



ARIHANTAM ACADEMY

*Faith Strength Education*

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## CHEMICAL KINETICS — DPP 19 TO 24

Student Workbook + Teacher Answer Key

**Arihantam Academy** • Faith Strength Education

Bihar Board Class 12 Chemistry: board-oriented daily practice for Chemical Kinetics.

**Coverage:** DPP 19 rate and factors; DPP 20 rate law/order; DPP 21 integrated equations; DPP 22 half-life and pseudo-first order; DPP 23 Arrhenius equation; DPP 24 full chapter test.



# ARIHANTAM ACADEMY

Faith Strength Education

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## DAILY PRACTICE PROBLEM — DPP 19

Chemical Kinetics | Rate of reaction and factors affecting rate

|                                                    |                  |
|----------------------------------------------------|------------------|
| Student Name: _____                                | Roll No.: _____  |
| DPP No.: 19 Chapter: Chemical Kinetics             | Date: _____      |
| Topic: Rate of reaction and factors affecting rate | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

### Section A — Objective Questions (15 × 1 = 15)

- Chemical kinetics deals with:  
(A) equilibrium composition only (B) rate of reaction (C) heat of reaction only (D) colour of reaction
- Rate of reaction is change in:  
(A) temperature only (B) concentration per unit time (C) pressure only (D) volume only
- Unit of rate is commonly:  
(A)  $\text{mol L}^{-1} \text{s}^{-1}$  (B)  $\text{mol L}^{-1}$  (C)  $\text{s}^{-1}$  (D)  $\text{L mol}^{-1}$
- Rate of disappearance of reactant is written as:  
(A)  $+d[R]/dt$  (B)  $-d[R]/dt$  (C)  $d[P]/dt$  only (D) zero
- Rate of appearance of product is:  
(A)  $-d[P]/dt$  (B)  $+d[P]/dt$  (C)  $-d[R]/dt$  (D) always zero
- For  $aA \rightarrow bB$ , rate is:  
(A)  $-d[A]/dt$  (B)  $-1/a d[A]/dt$  (C)  $-1/b d[B]/dt$  (D)  $d[A]/d[B]$
- A catalyst changes:  
(A) equilibrium constant (B) activation energy (C) enthalpy only (D) initial concentration
- Increasing temperature generally:  
(A) decreases rate (B) increases rate (C) does not affect rate (D) stops reaction
- Powdered  $\text{CaCO}_3$  reacts faster than marble chips because of:  
(A) higher mass (B) greater surface area (C) lower temperature (D) lower concentration
- Rate of a reaction generally increases with:  
(A) decrease in concentration (B) increase in concentration (C) decrease in surface area (D) removal of catalyst
- A reaction is fastest at:  
(A) lowest temperature (B) highest activation energy (C) higher temperature (D) zero concentration
- Rate of reaction depends on:  
(A) nature of reactants (B) colour only (C) atomic number only (D) container shape only
- A homogeneous reaction occurs in:  
(A) different phases only (B) same phase (C) solid only (D) gas only
- Unit of average rate may be:  
(A)  $\text{mol L}^{-1} \text{s}^{-1}$  (B)  $\text{mol}^2 \text{L}^{-2}$  (C)  $\text{s mol L}^{-1}$  (D)  $\text{L mol s}$
- Catalyst provides an alternative path with:  
(A) higher  $E_a$  (B) lower  $E_a$  (C) same  $E_a$  always (D) no  $E_a$

### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Define rate of reaction.
- Differentiate average rate and instantaneous rate.
- Write rate expression for  $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$ .
- State any four factors affecting rate of reaction.
- Why do powdered solids react faster than lumps?

### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Explain collision theory of reaction rate.
- For reaction  $A \rightarrow B$ , concentration of A decreases from 0.50 M to 0.30 M in 20 s. Calculate average rate of disappearance of A.

