.04\ \text{km/s}$$

REFLECT This is less than half the escape speed from the Earth's surface, which is 11.2 km/s.



61. ORGANIZE AND PLAN Use Eq. 9.7 to calculate the total energy of the satellite. The radius of the satellite's orbit is [Eq. 1] $r = R_E + h$, where h is the height of the satellite above the surface of the Earth.

Known: $m = 500$ kg; $h = 1500$ km; $M_E = 5.97 \times 10^{24}$ kg; $R_E = 6.37 \times 10^6$ m (Appendix E)

SOLVE Using Eq. (1) in Eq. 9.7 gives [Eq. 2]

$$E = -\frac{GM_E m}{2(R_E + h)} = -\frac{(6.67 \times 10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2)(5.97 \times 10^{24}\ \text{kg})(500\ \text{kg})}{2(6.37 \times 10^6\ \text{m} + 1.5 \times 10^6\ \text{m})} = -1.26 \times 10^{10}\ \text{J}$$

REFLECT Notice that the height was converted to SI units to be consistent with the other quantities in the calculation.