

How particles explain solids, liquids and gases

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

Name: _____ Date: _____ Class: _____

These 20 problems train you to use the particle model: describing solids, liquids and gases, explaining diffusion and pressure, reading data and graphs, and spotting errors. They start with simple recall and finish with problems that ask you to plan investigations and explain graphs.

They suit Grade 7 science students, NGSS middle school classes, Year 8 in the UK and Class 7 in India. Show your reasoning and write units in every calculation.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS1-1, MS-PS1-4

Problem 1 Fixed shape or not (easy)

A steel spoon, a cup of milk and the air in a balloon are in a kitchen.

1. State which of the three has a fixed shape.
2. State which of the three has a fixed volume but no fixed shape.
3. State which of the three fills any container it is put in.

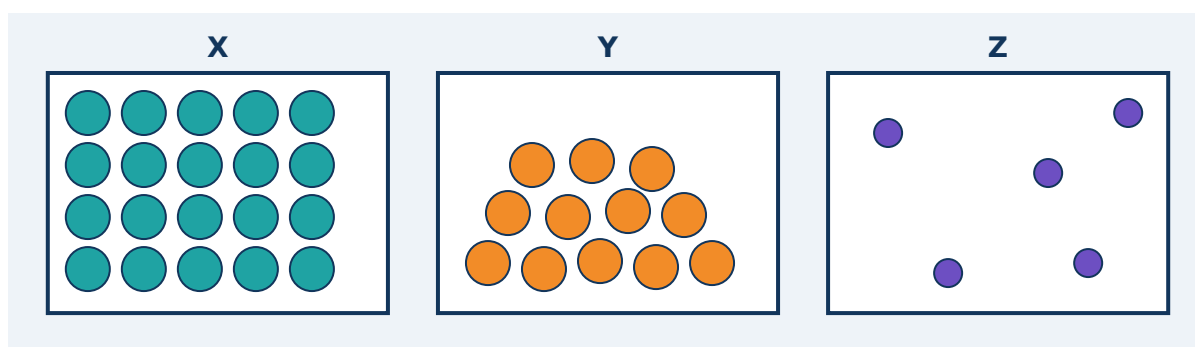
Problem 2 Describe the state (easy)

Match each description to solid, liquid or gas.

- A. Particles touch and vibrate in fixed places.
B. Particles are far apart and move quickly in all directions.
C. Particles touch but slide past each other.
1. Write the state for A.
 2. Write the state for B.
 3. Write the state for C.

Problem 3 Reading the particle boxes (easy)

Look at the figure showing boxes X, Y and Z.



Boxes X, Y and Z.

1. Identify which box is a gas.
2. Identify which box is a solid and give one reason.
3. Describe how the particles in Y move.

Problem 4 Name the change (easy)

Name the change of state in each case.

1. Wet washing on a line in Accra dries in the sun.
2. Water in a freezer becomes ice cubes.
3. Steam on a bathroom mirror turns into drops.
4. A puddle of candle wax goes hard again.

Problem 5 Complete the sentences (easy)

Choose from: vibrate, slide, far apart.

1. In a solid the particles ... about fixed positions.
2. In a liquid the particles ... past one another.
3. In a gas the particles are ... from one another.

Problem 6 States at room temperature (easy)

Data for four substances are given below. Room temperature is 25 °C.

Substance	Melting point (°C)	Boiling point (°C)
Oxygen	-219	-183
Ethanol	-114	78
Lead	327	1749
Mercury	-39	357

1. State the state of oxygen at 25 °C.
2. State the state of ethanol at 25 °C.
3. State the state of lead at 25 °C.
4. Identify the substance that is liquid at 25 °C and boils below 100 °C.

Problem 7 Perfume in a classroom (medium)

Aarav sprays a little perfume at the front of a classroom in Pune. Two minutes later a student in the back row can smell it.

