CAMBRIDGE IGCSE™ PHYSICS 0625 | TOPIC 1.8

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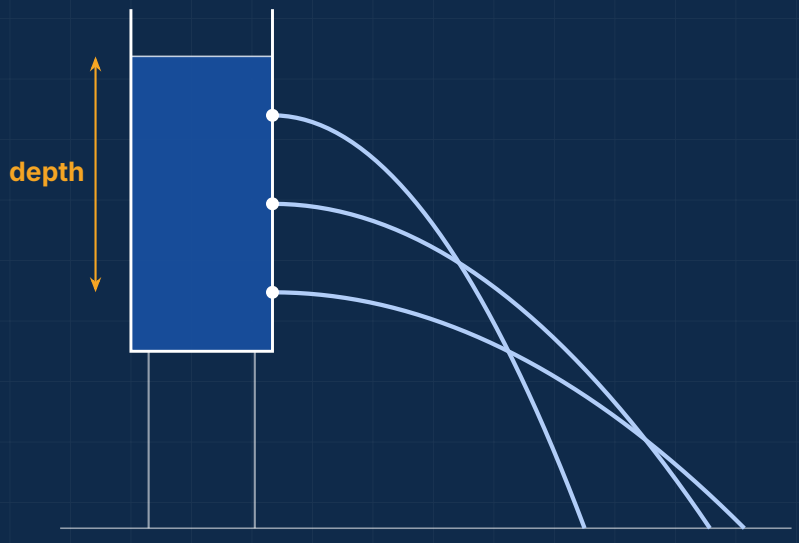
Pressure

Free sample: knowledge organiser and Worksheet 1 with answers

Pressure p = F/A | Force & area | Everyday examples | Pressure in liquids | Depth & density | $\Delta p = \rho g \Delta h$ | Exam-style questions

$$p = F / A$$

$$\Delta p = \rho g \Delta h$$



deeper → greater pressure → faster jet

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Free sample

Full pack: worksheets, exam paper, answers

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Knowledge organiser

Key words

Pressure – the force acting per unit area, at right angles to a surface.

Pascal (Pa) – the unit of pressure: 1 Pa = 1 N/m^2.

Depth – the vertical distance below the surface of a liquid.

Density – mass per unit volume, $\rho = m/V$, in kg/m^3.

Equations

$p = \frac{F}{A}$ p in Pa, F in N, A in m^2

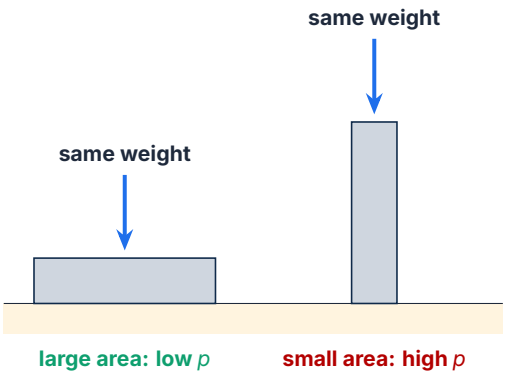
$\Delta p = \rho g \Delta h$ SUPPLEMENT

Δp change in pressure (Pa), ρ density (kg/m^3), $g = 9.8$ N/kg, Δh change in depth (m)

1 m^2 = 10 000 cm^2 = 1 000 000 mm^2

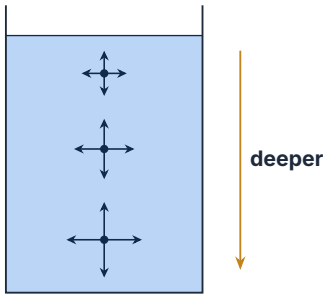
Force and area

Same force, different area:



Large area, low pressure: snowshoes, wide tractor tyres, wide foundations.
Small area, high pressure: knife blades, needles, drawing pins, studs on boots.

Pressure in a liquid



The pressure increases with **depth** and with the **density** of the liquid. At any point it acts equally in all directions. The shape of the container does not matter.

Worked example: solid

A crate of weight 800 N rests on a base of area 0.040 m^2.

