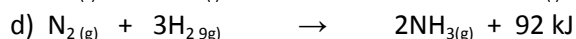


UNIT 3: ENERGY AND RATES OF REACTION

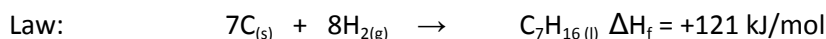
1. Write each equation using ΔH notation and state if the reaction is exothermic or endothermic.



2. Heptane undergoes complete combustion with oxygen to produce carbon dioxide gas and water vapour.

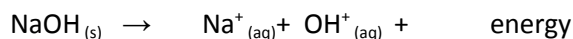
a) Write a balanced equation for the reaction and predict the sign of ΔH .

b) Given the following information and the values on the back of your periodic table, calculate ΔH_{comb} using Hess' Law:



c) How much energy would be released if $5.00 \times 10^2 \text{ g}$ of heptane undergoes combustion?

3. Sodium hydroxide undergoes an exothermic reaction when dissolving:

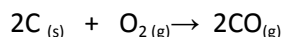


When 40.8 g of sodium hydroxide was dissolved in 1.30 L of water, the temperature of the water increased by 46.0 °C. Calculate ΔH in kJ/mol.

4. Using the average bond energy values from the periodic table, calculate the enthalpy change for the following reaction:



5. In the incomplete combustion of carbon, $\text{C}_{(s)}$, 74.0 g of oxygen gas reacts in 20.0 minutes. Calculate the rate of the reaction in terms of moles $\text{CO}_{(g)}$ produced per hour:



6. a) Sketch a potential energy diagram for this reaction and label it completely. Assume an initial P.E. value of 10 kJ/mol: $\text{A} + \text{B} \rightarrow \text{C} \quad \Delta H = -25 \text{ kJ/mol}; E_a = 70 \text{ kJ/mol}$

b) Using the graph determine the enthalpy change and activation energy for the reverse reaction.

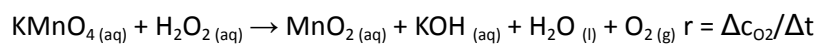
7. Explain how a catalyst works to increase the rate of a reaction by describing:

a) its effect on the kinetic energy distribution curve (Boltzmann distribution)

b) its effect on the potential energy diagram of a chemical reaction.

c) Repeat this question to explain the effect of temperature on the rate of reaction.

8. Consider the following reaction:



The initial rate of reaction was monitored by measuring the moles of oxygen produced per second and the following kinetic data collected.

Trial	[KMnO ₄] (mol/L)	[H ₂ O ₂] (mol/L)	Rate (mol/s)
1	0.001	0.004	0.003
2	0.002	0.004	0.012
3	0.003	0.004	0.027
4	0.004	0.001	0.002
5	0.004	0.002	0.016
6	0.004	0.003	0.054

- Determine the rate law equation for the reaction.
- What is the overall order of this reaction?
- By what factor would the reaction rate increase if both [KMnO₄] and [H₂O₂] were tripled at the same time?