



Hohete Tibe Share Company
Education and Technology Team
Ethio-Parents' Schools: Addis Ababa (Gerji/ Gullele) and Hawassa.
Chemistry 7th work sheet for Grade 11



Name _____ Section _____ Branch _____

Part -1: True or False Item

Direction: Read the following statements carefully and write TRUE if the statement is "correct" and FALSE if it is "wrong" on your own separate answer sheet.

- Order of overall reaction is same as molecularity of the slowest step.
- Molecularity of the slowest step is never zero or non interger.
- It catalyses the forward and backward reaction to the same extent.
- Catalyst provides an alternate mechanism by reducing activation energy between reactants and products.
- Number of effective collisions determines the rate of reaction.
- Collision of atoms or molecules possessing sufficient threshold energy results into the product formation.
- Molecules should collide with sufficient threshold energy and proper orientation for the collision to be effective.
- The rate of a reaction decreases with passage of time as the concentration of reactants dereases.
- The rate of a reaction is same at any time during the reaction.
- The rate of a reaction decreases with increase in concentration of reactant(s).
- Order of a reaction is experimentally determined quantity.
- The order of a reaction is always equal to the sum of the stoichiometric coefficients of reactants in the balanced chemical equation for a reaction.

Part - 2: Matching Item Type

Direction: Match the species under Column I with the bond order in Column II. Responses on the right may be used more than once or need not be used at all.

Column I	Column II
1. F_2^-	(a) 1.5
2. Be	(b) 2.0
3. Ne	(c) 2.5
4. O_2	(d) 3.0
5. N_2^+	
6. F_2^+	

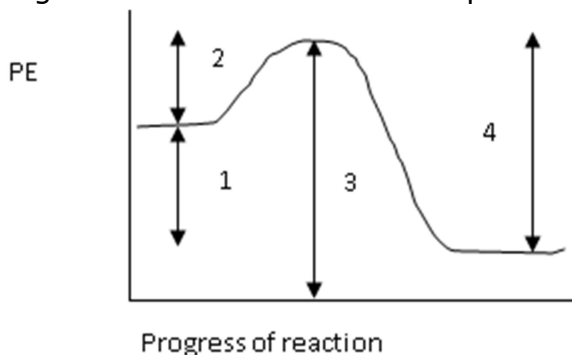
Part 3: Multiple Choice Item Questions

Direction: Choose the best answer and write the letter of your choice on the separate answer sheet provided.

- Consider the following reaction mechanism:
 step 1: $M + X \rightarrow MX$
 step 2: $MX + A \rightarrow D + X$: The chemical species MX is a(n)
 A. Catalyst C. inhibitor
 B. final product D. reaction intermediate
- The following information are given for a chemical reaction.
 I. nature of the reactants
 II. presence of a catalyst
 III. temperature of system
 IV. concentration of reactants
 Which of the above factors affect the rates of both homogeneous and heterogeneous reactions?
 A. I and IV only C. II and III only
 B. II, III, and IV only D. I, II, III, and IV

