FOUNDATION

C5F Energy Changes: Foundation Tier Practice

Total Marks

AQA 8462 · Calculator allowed · about 75 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A reaction that gives out heat to the surroundings is called exothermic.

Give the name used for a reaction that takes in heat from the surroundings.

(Total for Question 1 is 1 mark)

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2 When a hand warmer pack is activated it becomes warm because a chemical reaction happens inside the pack.

State whether the reaction in the hand warmer is exothermic or endothermic.

(Total for Question 2 is 1 mark)

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3 The word equation for burning magnesium is: magnesium + oxygen -> magnesium oxide

Is the reaction of magnesium burning exothermic or endothermic? Explain your answer in one sentence referring to temperature change.

(Total for Question 3 is 2 marks)

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4 A student mixes 25.0 g sodium hydroxide solution at 20.0 degrees C with 25.0 g hydrochloric acid solution at 20.0 degrees C in an insulated cup. The temperature rises to 28.0 degrees C.

Calculate the temperature change and state whether this shows the reaction is exothermic or endothermic.

(Total for Question 4 is 2 marks)

5 Bond breaking absorbs energy and bond forming releases energy.

Tick two correct statements from the list: A: Forming bonds absorbs energy. B: Breaking bonds absorbs energy. C: Forming bonds releases energy. D: Breaking bonds releases energy.

(Total for Question 5 is 2 marks)

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6 A reaction profile shows reactants at higher energy than products and a hump above the starting level.

Is the activation energy the energy difference between reactants and products, or the energy difference between reactants and the top of the hump? Give the correct choice.

(Total for Question 6 is 1 mark)

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7 A student measures temperature change when dissolving ammonium nitrate in water. The temperature falls from 22.0 degrees C to 16.5 degrees C.

Calculate the temperature change and state whether the dissolution is exothermic or endothermic.

(Total for Question 7 is 2 marks)

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8 A sample of water with mass 50.0 g is heated and the temperature rises by 10.0 degrees C. Use specific heat capacity of water = 4.2 J/g degrees C.

Calculate the energy absorbed by the water. Show substitution in an equation and give the final answer with units.

(Total for Question 8 is 3 marks)

9 In a neutralisation experiment 25.0 cm3 of 0.10 mol/dm3 hydrochloric acid is neutralised by 25.0 cm3 of 0.10 mol/dm3 sodium hydroxide. The solution mass is 50.0 g and the temperature increases from 20.0 degrees C to 22.0 degrees C. Use specific heat capacity of solution = 4.2 J/g degrees C.

Calculate the energy change for the neutralisation. Show substitution in q = m x c x deltaT and state whether the reaction is exothermic or endothermic.

(Total for Question 9 is 4 marks)

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10 A student repeats an experiment to measure the temperature change when mixing two solutions. The student keeps the volumes the same each time but notices the temperature results vary by about 0.8 degrees C between repeats.

Give one variable that should be controlled, name one likely source of random error that explains the variation, and suggest one improvement to reduce the variation. (3 marks)

(Total for Question 10 is 3 marks)

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11 A student is shown a reaction profile where reactants are at a higher energy level than products and there is a hump (activation energy) between them.

State whether the reaction is exothermic or endothermic, and explain in one sentence how the positions of reactants and products on the profile show this.

(Total for Question 11 is 3 marks)

12 100.0 g of water is heated and its temperature increases by 5.0 degrees C. Use specific heat capacity of water = 4.2 J/g degrees C.

Calculate the energy absorbed by the water and give the answer in kilojoules to 2 significant figures. Show substitution.