**Teacher record:** MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | **Total** \_\_\_\_/30



ARIHANTAM ACADEMY

*Faith Strength Education*

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 19

Chemical Kinetics | Rate of reaction and factors affecting rate

**MCQ answers:** 1-B, 2-B, 3-A, 4-B, 5-B, 6-B, 7-B, 8-B, 9-B, 10-B, 11-C, 12-A, 13-B, 14-A, 15-B

### Short-answer marking points

16. Change in concentration of reactant/product per unit time.
17. Average rate uses finite time interval; instantaneous rate is rate at a particular instant.
18.  $\text{Rate} = -1/2 \, d[\text{N}_2\text{O}]/dt = 1/4 \, d[\text{NO}]/dt = d[\text{O}]/dt$ .
19. Nature, concentration/pressure, temperature, catalyst, surface area, light where applicable.
20. Powder has larger surface area, giving more effective collisions.

### Long-answer marking points

21. Reactant particles must collide with proper orientation and energy at least equal to activation energy; only effective collisions form products.
22.  $\text{Rate} = -\Delta[A]/\Delta t = -(0.30 - 0.50)/20 = 0.010 \, \text{mol L}^{-1} \text{s}^{-1}$ .

**Remedial rule:** Score below 15/26: revise formulas, redo numerical steps and attempt a 10-MCQ re-test next class.



## ARIHANTAM ACADEMY

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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

### DAILY PRACTICE PROBLEM — DPP 20

Chemical Kinetics | Rate law, order and molecularity

|                                         |                  |
|-----------------------------------------|------------------|
| Student Name: _____                     | Roll No.: _____  |
| DPP No.: 20 Chapter: Chemical Kinetics  | Date: _____      |
| Topic: Rate law, order and molecularity | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

#### Section A — Objective Questions (15 × 1 = 15)

- Rate law expresses rate in terms of:  
(A) equilibrium constant only (B) concentration of reactants (C) temperature only (D) colour
- For  $\text{rate} = k[A]^2[B]$ , overall order is:  
(A) 1 (B) 2 (C) 3 (D) 4
- Order of a reaction may be:  
(A) always integer (B) zero or fractional (C) always molecularity (D) always positive integer
- Molecularity is defined for:  
(A) overall complex reaction only (B) elementary step (C) equilibrium only (D) all reactions exactly
- Order is determined:  
(A) from balanced equation always (B) experimentally (C) from molecularity always (D) from unit of  $k$  only
- Molecularity is always:  
(A) zero (B) positive integer (C) fractional (D) negative
- For zero-order reaction, rate is:  
(A)  $k[A]$  (B)  $k[A]^2$  (C)  $k$  (D)  $k/[A]$
- For first-order reaction, rate is:  
(A)  $k$  (B)  $k[A]$  (C)  $k[A]^2$  (D)  $k/[A]$
- Unit of  $k$  for first-order reaction is:  
(A)  $\text{mol L}^{-1} \text{s}^{-1}$  (B)  $\text{s}^{-1}$  (C)  $\text{L mol}^{-1} \text{s}^{-1}$  (D)  $\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$
- Unit of  $k$  for zero-order reaction is:  
(A)  $\text{s}^{-1}$  (B)  $\text{mol L}^{-1} \text{s}^{-1}$  (C)  $\text{L mol}^{-1} \text{s}^{-1}$  (D)  $\text{mol}^{-1} \text{L s}$
- Unit of  $k$  for second-order reaction is:  
(A)  $\text{s}^{-1}$  (B)  $\text{mol L}^{-1} \text{s}^{-1}$  (C)  $\text{L mol}^{-1} \text{s}^{-1}$  (D)  $\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$
- If rate doubles when  $[A]$  doubles, order in A is:  
(A) zero (B) one (C) two (D) three
- If rate becomes four times when  $[A]$  doubles, order in A is:  
(A) zero (B) one (C) two (D) four
- A zero-order reaction has rate independent of:  
(A) temperature (B) catalyst (C) reactant concentration (D) time only
- Rate constant is affected by:  
(A) concentration only (B) temperature (C) extent of reaction only (D) stoichiometric coefficient only

#### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Define rate law.
- Define order and molecularity.
- Write units of  $k$  for zero-, first- and second-order reactions.
- For  $\text{rate} = k[A][B]^2$ , state order in A, B and overall order.
- Why can order be zero or fractional while molecularity cannot?

#### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Differentiate order and molecularity.
- For a reaction  $\text{rate} = k[A]^2[B]$ , if  $[A]$  is doubled and  $[B]$  tripled, by what factor does rate change?

