PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 48

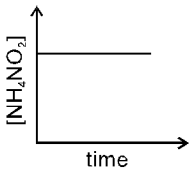
Total Marks : 35

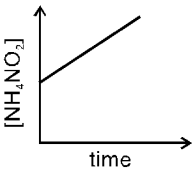
Max. Time : 35 min.

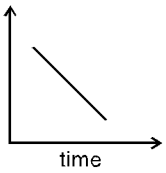
Topic : Chemical Kinetics

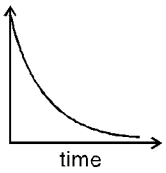
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks 3 min.)	[27, 27]
Multiple choice objective ('–1' negative marking) Q.10 to Q.11	(4 marks 4 min.)	[8, 8]

1. Decomposition of NH_4NO_2 (aq) into N_2 (g) and $2H_2O$ (ℓ) is first order reaction. Which of the following graph is correct?

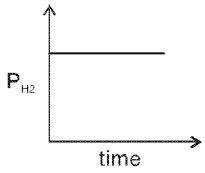
(A) 

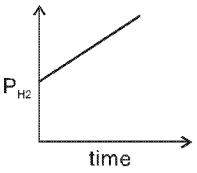
(B) 

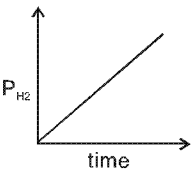
(C) 

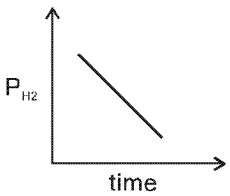
(D) 

2. Decomposition of HI (g) on Gold surface is zero order reaction. Initially, few moles of H_2 are present in container then which of the following graph is correct ?

(A) 

(B) 

(C) 

(D) 

3. A first order reaction is 75% completed in 100 minutes. How long time will it take for it's 87.5% completion?

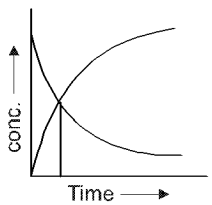
(A) 125 min (B) 150 min (C) 175 min (D) 200 min

4. For the zero order reaction A → B + C; initial concentration of A is 0.1 M. If A = 0.08 M after 10 minutes, then it's half-life and completion time are respectively :

(A) 10 min; 20 min (B) 2×10^{-3} min, 10^{-3} min

(C) 25 min, 50 min (D) 250 min, 500 min.

5. The accompanying figure depicts the change in concentration of species A and B for the reaction A ⟶ B, as a function of time, the point of intersection of the two curves represents



(A) $t_{1/2}$ (B) $t_{3/4}$

(C) $t_{2/3}$ (D) data insufficient to predict

6. For the reaction A $\longrightarrow$ products, the graph of the fraction of A remaining as a function of time (x–axis) is a straight line with –ve slope. The order of the reaction is therefore

(A) 1 (B) 2 (C) zero (D) –1

7. In the following reaction A $\rightarrow$ B + C, rate constant is 0.001 Ms^{-1}. If we start with 1 M of A then, conc. of A and B after 10 minutes are respectively :

(A) 0.5 M, 0.5 M (B) 0.6 M, 0.4 M (C) 0.4 M, 0.6 M (D) none of these

8. The rate law for the dimerisation of NO_2 into N_2O_4 is $-\frac{d[NO_2]}{dt} = k[NO_2]^2$.

Which of the following changes will change the value of the specific rate constant k ?

(A) Doubling the total pressure (B) Decreasing the pressure

(C) Changing the volume of the flask (D) Changing the temperature.

9. For an elementary reaction aA $\longrightarrow$ product, the graph plotted between $\log\left[\frac{-d[A]}{dt}\right]$ vs. time gives a straight line with intercept equal to 0.6 and showing an angle of 45° with origin, then :

(A) rate constant = 3.98 $time^{-1}$ and a = 1 (B) rate constant = 3.98 mol L^{-1} t^{-1} and a = 1

(C) rate constant = 1.99 $time^{-1}$ and a = 1 (D) rate constant = 1.99 mol^{-1} L^1 t^{-1} and a = 2

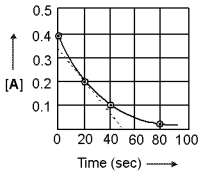
10. A certain reaction **A** $\rightarrow$ **B** follows the given concentration (Molarity)–time graph. Which of the following statement(s) is/are true ?

