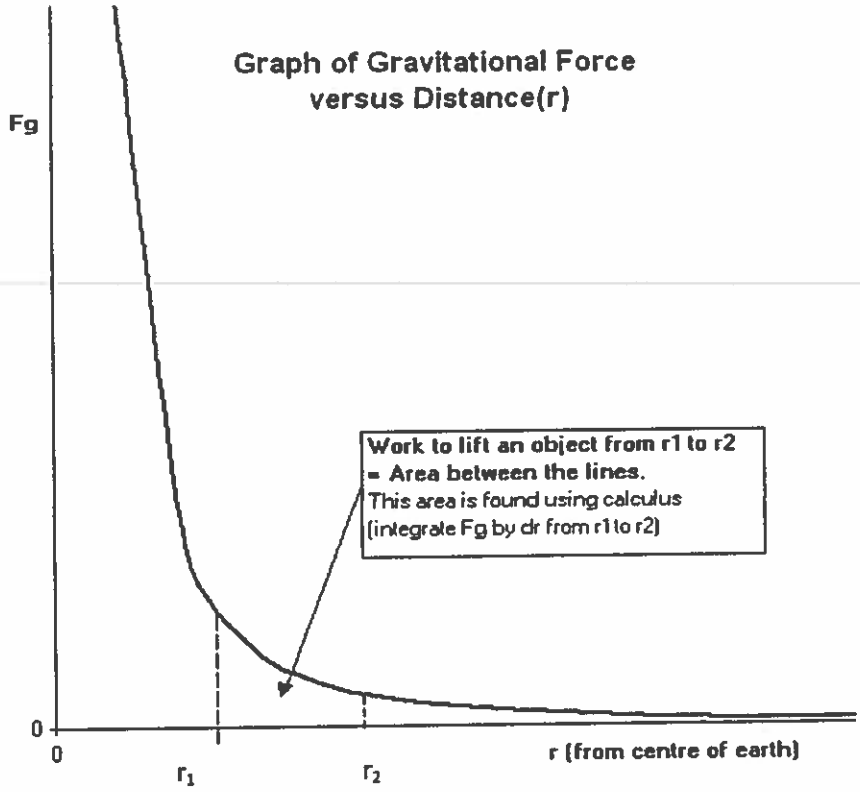
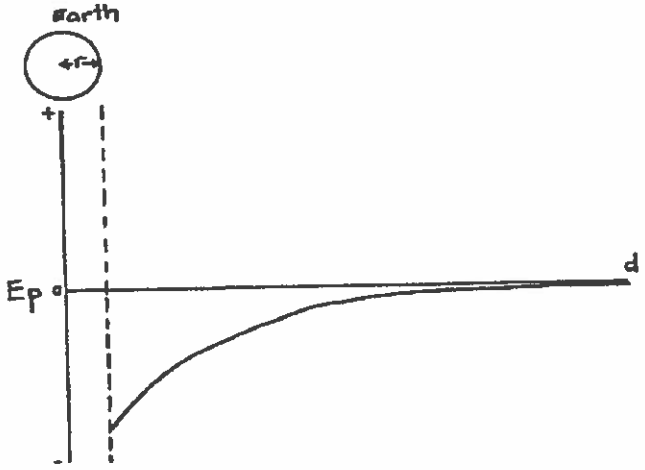
Gravitational Potential Energy not on Earth



- A graph of the E_p =*GPE* surrounding a planet:



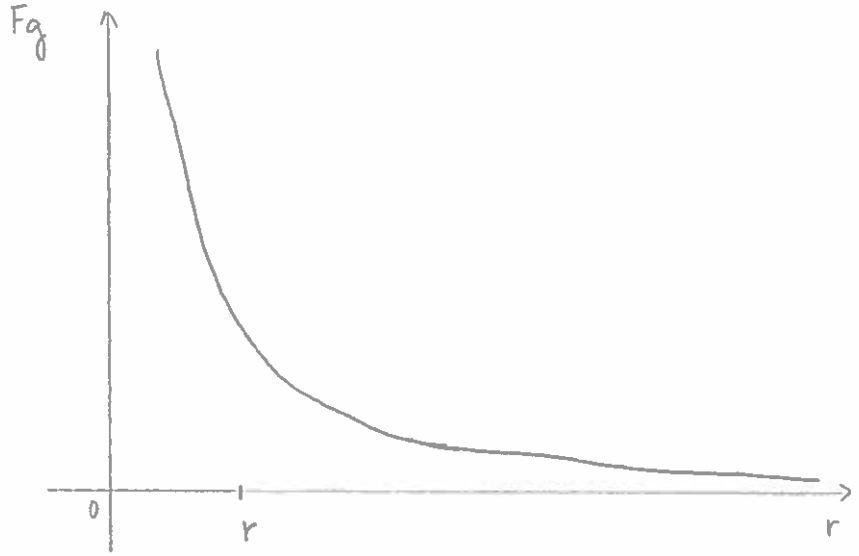
- When lifting an object against a gravitational field, e.g. launching a rocket, work is done on the object, that is, energy is transferred to the object. The object's gravitational potential energy, E_p =GPE, that is, the energy it has due to its position within the gravitational field, increases as a result.

- When an object moves toward the source of the gravitational field, such as when dropping a stone, energy due to position in a field is transformed into kinetic energy (the stone speeds up).

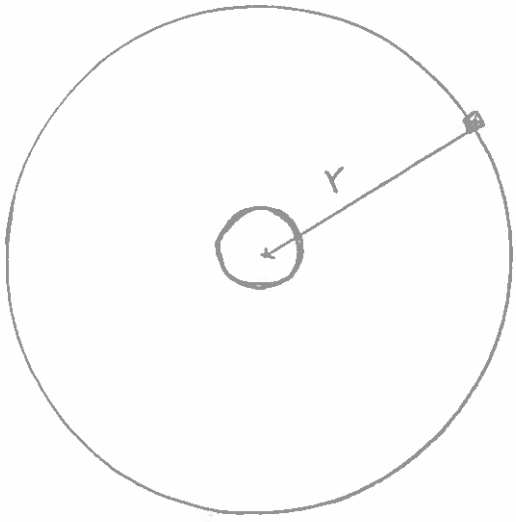
- Hence the position of lowest E_p =**GPE** in the gravitational field surrounding a planet is at the surface of the planet.

- An object only has zero E_p = **GPE** when it is no longer within the gravitational field, that is, a very large distance away. (Mathematically, distance must be infinite.) We say: **gravitational potential energy relative to zero at infinity.**

Example 1. Which of the indicated areas of the graph represent the work needed to send an object from separation distance r to infinity?



Example2: State the expression for the total energy of the orbiting satellite shown below?



Example 3. A 2.0×10^3 kg satellite is in a circular orbit around the earth. The satellite has a speed of 3.6×10^3 m /s at an orbital radius of 3.1×10^7 m. What is the total energy of this orbiting satellite?

Example4. A 5.2×10^4 kg rocket is initially at rest on the surface of the earth. If 3.0×10^{11} J of work is done on this rocket, what maximum altitude h will the rocket reach? (Assume the rocket's mass does not change.)

Example 5. How much work is required to move a 560-kg satellite from altitude 3.0×10^6 m above Earth to 4.0×10^7m above Earth?