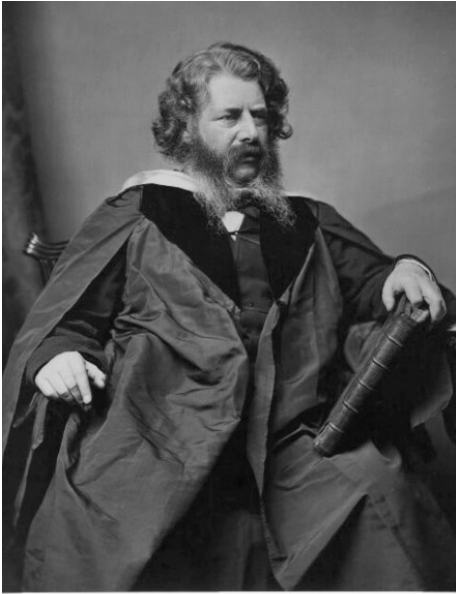




Rankine & potential energy



William Rankine

One of Scotland’s foremost mechanical engineers, William Rankine, was one of the founders of thermodynamic theory, along with Rudolf Clausius and William Thomson – Lord Kelvin. Like Lord Kelvin, Rankine had an absolute temperature scale in Fahrenheit named after him.

His love of science began at the age of 14 when his uncle gave him a copy of Sir Isaac Newton’s ‘Principia’.

Among other things, he wrote a complete theory of steam engines. His forethought and ideas helped to accelerate the progress of the global industrial revolution in transportation and manufacturing. In 1853, in his paper about energy transformation, he was the first to coin the term potential energy.

Gravitational potential energy is the energy stored in an object that increases with height above the earth.



$$\begin{matrix} \text{Gravitational} \\ \text{Potential} = \text{Mass} \times \text{Gravitational} \times \text{Height} \\ \text{Energy} & & \text{field strength} \\ \text{(Joules) J} & \text{(kg)} & \text{(N/kg)} & \text{(m)} \end{matrix}$$

$$E_p / \text{GPE} = mgh$$



Gravitational field strength
9.8N/kg

Question:

In a water polo match, a ball with a mass of 2kg is thrown 5m into the air. Calculate the GPE energy of the ball at the top of the throw?

$$\text{GPE} = mgh$$

Example:

In a water polo match, a ball with a mass of 2kg is thrown 5m into the air. Calculate the GPE energy of the ball at the top of the throw?

$$\begin{aligned} &= 2 \times 9.8 \times 5 \\ &= 98 \text{ Joules} \end{aligned}$$





Practice

1. Raju has a mass of 48 kg and climbs a ladder 3.4m tall. How much GPE has he gained? Quote your answer to 2SF.



2. A man with a mass of 80kg standing at the top of a tall building has 96000 J of GPE. How tall is the building? What is the answer to 2SF? What is the answer to 3SF?

3. How much GPE would an astronaut of 80kg have if she stood on the top floor of Starship, 120 meters from the the surface of the moon?
($g = 1.6 \text{ N/kg}$ on the moon)



4. A girl (on the earth) drops a ball of mass 0.5 kg from a height of 2 metres.

- How much GPE does the ball have before it has dropped?
- How much GPE does it have once it hits the ground?





More facts about potential energy

With GPE the height is decided arbitrarily, i.e., from the ground.

An object must be changed by any type of force to have potential energy.

When an object raises its speed the potential energy decreases.

Read the statements in the table and decide whether they describe kinetic (K) or potential energy (P).

What type of energy is it?	K or P?
The pendulum of a clock when it is at the top of swing.	
A child's stroller being pushed through a busy high street.	
A rollercoaster on the downward curve of its second loop.	
A ball in someone's hand.	
A lithium car battery in an electric vehicle.	
A skateboarder in a twist in the air.	
A pair of roller skates on the floor and not being used.	
An Olympic skier going through the finish flag at the bottom steep downhill slalom race.	
A car that is standing still at the top of hill in a traffic jam.	
An archer holding a bow back before firing the arrow.	