(Total for Question 12 is 4 marks)

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13 Bond breaking and bond forming determine whether a chemical reaction is exothermic or endothermic. Use this idea to explain why forming bonds releases energy while breaking bonds absorbs energy. You may refer to energy changes and to examples. (6 marks)

(Total for Question 13 is 6 marks)

Mark scheme · C5F Energy Changes: Foundation Tier Practice

Question 1

- **B1** endothermic cao
- **Answer: Endothermic**

Question 2

- **B1** exothermic cao
- **Answer: Exothermic**

Question 3

- **M1** states exothermic or describes heat is given out
- **A1** gives reason linked to temperature increase of surroundings or reaction getting hot cao
- **Answer: Exothermic. The reaction gives out heat so the surroundings get hotter and the temperature increases.**

Question 4

- **M1** correct temperature change calculated: 8.0 degrees C (28.0 - 20.0)
- **A1** identifies exothermic because temperature increased cao
- **Answer: Temperature change = 8.0 degrees C; exothermic**

Question 5

- **B1** B: Breaking bonds absorbs energy
- **B1** C: Forming bonds releases energy
- **Answer: B and C**

Question 6

- **B1** energy difference between reactants and the top of the hump (activation energy) cao
- **Answer: The energy difference between the reactants and the top of the hump (activation energy).**

Question 7

- **M1** correct temperature change: 5.5 degrees C (22.0 - 16.5) with sign or magnitude
- **A1** identifies endothermic because the temperature decreases cao
- **Answer: Temperature change = 5.5 degrees C; endothermic**

Question 8

- **M1** substitutes into q = m x c x deltaT, e.g. q = 50.0 x 4.2 x 10.0
- **M1** correct multiplication leading to 2100
- **A1** 2100 J cao
- **Answer: 2100 J**

Question 9

- **M1** substitutes into q = m x c x deltaT, e.g. q = 50.0 x 4.2 x 2.0
- **M1** evaluates multiplication correctly to 420
- **M1** gives unit J with answer
- **A1** states exothermic because temperature increased cao
- **Answer: 420 J; exothermic**

Question 10

- **B1** states a correct control variable, e.g. use same initial temperatures, same masses/volumes, or same concentration
- **B1** names a likely random error, e.g. reaction not mixed consistently between repeats, thermometer reading varies, heat lost to surroundings variably
- **B1** suggests a sensible improvement, e.g. use a lid on the cup, use a more accurate thermometer, stir the mixture the same way or repeat and take mean
- **Answer: Control variable: same initial temperature (or same volumes). Random error: inconsistent mixing/thermometer reading. Improvement: use a lid and stir consistently or use a more accurate thermometer and take repeats.**

Question 11

- **B1** states the reaction is exothermic
- **B1** notes products are at lower energy than reactants
- **B1** links lower energy of products to energy being released to the surroundings
- **Answer: Exothermic. The products are at lower energy than the reactants, so energy has been released to the surroundings.**

Question 12

- **M1** substitutes into q = m x c x deltaT, e.g. q = 100.0 x 4.2 x 5.0
- **M1** evaluates multiplication to 2100 J
- **M1** converts to kJ correctly: 2.10 kJ
- **A1** gives final answer 2.1 kJ cao (to 2 s.f.)
- **Answer: 2.1 kJ**

Question 13

- **Level 3** (5-6): Detailed explanation. Candidate explains that bond breaking requires energy input because chemical bonds must be overcome, and bond forming releases energy as new bonds form. Links these ideas to overall reaction enthalpy and gives an example or uses energy profile language to show how more energy released in bond formation than absorbed in bond breaking gives an exothermic reaction (or the reverse for endothermic).
- **Level 2** (3-4): Partial explanation. Candidate states that breaking bonds absorbs energy and forming bonds releases energy and makes a simple link to overall energy change, but explanation may lack depth or example.
- **Level 1** (1-2): Basic statements. Candidate recalls that breaking bonds needs energy or forming bonds releases energy but does not link these to overall reaction energy or provide an example.
- **Indicative content:**
  - Breaking bonds requires energy input to overcome attractions between atoms; energy is taken in from the surroundings.
  - Forming bonds releases energy because atoms move to lower energy arrangements and the excess energy is given out to the surroundings.
  - Overall reaction enthalpy depends on balance: if energy released from forming new bonds is greater than energy absorbed breaking old bonds, the reaction is exothermic.
  - If energy absorbed breaking bonds is greater than energy released forming new bonds, the reaction is endothermic.
  - Example: combustion of methane is exothermic because strong C-H and O-H bonds formed release more energy than that needed to break C-H and O=O bonds.
  - Reference to energy profile language is creditworthy: reactants to products energy difference, activation energy as hump, and overall release or absorption shown by vertical difference.