

Pressure

Mark Scheme



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1. Pressure is a measure of how much force is spread across a certain surface area.

For each of the following questions **circle** the letter of the correct answer.

- a) A wooden box exerts a downward force of 500 N on a floor. If the base area of the box is 2 m², what is the pressure exerted on the floor?

B – is the only correct answer.	1 mark
	Total: 1 mark

- b) A heavy cargo container of weight 38 000 N stands with all four support feet on the floor.

The average pressure on the floor due to the support feet in contact with it is 25 000 Pa.

What is the area of each support foot of the container?

B – is the only correct answer.	1 mark
	Total: 1 mark

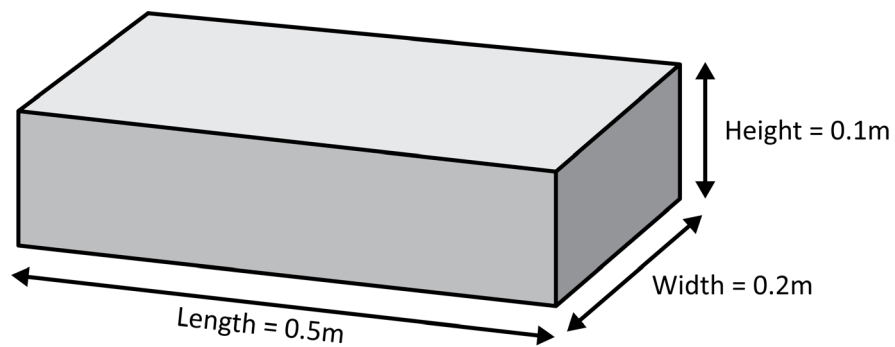
- c) Excavators are very heavy machines that use wide, continuous tracks to move. These tracks help to prevent the excavator from sinking into soft mud.

Which statement explains this?

D – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 1 is 3 marks)

2. A teacher places a concrete block on a wooden table. The figure below shows the block.



- a) State the equation that links pressure, force, and area.

Pressure = force $\div$ area	1 mark
Accept: $P = f \div a$	
	Total: 1 mark

- b) The concrete block exerts a downward force of 400 N on the table.
Calculate the pressure exerted by the block on the table when it is resting on its largest face.
Give the unit for your answer. Show your working.

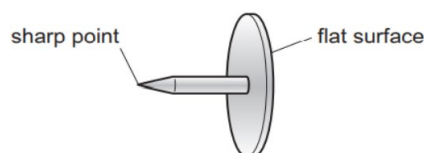
Calculating area: area = 0.5×0.2 Area = $0.1 \text{ (m}^2\text{)}$	1 mark
Substitution: Pressure = $400 \div 0.1$	1 mark
Final Value: 4000	1 mark
Unit: Pa or N/m^2	1 mark
	Total: 4 marks

- c) A student turns the concrete block so that it now rests on its smallest face.
State and explain what happens to the pressure exerted by the block on the table.
You may include calculations in your answer.

Statement: The pressure increases / is greater.	1 mark
Explanation: Because the same force/weight is spread over a smaller surface area.	1 mark
	Total: 2 marks

(Total for Question 2 is 7 marks)

3. Drawing pins are commonly used to hold up notes or ads on messaging boards.
The figure below shows a drawing pin.



- a) A student pushes the flat surface of the drawing pin into a wooden noticeboard.
They apply a force of 12 N to the flat surface.

The area of the sharp point in contact with the wood is $3.0 \times 10^{-7} \text{ m}^2$.

Calculate the pressure exerted by the sharp point on the wooden noticeboard.
Give your answer in standard form and state the unit.

Equation: $P = F \div A$	1 mark
Substitution: Pressure = $(12 \div 3.0 \times 10^{-7})$	1 mark
Calculation: 40 000 000	1 mark
Standard form: 4×10^7	1 mark
Unit: Pa or N/m^2	1 mark
	Total: 5 marks

- b) The area of the flat surface is much larger than the area of the sharp point.

Using the concept of pressure, explain why the drawing pin is designed this way.

