

Chemical Kinetics JEE Main PYQ – 3

Total Time: 1 Hour : 15 Minute

Total Marks: 120

Instructions

Instructions

1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Chemical Kinetics

1. A radioactive element has a half life of 200 days. The percentage of original activity remaining after 83 days is _____. (Nearest integer) (Given : antilog 0.125 = 1.333, antilog 0.693 = 4.93) (+4, -1)
-
2. It has been found that for a chemical reaction with rise in temperature by 9 K the rate constant gets doubled. Assuming a reaction to be occurring at 300 K, the value of activation energy is found to be _____ kJ mol⁻¹. [nearest integer] (Given ln10 = 2.3, R = 8.3 J K⁻¹ mol⁻¹, log 2 = 0.30) (+4, -1)
-
3. The rate constant for a first order reaction is given by the following equation : (+4, -1)
$$\ln k = 33.24 - \frac{2.0 \times 10^4 K}{T}$$
The activation energy for the reaction is given by _____ kJ mol⁻¹. (In nearest integer)
(Given : R = 8.3 J K⁻¹ mol⁻¹)
-
4. The equation $k = (6.5 \times 10^{12} \text{s}^{-1}) e^{-26000 \text{K}/T}$ is followed for the decomposition of compound A. The activation energy for the reaction is _____ kJ mol⁻¹. [nearest integer] (+4, -1)
(Given : R = 8.314 J K⁻¹ mol⁻¹)
-
5. For a reaction $A \rightarrow 2B + C$ the half lives are 100 s and 50 s when the concentration of reactant A is 0.5 and 1.0 mol L⁻¹, respectively. The order of the reaction is _____. (Nearest integer) (+4, -1)
-
6. Which of the following can be used to prevent the decomposition of H₂O₂? (+4, -1)
- a. Urea
 - b. Formaldehyde
 - c. Formic acid
 - d. Ethanol
-
7. The half-life for the decomposition of gaseous compound A is 240 s when the gaseous pressure was 500 torr initially. When the pressure was 250 torr, the half- (+4, -1)

life was found to be 4.0 min. The order of the reaction is _____. (Nearest integer)

8. For kinetic study of the reaction of iodide ion with H_2O_2 at room temperature : (+4, -1)

- (A) Always use freshly prepared starch solution
 - (B) Always keep the concentration of sodium thiosulphate solution less than that of KI solution
 - (C) Record the time immediately after the appearance of blue colour
 - (D) Record the time immediately before the appearance of blue colour
 - (E) Always keep the concentration of sodium thiosulphate solution more than that of KI solution
- Choose the correct answer from the options given below :

- a. (A), (B), (C) only
- b. (A), (D), (E) only
- c. (D), (E) only
- d. (A), (B), (E) only

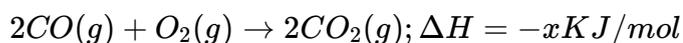
9. Reaction of $BeCl_2$ with $LiAlH_4$ gives: Choose the correct answer from options given below : (+4, -1)

- a. $AlCl_3$
- b. BeH_2
- c. LiH
- d. $LiCl$
- e. $BeAlH_4$

- a. (a), (d) and (e)
 - b. (a), (b) and (d)
 - c. (d) and (e)
 - d. (b), (c) and (d)
-

10. Select the correct option:

(+4, -1)



Then ΔH for, $C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow CO(g)$:

a. $x - \frac{y}{2}$

b. $\frac{x-2y}{2}$

c. $x + \frac{2y}{2}$

d. $\frac{x-y}{2}$

11. How many statements are correct:

(+4, -1)

1. If there is no relation between rate constant and temperature, then activation energy is negative.
2. If the activation energy is zero, rate constant is temperature independent.
3. If rate constant increases with increase of temperature, activation energy is positive.
4. If rate constant decreases with increase in temperature, activation energy is negative.

a. 1 and 2

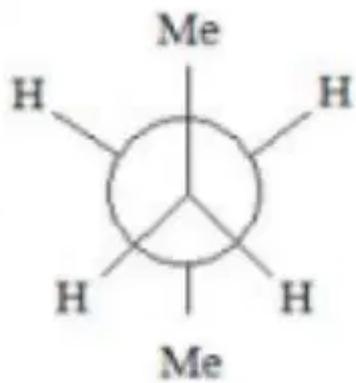
b. 2 and 3

c. 2, 3, and 4

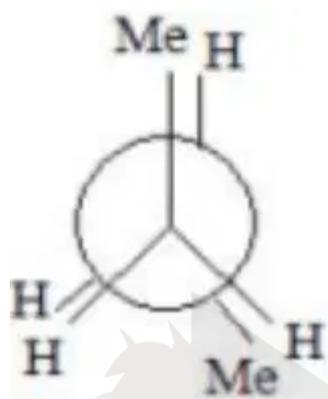
d. 4

12. Which of the following conformations will be the most stable?

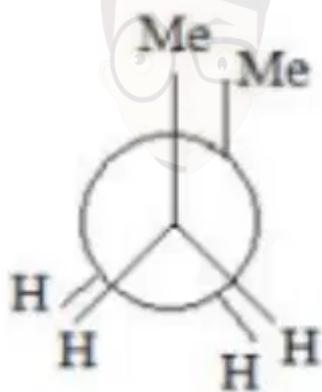
(+4, -1)



