

Work expands so as to fill
the time available for its
completion. --C. Parkinson

Unit 9 Sample Test

The test will follow the usual format, with 5 multiple choice questions, two required problems and one option, a choice of two out of four chemical reactions to write and one essay question.

The following are representative of typical multiple choice questions but do not necessarily indicate topics to be addressed on your actual test.

_____ 1. Consider the reaction:



The rate law for this reaction is $k[A][B]^2$. Doubling the concentration of A increases the rate of the reaction by a factor of

- a. 2
- b. 3
- c. 4
- d. 9

_____ 2. The mechanism of a reaction can sometimes be deduced from

- a. the temperature dependence of the rate
- b. the balanced equation
- c. the rate law
- d. the activation energy

_____ 3. A catalyst

- a. increases the average kinetic energy of reacting species
- b. increases the activation energy
- c. alters the reaction mechanism
- d. increases the frequency of collisions

_____ 4. The rate of a reaction in a system consisting of a solid and a gas depends on

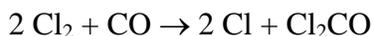
- a. the amount of exposed surface of the solid only
- b. the pressure of the gas only
- c. the temperature only
- d. both the amount of exposed surface of solid and the pressure of the gas

_____ 5. In the collision theory of reaction rates, which of the following accounts most for the observed temperature dependence?

- a. as temperature increases the rate of collisions between reacting molecules decreases
- b. in order for reaction to result from a collision, there is some minimum energy the colliding molecules must possess
- c. there are many collisions in which the molecules are not properly oriented to result in reaction
- d. the electrons in the reacting molecules are moving faster at higher temperatures

The next section consists of representative problems which might be found in the required section.

6. Consider the rate data for the reaction given below:



Initial Concentration			Initial Rate
[Cl ₂]	[Cl]	[CO]	(M/s)
0.1	0.1	0.1	0.2
0.1	0.3	0.1	0.6
0.1	0.1	0.3	0.6
0.2	0.1	0.1	0.8

This reaction occurs under conditions of ultraviolet light for which atomic chlorine is stable.

Determine a consistent rate law and evaluate the rate constant, k (with units!).

7. For a certain reaction, the following data were obtained:

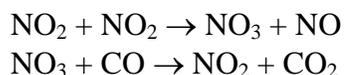
temperature, °C	20	40	50	60
k (s ⁻¹)	2.5×10^{-5}	2.7×10^{-4}	9.1×10^{-4}	2.9×10^{-3}

By graphical means (graph paper attached) determine the value of the activation energy, E_a , for this reaction.

The next section consists of representative problems such as might be found in the "options" section. Each student is expected to select one problem from this section to work on.

8. Consider the following reaction: $\text{NO}_2 + \text{CO} \rightarrow \text{NO} + \text{CO}_2$

A suggested mechanism is given below:



If the rate law is known to be $k[\text{NO}_2]^2$, which of the two steps is slower? Which substance (if any) is probably an unstable intermediate?

9. Predict the effect on the rate if the following changes are made in the reaction in #6 above:

- lower the temperature
- increase [CO]
- decrease the volume of container (all species are gases)

10. For the reaction $\text{CO} + \text{NO}_2 \rightarrow \text{CO}_2 + \text{NO}$, the following data on rate constants has been obtained:

Temperature, K	k (L/mol s)
600	0.028
750	6.0

Determine E_a , the activation energy, by calculation.

*The next section consists of representative reactions to complete and write balanced net-ionic equations for. Note that some reactions do not occur in aqueous solution and thus molecular equations are all that would be needed. In some cases no reaction may occur, based on either solubility rules or the activity series. In those cases, no products are required in the reaction. NR written to the right of the arrow will suffice. Each student is expected to choose two from this section. **Phase symbols ((s), (aq), etc.) are required.***

(all reactions below occur in aqueous solution)

11. calcium nitrate + sodium carbonate \rightarrow _____

12. zinc nitrate + copper metal \rightarrow _____

13. sulfuric acid + calcium metal \rightarrow _____

14. dichromate ion reacts with sulfide ion in acidic solution; chromium(III) ions and solid sulfur are among the products

The final section of the test will consist of one essay question selected from the following topics:

- collision theory
- activated complexes
- catalysts

[Answers](#)