$p = F/A = 800 \div 0.040 = 20\,000$ Pa (20 kPa)

Worked example: liquid SUPPLEMENT

Pressure change 3.0 m below the surface of water ($\rho = 1000$ kg/m^3):

$\Delta p = \rho g \Delta h = 1000 \times 9.8 \times 3.0 = 29\,400$ Pa

Common mistakes

- Leaving the area in cm^2 or mm^2: convert to m^2 first (divide cm^2 by 10 000).
- Using a mass in kg instead of a weight in N: use $W = mg$ first.
- Leaving a depth in cm in $\Delta p = \rho g \Delta h$: convert it to m.
- Thinking a wider or bigger tank gives a bigger pressure: only depth and density matter.

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Pressure, force and area

WORKSHEET 1
CORE

You will: define pressure, use $p = F/A$ with the correct units, and explain everyday examples of large and small areas.

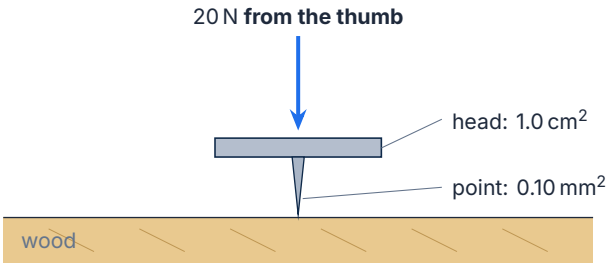
1 CORE Define **pressure** and state its SI unit. [2]

2 CORE Complete the table. Show your working in the space below it. [5]

Situation	Force	Area	Pressure
(a) box on a floor	600 N	2.0 m^2	_____ Pa
(b) foot of a table	50 N	0.025 m^2	_____ Pa
(c) loaded pallet	_____ N	0.50 m^2	4000 Pa
(d) stiletto heel	300 N	_____ m^2	3 000 000 Pa
(e) person lying on a bed	900 N	0.15 m^2	_____ Pa

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3 CORE A drawing pin has a head of area 1.0 cm^2 and a point of area 0.10 mm^2. A thumb pushes on the head with a force of 20 N.



(a) Convert both areas to m^2. Use $1\,m^2 = 10\,000\,cm^2 = 1\,000\,000\,mm^2$. [2]

head area = _____

point area = _____

(b) Calculate the pressure on the thumb and the pressure on the wood. [2]

.....

.....

on the thumb = _____

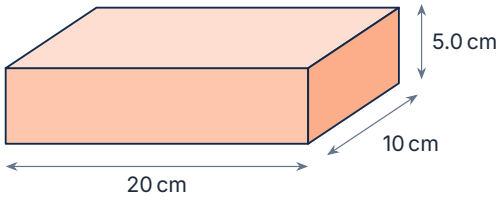
on the wood = _____

(c) The force on the thumb and on the wood is the same. Explain why the pin goes into the wood but does not hurt the thumb. [2]

.....

.....

4 CORE A brick has a mass of 2.4 kg. It measures 20 cm × 10 cm × 5.0 cm. It can rest on a table on any of its three different faces.



(a) Calculate the area of each face in m^2. [3]

20 cm × 10 cm face = _____

20 cm × 5.0 cm face = _____

10 cm × 5.0 cm face = _____

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(b) Take $g = 9.8$ N/kg. Calculate the weight of the brick. Then calculate the greatest pressure and the smallest pressure that the brick can exert on the table. [4]

.....

.....

weight = _____

greatest = _____

smallest = _____

(c) State which face should rest on soft sand so that the brick sinks least. Explain your answer. [2]

.....

.....

5 CORE Complete the table. For each example, state whether the area in contact is **large** or **small**, and explain why this is useful. [4]

Example	Area	Why it is useful
snowshoes		
a sharp kitchen knife		
wide tyres on a tractor		
wide concrete foundations under a wall		

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6 CORE An elephant has a weight of 50 000 N. When it stands on all four feet, each foot has an area of 0.10 m^2 in contact with the ground. A woman of weight 600 N balances on the heel of one stiletto shoe, of area 1.0 cm^2.

