6.1 – Ep – <u>Gravitational Potential Energy in Space</u> – Practise

Mas of earth - Me = 5.98 x 10^{24} kg **radius of earth - r_e = 6.38 x 10^6 m**

1. a) What is the gravitational potential energy of a 60 kg astronaut standing on earth?
   Hint: remember 'r' is distance from astronaut to centre of earth! It is not equal to zero here!
   [-3.75 x 10^9 J]
   b) What is his change in gravitational potential energy when he is placed in orbit 400 km above earth?
   Hint: 'change' means you need to calculate ΔEp. **[ΔEp = 2.2 x 10^8 J]**
   c) How much work does it take to accomplish this feat? (assume no frictional forces).
   [W = 2.2 x 10^8 J] **Need help? Read Example 2**

2. With what initial velocity must an object be projected vertically upward from the surface of the Earth in order to rise to a height equal to the Earth's radius? (neglect any air resistance)
   Hint: Use the conservation of energy AND if you don't know mass, leave it as 'm
   [v = 7.9 x 10^3 m/s] **Need help? Read Example 4**

3. A 1.0 kg mass is lifted 100 km above the Earth's surface. Determine it's ΔEp and calculate the % error you get by using the the earthbound formula Ep = mgh instead of the more specific formula, Ep = -GMm/r . (% relative to correct ΔEp space formula! = **1.2 %)**
   Need help? Read Example 3

4. What potential energy does the moon have? We know that the distances between the centre of Earth and the centre of the moon is approximately 3.94 x 10^5 km. **[-7.4 x 10^{28} J]**
   Need help? Read example 2