Any three from the following: - The large area of the flat surface means less pressure is exerted on the thumb/finger. - Preventing pain/injury to the user. - The small area of the sharp point means a high pressure is exerted on the wooden board. - This makes it easier to push into the wood / pierce the board (for the same applied force).	
	Total: 3 marks

(Total for Question 3 is 8 marks)

4. A workman uses a jack hammer to break up a section of road.



- a) The jackhammer strikes the concrete pavement with a downward force of 3200 N. The area of the chisel point in contact with the concrete is 0.0008 m².

Calculate the pressure exerted by the chisel point on the concrete.
Give the unit for your answer.

Equation: $P = F \div A$	1 mark
Substitution: Pressure = $3200 \div 0.0008$	1 mark
Calculation: 4 000 000	1 mark
Unit: Pa or N/m ²	1 mark
	Total: 4 marks

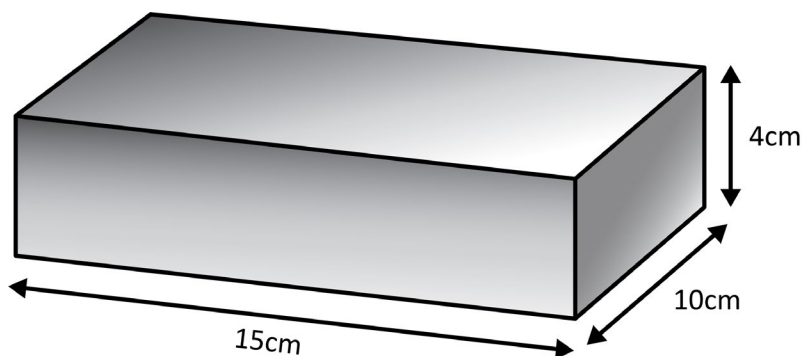
- b) Over time, the metal chisel becomes blunt, which means the area of the point increases.

Assuming the jackhammer still strikes the ground with the same force of 3200 N, explain how this will affect the jackhammer's ability to break the concrete.

Statement: It will be harder to break the concrete / it will be less effective.	1 mark
Allow: it won't break the concrete as easily.	
Explanation: Because the pressure exerted on the concrete will decrease / be less.	1 mark
Allow: the force is spread over a larger area so the pressure is lower.	
	Total: 2 marks

(Total for Question 4 is 6 marks)

5. A 3D rectangular solid metal block is shown.
Its three side lengths are clearly labelled: 15 cm, 10 cm, and 4 cm.



The metal block has a density of 7500 kg/m^3 . Gravitational field strength (g) = 9.8 N/kg .
Calculate the maximum pressure the metal block can exert when it rests on a horizontal table.

Give your answer to 3 significant figures.

Volume = $0.15 \times 0.10 \times 0.04$	1 mark
Volume = 0.0006 m^3	
Mass = 7500×0.0006	1 mark
Mass = 4.5 kg	
Weight = 4.5×9.8	1 mark
Weight = 44.1 N	
Area = 0.10×0.04	1 mark
Area = 0.004 m^2	
Pressure = $44.1 \div 0.004$	1 mark
Pressure = 11025	
Correctly rounded to 3 sig figs: 11 000 Unit: Pa or N/m^2	1 mark
	Total: 6 marks

(Total for Question 5 is 6 marks)

6. The figure below shows an industrial machine standing on four legs in a factory.



The total mass of the machine is 1200 kg. The diameter of each cylindrical leg is 10 cm.
Gravitational field strength (g) = 9.8 N/kg.

Calculate the pressure exerted by the machine on the concrete floor.
Give your answer in kilopascals (kPa) and to 3 significant figures.

Weight = 1200×9.8	
Weight = 11 760 N	1 mark
Radius = 0.05 (m)	1 mark
Total area: $4 \times (\pi \times 0.05^2)$	
Total Area = 0.0314... (m ²)	1 mark
Pressure = $11\,760 \div 0.0314$	
Pressure = 374 332 Pa	1 mark
Unit conversion & sig figs: 374	1 mark
Unit: kPa	1 mark
	Total: 6 marks

(Total for Question 6 is 6 marks)