Q 2-1.

To escape from the earth, we need

$$U_{diff} =$$

$$= \underbrace{\frac{G(81.3\,M)(m)}{(3.7R)}}_{\text{potential E of the earth}} - \underbrace{\frac{G(M)(m)}{R + L_0/4}}_{\text{potential E at the Moon}} \quad \text{at least}$$

Since we need additional energy to compress the spring in the Moon, we need more energy as follows.

$$U_{spring} = \frac{1}{2} k \left(\underbrace{\tfrac{3}{4} L_0}_{\Delta L = L_0 - \frac{L_0}{4}}\right)^2$$

energy principle

Thus, $K_{trans} = U_{diff} + U_{spring}$ (or $\Delta E = 0$ where $K - U_{diff} - U_{spring}$

$$\frac{1}{2} \cancel{m} v_i^2 = \frac{G(81.3\,M)\cancel{(m)}}{(3.7R)} - \frac{G(M)\cancel{(m)}}{R + L_0/4} + \frac{1}{2} k \left(\frac{3}{4} L_0\right)^2$$

Answer:

$$\boxed{V_i = \sqrt{\frac{2G(81.3M)}{(3.7R)} - \frac{2G(M)}{R + L_0/4} + \frac{k}{m}\left(\frac{3}{4}L_0\right)^2}}$$

Q 2.2

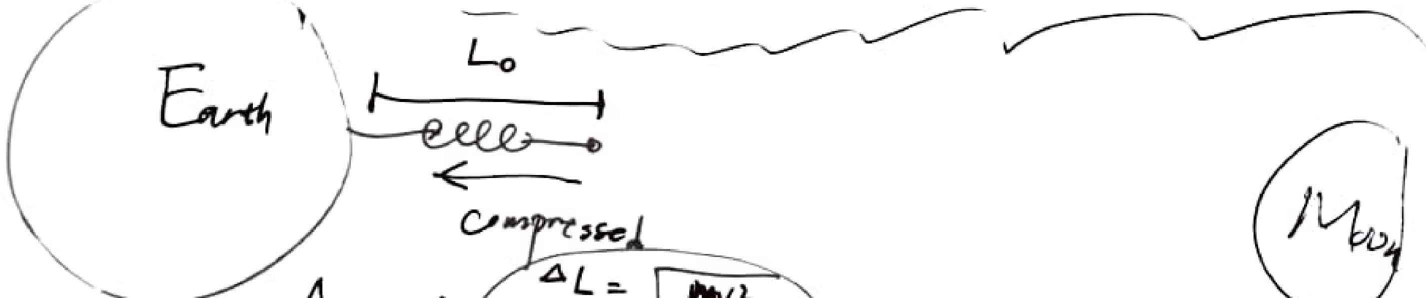
Again, Energy principle,

$$\Delta K = \Delta U_{spring}$$

$$\frac{1}{2}mv^2 = \frac{1}{2}(2k)\cdot(\Delta L)^2$$

That is,

$$\Delta L = \sqrt{\frac{mv^2}{2k}}$$



Answer: $\Delta L = \sqrt{\frac{mv^2}{2k}}$

compressed up to it's length $= L_0 - \sqrt{\frac{mv^2}{2k}}$

<Diagram>