Name: _____ Date: _____

WS 4.4: Gravitational Potential Energy

Unit 4: Circular Motion and Gravitation

1. How much work would a 60.0 kg person do in climbing from the surface of the Earth to the top of a mountain 2.00 km high?

   a. Use $E_p = mgh$ to find your solution. **Show all work**.

   b. Use $E_p = -GMm/r$ (both answers should be close)

   c. Why do both methods agree in this case?

2. Repeat the above question for the same person climbing a ladder to the moon (ignore the effect of the Moon's mass on his potential energy – only the Earth).

   a. Use $E_p = mgh$ to find your solution. **Show all work**.

   b. Use $E_p = -GMm/r$. **Show all work**.

   c. Why do both methods disagree in this case?

3. The escape velocity applies to any object *regardless* of its mass. Even very small particles, such as atmospheric gases, can reach escape velocities. Gas molecules at 20°C move with a velocity of approximately 5000 m/s, which is well below the escape velocity for Earth - Phew - we breath again! The value of a planet's escape velocity is one of the primary reasons why small planetoids, such as the moon, have no atmosphere. Determine the escape velocity for the moon. Will it be able to trap atmospheric gases at 20°C?

4. An 820 kg satellite is in circular orbit around Earth and has an orbital period of 2.20×10^4 s.
   a) What is the satellite's orbital radius?

   b) What is the gravitational potential energy of this satellite?

5. A 2.75×10^3 kg payload is lifted from Earth's surface to an altitude of 5.0×10^5 m. How much work is required to raise the payload to this height?

***Answers**: **1:** 1.18 x 10^6 J **| 2**: **a)** 2.22 x 10^9 J **b)** 3.69 x 10^9 J **| 3:** 2380 m/s **| 4: a)** 1.70 x10^{10} J **b)** -1.92 x 10^{10} J **| 5:** 1.21 x 10^{10} J*