

How heat moves and how to measure temperature

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

Use these answers to check your work after you have attempted every problem. Study the reasoning as well as the final result, and compare each explanation with your own. Final answers are shown in bold.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS3-3, MS-PS3-4

Problem 1 Heat or temperature

1. **Temperature.**
2. **Heat.**
3. **Temperature.**
4. **Heat.**

Problem 2 Read the thermometer

1. Each small division is 2 °C and the liquid is 7 divisions above 20 °C: $20 + 14 = \mathbf{34\text{ °C}}$.
2. **2 °C.**
3. $34 + 6 = 40$, so the liquid top would be at **40 °C**, three divisions higher.

Problem 3 Name the method

1. **Radiation.**
2. **Conduction.**
3. **Convection.**
4. **Conduction.**

Problem 4 Conductor or insulator

1. **Copper, aluminium foil, iron nail** (metals).
2. **Wool, plastic, polystyrene.**
3. Plastic is an insulator, so the handle stays cool enough to hold: **poor conduction.**

Problem 5 Fixed points

1. **0 °C.**
2. **100 °C.**
3. $100 - 0 = \mathbf{100\text{ degrees.}}$

Problem 6 Which way does heat flow?

1. Heat flows from the warm hand to the cold glass: **from hand to glass.**
2. **It falls.**
3. **Heat flow stops** because there is no temperature difference.

Problem 7 Temperature changes

1. $74 - 18 =$ **a rise of 56 °C.**
2. $25 - 4 =$ **a fall of 21 °C.**
3. $88 - 47 =$ **a fall of 41 °C.**
4. $17 - (-3) = 20$, **a rise of 20 °C.**

Problem 8 Cooling rate of soup

1. $96 - 60 =$ **36 °C.**
2. $36\text{ °C} \div 24\text{ min} =$ **1.5 °C/min.**
3. $1.5 \times 8 = 12\text{ °C}$ fall, so $60 - 12 =$ **48 °C.**

Problem 9 Saucepan design

1. Metal is a good conductor, so heat passes quickly from the hob to the food: **fast heating.**
2. Plastic is an insulator, so the handle conducts little heat and stays safe to hold: **poor conductor.**
3. **Conduction.**

Problem 10 Sea breeze

1. **Convection.**
2. The air above the hot land is warmed, expands, becomes less dense and rises.
3. Cooler, denser air from the sea moves in to replace it, giving the sea breeze: **cool air flows towards the land.**

Problem 11 White roofs

1. **The dark roof building is hotter inside.**
2. A dark roof absorbs more radiation from the Sun, but a white roof reflects most of it.
3. Any dark, matt surface, such as black: **black.**

Problem 12 Cooling curves

1. **62 °C.**
2. $90 - 40 =$ **50 °C.**
3. Cup B loses heat faster (90 to 40 against 90 to 53). **Cup B**, because without a lid warm air and vapour escape by convection and evaporation.

Problem 13 Heat in a bath

1. **They have the same temperature, 40 °C.**
2. The bathtub contains many more particles at the same temperature, so it contains more thermal energy: **the bathtub.**

3. **The bathtub**, because more energy is available to melt ice.

Problem 14 Spot the error

1. A duvet does not make heat; it traps air and slows the loss of your body heat.
2. Ice does not pass cold; heat flows from the juice into the ice.
3. **The duvet is an insulator that reduces heat loss; heat flows from the warm juice to the ice.**

Problem 15 Testing insulators

1. None: $80 - 38 = 42$ °C. Newspaper: $80 - 52 = 28$ °C. Cotton wool: $80 - 56 = 24$ °C. Bubble wrap: $80 - 49 = 31$ °C. **42, 28, 24 and 31 °C.**
2. A smaller fall means a better insulator: **cotton wool, newspaper, bubble wrap, none.**
3. Trapped air cannot circulate in small pockets, so there is almost no convection, and air conducts poorly.
4. $(42 - 24) \div 42 = 0.4286$: **about 43 % less.**

Problem 16 Fair test plan

1. Independent variable: the curtain material. Dependent variable: the temperature of the model room. **Material and temperature.**
2. Any four of: size of model, starting temperature, heat source, thickness of the curtain, time, position of the thermometer.
3. Repeat each test three times and take the mean, and read the thermometer at eye level.
4. A thick, fluffy material traps air, so **the room stays warmer.**

Problem 17 Hot-air balloon

1. Warming makes the air particles move faster and spread out, so there are fewer particles in each cubic metre: lower density.
2. The warm air is lighter than the cooler air around, so the balloon is pushed upwards.
3. **Convection.**
4. The air inside cools and becomes denser, so the upward push decreases and the balloon sinks.

Problem 18 Solar water heater

1. At A: **radiation.**
2. At B: **conduction.**
3. At C: **convection.**
4. Black is a good absorber of radiation, so the panel heats quickly; the tank is insulated to reduce heat loss to the roof and air: **black for absorbing, insulation for keeping.**

Problem 19 Cooling data

1. $80 - 62 = 18$; $62 - 50 = 12$; $50 - 42 = 8$; $42 - 36 = 6$. **18, 12, 8 and 6 °C.**
2. The fall gets smaller in every interval.
3. The bigger the difference between the coffee and the room, the faster heat flows out. As the coffee cools the difference shrinks, so it cools more slowly.
4. It cannot go below the room temperature: **20 °C.**

Problem 20 Layers of clothing

1. Clothes trap air next to the body, and air is a poor conductor that cannot circulate in small pockets.
2. Each layer traps its own pocket of air between layers, so the total trapped air is large: **several layers trap more air.**
3. Conduction, convection and radiation. Clothes mainly reduce **conduction and convection.**
4. The shiny blanket reflects the body's radiation back so it keeps the runner warm.