13.29 Escape velocity from Mars = ?

How fast would we need to travel for all our K at the surface of Mars to turn into U?

$$\Sigma \text{Energy}_i = \Sigma \text{Energy}_f$$

$$U_i + K_i = U_f + K_f$$

$$-\frac{GMm}{r} + \frac{1}{2} m v_{esc}^2 = 0 \text{ (at } \infty) + 0$$

$$\frac{1}{2} m v_{esc}^2 = \frac{GMm}{r}$$

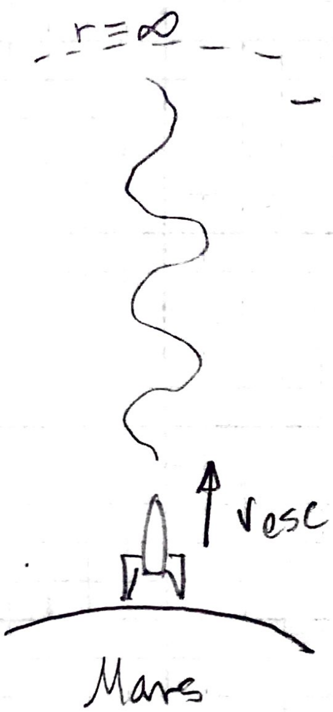
$$v_{esc} = \sqrt{\frac{2GM}{r}}$$

From Appendix in book

$$= \sqrt{\frac{(2)(6.672e{-11})(0.11 * 5.97e24\,kg)}{(6.794e6\,m/2)}}$$

$$= 5079\,m/s$$

$$\boxed{= 5.08e3\ m/s}$$



13.32

a)

$U_g = ?$

$$U = \frac{-GMm}{r}$$

$$= \frac{-(6.672e{-11})(5kg)(5kg)}{0.15\,m}$$

$$= \boxed{-1.11e{-8}\ J}$$

b) Released from rest, they will be attracted to each other & accelerate (slowly!) toward each other. How fast will they be traveling at impact? ($r_{each} = 0.0510m$)

$2 \times 0.0510 = 0.102m$

$$\Sigma E_i = \Sigma E_f$$

$$U + K + K = U + K + K$$

$$-\frac{GMm}{r_i} = -\frac{GMm}{r_f} + \left(\tfrac{1}{2}mv^2\right)(2)$$

Solve

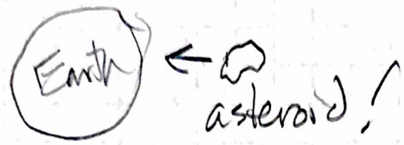
$$GMm\left(\frac{1}{r_f} - \frac{1}{r_i}\right) = mv^2$$

$$v = \sqrt{GM\left(\frac{1}{r_f} - \frac{1}{r_i}\right)}$$

$$= \sqrt{(6.672e{-11})(5)\left(\frac{1}{0.102} - \frac{1}{0.15}\right)}$$

$$= \boxed{3.24e{-5}\ m/s}$$

13.33



m = 2.0e13 kg

m = 5.98e24 kg

Initial distance
5.0e10 m

Initial v = 2.0e3 m/s

I'll consider atmosphere to effectively be at the surface of the earth = 6.37e6 m

Find v at atmosphere (surface)

$$\Sigma E_i = \Sigma E_f$$

$$U + K = U + K$$

$$-\frac{GMm}{r_i} + \frac{1}{2}mv_i^2 = -\frac{GMm}{r_f} + \frac{1}{2}mv_f^2$$

$$2\left(GM\left(\frac{1}{r_f} - \frac{1}{r_i}\right) + \frac{1}{2}v_i^2\right) = v_f^2$$

$$v_f = \sqrt{2(6.672e{-11})(5.98e24)\left(\frac{1}{6.37e6} - \frac{1}{5e10}\right) + (2000)^2}$$

$$= \boxed{1.14\ e4\ m/s}$$