

Combined science - Physics - Key stage 4 - Energy

The gravitational potential energy store

- worksheet

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Q1.

A rock climber of mass 90 kg is climbing a boulder.

Calculate the change in gravitational potential energy of the climber when he moves 25 m vertically downwards

gravitational field strength = 10 N/kg

Show clearly how you work out your answer

(2)



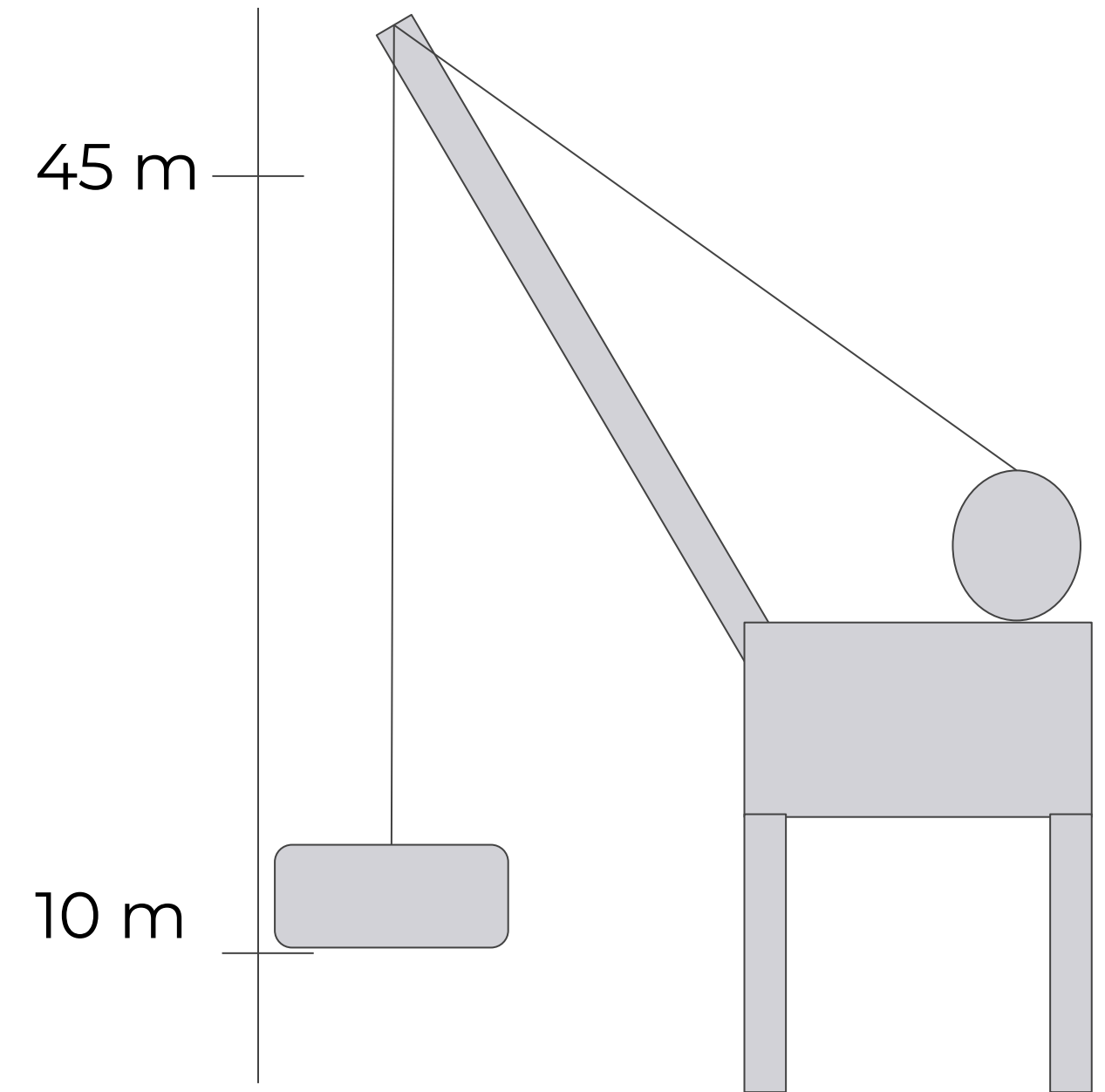
Q2.

A crane raises a concrete block vertically from 10 m to 45 m.

The mass of the concrete block is 800 kg.

Calculate the change in gravitational potential energy for the rollercoaster.
State the unit

Gravitational field strength = 9.8 N / kg .
(4)



Answers



Q1.

GPE = mass × gravitational field strength × height

$$\text{GPE} = 90 \times 10 \times 25$$

1

22 500 (J)

1

Q2.

$$\text{height change} = 45 - 10 = 35$$

1

GPE = mass × gravitational field strength × height change

$$\text{GPE} = 800 \times 9.8 \times 35$$

1

$$= 205\,800$$

1

Unit = J or Joules. kJ can be accepted if the answer given is 205.8 kJ

1



In lesson questions

The following slides were the questions used throughout the lesson.



Independent practice

1. Define gravitational potential energy store.
 - a. **The _____ stored due to the _____ of an object in a _____ field**
2. What does g measure?
 - a. **keywords: Strength, gravitational**
3. What will happen to GPE if you double the height of an object?
4. How can a 5 kg object at 10 m above the surface of the Earth have the same GPE value as a 5 kg object held above the surface of the Moon?



