32 $U_g = ?$

$$U_g = G\frac{m\,M}{r}$$

$$U_g = -6.67E\text{-}11\,\frac{(5.2)(2.4)}{19.04_m}$$

$$U_g = -4.37\times10^{-11}\,J$$

29. $K_{min} = ?$ (to escape)

To escape, $K_i + U_i = 0$

$$K_i + (-5 \times 10^9 \text{ J}) = 0$$

$$K_i = 5 \times 10^9 \text{ J}$$

36. $K = ?$ $\quad E_0 = 5 \times 10^7 \text{ J}$

$r_f = 4 \times 10^6 \text{ m}$

$$E = K + U$$

$$= K + \left(\frac{-GMm}{r}\right)$$

$$5E7 = K + \left(-G\frac{(5E23)(10)}{4E6}\right)$$

$$K = 1.33 \times 10^8 \text{ J}$$

b) $K_0 = ?$ if $r_f = 8 \times 10^6 \text{ m}$

43. $V = ?$ (circular orbit)

$a_H = 160\ km \qquad r = 6.53E6\ m$

$M_E = 5.98E24\ kg$

$$\Sigma F_c = \frac{mv^2}{r}$$

$$G\frac{M\cancel{m}}{\cancel{r^2}} = \frac{\cancel{m}v^2}{\cancel{r}}$$

$$G\frac{M}{r} = v^2$$

$$\sqrt{\frac{GM}{r}} = V$$

$$\sqrt{\frac{G(5.98E24)}{6.53E6}} = V$$

$$7816\ m/s = V$$

b) $T = ?$ $\qquad V = \dfrac{2\pi r}{T}$

$$T = \frac{2\pi r}{V} = \frac{2\pi(6.53E6)}{7816}$$

50. $T = 86\,400\ s$ (one day)

$alt = ?$

$$v^2 = \frac{GM}{r}$$

$$\left(\frac{2\pi r}{T}\right)^2 = \frac{GM}{r}$$

$$4\pi^2 r^3 = GMT^2$$

$$r = \sqrt[3]{\frac{GMT^2}{4\pi^2}}$$

$$r = \sqrt[3]{\frac{G(5.98E24)(86\,400)^2}{4\pi^2}}$$

$$r = 4.23 \times 10^7\ m$$

$$\boxed{alt = 3.59E7\ m}$$

62 a) $\frac{U_B}{U_A} = ?$ $\quad U = -G\frac{Mm}{r}$

$$\frac{U_B}{U_A} = \frac{\frac{GM_E m_S}{(2.548E7)}}{\frac{GM_E m_S}{(1.274 \times 10^7)}} = \frac{1.274\,E^7}{2.548\,E7}$$

$$= 0.5$$

b) $\frac{K_B}{K_A} = ?$ $\quad K = \frac{-U}{2}$ (see p. 345 + 346)

$$\frac{K_B}{K_A} = \frac{\frac{-U_B}{2}}{\frac{-U_A}{2}} = \frac{U_B}{U_A} = 0.5$$

c) $\frac{E_B}{E_A} = ?$ $\quad E = \frac{-GMm}{2r}$

$$\frac{E_B}{E_A} = \frac{\frac{-Gmm}{5.168E7}}{\frac{-Gmm}{2.548E7}} = 0.5$$

so $E_A = 2E_B$

60. $E = ?$ $\quad U = -G\frac{Mm}{r}$ $\quad K = -\frac{U}{2}$

$E = U + K$

$E = K_A + K_B + U_{A\text{-}E} + U_{B\text{-}E}$

$E = (-U_{A\text{-}E}) + (2U_{A\text{-}E})$

$E = U_{A\text{-}E}$

$E = -G\frac{M_E m_A}{r_{orbit}} = -G\frac{(5.98\times10^{24})(12.5)}{7.87\times10^{6}}$

$E = -6.34\times10^{9}\ \text{J}$

b) $E_f = ? = U_f$ $(K_f = 0$

$$U_f = -\frac{2GMm}{r}$$

$$E_f = -1.27 \times 10^{10}\ \text{J}$$