1. Name the process that carries the smell across the room.
2. Explain this process using the particle model.
3. Explain why the smell takes minutes to arrive, even though gas particles move very fast.

Problem 8 Warm and cold cups (medium)

Chiamaka in Lagos puts a drop of food colouring in a cup of warm water and another in a cup of cold water. Neither is stirred.

1. Predict which cup becomes evenly coloured first.
2. Explain your prediction using particle speed.
3. State what would happen if the colouring were dropped onto a block of ice.

Problem 9 Pouring and not pouring (medium)

Compare sand, water and a block of wood in terms of whether they can be poured.

1. Explain why water can be poured in a smooth stream.
2. Explain why a block of wood cannot be poured at all.
3. Suggest why sand can be poured even though each grain is solid.

Problem 10 Why a balloon pushes out (medium)

A balloon is filled with gas. Wanjiru squeezes it gently in her hands.

1. Explain, using particles, why the balloon pushes outwards on every side.
2. Predict what happens to the number of particle collisions per second on the wall when she squeezes the balloon smaller.
3. State what happens to the pressure inside.

Problem 11 Dye front data (medium)

Bilal measured how far a dye front spread through still water:

Time (min)	Distance (mm)
0	0
10	12
20	17
30	21
40	24

1. Calculate the distance the front moves in the first 10 minutes and in the second 10 minutes.
2. Calculate the average speed in each of these two intervals in mm/min.
3. Describe how the speed changes over the 40 minutes.

Problem 12 Drying puddle (medium)

After rain in Nairobi a puddle on a road disappears in the afternoon, although the temperature never reaches 100 °C.

1. Name the process that removes the water.
2. Explain which particles leave the puddle first.
3. Explain why the puddle disappears faster on a windy day.

Problem 13 Spot the error (medium)

Emma writes: 'When ice melts, the particles themselves turn into liquid and get softer. The particles in ice do not move at all.'

1. Identify the two mistakes in Emma's sentence.
2. Write a corrected version of her sentence.

Problem 14 Bike pump (medium)

Diego holds his finger over the nozzle of a bike pump and pushes the handle in.

1. Predict what happens to the volume of air inside.
2. Predict what happens to the distance between the air particles.
3. Explain why it gets harder to push the handle in the further you go.

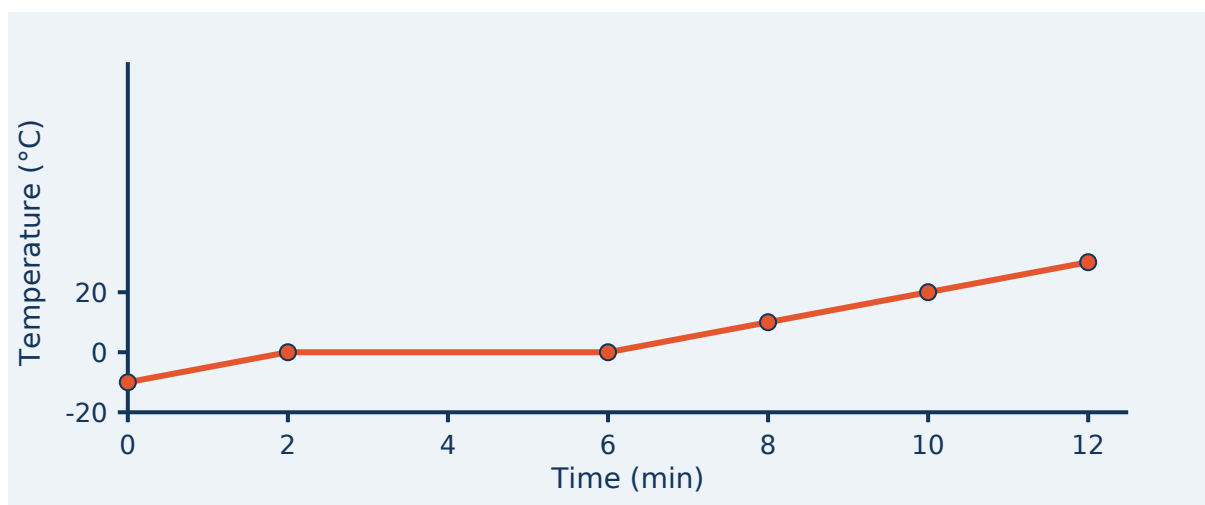
Problem 15 Air or water in a syringe (medium)

Aisha seals the tips of two syringes. One holds 30 cm³ of air and the other 30 cm³ of water. She pushes both plungers in as far as she can.