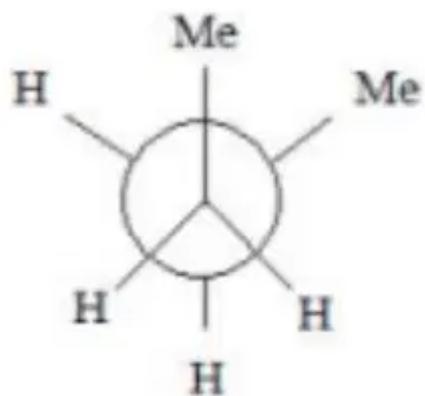
a.



b.



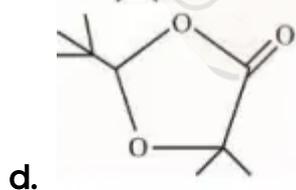
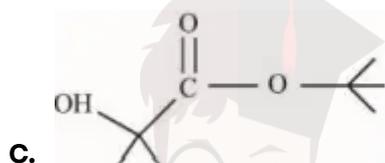
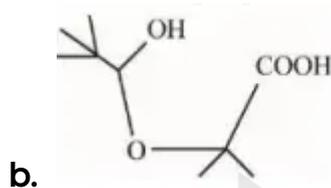
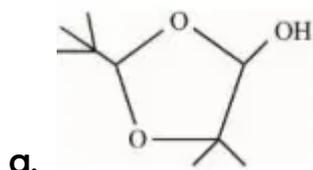
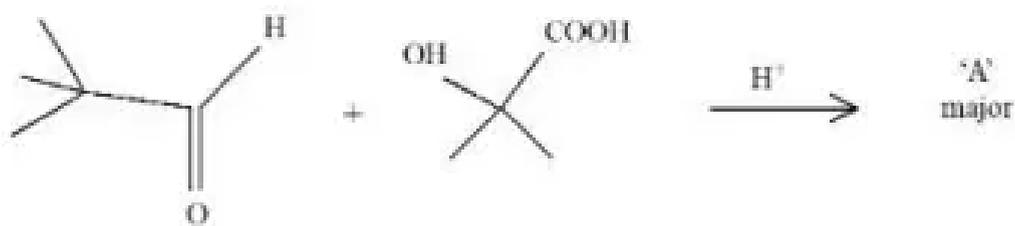
c.



d.

13. 'A' in the given reaction is

(+4, -1)



14. Given below are two statements :

(+4, -1)

Statement I : Sulphanilic acid gives esterification test for carboxyl group

Statement II : Sulphanilic acid gives red colour in Lassigne's test for extra element detection In the light of the above statements, choose the most appropriate answer from the options given below :

- Both Statement I and Statement II are correct
- Both Statement I and Statement II are incorrect
- Statement I is incorrect but Statement II is correct

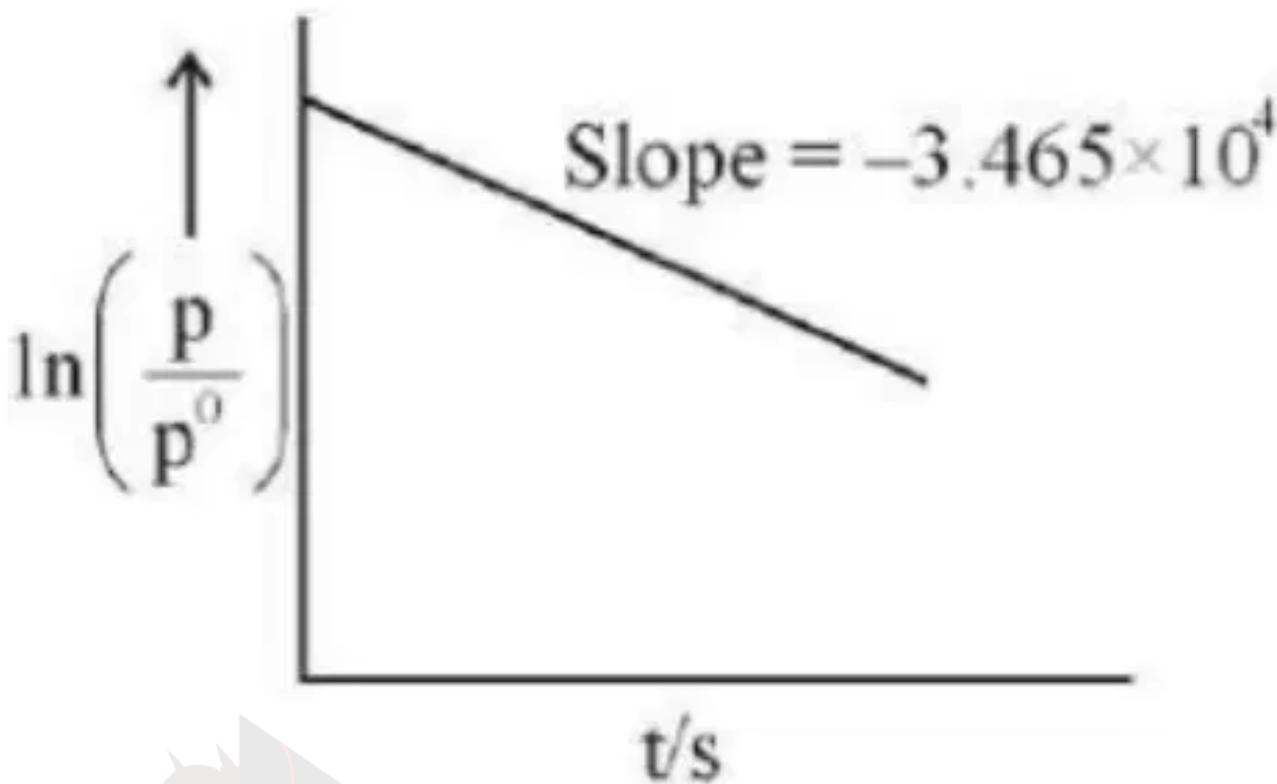
d. Statement I is correct but Statement II is incorrect

