

How water melts, boils and freezes

Grade 6 science (Year 7 · Class 6) · Worksheet answers

Compare your working with each answer. For explanation problems, look for the key ideas: heat taken in or given out, particles separating or coming together, and the temperature staying constant during a change. Units must follow every number.

Level: Grade 6 science (Year 7 · Class 6) · **Curriculum:** MS-PS1-4

Problem 1 Name the change

1. **Melting.**
2. **Evaporation.**
3. **Condensation.**
4. **Freezing.**
5. **Boiling.**

Problem 2 Key temperatures

1. **0 °C.**
2. **0 °C.**
3. **100 °C.**
4. **100 °C.**

Problem 3 Labelling a state diagram

1. A: **melting** (solid to liquid).
2. B: **freezing** (liquid to solid).
3. D: **condensation** (gas to liquid).
4. Arrows **A and C** (the red ones) take in heat.

Problem 4 Heat in or heat out

1. Melting: heat **taken in**.
2. Freezing: heat **given out**.
3. Boiling: heat **taken in**.
4. Condensation: heat **given out**.

Problem 5 An ice cube in a cup

1. **Melting.**
2. **50 g**, because mass does not change in a change of state.
3. The particles are neither made nor destroyed; they are just rearranged.

Problem 6 Completing sentences

1. **Evaporation** happens at the **surface** of a liquid.
2. **Boiling** forms **bubbles** throughout the liquid.
3. Pure water boils at **100 °C**.

Problem 7 Warming water

1. $100 - 22 = 78$ °C.
2. The reading **stays at 100 °C** while the water boils.

Problem 8 Reading a heating curve

1. **-10 °C**.
2. From 1 min to 13 min: $13 - 1 = 12$ min.
3. From 13 to 33 min the temperature rises 100 °C in 20 min: $100 \div 20 = 5$ °C/min.
4. The water is boiling, so the heat is used to turn the liquid into gas and the temperature stays at 100 °C.

Problem 9 Evaporation or boiling?

1. **B**.
2. **E**.
3. **B**.
4. **E**.
5. **E**.

Problem 10 Drying laundry

1. **Evaporation**.
2. Heat gives more water particles enough energy to escape; wind carries vapour away; spread-out shirts have more surface exposed.
3. Evaporation happens at the surface at any temperature, because the fastest particles can escape without the liquid being at its boiling point.

Problem 11 Freezing data

1. **0 °C**.
2. $(20 - 3) \div 20 = 17 \div 20 = 0.85$ °C/min.
3. Freezing releases heat as the particles settle into place, which balances the heat lost to the freezer, so the temperature stays at 0 °C until all the water is ice.

Problem 12 A misty mirror

1. **Condensation**.

2. The hot shower evaporated water, making water vapour in the air.
3. The mirror is cooler than the air, so vapour particles lose energy when they touch it and turn into liquid droplets.

Problem 13 Spot the errors

1. Steam is invisible. The white cloud is tiny droplets of liquid water that **condensed** from the vapour.
2. Water evaporates at **any temperature**; only boiling needs 100 °C.

Problem 14 Conservation of mass

1. **250 g**.
2. $250 - 40 = \mathbf{210\ g}$.
3. It is now water vapour in the air; the particles have spread out, they have not vanished.

Problem 15 Melting rate

1. $60 \div 4 = \mathbf{15\ min}$.
2. Melted = $4 \times 6 = 24\ g$, so $60 - 24 = \mathbf{36\ g}$ still solid.
3. **Longer**, because less heat reaches the lolly.

Problem 16 Kettle timing

1. Rise = $100 - 15 = 85\ ^\circ\text{C}$; time = $85 \div 20 = \mathbf{4.25\ min}$.
2. $0.25\ min \times 60 = 15\ s$, so **4 min 15 s**.
3. At 100 °C the water boils, and the heat is used to turn liquid to gas, so the temperature stays constant.

Problem 17 Cooling curve of steam

1. Steam (gas) cools from 130 °C to 100 °C; condenses to liquid at 100 °C; liquid water cools to 0 °C; freezes to ice at 0 °C; ice cools to -20 °C.
2. **100 °C and 0 °C**.
3. At 100 °C the particles lose energy and move closer together as the gas becomes a liquid, but their average speed is unchanged.

Problem 18 Two flames

1. A: $120 \div 10 = \mathbf{12\ g/min}$. B: $60 \div 10 = \mathbf{6\ g/min}$.
2. **100 °C** in both.
3. The extra heat from the bigger flame is used to turn more liquid into gas each minute, so the water boils faster but its temperature stays at 100 °C.

Problem 19 Plan an evaporation test

1. Independent: the temperature of the water. Dependent: the mass (or volume) lost by evaporation.
2. Same volume of water, same container shape, same air movement, same time.
3. Weigh the container on a balance before and after a set time; mass lost is the water evaporated.
4. **Warmer water loses more mass**, because more particles have enough energy to escape.

Problem 20 Cooling by evaporation

1. **Evaporation.**
2. The fastest, highest-energy particles escape from the water on her skin, so the remaining water, and her skin, has lower average energy and feels cooler.
3. She would feel **colder** on a windy day, because wind removes the vapour and speeds up the evaporation.