1. Predict which syringe can be pushed in further.
2. Explain your prediction using the spacing of particles.
3. Predict the volume of the water after the push and give a reason.

Problem 16 Heating ice (hard)

Kofi heats a beaker of crushed ice steadily and records the temperature.



Temperature of an ice sample heated steadily.

1. State the temperature of the ice at the start.

2. State the length of time for which the temperature stays constant.
3. Explain, using particles, why the temperature stays constant even though the heater keeps supplying energy.
4. Calculate how much the temperature rises between 8 and 12 minutes.

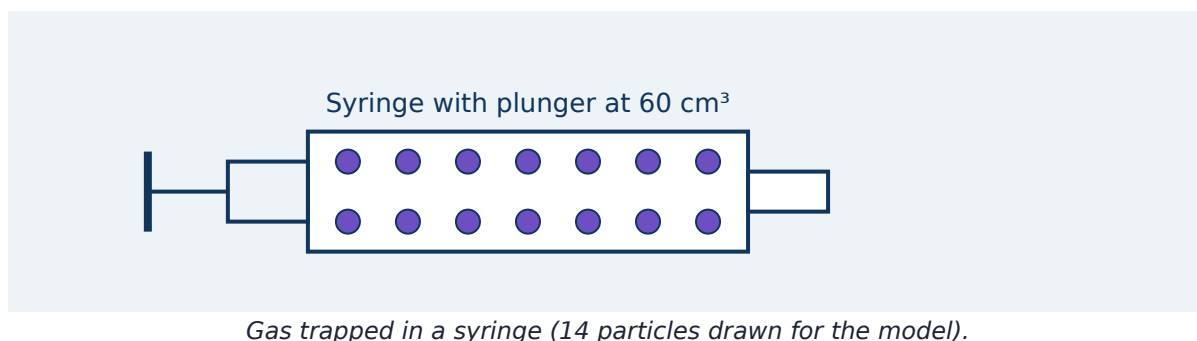
Problem 17 Specks in smoke (hard)

A student fills a small glass cell with smoke and watches the tiny smoke specks through a microscope. The specks jiggle in random directions.

1. Explain what the jigging shows about air particles.
2. Explain why the specks move although the air particles cannot be seen.
3. Predict how the jigging would change if the cell were cooled, and explain why.

Problem 18 Squashing gas in a syringe (hard)

A syringe holds 60 cm^3 of air. The model in the figure uses 14 particles for the air.



1. The plunger is pushed in until the volume is 20 cm^3 . Calculate the number of particles per cm^3 before and after, and state how many times more crowded they are.
2. State the number of particles in the syringe after the push.
3. Explain why the force needed on the plunger grows as the plunger moves in.

Problem 19 Plan a diffusion test (hard)

Mei wants to find out how water temperature affects how fast a drop of dye spreads.

1. Identify the independent variable and the dependent variable.
2. List three control variables.
3. Suggest how she can decide when the dye has finished spreading.
4. Predict the pattern of results using the particle model.

Problem 20 Cooling a vapour (hard)

Hot wax vapour rises from a heated pan, touches a cold lid and finally turns into hard drops on it.

1. Name the two changes of state.
2. Describe how the spacing of wax particles changes in each change.

3. Describe how the movement of wax particles changes in each change.
4. Explain why the particles do not disappear when the wax hardens.