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SPECA

GCSE Combined Science (AQA Trilogy) · Chemistry

Energy Changes · Mark Scheme

For use with the Tiered Worksheet. Marking points are indicative, not exhaustive: award equivalent correct answers.

Section A: Foundation (Q1 to 11)

1) A reaction that transfers energy to the surroundings, raising their temperature (1) [1]

2) A reaction that takes in energy from the surroundings, lowering their temperature (1) [1]

3) Exothermic (1); the reaction transfers energy to the surroundings, so the sachet and its surroundings get hotter (1) [2]

4) Endothermic (1); the reaction takes in energy from the surroundings, so the pack and its surroundings get colder (1) [2]

5) (a) Exothermic (1) (b) Endothermic (1) (c) Exothermic (1) [3]

6) Energy is conserved overall (1); if energy is transferred out to the surroundings, the products must hold less energy than the reactants did, by the amount transferred (1) [2]

7) The minimum amount of energy needed for a reaction to happen (1) [1]

8) Particles must collide with at least the activation energy for the reaction to occur: collisions with less energy than this do not result in a reaction (1); reacting particles must actually meet (collide) for bonds to break and re-form at all (1) [2]

9) (a) 210 − 150 = 60 kJ (1) (b) Overall energy change = 150 − 90 = 60 kJ released (1); exothermic, because the products end at a lower energy level than the reactants (1) [3]

10) Endothermic (1); the products (105 kJ) end at a higher energy level than the reactants (80 kJ), so energy has been taken in from the surroundings (1) [2]

11) Energy cannot be created or destroyed in a chemical reaction, only transferred (1); the total energy in the universe is the same before and after the reaction (1) [2]

Section B: Higher (Q12 to 16)

12) Energy must be put in to overcome the forces holding the atoms together in a bond (1) [1]

13) Energy is released as new, stable bonds form between atoms (1) [1]

14) Overall energy change = 610 − 550 = 60 kJ/mol (1); released, i.e. more energy is released forming bonds than is needed to break them (1); exothermic (1) [3]

15) Energy to break bonds: H-H + Cl-Cl = 436 + 242 = 678 kJ/mol (1); energy released forming bonds: 2 × H-Cl = 2 × 431 = 862 kJ/mol (1); overall change = 678 − 862 = −184 kJ/mol, i.e. 184 kJ/mol released (1); exothermic, because more energy is released forming bonds than is needed to break them (1) [4]

16) Energy to break bonds: (4 × C-H) + (2 × O=O) = (4 × 413) + (2 × 498) = 1652 + 996 = 2648 kJ/mol (1); energy released forming bonds: (2 × C=O) + (4 × O-H) = (2 × 799) + (4 × 464) = 1598 + 1856 = 3454 kJ/mol (1); overall change = 2648 − 3454 = −806 kJ/mol, i.e. 806 kJ/mol released (1); exothermic (1) [4]

Total: 21 marks (Section A) + 13 marks (Section B) = 34 marks

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