

What air is made of and why it presses

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

Name: _____ Date: _____ Class: _____

These problems train you to use the composition of air, the density of air and the pressure formula $p = F \div A$. You will read graphs and barometers, convert between pascals, kilopascals and hectopascals, and explain everyday effects of atmospheric pressure. They suit Grade 7 science students, Year 8 learners and Class 7 pupils studying the atmosphere and weather.

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

Problem 1 Weighing a volleyball (easy)

Wanjiru in Nairobi weighs a flat volleyball and finds 262 g. After pumping it up, the reading is 270 g.

1. Calculate the mass of the air that was added.
2. State what this shows about air.

Problem 2 Gases in air (easy)

Answer using what you know about the composition of air.

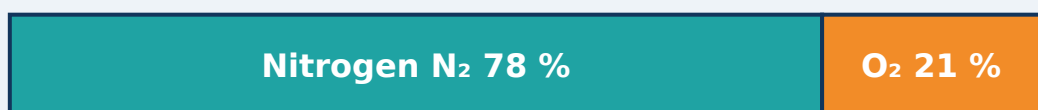
1. Name the most abundant gas in air.
2. State the approximate percentage of oxygen in air.
3. Name the gas present at about 0.04 %.

Problem 3 Oxygen in a room (easy)

A sample of 500 litres of air is taken from a school hall in Lagos. Use 78 % nitrogen and 21 % oxygen.

1. Calculate the volume of oxygen.
2. Calculate the volume of nitrogen.

Dry air by volume



argon, carbon dioxide and traces: about 1 %

The composition of dry air.

Problem 4 Pressure units (easy)

Convert each pressure.

1. 2.5 kPa into Pa
2. 101 300 Pa into kPa
3. 1013 hPa into Pa

Problem 5 Pressure on a table (easy)

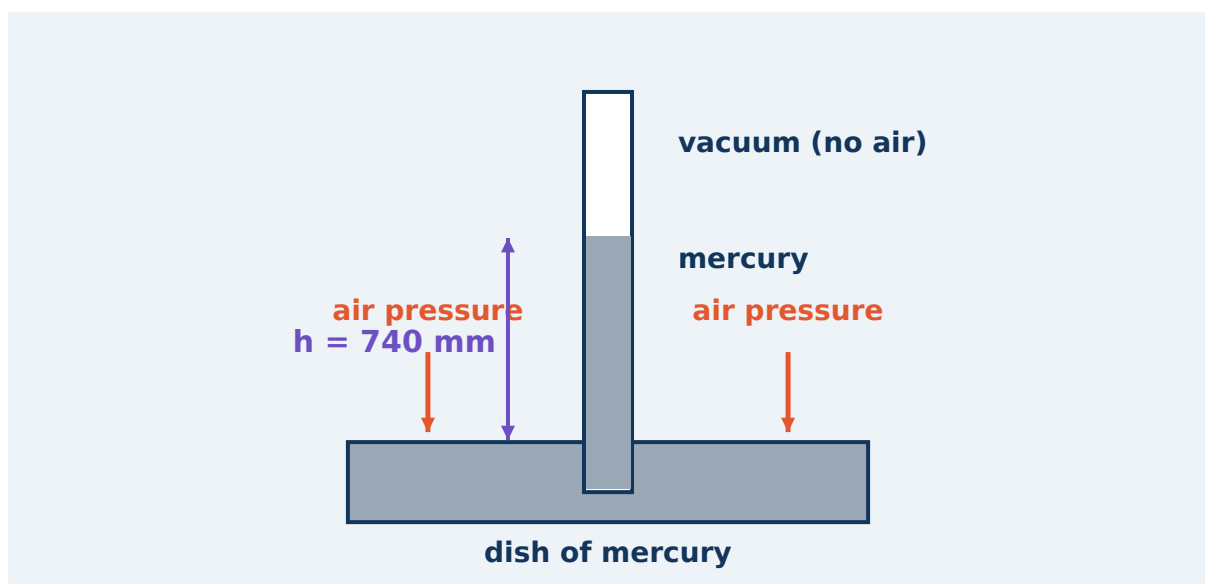
A force of 200 N acts on an area of 2.0 m².

1. Write the formula for pressure.
2. Calculate the pressure in pascals.

Problem 6 Reading a barometer (easy)

A mercury barometer stands in a hall on a stormy day in Leeds.

1. Read the height of the mercury column.
2. State whether it is above or below the standard value of 760 mm.
3. State what the vacuum above the mercury contains.



A mercury barometer on a stormy day.

Problem 7 Air in a classroom (medium)

Aarav in Pune measures a classroom that is 9.0 m long, 6.0 m wide and 3.0 m high. The density of air is 1.2 kg/m³.

