**CHE1031 Lecture 10 Homework [ABRIDGED]**

Problems must be solved, or written out, in their entirety with all work shown on engineering graph paper. You must label each set in the upper left hand corner with your name, the date and the chapter. Problems must be identified by number and all work must be shown with answers boxed. Be sure your handwriting is legible.

**10.1: Reaction rates**

1. Reaction rate

~~a. What does the term ‘reaction rate’ mean?~~

b. What factors affect reaction rates?

~~c. What information do you need to relate the rate of disappearance of reactants to the rate of appearance of products?~~

~~2. Looking at the graph shown here, answer these questions:~~

~~a. Is X a reactant or product?~~

~~b. Why is the rate between X1 and X2 greater than the rate between X3 and X4?~~

~~3. The rate of a reaction is studied, and the concentration of A and B are plotted here. Which chemical equation could be represented by this data? And why?~~

~~a. A 🡪 B~~

~~b. B 🡪 A~~

~~c. A 🡪 2B~~

~~d. B 🡪 2A~~

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~~4. The data shown here are collected by a chemist studying the reaction of A (aq) 🡪 B (aq) after a flask is charged with 0.065 mol of A in a total volume of 100.0 mL.~~

~~a. Calculate the moles of B at each time point if B’s initial concentration is zero.~~

~~b. Calculate the average rate of disappearance of A over each 10-minute interval in units of M/s.~~

~~c. Between 10 and 30 minutes, what is the average rate of appearance of B in M/s?~~

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **~~Time (min)~~** | **~~0~~** | **~~10~~** | **~~20~~** | **~~30~~** | **~~40~~** |
| ~~A (moles)~~ | ~~0.065~~ | ~~0.051~~ | ~~0.042~~ | ~~0.036~~ | ~~0.031~~ |

~~5. For each of the following gas-phase reactions, indicate how the rate of disappearance of each reactant is related to the rate of appearance of each product.~~

~~a. H2O2 🡪 H2 + O2~~

~~b. 2N2O 🡪 2N2 + O2~~

~~c. N2 + 3H2 🡪 2NH3~~

**~~10.4: Temperature & reaction rates~~**

~~6. What factors determines whether the collision between two molecules will lead to a chemical reaction?~~

~~7. In the collision model of reaction, what role does temperature play in the rate of reactions?~~

~~8. For which reaction will molecular orientation play a greater role?~~*~~[Hint: draw Lewis dot structures.]~~*

~~a. NO + O 🡪 NO2~~

~~b. H + Cl 🡪 HCl~~

~~9. Based on activation energies and energy changes, and assuming collision factors are identical, which of these reactions would be fastest and which slowest? Explain your answer.~~

~~a. Ea = 45 kJ/mol and ΔE = -25 kJ/mol~~

~~b. Ea = 35 kJ/mol and ΔE = -10 kJ/mol~~

~~c. Ea = 55 kJ/mol and ΔE = 10 kJ/mol~~

~~10. For the reactions in the previous problem, rank the speed of the reverse reactions. Explain your answer.~~

**~~10.5: Rate-limiting steps~~**

~~11. A reaction has the energy profile shown here.~~

~~a. How many transition states are there?~~

~~b. How many intermediates are there?~~

~~c. Which step limits the speed of the reaction?~~

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**10.6: Catalysis**

12. What part of a reaction’s energy profile is affected by a catalyst?

13. What is the difference between homogenous and heterogeneous catalysts?

14. In the diagram below, the first frame shows reactants and the last shows products. Each sphere is an atom, and the red, blue and green spheres represent different elements.

a. Write a balanced chemical equation for the reaction, using R, B and G to represent atoms.

b. What is the intermediate?

c. What is the catalyst?