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 20

Chemical Kinetics | Rate law, order and molecularity

**MCQ answers:** 1-B, 2-C, 3-B, 4-B, 5-B, 6-B, 7-C, 8-B, 9-B, 10-B, 11-C, 12-B, 13-C, 14-C, 15-B

### Short-answer marking points

16.  $\text{Rate} = k[A]^m[B]^n$ , determined experimentally.

17. Order = sum of powers in experimental rate law; molecularity = number of species colliding in elementary step.

18. Zero:  $\text{mol L}^{-1} \text{s}^{-1}$ ; first:  $\text{s}^{-1}$ ; second:  $\text{L mol}^{-1} \text{s}^{-1}$ .

19. Order  $A=1$ ,  $B=2$ , overall  $=3$ .

20. Order is empirical and can vary; molecularity is based on elementary collisions, hence positive integer.

### Long-answer marking points

21. Order is experimental, may be zero/fractional and applies overall; molecularity is theoretical for elementary step, always positive integer, never zero/fractional.

22. Rate factor  $= (2^2)(3) = 12$ .

**Remedial rule:** Score below 15/26: revise formulas, redo numerical steps and attempt a 10-MCQ re-test next class.



# ARIHANTAM ACADEMY

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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## DAILY PRACTICE PROBLEM — DPP 21

Chemical Kinetics | Integrated rate equations: zero order and first order

|                                                              |                  |
|--------------------------------------------------------------|------------------|
| Student Name: _____                                          | Roll No.: _____  |
| DPP No.: 21 Chapter: Chemical Kinetics                       | Date: _____      |
| Topic: Integrated rate equations: zero order and first order | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

### Section A — Objective Questions (15 × 1 = 15)

- Integrated zero-order equation is:  
(A)  $[A]_t = [A]_0 - kt$  (B)  $\ln[A]_t = \ln[A]_0 - kt$  (C)  $1/[A]_t = 1/[A]_0 + kt$  (D)  $[A]_t = [A]_0 e^{-kt}$
- Integrated first-order equation is:  
(A)  $[A]_t = [A]_0 - kt$  (B)  $k = 2.303/t \log([A]_0/[A]_t)$  (C)  $1/[A]_t = 1/[A]_0 + kt$  (D)  $k = t/2.303 \log$  ratio
- For zero order, plot of  $[A]$  versus  $t$  is:  
(A) straight line (B) parabola (C) hyperbola (D) vertical line
- For first order, plot of  $\log[A]$  versus  $t$  is:  
(A) straight line (B) circle (C) horizontal line always (D) parabola
- Slope of  $[A]$  vs  $t$  for zero order is:  
(A)  $+k$  (B)  $-k$  (C)  $-1/k$  (D) 0
- Slope of  $\log[A]$  vs  $t$  for first order is:  
(A)  $-k/2.303$  (B)  $+k$  (C)  $-1/k$  (D)  $k^2$
- Half-life of zero-order reaction depends on:  
(A) initial concentration (B) only  $k$  (C) temperature only (D) molecularity only
- Half-life of first-order reaction is:  
(A)  $[A]_0/2k$  (B)  $0.693/k$  (C)  $2.303/k$  (D)  $k/0.693$
- For zero-order reaction, unit of  $k$  is:  
(A)  $\text{s}^{-1}$  (B)  $\text{mol L}^{-1} \text{s}^{-1}$  (C)  $\text{L mol}^{-1} \text{s}^{-1}$  (D) dimensionless
- For first-order reaction, unit of  $k$  is:  
(A)  $\text{mol L}^{-1} \text{s}^{-1}$  (B)  $\text{s}^{-1}$  (C)  $\text{L mol}^{-1} \text{s}^{-1}$  (D)  $\text{mol}^{-1} \text{L s}$
- For first-order reaction, equal fractions react in:  
(A) equal times (B) increasing times (C) decreasing times (D) zero time
- Time for 75% completion of first-order reaction is:  
(A)  $t_{1/2}$  (B)  $2t_{1/2}$  (C)  $3t_{1/2}$  (D)  $4t_{1/2}$
- At  $t = t_{1/2}$ , fraction of first-order reactant left is:  
(A) 1 (B)  $1/2$  (C)  $1/4$  (D)  $3/4$
- A zero-order reaction is often found in:  
(A) surface-catalysed reactions (B) all gas reactions only (C) radioactive decay only (D) ideal solutions only
- A first-order reaction is commonly:  
(A) radioactive decay (B) surface saturation reaction only (C) always bimolecular (D) always zero order

### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Write integrated rate equation for zero-order reaction.
- Write integrated rate equation for first-order reaction.
- State half-life formulas for zero and first order reactions.
- How can graph distinguish zero- and first-order reaction?
- A first-order reaction has  $k = 0.693 \text{ min}^{-1}$ . Find  $t_{1/2}$ .

### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Derive integrated rate equation for first-order reaction.
- For zero-order reaction  $[A]_0 = 0.80 \text{ M}$  and  $k = 0.10 \text{ mol L}^{-1} \text{ min}^{-1}$ . Find  $[A]$  after 5 min and time for completion.

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 21

Chemical Kinetics | Integrated rate equations: zero order and first order

**MCQ answers:** 1-A, 2-B, 3-A, 4-A, 5-B, 6-A, 7-A, 8-B, 9-B, 10-B, 11-A, 12-B, 13-B, 14-A, 15-A

### Short-answer marking points

16.  $[A]_t = [A]_0 - kt$ .

17.  $k = (2.303/t) \log([A]_0/[A]_t)$ .

18. Zero:  $t_{1/2} = [A]_0/2k$ ; first:  $t_{1/2} = 0.693/k$ .

19. Zero:  $[A]$  versus  $t$  straight; first:  $\log[A]$  versus  $t$  straight.

20.  $t_{1/2} = 0.693/0.693 = 1$  min.

### Long-answer marking points

21. Start with  $-d[A]/dt = k[A]$ , integrate from  $[A]_0$  to  $[A]_t$ :  $\ln([A]_0/[A]_t) = kt$ ; convert to common log.

22.  $[A]_t = 0.80 - 0.10 \times 5 = 0.30$  M; completion time  $= [A]_0/k = 8$  min.

**Remedial rule:** Score below 15/26: revise formulas, redo numerical steps and attempt a 10-MCQ re-test next class.



# ARIHANTAM ACADEMY

Faith Strength Education

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## DAILY PRACTICE PROBLEM — DPP 22

Chemical Kinetics | Half-life, pseudo-first order and graphical interpretation

|                                                                   |                  |
|-------------------------------------------------------------------|------------------|
| Student Name: _____                                               | Roll No.: _____  |
| DPP No.: 22 Chapter: Chemical Kinetics                            | Date: _____      |
| Topic: Half-life, pseudo-first order and graphical interpretation | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

### Section A — Objective Questions (15 × 1 = 15)

- For first-order reaction,  $t_{1/2}$  is independent of:  
(A) initial concentration (B) rate constant (C) temperature (D) pressure
- For zero-order reaction,  $t_{1/2}$  is directly proportional to:  
(A)  $1/[A]_0$  (B)  $[A]_0$  (C)  $k$  only (D) temperature only
- For first-order reaction, time for 87.5% completion is:  
(A)  $t_{1/2}$  (B)  $2t_{1/2}$  (C)  $3t_{1/2}$  (D)  $4t_{1/2}$
- After 3 half-lives of first order, fraction left is:  
(A)  $1/2$  (B)  $1/4$  (C)  $1/8$  (D)  $1/16$
- Pseudo-first order reaction occurs when:  
(A) all reactants equal concentration (B) one reactant is in large excess (C) no catalyst (D) reaction is zero order
- Hydrolysis of ester in excess water is:  
(A) zero order (B) pseudo-first order (C) second order (D) third order
- For a first-order reaction, plot of  $\log([A]_0/[A]_t)$  against time has slope:  
(A)  $k/2.303$  (B)  $-k$  (C)  $k^2$  (D)  $1/k$
- For zero-order reaction, time for completion is:  
(A)  $[A]_0/k$  (B)  $0.693/k$  (C)  $2[A]_0/k$  (D)  $k/[A]_0$
- If first-order half-life is 10 min, time for 93.75% completion is:  
(A) 10 min (B) 20 min (C) 30 min (D) 40 min
- For first-order, time for 99% completion is:  
(A)  $t_{1/2}$  (B)  $2t_{1/2}$  (C)  $6.64 t_{1/2}$  (D)  $10 t_{1/2}$
- Half-life of a reaction is time required for concentration to become:  
(A) zero (B) half initial (C) double initial (D) one mole
- For first-order reaction, rate constant from  $t_{1/2}$  is:  
(A)  $0.693/t_{1/2}$  (B)  $t_{1/2}/0.693$  (C)  $[A]_0/2t_{1/2}$  (D)  $2t_{1/2}/[A]_0$
- If  $[A]_0$  is doubled for zero order,  $t_{1/2}$ :  
(A) halves (B) doubles (C) unchanged (D) becomes zero
- If  $[A]_0$  is doubled for first order,  $t_{1/2}$ :  
(A) halves (B) doubles (C) unchanged (D) quadruples
- A straight line  $[A]$  vs  $t$  plot has intercept:  
(A)  $k$  (B)  $[A]_0$  (C)  $-k$  (D) zero always

### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- What is half-life of a reaction?
- Why is half-life of first-order reaction independent of initial concentration?
- Define pseudo-first order reaction with an example.
- A first-order reaction has  $t_{1/2}=20$  min. Find time for 75% completion.
- For a zero-order reaction  $[A]_0=0.40$  M and  $k=0.02$  M min<sup>-1</sup>, calculate  $t_{1/2}$ .

### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Explain graphical determination of order of reaction for zero and first order.
- A first-order reaction is 75% complete in 20 min. Calculate  $k$  and time for 87.5% completion.

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 22

Chemical Kinetics | Half-life, pseudo-first order and graphical interpretation

**MCQ answers:** 1-A, 2-B, 3-C, 4-C, 5-B, 6-B, 7-A, 8-A, 9-C, 10-C, 11-B, 12-A, 13-B, 14-C, 15-B

### Short-answer marking points

16. Time required for reactant concentration to fall to half its initial value.

17.  $t_{1/2} = 0.693/k$  contains no  $[A]_0$  term.

18. A higher-order reaction appearing first order because one reactant is in large excess; ester hydrolysis in excess water.

19. 75% complete leaves 1/4, so  $\text{time} = 2t_{1/2} = 40$  min.

20.  $t_{1/2} = [A]_0/2k = 0.40/(0.04) = 10$  min.

### Long-answer marking points

21. Zero-order:  $[A]$  vs  $t$  linear with slope  $-k$ . First-order:  $\log[A]$  vs  $t$  linear with slope  $-k/2.303$ .

22. 75% means two half-lives = 20 min,  $t_{1/2} = 10$  min;  $k = 0.693/10 = 0.0693 \text{ min}^{-1}$ . 87.5% means three half-lives = 30 min.

**Remedial rule:** Score below 15/26: revise formulas, redo numerical steps and attempt a 10-MCQ re-test next class.



# ARIHANTAM ACADEMY

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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## DAILY PRACTICE PROBLEM — DPP 23

Chemical Kinetics | Arrhenius equation, activation energy and catalysts

|                                                            |                  |
|------------------------------------------------------------|------------------|
| Student Name: _____                                        | Roll No.: _____  |
| DPP No.: 23 Chapter: Chemical Kinetics                     | Date: _____      |
| Topic: Arrhenius equation, activation energy and catalysts | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

