Reaction profiles and bond energies

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Name _____ Date _____

1. A cooler mixture

A reaction mixture cools from 20 °C to 16 °C. Is the reaction exothermic or endothermic? Describe where energy is transferred.

2. Compare temperature rises

In two runs, mixture A warms from 18.6 °C to 27.2 °C and mixture B warms from 21.0 °C to 28.1 °C. A student says B warmed more because it finished hotter. Use the data to check the claim.

3. Observe dissolving an ionic solid

An ionic solid is stirred into water and dissolves. The solution temperature falls from 19.5 °C to 15.0 °C. Calculate the temperature decrease. Explain what the fall shows about the direction of energy transfer during dissolving.

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4. Draw a reaction profile

On a reaction profile the reactants are at 30 kJ mol^{-1}, the peak is at 85 kJ mol^{-1} and the products are at 10 kJ mol^{-1}. Sketch and label the profile. Give the forward activation energy.

5. Use bond energies (Higher)

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$. Bond energies in kJ mol^{-1} are H-H 436, Cl-Cl 242 and H-Cl 431. Calculate the overall energy change for the equation as written.

6. Count bonds in combustion (Higher)

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. Bond energies in kJ mol^{-1} are C-H 413, O=O 498, C=O in CO_2 805 and O-H 463. Calculate the energy change when 1 mol of methane reacts. Treat all substances as gases.

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7. Add a catalyst

An exothermic reaction goes through a different pathway when a catalyst is added. Sketch both reaction profiles on one set of axes. Explain the change in activation energy and any effect on the overall energy change.

8. Find a missing bond energy (Higher)

$H_2(g) + I_2(g) \rightarrow 2HI(g)$. Breaking H-H takes 436 kJ mol^{-1} and breaking I-I takes 151 kJ mol^{-1}. The change is −11 kJ for the amounts in the equation. Calculate the H-I bond energy.

9. Extra challenge · Interpret an energy profile

In a reaction profile, reactants are at 184 kJ mol^{-1}, products at 116 kJ mol^{-1} and the peak is at 251 kJ mol^{-1}. When a catalyst is added the peak is at 221 kJ mol^{-1}. Find the two forward activation energies and the overall energy change. Explain whether the catalysed reaction is also exothermic.

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