Weight and work done

Worked solutions

GCSE science calculations

This topic online

1 Tomasz has a mass of 65 kg.

Gravitational field strength on Earth = 9.8 N/kg

Calculate the weight of Tomasz. (2 marks)

Weight = mass x gravitational field strength

$W = 65 \times 9.8$

637 N

2 Grace pushes a supermarket trolley with a constant force of 40 N. The trolley moves 15 m in the direction of the force.

Calculate the work done by Grace. (2 marks)

Work done = force x distance

$W = 40 \times 15$

600 J

3 An astronaut and her spacesuit have a total mass of 120 kg.

Gravitational field strength on the Moon = 1.6 N/kg

Calculate the weight of the astronaut and spacesuit on the Moon. (2 marks)

Weight = mass x gravitational field strength

$W = 120 \times 1.6$

192 N

4 An apple has a mass of 150 g.

Gravitational field strength on Earth = 9.8 N/kg

Calculate the weight of the apple. (2 marks)

Weight = mass x gravitational field strength

$150\ g = 150 \div 1000 = 0.150\ kg$

$W = 0.150 \times 9.8$

1.47 N

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5 Niamh closes a drawer by pushing it with a force of 12 N. The drawer moves 45 cm.
Calculate the work done by Niamh. (2 marks)

Work done = force x distance

45 cm = 45 ÷ 100 = 0.45 m

W = 12 x 0.45

5.4 J

6 A tractor pulls a trailer along a farm track with a constant force of 2.5 kN. The trailer moves 0.40 km.
Calculate the work done by the tractor in joules.
Give your answer in standard form. (3 marks)

Work done = force x distance

2.5 kN = 2.5 x 1000 = 2500 N

0.40 km = 0.40 x 1000 = 400 m

W = 2500 x 400

W = 1 000 000 J

1.0×10^6 J

7 A suitcase has a weight of 196 N.
Gravitational field strength on Earth = 9.8 N/kg
Calculate the mass of the suitcase. (2 marks)

Weight = mass x gravitational field strength

196 = m x 9.8

Divide both sides by 9.8

m = 196 ÷ 9.8

20 kg

8 A rock sample on Mars has a mass of 3.0 kg. A rover measures its weight on Mars as 11.1 N.
Calculate the gravitational field strength on Mars. (2 marks)

Weight = mass x gravitational field strength

11.1 = 3.0 x g

Divide both sides by 3.0

g = 11.1 ÷ 3.0

3.7 N/kg

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9 Ibrahim pulls a sledge 8.0 m across snow. He does 1.2 kJ of work on the sledge.

Calculate the force Ibrahim uses to pull the sledge.

Assume the force acts along the direction the sledge moves.

(3 marks)

Work done = force x distance

1.2 kJ = 1.2 x 1000 = 1200 J

1200 = F x 8.0

Divide both sides by 8.0

F = 1200 ÷ 8.0

150 N

10 Mei lifts a box of books with a mass of 12 kg onto a shelf 1.5 m above the floor.

Gravitational field strength on Earth = 9.8 N/kg

Calculate the work done lifting the box.

Give your answer to 2 significant figures. Show your working.

(4 marks)

Weight = mass x gravitational field strength

W = 12 x 9.8

W = 117.6 N

Lifting force = weight. Work done = force x distance

work done = 117.6 x 1.5

work done = 176.4 J

180 J

11 Ravi and Leah push a sofa across a floor at a steady speed. The friction force on the sofa is 180 N. They push the sofa 3.5 m in 14 s.

a. Calculate the work done against friction.

b. Calculate the power they develop. Show your working.

(4 marks)

a)

Steady speed, so pushing force = friction = 180 N

Work done = force x distance

W = 180 x 3.5

630 J

b)

Power = work done ÷ time

P = 630 ÷ 14

45 W

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12 A lift in a block of flats in Leeds carries passengers up 18 m at a steady speed. The total mass of the lift car and the passengers is 850 kg.

Gravitational field strength on Earth = 9.8 N/kg

Calculate the work done against gravity raising the lift car and passengers.

Give your answer in standard form to 2 significant figures. Show your working. (4 marks)

Weight = mass x gravitational field strength

$W = 850 \times 9.8$

$W = 8330\ N$

Steady speed, so upward force = weight. Work done = force x distance

work done $= 8330 \times 18$

work done $= 149\,940\ J$

$1.5 \times 10^5\ J$

13 A space rover has a weight of 1764 N on Earth. It is sent to Mars.

Gravitational field strength on Earth = 9.8 N/kg

Gravitational field strength on Mars = 3.7 N/kg

a. Calculate the mass of the rover.

b. Calculate the weight of the rover on Mars. Show your working. (4 marks)

a)

Weight = mass x gravitational field strength

$1764 = m \times 9.8$

Divide both sides by 9.8

$m = 1764 \div 9.8$

180 kg

b)

Mass stays the same on Mars

$W = 180 \times 3.7$

666 N

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14 Elif pushes a 25 kg wheelbarrow 12 m along a flat garden path. She pushes with a constant force of 80 N in the direction it moves.

Calculate the work done by Elif. (2 marks)

Use the pushing force (80 N). The 25 kg is not needed

Work done = force x distance

$W = 80 \times 12$

960 J

15 Kwabena pushes a 40 kg box up a ramp into a van. The ramp is 3.0 m long. The floor of the van is 0.80 m above the ground.

Gravitational field strength = 9.8 N/kg

Calculate the work done against gravity in raising the box onto the van floor. Show your working. (4 marks)

Against gravity, so use the vertical height (0.80 m), not the ramp length (3.0 m)

Weight = mass x gravitational field strength

$W = 40 \times 9.8$

$W = 392$ N

Work done = force x distance

work done $= 392 \times 0.80$

313.6 J

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