(A) The reaction is second order with respect to **A**

(B) The rate for this reaction at 20 second will be 7×10^{-3} M s^{-1}

(C) The rate for this reaction at 80 second will be 1.75×10^{-3} M s^{-1}

(D) The [B] will be 0.35 M at t = 60 second



11. For the reaction 2A + B $\longrightarrow$ C with the rate law $\frac{d[C]}{dt} = k[A]^1[B]^{-1}$ and started with A and B in stoichiometric proportion. Which is/are true?

(A) unit of k is Ms^{-1} (B) [A], [B] and [C] all will be linear functions of time

(C) [C] = 2kt (D) [C] = kt

Answer Key

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1.	(D)	**2.**	(B)	**3.**	(B)	**4.**	(C)	**5.**	(A)
6.	(C)	**7.**	(C)	**8.**	(D)	**9.**	(A)	**10.***	(BD)
11.*	(ABC)								

Hints & Solutions

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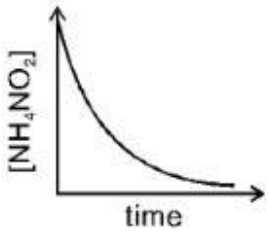
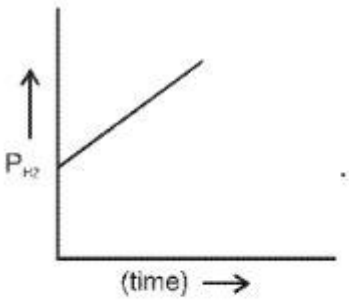
1. $C_t = C_o e^{-kt}$ (For Ist order) $\quad NH_4NO_2\,(aq) \longrightarrow N_2(g) + 2H_2O\,(\ell)$ (Ist order)



2.

	$2HI(g) \longrightarrow$	$H_2(g) +$	$I_2\,(g)$	(zero order)
$t = 0$	a	b	0	$b \propto P_{H_2}$, initial
$t = t$	$a - 2x$	$b + x$		$P_{H_2} \propto (b + x)$

$\Rightarrow \quad P_{H_2} = P_{H_2}$, initial + kt (zero order reaction)

So, graph is 

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3. $\because \quad C_t = \dfrac{C_0}{2^n}$

For 75% completion, no. of half lives taken = 2 half life $= \dfrac{100}{2} = 50$ min

For 87.5% completion, no. of half lives taken = 3.

$\therefore$ Time taken = $3 \times 50 = 150$ min.

4. For zero order, rate $= K = \dfrac{-(0.08 - 0.1)}{10} = \dfrac{0.02}{10}$ M min^{-1}

half life $= \frac{C_o}{2K} = \frac{0.1 \times 10}{2 \times 0.02} = 25$ min $\Rightarrow$ completion time $= \frac{C_o}{K} = \frac{0.1 \times 10}{0.02} = 50$ min.

5.

	A $\longrightarrow$	B
t = 0	a	0
t = t	a – x	x

At intersection, a – x = x

$\Rightarrow \quad x = \frac{a}{2}$

so, this time represents half life.

6.

	A $\longrightarrow$	Products
t = 0	a	0
t = t	a – x	x

$\frac{a-x}{a}$ = fraction of A $\Rightarrow$ (a – x) = a – kt $\Rightarrow$ $\frac{a-x}{a} = -kt$

So, it is zero order.

7. $A \longrightarrow B + C$

rate constant = 0.001 Ms^{-1}

$[C_o]_A = 1$ M

From unit of rate constant, we can conclude that rate is of zero order.

Decrease in concentration of A in 10 min = 0.001 × 10 × 60 = 0.6 M

$[C_o]_A$ t = 10 min = 1 – 0.6 = 0.4 M

$[C_B]$ t = 10 min = 0.6 M.

9. (A) Rate (दर) $= -\frac{dC_A}{dt} = K C_A^a$

$\therefore \quad \log\left[-\frac{dC_A}{dt}\right] = \log K + a \log C_A$

$\therefore \quad \log K = 0.6$

$K = 3.98$ time^{-1} and $a = \tan 45^\circ = 1$.

10. Rate for the reaction at 20 second $= \frac{0.35}{50} = 7 \times 10^{-3}$ Ms^{-1}

	A $\longrightarrow$	B
t = 0	0.4	0
t = 60	0.05	0.35

11.

	2A +	B $\longrightarrow$	C
t = 0	2a	a	0
t = t	2a – 2x	a – x	x

$\frac{d[C]}{dt} = k\,(2\,(a-x)\,(a-x)^{-1}) = 2k$

$\Rightarrow \quad \int d[c] = \int k\,dt \Rightarrow \quad [C] = 2\,kt$

unit of k = Ms^{-1}

[A] = 2 (a – x) and [C] = x

[B] = (a – x).