

CHEMICAL KINETICS (1ST SEMESTER)

A. SHORT QUESTION

1. The unit of rate constant of a reaction is $\text{Mol}^{-1}\text{L.S}^{-1}$. What is the order of the reaction? (1)
2. What happens to the half-life period for a first order reaction, if the initial concentration of the reactants is increased? (1)
3. Give an example of a zero-order reaction. (1)
4. A reaction is first order with respect to the reactant A and second order w.r.t reactant B in the reaction , $A + B \rightarrow \text{Product}$
 - (i) Write the differential rate equation
 - (ii) How is the rate of the reaction affected on increasing the concentration of B by 2 times? (2)
5. A certain first order reaction is half completed in 46 mins. Calculate the rate constant and also time taken for 75% completion of the reaction . (3)
6. Show that in case of a first order reaction, the time taken for completion of 99% reaction is ten times the time required for half change of the reaction. (3)
7. The half-life for radioactive decay of ^{14}C is 5730 years. An archaeological artifact containing wood had only 80% of the ^{14}C found in a living tree. Estimate the age of the sample . (3)
8. Derive integrated rate equation for the first order reaction . (3)
9. The rate of a particular reaction doubles when the temperature changes from 300 K to 310 K. calculate the energy of activation of the reaction [given, $R=8.314 \text{ JK}^{-1}\text{mol}^{-1}$] (3 marks)
10. Show that the half-life period of a first order reaction is independent of initial concentration of reacting species. (2)
11. Rate constant of a first order reaction 0.693 min^{-1} . Calculate the percentage of the reactant remaining at the end of 60 minutes . (3)
12. Show that half-life period for a zero order reaction is directly proportional to initial concentration. (2)
13. For the reaction $2A + B + 2C \rightarrow D + 2E$, the rate law is: $\text{rate} = k[\text{A}]^2[\text{B}]^1[\text{C}]^1$

Which of the following statements is false:

 - a. the reaction is second order in [A]
 - b. the reaction is first order in [B]
 - c. the reaction is second order in [C]
 - d. the reaction is 4th order overall

14. For the reaction $1A + 2B + 1C \rightarrow 2D + 1E$, the rate law is: $\text{rate} = k[B]^2[C]^1$
 Which of the following statements is false:
 a. the reaction is first order in [A]
 b. the reaction is second order in [B]
 c. the reaction is first order in [C]
 d. the reaction is third order overall
15. For the rate law $\text{Rate} = k[A]^{0.5}[B]$, the partial order with respect to A is _____, the partial order with respect to B is _____, and the total order is _____.
 a. 1/2; 0; 1/2
 b. 1/2; 1; 1
 c. 1/2; 1; 3/2
 d. 1/2
 e. The orders cannot be determined without a chemical reaction.
16. For the rate law $\text{Rate} = k[A][B]^{3/2}$, the order with respect to A is _____, the order with respect to B is _____, and the overall reaction order is _____.
 a. 0; 3/2; 3/2
 b. 1; 3/2; 1
 c. 1; 3/2; 5/2
 d. 1; 3/2; 7/2
 e. The orders cannot be determined without a chemical reaction
17. The reaction $A + 2B \rightarrow C$
 is first order in B and A. The overall order of the reaction is _____
 a. first. d. zero.
 b. second. e. fourth.
 c. third.
18. The first-order reaction $A \rightarrow B$, has $k = 8.00 \text{ s}^{-1}$. If $[A]_0 = 0.500 \text{ M}$, how long will it take $[A] = 0.200 \text{ M}$?
 a. 0.115 s d. 0.244 s.
 b. 0.100 s e. 0.488 s
 c. 8.18 s
19. The first-order reaction $A \rightarrow B$, has $k = 5.67 \text{ s}^{-1}$. If $[A]_0 = 0.500 \text{ M}$, how long will it take $[A] = 0.124 \text{ M}$?
 a. 0.122 s d. 0.244 s
 b. 0.100 s e. 0.488 s
 c. 8.18 s
20. A reaction is first order in A. If the rate constant of the reaction is $6.00 \cdot 10^{-3} \text{ s}^{-1}$, what is the half-life ($t_{1/2}$) of the reaction?
 a. $4.98 \times 10^{-3} \text{ s}$ d. 115 s
 b. 200 s e. $1.73 \times 10^{-3} \text{ s}$
 c. $3.45 \times 10^{-3} \text{ s}$
21. A reaction is first order in A. If the rate constant of the reaction is $3.45 \times 10^{-3} \text{ s}^{-1}$, what is the half-life ($t_{1/2}$) of the reaction?

- a. 4.98×10^{-3} s
- b. 201 s
- c. 3.45×10^{-3} s
- d. 100 s
- e. 1.73×10^{-3} s

22. The half-life ($t_{1/2}$) of a first-order reaction is 0.100 s. What is the rate constant?

- a. 6.93 s^{-1}
- b. 0.693 s^{-1}
- c. 0.0693 s^{-1}
- d. 0.144 s^{-1}
- e. 3.01 s^{-1}

23. The half-life ($t_{1/2}$) of a first-order reaction is 0.950 s. What is the rate constant?

- a. 6.93 s^{-1}
- b. 0.729 s^{-1}
- c. 0.0693 s^{-1}
- d. 0.144 s^{-1}
- e. 3.01 s^{-1}

24. What percentage of a material will persist after 60 minutes if it's half life is 30 minutes?

- a. 50%
- b. 33%
- c. 25%
- d. 12.5%
- e. none of the above

25. What percentage of a material will persist after 80 minutes if it's half life is 20 minutes?

- a. 50%
- b. 33%
- c. 25%
- d. 12.5%
- e. 6.25%

26. $\text{rate} = k[\text{A}]^2$

For the reaction for which rate law is given above, a plot of which of the following is a straight line?

