

Chem!stry

Name: ()

Class:

Date: / /

Investigating Exothermic Reactions at the Molecular Level – Ammonia

Question 1:

a) Explain what is meant by the term *exothermic* chemical reaction:

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b) For an *exothermic* chemical reaction, the energy change is: Positive Negative

Question 2:

a) Explain what is meant by the term *endothermic* chemical reaction:

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b) For an *endothermic* chemical reaction, the energy change is: Positive Negative

Question 3:

During a chemical reaction, existing chemical bonds are *broken* and new chemical bonds are *formed*.

a) Bond breaking is: Exothermic Endothermic

b) Bond formation is: Exothermic Endothermic

Question 4:

The following word equation describes the formation of ammonia from nitrogen and hydrogen:



Write the balanced chemical equation for this reaction, including state symbols:

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Question 5:

For the reaction between nitrogen and hydrogen forming ammonia, $\Delta H = -92.4 \text{ kJ}$.

a) What is meant by the term ΔH ?

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b) What is the significance of the value -92.4 kJ ?

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Question 6:

Using the molecular modelling kits that have been provided, apply your knowledge bonding to construct molecular models of nitrogen and hydrogen. Now *react* the molecular models together to form ammonia. In the space provided below, use words and diagrams to explain the process that you went through to convert the molecular models of nitrogen and hydrogen into the molecular models of ammonia. Try to capture as many of your thoughts, ideas and questions as possible:

Question 7:

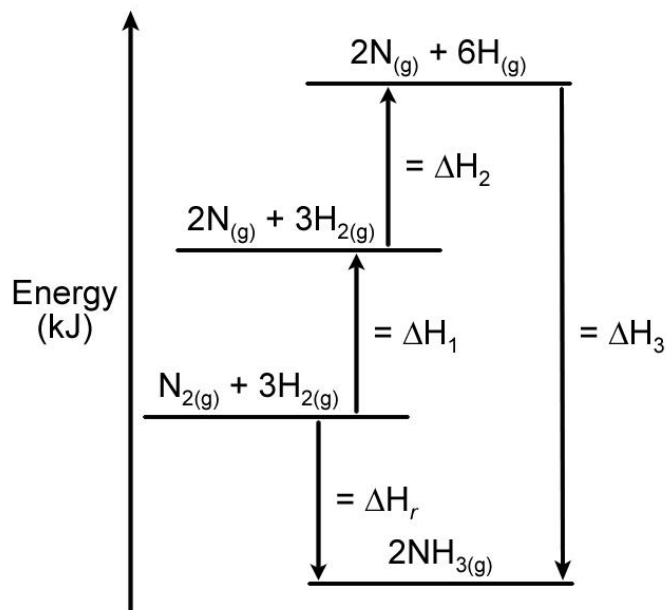
Refer to the energy level diagram given on the right. Use the following average bond energies to calculate values for ΔH_1 , ΔH_2 and ΔH_3 and hence the overall energy change for the reaction: ΔH_r . You may wish to refer to the molecular models and notes that you made in answer to **Question 6** to help you visualise exactly what ΔH_1 , ΔH_2 and ΔH_3 represent.

$$\text{N}\equiv\text{N} = 944 \text{ kJ/mol}$$

$$\text{H}-\text{H} = 436 \text{ kJ/mol}$$

$$\text{N}-\text{H} = 388 \text{ kJ/mol}$$

With reference to bond breaking and bond formation, rationalise why the formation of ammonia from nitrogen and hydrogen is an *exothermic* reaction.



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- Scan the QR Code below for the answers to this assignment.



http://www.chemist.sg/energy_changes/enthalpy_change_calcs/ammonia_ans.pdf