

## GRAVITATIONAL POTENTIAL ENERGY WORD PROBLEMS (A)

**Gravitational potential energy** (GPE) is the energy an object has because of its position above the ground. The energy is stored due to the attraction of object towards the Earth because of the force of gravity. To calculate the GPE, use the following formula:

$$\text{GPE} = \text{Mass} \times \text{Gravity Constant} \times \text{Height} \quad \text{or...} \quad \text{GPE} = mgh$$

<i>Where...</i>	<b>Mass:</b> measured in kilograms (kg)
	<b>Gravity:</b> gravity constant on Earth = <b><u>10.00 m/s<sup>2</sup></u></b>
	<b>Height:</b> measured in meters (m)
	<b>GPE:</b> measured in Joules (J) <i>or</i> kilojoules (kJ)

**NOTE:** To earn full marks when solving science word problems, you must **SHOW YOUR WORK:**

Formula	Rough work	Final answer rounded to the correct significant figures	Correct units
---------	------------	---	---------------

### Example:

- Q. Roger Federer's tennis ball has a mass of 0.3 kg. If he holds the ball above the ground at a height of 2.0 m to serve, what is its gravitational potential energy (GPE)?

Given Values:
<b>Mass</b> = 0.3 kg
<b>Height</b> = 2.0 m

Unknown Values:
<b>GPE</b> = mgh

Solution:
<b>GPE</b> = mgh
= 0.3 kg $\times$ 10.00 m/s <sup>2</sup> $\times$ 2.0 m
= 6.00 Joules (not rounded)
<b>GPE</b> = 6.0 J (note significant figures)

**Questions:**      (*Your solutions should be organized similar to the example above*)

- Determine the gain in the potential energy when a 4.0 kg rock is raised 18.000 m.
  
- A leopard with a mass of 55.00 kg climbs 12.0 m up a tree. What is its gain in GPE?

3. An aircraft is taking a group of skydivers up into the air. Evan is dressed in his parachuting outfit, which brings his mass to a total of 90.0 kg. The aircraft takes the group to a height of 5000.00 m before the jump. How much GPE does Evan gain before jumping?
  
4. An owl has a mass of 4.00 kg. It dives to catch a mouse, losing 800.00 J of its GPE. What was the starting height of the owl, in meters?
  
5. An astronaut with a mass of 110.0 kg visits the moon (which has a different gravitational force than Earth). The astronaut climbs 5.0 m up the ladder into his spacecraft and gains 880.0 J in GPE. What is the strength of gravity on the moon?
  
6. One of the tallest radio towers is in Fargo, North Dakota. The tower is 629.9 m tall. If a bird lands on top of the tower, so that the gravitational potential energy associated with the bird is 2033.76 J, what is its mass, in kilograms?
  
7. The largest sea turtle found in the United States had a mass of 860.24 kg. If the gravitational potential energy associated with the turtle as it was being lifted onto a ship was 20,320.7 J, how high above the water was the turtle when it was lifted?
  
8. The heaviest piece of equipment ever carried by an airplane was a 12,400.05 kg generator built in Germany in 1993. How far above the ground was the generator when the GPE was 91,700,000.00 J?