3. Consider the following reaction:
 $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
 At a certain temperature the rate of decomposition of $2\text{N}_2\text{O}_5(\text{g})$ is 2.5×10^{-6} mol/s. The rate of formation of NO_2 is
 A. 1.0×10^{-5} mol/s C. 1.3×10^{-6} mol/s
 B. 2.5×10^{-6} mol/s D. 5.0×10^{-6} mol/s
4. Consider the following mechanism:
 Step 1: $\text{Cl} + \text{O}_3 \rightarrow \text{ClO} + \text{O}_2$
 Step 2: $\text{O} + \text{ClO} \rightarrow \text{Cl} + \text{O}_2$
 The reaction intermediate is
 A. Cl C. O_2
 B. O_3 D. ClO
5. A catalyst increases the rate of a reaction by
 A. increasing the concentration of reactant(s).
 B. decreasing the concentration of the reactant(s).
 C. increasing the activation energy of the overall reaction.
 D. decreasing the activation energy of the overall reaction.
6. The following chemical reaction that is taking place in an open container.
 $\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$
 Which of the following properties could be used to measure the rate of the following reaction?
 A. mass of Zn
 B. solubility of HCl
 C. concentration of Cl^-
 D. color of the solution
7. In a reaction mechanism, the rate determining step is the
 A. fastest and has the lowest activation energy.
 B. fastest and has the highest activation energy.
 C. slowest and has the lowest activation energy.
 D. slowest and has the highest activation energy.
8. Consider the following reactions:
 I. $\text{N}_2 + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$
 II. $\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{MgO}(\text{s})$
 III. $\text{CaCO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
 Increasing the surface area will increase the reaction rate in
 A. II only C. I and III only
 B. II and III only D. I, II, and III
9. Consider the following reaction mechanism:
 Step 1: $\text{V}^{3+} + \text{Cu}^{2+} \rightarrow \text{V}^{4+} + \text{Cu}^+$
 Step 2: $\text{Cu}^+ + \text{Fe}^{3+} \rightarrow \text{Cu}^{2+} + \text{Fe}^{2+}$ slow
 The reaction catalyst and intermediate respectively are
 A. Cu^+ C. Cu^{2+}
 B. V^{3+} D. Fe^{3+}
10. Consider the following reaction:
 $2\text{MnO}_4^-(\text{aq}) + 5\text{C}_2\text{O}_4^{2-}(\text{aq}) + 16\text{H}^+(\text{aq}) \rightarrow 2\text{Mn}^{2+}(\text{aq}) + 10\text{CO}_2(\text{g}) + 8\text{H}_2\text{O}(\text{l})$
 The rate of decomposition of the oxalate ion is increased by
 A. adding NaOH.
 B. removing CO_2
 C. adding a catalyst
 D. decreasing the pressure
11. The minimum amount of energy needed to start a reaction is called the
 A. activation energy.
 B. energy of reaction.
 C. entropy of reaction
 D. reaction mechanism energy
12. In general rates double when the temperature is increased by 10°C . The temperature of a reaction is increased by 40°C . The rate will increase by a factor of
 A. 2 C. 4
 B. 8 D. 16
13. Calculate the activation energy, in kJ/mol, for the redox reaction
 $\text{Sn}^{2+} + 2\text{Co}^{3+} \rightarrow \text{Sn}^{4+} + 2\text{Co}^{2+}$.
 A. 59.2 B. 0.477
 C. 5.37 D. 48.1 kJ

14. Consider the following factors
 I. Reactant particles collide
 II. Sufficient kinetic energy is present
 III. A favorable geometry exists
 IV. Catalysts are present
 Which combination of the above factors is required for all successful collisions?
 A. I only C. II and III only
 B. I, II and III only D. I, II, III, and IV
15. Consider the following reaction at constant temperature in an open system:
 $\text{MgCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) + \text{MgCl}_2(\text{aq})$
 Which of the following properties could be used to determine the reaction rate?
 A. mass of the system
 B. pressure of the gas
 C. concentration of H_2O
 D. concentration of MgCO_3
16. Which combination of factors will affect the rate of the following reaction?
 $\text{MgCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) + \text{MgCl}_2(\text{aq})$
 A. temperature and surface area only
 B. temperature and concentration only
 C. concentration and surface area only
 D. temperature, concentration, and surface area only
17. Consider the following potential energy diagram for the next three five questions.



The interval representing ΔH for the reverse reaction is

- A. 1 C. 2
 B. 3 D. 4

18. The interval representing ΔH for the forward reaction is
 A. 1 C. 2
 B. 3 D. 4
19. The interval representing E_a for the reverse reaction is
 A. 1 C. 2
 B. 3 D. 4
20. The interval representing the energy of the activated complex is
 A. 1 C. 3
 B. 2 D. 4
21. When a lit match is touched to the wick of a candle, the candle begins to burn. When the match is removed, the candle continues to burn, the match,
 A. behaves as a catalyst
 B. supplies the activation energy
 C. is part of the rate determining step
 D. lowers the activation energy barrier
22. For the reaction represented below, the experimental rate law is given by $\text{rate} = k [(\text{CH}_3)_3\text{CCl}]$.
 $(\text{CH}_3)_3\text{CCl}(\text{aq}) + \text{OH}^- \rightarrow (\text{CH}_3)_3\text{COH}(\text{aq}) + \text{Cl}^-$
 If some solid sodium hydroxide were added to a solution in which $[(\text{CH}_3)_3\text{CCl}] = 0.01 \text{ M}$ and $[\text{NaOH}] = 0.10 \text{ M}$, which of the following would be true? (Assume the temperature and volume remains constant.)
 A. Both the reaction rate and k would increase.
 B. Both the reaction rate and k would remain the same.
 C. The reaction rate would increase but k would remain the same.
 D. The reaction rate would decrease but k would remain the same.
23. The activated complex is a chemical species that is
 A. stable and has low PE.
 B. stable and has high PE.
 C. unstable and has low PE.
 D. unstable and has high PE.

