

Worksheet 2.3: Gravitational Potential Energy ($E_p = mgh$) Physics Sheets

Specification: GCSE Physics (AQA 4.1.1.1 / Edexcel SP3)

Core Equation: Gravitational Potential Energy

$$E_p = m \times g \times h$$

Rearranged Forms:

$$m = \frac{E_p}{g \times h} \quad \left| \quad g = \frac{E_p}{m \times h} \quad \left| \quad h = \frac{E_p}{m \times g} \right. \right.$$

Units:

E_p (Gravitational potential energy) = **Joules (J)**

m (Mass) = **kilograms (kg)**

g (Gravitational field strength) = **Newtons per kilogram (N/kg)**

h (Height) = **metres (m)**

Section A: Formula Recall & Unit Conversions

1. Complete the table below by stating the correct SI unit and its symbol for each variable in the

	Variable	SI Unit	Symbol
gravitational potential energy equation.	Gravitational Potential Energy (E_p)	_____	_____
	Mass (m)	_____	_____
	Gravitational field strength (g)	_____	_____
	Height (h)	_____	_____

2. Rearrange the formula $E_p = mgh$ to make each of the following variables the subject:

- a) Mass (m): $m =$ _____
b) Gravitational field strength (g): $g =$ _____
c) Height (h): $h =$ _____

3. Convert the following values into their standard SI units for use in calculations:

- a) 500 g = _____ kg
b) 250 cm = _____ m
c) 1.2 kJ = _____ J
d) 0.075 tonnes = _____ kg

Section B: Practice Calculations

Unless otherwise stated, use $g = 9.8 \text{ N/kg}$ for all calculations in this section.

4. A student lifts a 2.0 kg textbook from the floor to a shelf 1.5 m high.

- a) Calculate the gravitational potential energy gained by the textbook. Show your working.

- b) A heavier textbook with a mass of 3500 g is lifted to the same shelf. Calculate the gravitational potential energy gained by this textbook. Show your working and state the unit.

- c) A box gains 120 J of gravitational potential energy when it is lifted 2.5 m vertically. Calculate the mass of the box. Give your answer to 2 significant figures. Show your working.

- d) A 15 kg object gains 0.735 kJ of gravitational potential energy when it is lifted. Calculate the vertical height it was lifted. Show your working.

Section C: Challenge Context

5. A crane lifts a 2.5 tonne concrete block from the ground to a height of 30 m in 45 seconds.

- a) Calculate the gravitational potential energy gained by the concrete block. Give your answer in kilojoules (kJ) to 3 significant figures. (Use $g = 9.8 \text{ N/kg}$)

- b) Calculate the useful power output of the crane during this lift. Show your working and state the unit.

6. Figure 1 shows a rollercoaster car of mass 400 kg at two different points on its track.

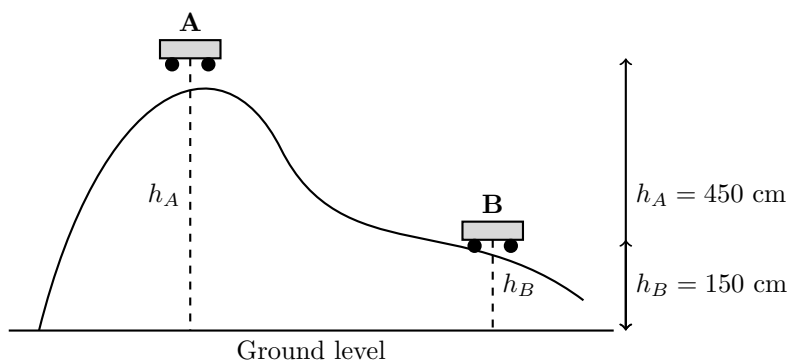


Figure 1: Rollercoaster Track

(Use $g = 9.8 \text{ N/kg}$)

- a) Calculate the gravitational potential energy of the rollercoaster car at point A. Show your working.

- b) Describe the energy transfers that occur as the rollercoaster car moves from point A to point B. Explain how the gravitational potential energy changes and what happens to this energy.