- a. $1/[\text{A}]$ versus time
- b. $[\text{A}]$ versus $1/\text{time}$
- c. $[\text{A}]$ versus time
- d. $\ln [\text{A}]$ versus time
- e. $\ln [\text{A}]$ versus $1/\text{time}$

27. Which is the label for k , the rate constant?

- a. $\text{mol}^2 \text{ L}^{-2} \text{ sec}^{-1}$
- b. $\text{L mol}^{-1} \text{ sec}^{-1}$
- c. $\text{L}^2 \text{ mol}^{-2} \text{ sec}^{-1}$
- d. $\text{L}^2 \text{ sec mol}^{-1}$
- e. $\text{L}^2 \text{ sec mol}^{-2}$

28. When $[\text{B}]$ decreases 0.4 M, what will be the value of $[\text{A}]$?

- a. 0.8 M
- b. 1.6 M
- c. 2.8 M
- d. 3.4 M
- e. 3.6 M

29. The first order decomposition of some radioactive isotope is 3 days. Approximately what percentage of the original substance will have decayed after 12 days have passed?

- a. 94%
- b. 88%
- c. 50%
- d. 25%
- e. 6%

30. The values for the change in enthalpy, ΔH , and the activation energy, E_a , for a given reaction are known. The value of E_a for the reverse reaction equals

- a. E_a for the forward reaction.
- b. $-(E_a)$ for the forward reaction.
- c. the sum of $-(\Delta H)$ and E_a
- d. the sum of E_a and ΔH
- e. the difference between ΔH and E_a

31. For a reaction that is first order with respect to [D] and second order with respect to [E], which of the following will result in no change to the overall reaction rate.

- a. Doubling [D] and halving [E]
- b. Doubling [E] and halving [D]
- c. Doubling [D] and Doubling [E]
- d. Increasing [D] by a factor of four and halving [E]
- e. Increasing [D] by a factor of four and dividing [E] by a factor of four.

32. For the rate law shown below, where the rate is measured in units of $M s^{-1}$ and the concentrations of X and Y are measured in M, which of the following statements is true?

$$\text{Rate} = k[X]^2 [Y]$$

I. the units of $k = M^2 s^{-1}$

II. doubling the concentration of y while keeping all other conditions constant will not affect the rate.

III. The reaction can be described as third-order.

- a. I only
- b. III only
- c. I and II only
- d. II and III only
- e. I, II, and III

33. Which of the following plots will yield a straight line for a first order reaction where the slope = $-k$?

- a. $\ln [A]$ versus time
- b. $[A]$ versus rate
- c. $1/[A]$ versus time
- d. time versus $1/[A]$
- e. $\ln k$ versus time

34. If tripling the concentration of a single reactant R in a multi-reactant reaction (while leaving all other conditions unchanged) leads to a nine-fold increase in rate, it can be deduced

- a. that the complete rate law is $\text{Rate} = k[R]$
- b. that the complete rate law is $\text{Rate} = k[R]^2$
- c. that the complete rate law is $\text{Rate} = k[R]^3$
- d. that the complete rate law is $\text{Rate} = k[R]^9$

- e. only that the order with respect to [R] is 2
35. If 75% of a sample of pure ^3_1H decays in 24.6 years, what is the half-life of ^3_1H
- 24.6 years
 - 18.4 years
 - 12.3 years
 - 6.15 years
 - 3.07 years
36. If the half-life of a reaction is independent of concentration, what is the order of the reaction?
- zero
 - first
 - second
 - half-life is unrelated to the order of the reaction
 - unable to be determined without knowing starting concentrations
37. A particular nuclear decay has a rate constant of 0.00346 Min^{-1} . What is the half-life?
- 3.3 hours
 - 1.6 hours
 - 0.0012 min
 - 0.0024 min
 - 0.0050 min
38. After 44 minutes, a sample of $^{44}_{19}\text{K}$ is found to have decayed to 25 percent of the original amount present. What is the half-life of $^{44}_{19}\text{K}$?
- 11 minutes
 - 22 minutes
 - 44 minutes
 - 66 minutes
 - 88 minutes
39. For a first order reaction that has a half-life of 69 s at 80°C , the value of the rate constant, k , is closest to?
- 0.01 s^{-1}
 - 0.1 s^{-1}
 - 1 s^{-1}
 - 10 s^{-1}
 - 100 s^{-1}
40. Which of the following is true of all catalysts?
- They are used up in chemical reactions
 - They are always transition metals
 - They do not take part in chemical reactions.
 - They work by increasing the activation energy of a reaction.
 - They are present at the beginning of a reaction and are unchanged at the end.