24. Nitrous oxide (N_2O) decomposes at 600°C according to the balanced equation
 $2\text{N}_2\text{O}(\text{g}) \rightarrow 2\text{N}_2(\text{g}) + \text{O}_2(\text{g})$
 A reaction mechanism involving three steps is shown below. Identify all of the catalysts in the following mechanism.
 $\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$
 $\text{N}_2\text{O}(\text{g}) + \text{Cl}(\text{g}) \rightarrow \text{N}_2(\text{g}) + \text{ClO}(\text{g})$ (occurs twice)
 $\text{ClO}(\text{g}) + \text{ClO}(\text{g}) \rightarrow \text{Cl}_2(\text{g}) + \text{O}_2(\text{g})$
 A. Cl B. Cl_2
 C. ClO D. ClO and Cl
25. For the chemical reaction $\text{A} \rightarrow \text{C}$, a plot of $1/[\text{A}]t$ versus time was found to give a straight line with a positive slope. What is the order of reaction?
 A. zeroth B. first
 C. second D. cannot be determined
26. The reaction $2\text{NO}_2(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$ is suspected to be second order in NO_2 . Which of the following kinetic plots would be the most useful to confirm whether or not the reaction is second order?
 A. a plot of $[\text{NO}_2]^{-1}$ vs. t
 B. a plot of $\ln [\text{NO}_2]$ vs. t
 C. a plot of $\ln [\text{NO}_2]^{-1}$ vs. t
 D. a plot of $[\text{NO}_2]^2$ vs. t
27. For the reaction $\text{X} + \text{Y} \rightarrow \text{Z}$, the reaction rate is found to depend only upon the concentration of X. A plot of $1/\text{X}$ versus time gives a straight line. What is the rate law for this reaction?
 A. $\text{rate} = k [\text{X}]$ B. $\text{rate} = k [\text{X}]^2$
 C. $\text{rate} = k [\text{X}][\text{Y}]$ D. $\text{rate} = k [\text{X}]^2[\text{Y}]$
28. Appropriate units for a second-order rate constant are
 A. M/s. B. 1/M.s.
 C. 1/s. D. $1/\text{M}^2\text{s}$.
29. A first-order reaction has a rate constant of $3.00 \times 10^{-3} \text{ s}^{-1}$. The time required for the reaction to be 75.0% complete is
 A. 95.8 s. B. 231 s
 C. 201 s. D. 41.7 s.
30. The reaction $\text{A} + 2\text{B} \rightarrow \text{products}$ was found to follow the rate law, $\text{rate} = k[\text{A}]^2[\text{B}]$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled, the concentration of B is tripled, and the temperature remains constant.
 A. 5 B. 6
 C. 12 D. 18
31. Consider the Arrhenius equation given below and mark the correct option.
 A. Rate constant increases exponentially with increasing activation energy and decreasing temperature.
 B. Rate constant decreases exponentially with increasing activation energy and decreasing temperature.
 C. Rate constant increases exponentially with decreasing activation energy and decreasing temperature.
 D. Rate constant increases exponentially with decreasing activation energy and increasing temperature.

Part 4: Explain and workout type questions

- How can you determine the rate law of the following reaction?
 $2\text{NO}(\text{g}) + \text{O}(\text{g}) \rightarrow 2\text{NO}(\text{g})$
- For which type of reactions, order and molecularity have the same value?
- In a reaction if the concentration of reactant A is tripled, the rate of reaction becomes twenty seven times. What is the order of the reaction?
- Derive an expression to calculate time required for completion of zero order reaction.

