Pressure and area

Worked solutions

GCSE science calculations

This topic online

1 A storage crate in a school stockroom pushes down on the floor with a force of 1200 N. The base of the crate has an area of 0.48 m^2.

Calculate the pressure the crate exerts on the floor. (2 marks)

Pressure = force ÷ area

$p = 1200 \div 0.48$

2500 Pa

2 Gareth builds a wooden garden shed on a flat base. The shed and its contents push down on the base with a force of 6300 N. The floor of the shed has an area of 4.5 m^2.

Calculate the pressure on the base. (2 marks)

Pressure = force ÷ area

$p = 6300 \div 4.5$

1400 Pa

3 A wardrobe is 1.9 m tall. Its weight is 840 N. The base of the wardrobe that rests on the carpet has an area of 0.35 m^2.

Calculate the pressure the wardrobe exerts on the carpet. (2 marks)

The height is not needed: use the weight and the area of the base

Pressure = force ÷ area

$p = 840 \div 0.35$

2400 Pa

4 A large recipe book lies flat on a kitchen worktop. The weight of the book is 15 N. The area of the book touching the worktop is 600 cm^2.

Calculate the pressure the book exerts on the worktop in pascals. (3 marks)

1 cm^2 = 0.0001 m^2 (1 m^2 = 10 000 cm^2)

$A = 600 \times 0.0001 = 0.06\ m^2$

Pressure = force ÷ area

$p = 15 \div 0.06$

250 Pa

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5 Precious pushes a drawing pin into a cork noticeboard with a force of 18 N. The area of the point of the pin is 0.15 mm^2.

1 mm^2 = 0.000 001 m^2

Calculate the pressure under the point of the pin. Give your answer in standard form. (3 marks)

1 mm^2 = 0.000 001 m^2

$A = 0.15 \times 0.000\,001 = 1.5 \times 10^{-7}\ m^2$

Pressure = force ÷ area

$p = 18 \div (1.5 \times 10^{-7})$

$p = 120\,000\,000\ Pa$

$1.2 \times 10^8\ Pa$

6 A vending machine in a leisure centre exerts a force of 2.4 kN on the floor. The base of the machine has an area of 0.16 m^2.

Calculate the pressure on the floor in kPa. (3 marks)

1 kN = 1000 N

$F = 2.4 \times 1000 = 2400\ N$

Pressure = force ÷ area

$p = 2400 \div 0.16$

$p = 15\,000\ Pa$

1 kPa = 1000 Pa

$p = 15\,000 \div 1000$

15 kPa

7 A walker in the Cairngorms wears a pair of snowshoes. The total area of the snowshoes touching the snow is 0.075 m^2. The pressure under the snowshoes is 9600 Pa.

Calculate the force the walker exerts on the snow. (2 marks)

Pressure = force ÷ area

$9600 = F \div 0.075$

Multiply both sides by 0.075

$F = 9600 \times 0.075$

720 N

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8 A wooden floor can safely take a pressure of up to 500 000 Pa. One leg of a piano pushes down on the floor with a force of 1100 N.

Calculate the smallest area the end of the leg can have without damaging the floor. Give your answer in cm^2.

(3 marks)

Pressure = force ÷ area

$500\,000 = 1100 \div A$

Rearrange: area = force ÷ pressure

$A = 1100 \div 500\,000$

$A = 0.0022\ m^2$

$1\ m^2 = 10\,000\ cm^2$

$A = 0.0022 \times 10\,000$

$22\ cm^2$

9 A suction hook is stuck to a bathroom tile. The air outside pushes on the hook with a pressure of 100 000 Pa. The area of the hook that the air pushes on is 12 cm^2.

Calculate the force of the air on the hook.

(3 marks)

$1\ cm^2 = 0.0001\ m^2$

$A = 12 \times 0.0001 = 0.0012\ m^2$

Pressure = force ÷ area, so force = pressure × area

$F = 100\,000 \times 0.0012$

120 N

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10 Amara has a mass of 54 kg. She stands still on both feet. The sole of each of her trainers has an area of 180 cm^2 touching the ground.

Gravitational field strength = 9.8 N/kg

Calculate the pressure Amara exerts on the ground.

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

(4 marks)

The force is her weight, not her mass

Weight = mass x gravitational field strength

$W = 54 \times 9.8$

$W = 529.2\ N$

Two trainers, so add both areas

$A = 2 \times 180 = 360\ cm^2$

$1\ cm^2 = 0.0001\ m^2$

$A = 360 \times 0.0001 = 0.036\ m^2$

Pressure = force ÷ area

$p = 529.2 \div 0.036$

$p = 14\,700\ Pa$

15 000 Pa

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11 A small mobile crane on a building site in Leeds has a mass of 18 000 kg. When it lifts, its whole weight rests on four flat pads. Each pad is 0.60 m long and 0.50 m wide.

The ground can safely take a pressure of 200 000 Pa.

Gravitational field strength = 9.8 N/kg

a. Calculate the pressure the crane exerts on the ground. Show your working.

b. Is it safe for the crane to stand on this ground? Give a reason.

(5 marks)

a)

Weight = mass x gravitational field strength

$W = 18\,000 \times 9.8$

$W = 176\,400\ N$

Area of one pad

$A = 0.60 \times 0.50 = 0.30\ m^2$

The weight is spread over all four pads

$A = 4 \times 0.30 = 1.2\ m^2$

Pressure = force ÷ area

$p = 176\,400 \div 1.2$

147 000 Pa

b)

147 000 Pa < 200 000 Pa

Yes, it is safe

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12 A concrete building block has a mass of 15 kg. It measures 40 cm by 20 cm by 10 cm.

The block can be laid on the ground on any one of its faces.

Gravitational field strength = 9.8 N/kg

Calculate the largest pressure the block can exert on the ground.

Give your answer to 2 significant figures. Show your working. (5 marks)

Largest pressure = smallest area: the 20 cm by 10 cm face

$A = 20 \times 10 = 200 \text{ cm}^2$

$1 \text{ cm}^2 = 0.0001 \text{ m}^2$

$A = 200 \times 0.0001 = 0.02 \text{ m}^2$

The force is the weight. Weight = mass x gravitational field strength

$W = 15 \times 9.8$

$W = 147 \text{ N}$

Pressure = force ÷ area

$p = 147 \div 0.02$

$p = 7350 \text{ Pa}$

7400 Pa

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