(a) Calculate the pressure under the elephant's feet. [2]

pressure = _____

(b) Calculate the pressure under the stiletto heel. [2]

pressure = _____

(c) Some old wooden floors have signs that ban stiletto heels but not heavy furniture. Use your answers to explain why. [2]

7 CORE CHALLENGE A student of weight 600 N stands on both feet. Each shoe has an area of 0.020 m^2 in contact with the floor. She then lifts one foot. Calculate the pressure on the floor in each case, and explain why the pressure changes even though her weight does not. [3]

Exam tip Always convert the area to m^2 before you divide: $1\,cm^2 = 0.0001\,m^2$ and $1\,mm^2 = 0.000\,001\,m^2$. If you are given a mass, find the weight first: $W = mg$.

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Answers: Worksheet 1

Mark codes: B1 independent mark C1 method mark, implied by a correct final answer A1 correct answer with unit. Accept answers that round correctly; allow error carried forward from earlier parts. $g = 9.8$ N/kg throughout. Accept N/m^2 for Pa.

Worksheet 1 – Pressure, force and area

1 Force per unit area (acting at right angles to a surface) B1; unit **pascal, Pa** (N/m^2) B1

2 **(a)** $600 \div 2.0 = 300$ Pa B1
(b) $50 \div 0.025 = 2000$ Pa B1
(c) $F = pA = 4000 \times 0.50 =$ **2000 N** B1
(d) $A = F/p = 300 \div 3\,000\,000 =$ **0.000 10 m^2** (1.0 cm^2) B1
(e) $900 \div 0.15 = 6000$ Pa B1

3 **(a)** head: $1.0 \div 10\,000 =$ **1.0×10^{-4} m^2** B1; point: $0.10 \div 1\,000\,000 =$ **1.0×10^{-7} m^2** B1
(b) thumb: $20 \div (1.0 \times 10^{-4}) =$ **2.0×10^{5} Pa** B1; wood: $20 \div (1.0 \times 10^{-7}) =$ **2.0×10^{8} Pa** B1
(c) The point has a very small area, so the pressure on the wood is very large (1000 times larger) B1; the head has a large area, so the pressure on the thumb is small. B1

4 **(a)** 200 cm^2 = **0.020 m^2** B1; 100 cm^2 = **0.010 m^2** B1; 50 cm^2 = **0.0050 m^2** B1
(b) $W = mg = 2.4 \times 9.8 =$ **23.52 N** (24 N) B1; greatest: smallest face, $23.52 \div 0.0050$ C1 = **4704 Pa** (4700 Pa) A1; smallest: $23.52 \div 0.020 =$ **1176 Pa** (1200 Pa) B1
(c) The 20 cm × 10 cm face (largest area) B1; it gives the smallest pressure on the sand. B1

5 snowshoes: large; low pressure, so you do not sink into snow B1
knife: small; high pressure, so it cuts easily B1
tractor tyres: large; low pressure, so it does not sink into soft ground B1
foundations: large; the weight of the wall is spread, so the pressure on the ground is low and the wall does not sink B1

6 **(a)** $A = 4 \times 0.10 = 0.40$ m^2 C1; $50\,000 \div 0.40 =$ **1.3×10^{5} Pa** (125 000 Pa) A1
(b) $A = 1.0 \times 10^{-4}$ m^2 C1; $600 \div (1.0 \times 10^{-4}) =$ **6.0×10^{6} Pa** A1
(c) The pressure under the heel is much greater (about 48 times) B1; this large pressure dents the wood. Furniture is heavy but spreads its weight over a larger area. B1

7 Both feet: $600 \div 0.040 =$ **15 000 Pa** B1; one foot: $600 \div 0.020 =$ **30 000 Pa** B1; the same force acts on half the area, so the pressure doubles. B1

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Get the full pack

You have just used Worksheet 1. The full Pressure pack contains:

- **Worksheet 1:** Pressure, force and area
- **Worksheet 2:** Pressure in liquids
- **Worksheet 3:** Calculating pressure in liquids
- **Multiple-choice practice:** 10 Paper 1/2-style questions
- **Practical skills:** an Alternative to Practical (Paper 6) question
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