

Heat in and out of reactions

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Test answers (mark scheme)

Award the marks as shown in each marking note. Give credit for correct method even if an earlier number is wrong, and remember that a missing or wrong sign for ΔH loses the final mark. Total the marks out of 20.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-4

Question 1 Hand warmers and cold packs (2 marks)

- a. The hand warmer. (1 mark)
- b. It falls, because energy is taken in from the surroundings. (1 mark)

Marking: 1 mark each.

Question 2 Reading a reaction profile (3 marks)

- a. Activation energy. (1 mark)
- b. Positive (ΔH is greater than zero). (1 mark)
- c. Endothermic. (1 mark)

Marking: 1 mark each; the products are above the reactants.

Question 3 Hydrogen fluoride (3 marks)

- a. $436 + 158 = 594 \text{ kJ}$ (1 mark)
- b. $2 \times 568 = 1136 \text{ kJ}$ (1 mark)
- c. $\Delta H = 594 - 1136 = -542 \text{ kJ/mol}$ (1 mark)

Marking: accept ecf for (c) from wrong (a) or (b); the sign must be negative.

Question 4 Energy from a temperature rise (3 marks)

- a. $q = 200 \times 4.2 \times 8.5 = 7140 \text{ J} = 7.14 \text{ kJ}$ (2 marks)
- b. $7.14 \div 0.050 = 143 \text{ kJ/mol}$; the reaction is exothermic, so $\Delta H = -143 \text{ kJ/mol}$. (1 mark)

Marking: 1 mark for the substitution, 1 for 7.14 kJ; 1 mark for the sign and value.

Question 5 Starting a fire (2 marks)

Particles must collide with at least the activation energy for bonds to break. The flame supplies this energy. Once burning begins, the energy released provides the activation energy for further particles. **Activation energy supplied by the flame.**

Marking: 1 mark for activation energy needed, 1 for the flame or released energy sustaining burning.

Question 6 Bond breaking (2 marks)

Bonds hold atoms together, so energy must be supplied to separate them: breaking is endothermic. When atoms join and form bonds, the same type of energy is released: making is exothermic. **Breaking takes in energy; making releases it.**

Marking: 1 mark for each half.

Question 7 Self-heating can (3 marks)

- a. Exothermic. (1 mark)
- b. The products are lower in energy than the reactants. (1 mark)
- c. Energy is released to the surroundings, so it passes into the soup and the temperature rises. (1 mark)

Marking: 1 mark each.

Question 8 Energy per mole (2 marks)

Energy per mole = $125 \div 0.25 = 500$ kJ/mol. Burning is exothermic, so $\Delta H = -500$ kJ/mol.

Marking: 1 mark for 500, 1 mark for the negative sign.