5. For a reaction $A + B \rightarrow \text{Products}$, the rate law is $-\text{Rate} = k [A][B]^{3/2}$

Can the reaction be an elementary reaction? Explain.

6. For a certain reaction large fraction of molecules has energy more than the threshold energy, yet the rate of reaction is very slow. Why?

7. Write the rate equation for the reaction $2A + B \rightarrow C$ if the order of the reaction is zero.

8. State a condition under which a bimolecular reaction is kinetically first order reaction.

9. Nitric oxide (NO) is involved in the decomposition of ozone by the following mechanism:

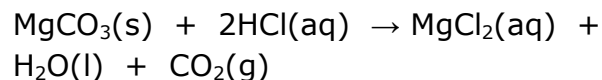
Step 1: $O_3 + \text{sunlight} \rightarrow O_2 + O$

Step 2: $O_3 + NO \rightarrow NO_2 + O_2$

Step 3: $NO_2 + O \rightarrow NO + O_2$

- (A) Write the net equation for the decomposition reaction
(B) Identify a catalyst
(C) Identify a reaction intermediate
(D) What is the function of sunlight in this reaction?

10. Consider this reaction:



Suggest two properties which could be used to determine the rate of this reaction, and state what would happen to each property as the reaction proceeds.

i.

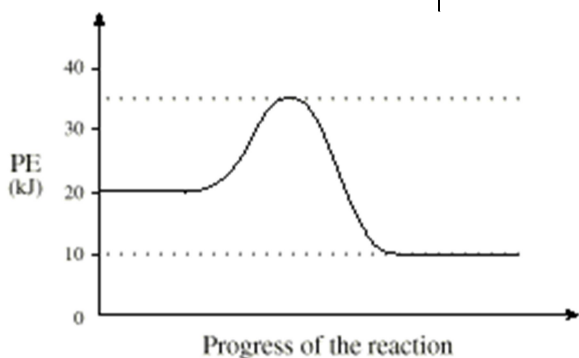
ii.

11. Describe the relationship between activation energy and the rate of a chemical reaction.

12. At 25°C , the second-order reaction $NOCl(g) \rightarrow NO(g) + \frac{1}{2}Cl_2(g)$ is 50% complete after 5.82 hours when the initial concentration of NOCl is 4.46 mol/L. How long will it take for the reaction to be 75% complete?

13. At a particular temperature the first-order gas-phase reaction $2N_2O_5 \rightarrow 2N_2O_4 + O_2$ has a half-life for the disappearance of dinitrogen pentoxide of 3240 s. If 1.00 atm of N_2O_5 is introduced into an evacuated 5.00 L flask, what will be the total pressure of the gases in the flask after 1.50 hours?

14. Consider the following potential energy diagram for a reversible reaction:

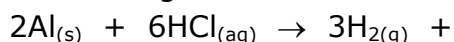


- Calculate the activation energy for the forward reaction.
- Calculate ΔH for the forward reaction.
- Calculate the activation energy for the reverse reaction.
- On the diagram above, sketch a curve that is its rate constant?

15. Using collision theory, explain how each of these four factors increases the rate of the reaction.

-
-
-
-

16. An experiment is done to determine the rate of the following reaction:



The following data are collected:

TIME (s)	MASS OF FLASK PLUS CONTENTS (g)
0.0	270.230
30.0	270.200
60.0	270.170



- Calculate the rate of formation of H_2 in mol/min.
- Calculate the rate of consumption of Al in g/sec.

17. A certain first-order reaction $\text{A} \rightarrow \text{B}$ is 25% complete in 42 min at 25°C . What is its rate constant?

18. The isomerization of cyclopropane to form propene is a first-order reaction. At 760 K, 85% of a sample of cyclopropane changes to propene in 79.0 min. Determine the rate constant for this reaction at 760 K.

19. A certain reaction $\text{A} \rightarrow \text{products}$ is second order in A. If this reaction is 85% complete in 12 minutes, how long

would it take for the reaction to be 15% complete?