### Section A — Objective Questions (15 × 1 = 15)

- Arrhenius equation is:  
(A)  $k = Ae^{(-E_a/RT)}$  (B)  $k = E_a/RT$  (C)  $k = RT/E_a$  (D)  $k = A + E_a$
- $E_a$  denotes:  
(A) activation energy (B) average energy (C) electrode energy (D) atomic energy
- A catalyst increases rate by:  
(A) increasing  $E_a$  (B) decreasing  $E_a$  (C) increasing  $\Delta H$  always (D) changing  $K$  permanently
- Pre-exponential factor  $A$  relates to:  
(A) frequency/orientation of collisions (B) molar mass only (C) density only (D) equilibrium only
- Plot of  $\ln k$  versus  $1/T$  has slope:  
(A)  $E_a/R$  (B)  $-E_a/R$  (C)  $R/E_a$  (D)  $-R/E_a$
- Plot of  $\log k$  versus  $1/T$  has slope:  
(A)  $-E_a/2.303R$  (B)  $+E_a/2.303R$  (C)  $-R/E_a$  (D)  $E_a/R$
- Increasing temperature makes rate constant:  
(A) decrease always (B) increase generally (C) zero (D) independent of  $E_a$
- Activation energy is minimum energy for:  
(A) any collision (B) effective collision (C) product decomposition only (D) equilibrium only
- A catalyst affects equilibrium constant:  
(A) increases (B) decreases (C) does not change (D) makes zero
- At higher temperature, fraction of molecules with energy  $\geq E_a$ :  
(A) decreases (B) increases (C) remains zero (D) is same
- Unit of  $E_a$  is commonly:  
(A)  $J \text{ mol}^{-1}$  (B)  $\text{mol L}^{-1}$  (C)  $\text{s}^{-1}$  (D)  $J \text{ K}^{-1}$
- If  $k$  doubles on raising temperature, reaction:  
(A) becomes slower (B) becomes faster (C) stops (D) must be zero order
- For same reaction, catalyst provides:  
(A) different mechanism (B) same mechanism with higher  $E_a$  (C) no collision (D) different products necessarily
- Arrhenius plot is useful to find:  
(A) activation energy (B) molar mass only (C) density (D) pH only
- Rate constant depends strongly on:  
(A) temperature (B) colour (C) volume only (D) moles only

### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- State Arrhenius equation and define symbols.
- What is activation energy?
- How does a catalyst increase reaction rate?
- What is Arrhenius plot?
- Calculate  $E_a$  if slope of  $\ln k$  vs  $1/T$  plot is  $-12000 \text{ K}$ . ( $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ )

### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Derive logarithmic form of Arrhenius equation.
- For a reaction  $k_1 = 2.0 \times 10^{-3} \text{ s}^{-1}$  at 300 K and  $k_2 = 8.0 \times 10^{-3} \text{ s}^{-1}$  at 330 K. Calculate  $E_a$  using  $\log(k_2/k_1) = E_a/(2.303R)[(1/T_2 - 1/T_1)]$ .

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 23

Chemical Kinetics | Arrhenius equation, activation energy and catalysts

**MCQ answers:** 1-A, 2-A, 3-B, 4-A, 5-B, 6-A, 7-B, 8-B, 9-C, 10-B, 11-A, 12-B, 13-A, 14-A, 15-A

### Short-answer marking points

16.  $k = Ae^{(-E_a/RT)}$ ; A is pre-exponential factor,  $E_a$  activation energy, R gas constant, T kelvin temperature.

17. Minimum energy required for colliding molecules to form activated complex/effective collision.

18. It offers alternative pathway with lower  $E_a$ ; it does not change  $\Delta H$  or equilibrium constant.

19. Graph of  $\ln k$  against  $1/T$ , slope  $= -E_a/R$ .

20.  $E_a = 12000 \times 8.314 = 99768 \text{ J mol}^{-1} \approx 99.8 \text{ kJ mol}^{-1}$ .

### Long-answer marking points

21. Taking natural log:  $\ln k = \ln A - E_a/RT$ ; or  $\log k = \log A - E_a/(2.303RT)$ .

22.  $\log(4) = 0.6021$ ;  $E_a = 2.303 \times 8.314 \times 0.6021 \times (300 \times 330) / 30 \approx 3.79 \times 10^4 \text{ J mol}^{-1} \approx 37.9 \text{ kJ mol}^{-1}$ .

**Remedial rule:** Score below 15/26: revise formulas, redo numerical steps and attempt a 10-MCQ re-test next class.



# ARIHANTAM ACADEMY

Faith Strength Education

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## DAILY PRACTICE PROBLEM — DPP 24

Chemical Kinetics | Chemical Kinetics: full chapter important-question test

|                                                                |                  |
|----------------------------------------------------------------|------------------|
| Student Name: _____                                            | Roll No.: _____  |
| DPP No.: 24 Chapter: Chemical Kinetics                         | Date: _____      |
| Topic: Chemical Kinetics: full chapter important-question test | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

