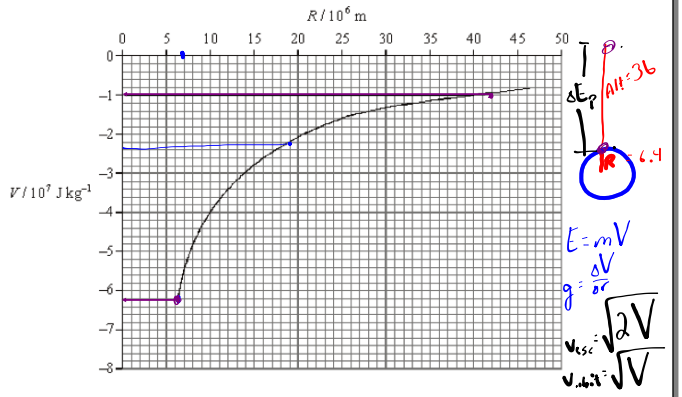
2. The graph below shows the variation of gravitational potential V due to the Earth with distance R from the centre of the Earth. The radius of the Earth is 6.4 x 10^6 m. The graph does not show the variation of potential V within the Earth.

$r = 42.4 \times 10^6$ m



ΔE_p All = 36

6.4

$E = mV$

$g = \frac{\Delta V}{\Delta r}$

$v_{esc} = \sqrt{2V}$

$v_{orbit} = \sqrt{V}$

Use the graph to determine the minimum energy required to put a satellite of mass 1.0 x 10^4 kg into an orbit at a height of 3.6 x 10^7 m above the surface of Earth.

$E_{p_i} = m V_i = 10^4 kg \cdot (-6.2 \times 10^7 J/kg) = -6.2 \times 10^{11} J$

$E_{p_f} = m V_f = 10^4 kg (-1 \times 10^7 J/kg) = -1 \times 10^{11} J$

$\Delta E_p = 5.2 \times 10^{11} J$

$E_K = \frac{1}{2} E_p = 0.5 \times 10^{11} J$

$E_K = \frac{1}{2} m v^2$

$v_{orbit} = \sqrt{V}$

$V_{orbit} = \sqrt{\frac{GM}{r}}$

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

More energy than this is needed because: