

Pressure, Force and Area

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (2 marks)

A wardrobe stands on four legs on a floor.

The wardrobe exerts a force of 900 newtons on the floor.

The pressure on the floor under the legs is 22 500 newtons/m²

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the total area of the four legs in contact with the floor.

Rearrange the formula: area = force ÷ pressure

$$900 \div 22\,500 = 0.04$$

Answer: 0.04 m²

Tip: Area is force ÷ pressure. Check: a big pressure on a small area is sensible for four thin legs.

Marks: 1 mark for 900 ÷ 22 500. 1 mark for 0.04

2 (2 marks)

A pressure of 45 newtons/m² acts on an area of 1.6 m² of ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the force on the ground.

Rearrange the formula: force = pressure × area

$$45 \times 1.6 = 72$$

Answer: 72 N

Marks: 1 mark for 45×1.6 . 1 mark for 72.

3 (2 marks)

A fridge stands on a kitchen floor.

The base of the fridge is a rectangle 60 cm by 55 cm.

The fridge exerts a force of 660 newtons on the floor.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the pressure on the floor due to the fridge.

$$\text{Area of the base: } 60 \times 55 = 3300 \text{ cm}^2$$

$$\text{Pressure} = \text{force} \div \text{area}$$

$$660 \div 3300 = 0.2$$

Answer: 0.2 N/cm²

Marks: 1 mark for $660 \div (60 \times 55)$. 1 mark for 0.2

4 (3 marks)

A water butt in the shape of a cylinder stands on horizontal ground.

The base of the water butt is a circle of radius 30 cm.

When it is full of water, the water butt exerts a force of 1500 newtons on the ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the pressure on the ground due to the water butt.

Give your answer correct to 2 decimal places.

The base is a circle of radius 30 cm.

$$\text{Area of the base: } \pi \times 30^2 = 2827.43 \dots \text{ cm}^2$$

$$\text{Pressure} = \text{force} \div \text{area}$$

$$1500 \div 2827.43 \dots = 0.5305 \dots$$

Correct to 2 decimal places: 0.53

Answer: 0.53 N/cm²

Tip: Square the radius before multiplying by π . $\pi \times 30 \times 2$ is the circumference, not the area.

Marks: 1 mark for $\pi \times 30^2$ (2827.4...). 1 mark for $1500 \div$ their area. 1 mark for 0.53

5 (3 marks)

A box in the shape of a cuboid measures 40 cm by 25 cm by 10 cm.

The box exerts a force of 200 newtons on a floor.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

The box can rest on the floor on any of its faces.

Work out the greatest possible pressure the box can exert on the floor.

The force is the same whichever face the box rests on.

The smallest area gives the greatest pressure.

$$\text{Smallest face: } 25 \times 10 = 250 \text{ cm}^2$$

$$\text{Pressure} = 200 \div 250 = 0.8$$

Answer: 0.8 N/cm²

Marks: 1 mark for choosing the smallest face (250). 1 mark for $200 \div 250$. 1 mark for 0.8

6 (3 marks)

A concrete block is a prism.

The block stands on its cross-section on horizontal ground.

The volume of the block is 0.9 m^3

The block exerts a force of 21 600 newtons on the ground.

The pressure on the ground due to the block is 7200 newtons/m^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the height of the block.

Area of the base = force $\div$ pressure

$$21\,600 \div 7200 = 3 \text{ m}^2$$

Volume of a prism = area of cross-section $\times$ height

So height = volume $\div$ area of base

$$0.9 \div 3 = 0.3$$

Answer: 0.3 m

Tip: First find the area of the base from the force and the pressure. Then divide the volume by this area.

Marks: 1 mark for $21\,600 \div 7200$ (3). 1 mark for $0.9 \div 3$. 1 mark for 0.3

7 (3 marks)

A crate stands on a horizontal floor.

The base of the crate is a square.

The crate exerts a force of 810 newtons on the floor.

The pressure on the floor due to the crate is 1000 newtons/m^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the length of one side of the base.

Area = force $\div$ pressure

$$810 \div 1000 = 0.81 \text{ m}^2$$

The base is a square, so side $\times$ side = 0.81

$$\text{Side} = \sqrt{0.81} = 0.9$$

Answer: 0.9 m

Tip: The area of a square is side^2 , so take the square root. Do not divide 0.81 by 4.

Marks: 1 mark for $810 \div 1000$. 1 mark for $\sqrt{0.81}$. 1 mark for 0.9

8 (3 marks)

A solid steel cube rests on a horizontal bench.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

The cube exerts a force of 600 newtons on the bench.

The pressure on the bench due to the cube is 1.5 newtons/cm²

Work out the volume of the cube.

Area of the face on the bench = force $\div$ pressure

$$600 \div 1.5 = 400 \text{ cm}^2$$

The face is a square, so the side length is $\sqrt{400} = 20 \text{ cm}$

$$\text{Volume of the cube: } 20 \times 20 \times 20 = 8000 \text{ cm}^3$$

Answer: 8000 cm³

Tip: 400 cm² is the area of one face. Find the side length first, then cube it. 400 $\times$ 20 is not the volume.

Marks: 1 mark for $600 \div 1.5$. 1 mark for $\sqrt{400} = 20$. 1 mark for 8000

9 (3 marks)

A loaded sledge is on flat snow.

The sledge exerts a force of 900 newtons on the snow.

The area of the runners in contact with the snow is 0.15 m^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Some bags are taken off the sledge, so the force decreases by 20%.

Wider runners are fitted, so the area in contact with the snow is now 0.2 m^2

Work out the percentage decrease in the pressure on the snow.

You must show your working.

Pressure before: $900 \div 0.15 = 6000 \text{ N/m}^2$

New force: 20% of 900 is 180, so $900 - 180 = 720 \text{ N}$

Pressure after: $720 \div 0.2 = 3600 \text{ N/m}^2$

Decrease: $6000 - 3600 = 2400$

Percentage decrease: $\frac{2400}{6000} \times 100 = 40\%$

Answer: 40%

Tip: Divide the decrease by the **original** pressure (6000), not the new pressure.

Marks: 1 mark for 6000, 720 or 3600. 1 mark for $\frac{6000-3600}{6000} \times 100$ or equivalent. 1 mark for 40
