

What air is made of and why it presses

Grade 7 science (Year 8 · Class 7) · Worksheet answers

Each answer shows the formula, the substitution and the result with its unit in bold. Check the unit conversions first, because mixing up Pa, kPa and hPa is the most common cause of a wrong pressure answer.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-ESS2-5

Problem 1 Weighing a volleyball

1. $270 - 262 = \mathbf{8\text{ g}}$.
2. It shows that **air has mass**.

Problem 2 Gases in air

1. **Nitrogen**.
2. About **21 %**.
3. **Carbon dioxide**.

Problem 3 Oxygen in a room

1. $0.21 \times 500 = \mathbf{105\text{ L}}$.
2. $0.78 \times 500 = \mathbf{390\text{ L}}$.

Problem 4 Pressure units

1. $2.5 \times 1000 = \mathbf{2500\text{ Pa}}$.
2. $101\,300 \div 1000 = \mathbf{101.3\text{ kPa}}$.
3. $1013 \times 100 = \mathbf{101\,300\text{ Pa}}$.

Problem 5 Pressure on a table

1. $p = F \div A$.
2. $p = 200 \div 2.0 = \mathbf{100\text{ Pa}}$.

Problem 6 Reading a barometer

1. The column is **740 mm** high.
2. It is 20 mm **below** 760 mm, so the pressure is lower than standard (low pressure often brings rain).
3. The space above holds **no air (a vacuum)**.

Problem 7 Air in a classroom

1. $V = 9.0 \times 6.0 \times 3.0 = \mathbf{162 \text{ m}^3}$.
2. $m = 1.2 \times 162 = 194.4$, so $m \approx \mathbf{194 \text{ kg}}$.

Problem 8 The air on your hand

1. $F = p \times A = 101\,000 \times 0.015 = 1515$, so $F \approx \mathbf{1500 \text{ N}}$.
2. Air also pushes on the back of her hand, and the fluids inside the hand push outwards with the same pressure, so the forces balance.

Problem 9 Weather balloon graph

1. $\mathbf{62 \text{ kPa}}$.
2. $100 - 79 = \mathbf{21 \text{ kPa}}$.
3. 50 kPa lies between 62 kPa at 4 km and 47 kPa at 6 km, closer to 6 km: about $\mathbf{5.5 \text{ km}}$.

Problem 10 Crisp packets on a flight

1. The outside pressure **decreases**.
2. The pressure inside the packet stays higher than the pressure outside, so the air inside pushes the packet outwards and it expands.

Problem 11 Drinking through a straw

1. Sucking removes some of the air, so the pressure inside the straw falls below atmospheric pressure.
2. The atmosphere pushes on the juice in the glass and **forces the juice up the straw** into the lower-pressure region.

Problem 12 Millimetres to kilopascals

1. $101.3 \div 760 = \mathbf{0.1333 \text{ kPa per mm}}$.
2. $745 \times 0.1333 = 99.3$, $\mathbf{99.3 \text{ kPa}}$.
3. $99.3 \times 10 = \mathbf{993 \text{ hPa}}$.

Problem 13 Totals for air

1. $78.08 + 20.95 + 0.93 + 0.04 = \mathbf{100.00 \%}$.
2. $0.2095 \times 5.0 = 1.0475$, so $\approx \mathbf{1.05 \text{ m}^3}$.

Problem 14 Spot the mistakes

1. Air is matter. It has mass: a pumped ball is heavier than a flat one, and 1 m^3 of air has a mass of about 1.2 kg.

2. Air pressure acts in **all directions**, because air particles collide with surfaces from every side.

Problem 15 High pressure day

1. $1030 - 1013 = \mathbf{17 \text{ hPa}}$ above standard.
2. $17 \times 100 = \mathbf{1700 \text{ Pa}}$.
3. High pressure usually goes with **settled, dry weather**.

Problem 16 Falling pressure

1. $1015 - 995 = \mathbf{20 \text{ hPa}}$.
2. $20 \times 100 = \mathbf{2000 \text{ Pa}}$.
3. Falling pressure suggests **cloud and rain are likely**.

Problem 17 A window in a storm

1. $A = 1.2 \times 0.80 = \mathbf{0.96 \text{ m}^2}$.
2. $F = 101\,000 \times 0.96 = \mathbf{96\,960 \text{ N}}$ outwards.
3. Outside force = $90\,000 \times 0.96 = 86\,400 \text{ N}$ inwards. Net = $96\,960 - 86\,400 = \mathbf{10\,560 \text{ N}}$ outwards.

Problem 18 Breathing on a summit

1. $m = 1.2 \times 0.50 = \mathbf{0.60 \text{ g}}$.
2. $50 \div 101 = \mathbf{0.50}$ (to 2 decimal places).
3. The density is about half, so $m \approx 0.60 \times 0.50 = \mathbf{0.30 \text{ g}}$.
4. Each breath holds only about half as many oxygen particles, so the body receives less oxygen.

Problem 19 A water barometer

1. $h = 0.760 \times 13.6 = 10.336$, so $\approx \mathbf{10.3 \text{ m}}$.
2. A water barometer would need a tube more than 10 m tall. Mercury is much denser, so a tube less than 1 m tall is enough.

Problem 20 The suction cup

1. $F = p \times A = 101\,000 \times 0.0020 = \mathbf{202 \text{ N}}$.
2. $m = F \div g = 202 \div 9.8 = 20.6$, $\approx \mathbf{21 \text{ kg}}$.
3. Air leaks in under the edge, so the vacuum is not perfect, and the surface is never perfectly smooth.