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GCSE Combined Science (AQA Trilogy) · Chemistry

Energy Changes · Tiered Worksheet

Section A: Foundation

Exothermic and endothermic reactions

1) Define an exothermic reaction. [1]

2) Define an endothermic reaction. [1]

3) A hand warmer sachet gets hot when it is activated. State whether the reaction inside it is exothermic or endothermic, and explain how you know. [2]

4) A sports injury cold pack gets cold when it is activated. State whether the reaction inside it is exothermic or endothermic, and explain how you know. [2]

5) Classify each of the following as exothermic or endothermic: (a) burning natural gas in a boiler (b) the thermal decomposition of a metal carbonate on heating (c) an acid reacting with an alkali. [3]

6) Explain, in terms of energy transfer to the surroundings, why the products of an exothermic reaction hold less energy than the reactants did. [2]

Activation energy and reaction profiles

7) Define activation energy. [1]

8) Explain why a reaction can only occur when reacting particles collide. [2]

9) A reaction profile shows the reactants starting at an energy level of 150 kJ, rising to a peak of 210 kJ, then falling to a products level of 90 kJ. (a) State the activation energy shown by this profile. (b) State the overall energy change for this reaction, and say whether the reaction is exothermic or endothermic. [3]

10) A different reaction profile shows reactants at an energy level of 80 kJ, rising to a peak of 130 kJ, then falling to a products level of 105 kJ. State whether this reaction is exothermic or endothermic, and explain your answer using the reactant and product energy levels shown. [2]

11) State the law of conservation of energy as it applies to a chemical reaction, and explain what this means for the total energy of the universe before and after the reaction takes place. [2]

Section B: Higher (in addition to Section A)

Bond energy calculations

12) Explain, in terms of bonds, why breaking bonds in the reactants of a reaction requires an input of energy. [1]

13) Explain, in terms of bonds, why forming new bonds in the products of a reaction releases energy. [1]

14) A reaction requires 550 kJ/mol of energy to break the bonds in its reactants, and releases 610 kJ/mol of energy forming the bonds in its products. Calculate the overall energy change for this reaction, and state whether it is exothermic or endothermic. [3]

15) Hydrogen reacts with chlorine to form hydrogen chloride: $H_2 + Cl_2 \rightarrow 2HCl$. Given the bond energies H-H = 436 kJ/mol, Cl-Cl = 242 kJ/mol, and H-Cl = 431 kJ/mol, calculate the overall energy change for this reaction and state whether it is exothermic or endothermic. [4]

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16) Methane burns completely in oxygen: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. Given the bond energies C-H = 413 kJ/mol, O=O = 498 kJ/mol, C=O = 799 kJ/mol, and O-H = 464 kJ/mol, calculate the overall energy change for this reaction and state whether it is exothermic or endothermic. **[4]**

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