### Section A — Objective Questions (15 × 1 = 15)

- Rate unit is:  
(A)  $\text{mol L}^{-1} \text{s}^{-1}$  (B)  $\text{mol L}^{-1}$  (C)  $\text{s}^{-1}$  (D)  $\text{L mol}^{-1}$
- Order is determined:  
(A) from balanced equation (B) experimentally (C) from molecularity (D) from colour
- Molecularity is always:  
(A) zero (B) positive integer (C) fractional (D) negative
- Unit of first-order k is:  
(A)  $\text{mol L}^{-1} \text{s}^{-1}$  (B)  $\text{s}^{-1}$  (C)  $\text{L mol}^{-1} \text{s}^{-1}$  (D) dimensionless
- First-order  $t_{1/2}$  equals:  
(A)  $[A]_0/2k$  (B)  $0.693/k$  (C)  $2.303/k$  (D)  $k/0.693$
- Zero-order integrated equation is:  
(A)  $[A]_t = [A]_0 - kt$  (B)  $\log[A]_t = \log[A]_0 - kt$  (C)  $1/[A]_t = 1/[A]_0 + kt$  (D)  $[A]_t = [A]_0 e^{-kt}$
- Catalyst lowers:  
(A) activation energy (B) enthalpy (C) equilibrium constant (D) initial concentration
- Slope of  $\ln k$  vs  $1/T$  is:  
(A)  $E_a/R$  (B)  $-E_a/R$  (C)  $R/E_a$  (D)  $-R/E_a$
- Pseudo-first order needs:  
(A) equal concentrations (B) one reactant in excess (C) no solvent (D) solid catalyst only
- For first-order 75% completion requires:  
(A)  $1 t_{1/2}$  (B)  $2 t_{1/2}$  (C)  $3 t_{1/2}$  (D)  $4 t_{1/2}$
- If  $k = 0.231 \text{ min}^{-1}$  for first-order reaction,  $t_{1/2}$  is:  
(A) 1 min (B) 2 min (C) 3 min (D) 4 min
- For zero-order, rate is:  
(A)  $k[A]$  (B)  $k$  (C)  $k[A]^2$  (D)  $k/[A]$
- Rate constant is affected by:  
(A) temperature (B) extent only (C) stoichiometry only (D) colour only
- For  $\text{rate} = k[A]^2[B]$ , overall order is:  
(A) 1 (B) 2 (C) 3 (D) 4
- Effective collision requires:  
(A) proper orientation and sufficient energy (B) any collision only (C) zero activation energy (D) high pressure only

### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Define rate law.
- Differentiate order and molecularity.
- Write integrated equation for first-order reaction.
- A first-order reaction has  $k = 0.231 \text{ min}^{-1}$ . Find  $t_{1/2}$ .
- State Arrhenius equation.

### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Derive first-order integrated rate equation.
- For reaction  $A \rightarrow \text{products}$ ,  $[A]$  falls from 0.80 M to 0.20 M in 20 min. Assuming first order, calculate k and  $t_{1/2}$ .

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



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## TEACHER ANSWER KEY — DPP 24

Chemical Kinetics | Chemical Kinetics: full chapter important-question test

**MCQ answers:** 1-A, 2-B, 3-B, 4-B, 5-B, 6-A, 7-A, 8-B, 9-B, 10-B, 11-C, 12-B, 13-A, 14-C, 15-A

### Short-answer marking points

16.  $\text{Rate} = k[A]^m[B]^n$ , powers found experimentally.

17. Order is sum of powers in rate law and may be zero/fractional; molecularity is number of species in elementary step and is positive integer.

18.  $k = (2.303/t) \log([A]_0/[A]_t)$ .

19.  $t_{1/2} = 0.693/0.231 = 3 \text{ min}$ .

20.  $k = Ae^{(-E_a/RT)}$ .

### Long-answer marking points

21. Integrate  $-d[A]/dt = k[A]$ :  $\ln([A]_0/[A]_t) = kt$  and convert to common logarithm.

22.  $k = (2.303/20) \log(0.80/0.20) = (2.303/20) \log 4 = 0.0693 \text{ min}^{-1}$ ;  $t_{1/2} = 0.693/0.0693 = 10 \text{ min}$ .

**Remedial rule:** Score below 15/26: revise formulas, redo numerical steps and attempt a 10-MCQ re-test next class.