Review

1. Define gravitational potential energy store. **The energy stored due to the position of an object in a gravitational field**
2. What does g measure? **The gravitational field strength**
3. What will happen to GPE if you double the height of an object? **The energy stored in the GPE store will doubled.**
4. How can a 5 kg object at 10 m above the surface of the Earth have the same GPE value as a 5 kg object held above the surface of the Moon? **It needs to be held higher as the Moon has a weaker gravitational field strength**



Independent practice

For all of these questions, assume $g = 9.8 \text{ N/kg}$, unless stated.

1. Find the gravitational potential energy stored when an apple of mass 0.23 kg , 65 m above the Earth's surface.
2. A cable car of mass $4\,500 \text{ kg}$ is suspended $1\,200 \text{ m}$ above the Earth's surface. Find the gravitational potential energy stored.
3. **Challenge:** An astronaut lifts a golf ball 2.6 m above the Moon's surface. If the golf ball's mass is 200 g , find the gravitational potential energy stored. Assume $g = 1.63 \text{ N/kg}$.
4. **Challenge:** An aeroplane flies over Britain at a height of 6.8 km . If its mass is $3\,500 \text{ kg}$, find the gravitational potential energy stored in kJ .



Review

For all of these questions, assume $g = 9.8 \text{ N/kg}$, unless stated.

1. Find the gravitational potential energy stored when an apple of mass 0.23 kg , 65 m above the Earth's surface. **150 J (146.51)**
2. A cable car of mass $4\,500 \text{ kg}$ is suspended $1\,200 \text{ m}$ above the Earth's surface. Find the gravitational potential energy stored. **52 920 000 J or $5.3 \times 10^7 \text{ J}$**
3. **Challenge:** An astronaut lifts a golf ball 2.6 m above the Moon's surface. If the golf ball's mass is 200 g , find the gravitational potential energy stored. Assume $g = 1.63 \text{ N/kg}$. **0.85 J**
4. **Challenge:** An aeroplane flies over Britain at a height of 6.8 km . If its mass is $3\,500 \text{ kg}$, find the gravitational potential energy stored in kJ. **233 kJ (233240 kJ)**



Independent practise

1. A helicopter hovers 580 m above a field and 96 000 000 J of gravitational potential energy is stored. Assuming $g = 9.8 \text{ N/kg}$, find the helicopter's mass.
2. What is the mass of a satellite 250 000 m above the Moon's surface if 1 250 000 J of gravitational potential energy is stored?

Assume g on the Moon = 1.63 N/kg.

3. A parcel is suspended 120 m above the Earth's surface. Assuming $g = 9.8 \text{ N/kg}$, what is the mass of the buzzard if the gravitational potential energy stored is 5 400 J?



Independent practice

- 1. Challenge** A probe is travelling above the surface of Mars at a height of 390 km. Assuming g on Mars is 3.71 N/kg , find the mass of the probe if its gravitational potential energy store is 28 MJ.



Review

1. A helicopter hovers 580 m above a field and 96 000 000 J of gravitational potential energy is stored. Assuming $g = 9.8 \text{ N/kg}$, find the helicopter's mass.
17000 kg (16889 kg)
2. What is the mass of a satellite 250 000 m above the Moon's surface if 1 250 000 J of gravitational potential energy is stored? Assume g on the Moon = 1.63 N/kg. **3.1 kg (3.06 kg)**
3. A parcel is suspended 120 m above the Earth's surface. Assuming $g = 9.8 \text{ N/kg}$, what is the mass of the buzzard if the gravitational potential energy stored is 5 400 J? **4.6 kg (4.59 kg)**



Review

1. **Challenge** A probe is travelling above the surface of Mars at a height of 390 km. Assuming g on Mars is 3.71 N/kg , find the mass of the probe if its gravitational potential energy store is 28 MJ. **20 kg (19.4 kg)**



Independent practice

1. A helicopter with a mass of 10 500 kg has a gravitational potential energy store of 48 900J. Find its height above the Earth's surface. Assume $g = 9.8 \text{ N/kg}$.
2. What height must we raise a 65 kg astronaut above the surface of the Moon in order to cause 25 000 J of gravitational potential energy to be stored? Assume g on the Moon is 1.63 N/kg .
3. **Challenge:** Find the height of a sparrow, with a mass of 240 g, above the Earth's surface if the gravitational potential energy stored is 4.4 kJ. Assume $g = 9.8 \text{ N/kg}$.



Independent practice

1. **Challenge:** An arrow with a mass of 500 g is fired straight up in the air and has a maximum store of 0.2 kJ. What height does it reach? Assume $g = 9.8 \text{ N/kg}$.



Review

1. A helicopter with a mass of 10 500 kg has a gravitational potential energy store of 48 900J. Find its height above the Earth's surface. Assume $g = 9.8 \text{ N/kg}$. **0.5 m (0.48 m)**
2. What height must we raise a 65 kg astronaut above the surface of the Moon in order to cause 25 000 J of gravitational potential energy to be stored? Assume g on the Moon is 1.63 N/kg . **240 m (236 m)**
3. **Challenge:** Find the height of a sparrow, with a mass of 240 g, above the Earth's surface if the gravitational potential energy stored is 4.4 kJ. Assume $g = 9.8 \text{ N/kg}$. **1900 m (1870 m)**



Review

1. **Challenge:** An arrow with a mass of 500 g is fired straight up in the air and has a maximum store of 0.2 kJ. What height does it reach? Assume $g = 9.8$ N/kg. **41 m (40.8 m)**