1. Calculate the volume of the room.
2. Calculate the mass of the air in the room.

Problem 8 The air on your hand (medium)

The area of the palm of Mei's hand in Singapore is 0.015 m². Atmospheric pressure is 101

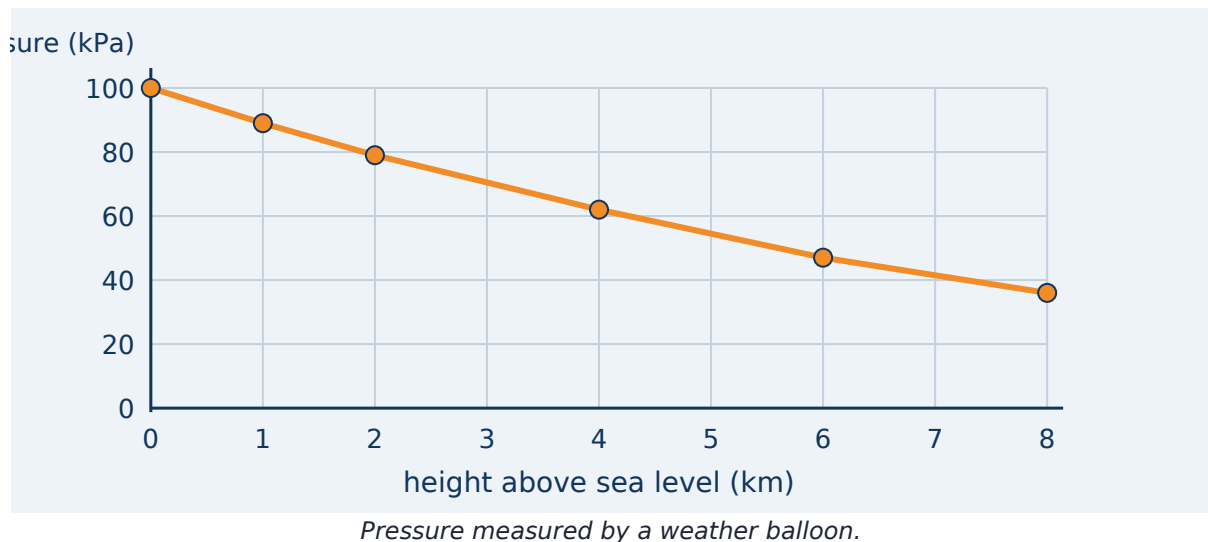
000 Pa.

1. Calculate the force of the air on her palm.
2. Explain why her hand is not crushed.

Problem 9 Weather balloon graph (medium)

The graph shows air pressure as a weather balloon rises.

1. Read the pressure at a height of 4 km.
2. Calculate the fall in pressure between sea level and 2 km.
3. Estimate the height at which the pressure is 50 kPa.



Problem 10 Crisp packets on a flight (medium)

Diego flies from Houston and notices that a sealed crisp packet puffs up when the aircraft is high in the sky.

1. State what happens to the air pressure outside the packet as the aircraft climbs.
2. Explain why the packet puffs up.

Problem 11 Drinking through a straw (medium)

Bilal in Lahore drinks juice through a straw.

1. Explain what happens to the pressure inside the straw when he sucks.
2. Explain what pushes the juice up the straw.

Problem 12 Millimetres to kilopascals (medium)

Standard pressure is 760 mm of mercury, which is 101.3 kPa. Emma reads a barometer at 745 mm.

1. Calculate the pressure in kilopascals for each millimetre of mercury.
2. Calculate the pressure at 745 mm in kilopascals to 1 decimal place.
3. Convert that pressure to hectopascals.

Problem 13 Totals for air (medium)

Dry air has the composition in the table.

Gas	Share (%)
Nitrogen	78.08
Oxygen	20.95
Argon	0.93
Carbon dioxide	0.04

1. Calculate the total of the shares.
2. Calculate the volume of oxygen in a room of volume 5.0 m^3 .

Problem 14 Spot the mistakes (medium)

Kofi in Accra writes: 'Air has no mass because we cannot see it' and 'Atmospheric pressure only pushes downwards.'

1. Explain what is wrong with the first claim.
2. Explain what is wrong with the second claim.

Problem 15 High pressure day (medium)

On a clear morning in Pune the barometer reads 1030 hPa. Standard pressure is 1013 hPa.

1. Calculate the difference from standard pressure in hPa.
2. Convert the difference into pascals.
3. State the weather this reading usually goes with.

Problem 16 Falling pressure (hard)

A weather station in Mombasa shows pressure of 1015 hPa in the morning and 995 hPa in the evening.

1. Calculate the fall in pressure in hPa.
2. Convert the fall into pascals.
3. Predict the likely change in the weather.

Problem 17 A window in a storm (hard)

A window is 1.2 m high and 0.80 m wide. Inside the house the pressure is 101 kPa. Outside, a storm lowers the pressure to 90 kPa.

1. Calculate the area of the window.
2. Calculate the force of the inside air on the window.
3. Calculate the net outward force on the window.

Problem 18 Breathing on a summit (hard)

A hiker in Tanzania climbs a mountain where the pressure at the top is 50 kPa. At sea level the pressure is 101 kPa. Take the density of air at sea level as 1.2 g per litre and assume the same temperature.

1. Calculate the mass of air in a 0.50 L breath at sea level.
2. Calculate the ratio of the summit pressure to the sea-level pressure.
3. Estimate the mass of air in a 0.50 L breath at the summit.
4. Explain why the hiker feels short of breath.

Problem 19 A water barometer (hard)

Mercury is 13.6 times denser than water. At standard pressure a mercury barometer column is 0.760 m high.

1. Calculate the height of a water column that the same pressure could hold.
2. Explain why barometers use mercury instead of water.

Problem 20 The suction cup (hard)

A rubber suction cup of area 0.0020 m^2 is pressed on a smooth tile. Assume a perfect vacuum under it and a pressure of 101 000 Pa. Use $g = 9.8 \text{ N/kg}$.

1. Calculate the largest force the air can hold the cup with.
2. Calculate the largest mass that could hang from the cup.
3. Give two reasons why real cups hold less.