15. A student has studied the decomposition of a gas AB_3 at $25^\circ C$. He obtained the following data. (+4, -1)

$p(\text{mmHg})$	50	100	200	400
relative $t_{1/2}(s)$	4	2	1	0.5

The order of the reaction is.....

- a. 1
- b. 0.5
- c. 0 (zero)
- d. 2
-
16. The number of correct statement/s from the following is (+4, -1)
- A. Larger the activation energy, smaller is the value of the rate constant
- B. The higher is the activation energy, higher is the value of the temperature coefficient
- C. At lower temperatures, increase in temperature causes more change in the value of k than at higher temperature
- D. A plot of $\ln k$ vs $\frac{1}{T}$ is a straight line with slope equal to $-\frac{E_a}{R}$
-
17. For the decomposition of azomethane $CH_3N_2CH_3(g) \rightarrow CH_3CH_3(g) + N_2(g)$ a first order reaction, the variation in partial pressure with time at $600 K$ is given as (+4, -1)



The half life of the reaction is _____ $\times 10^{-5} s$ [Nearest integer]

18. A first order reaction has the rate constant, $k = 46 \times 10^{-3} s^{-1}$ The number of correct statement/s from the following is/are _____ (+4, -1)
 Given: $\log 3 = 0.48$
- A. Reaction completes in 1000 s
 - B. The reaction has a half-life of 500 s
 - C. The time required for 10% completion is 25 times the time required for 90% completion
 - D. The degree of dissociation is equal to $(1 - e^{-kt})$
 - E. The rate and the rate constant have the same unit
-
19. An organic compound undergoes first order decomposition If the time taken for the 60% decomposition is 540 s, then the time required for 90% decomposition will be is _____ s. (Nearest integer) (+4, -1)
 (Given: $\ln 10 = 2.3$; $\log 2 = 0.3$)
-
20. For the first order reaction $A \rightarrow B$, the half life is 30min The time taken for 75% completion of the reaction is min (Nearest integer) Given : $\log_2 2 = 0.3010$ $\log 3 = 0.4771$ $\log 5 = 0.6989$ (+4, -1)

21. If compound A reacts with B following first-order kinetics with rate constant $2.011 \times 10^{-3} \text{ s}^{-1}$, the time taken by A (in seconds) to reduce from 7 g to 2 g will be ----- (Nearest Integer). (+4, -1)

Given:

$$\log 5 = 0.698, \log 7 = 0.845, \log 2 = 0.301.$$

22. The rate constant for a first order reaction is 20 min^{-1} . The time required for the initial concentration of the reactant to reduce to its $\frac{1}{32}$ level is $\text{---} \times 10^{-2} \text{ min}$ (Nearest integer) (+4, -1)
 (Given: $\ln 10 = 2.303$ $\log 2 = 0.3010$)
-

23. $A \rightarrow B$ The rate constants of the above reaction at 200K and 300K are 0.03 min^{-1} and 0.05 min^{-1} respectively. The activation energy for the reaction is $\text{--} \text{ J}$ (Nearest integer) (Given : $\ln 10 = 2.3$) (+4, -1)

$$R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$$

$$\log 5 = 0.70$$

$$\log 3 = 0.48$$

$$\log 2 = 0.30$$

24. $A \rightarrow B$ The above reaction is of zero order. Half life of this reaction is 50 min. The time taken for the concentration of A to reduce to one-fourth of its initial value is $\text{---} \text{ min}$ (Nearest integer) (+4, -1)
-

25. A and B are two substances undergoing radioactive decay in a container. The half life of A is 15 min and that of B is 5 min . If the initial concentration of B is 4 times that of A and they both start decaying at the same time, how much time will it take for the concentration of both of them to be same? $\text{---} \text{ min}$ (+4, -1)
-

26. A real gas will behave as an ideal gas at : (+4, -1)

a. (A) Low temperature and high pressure

- b. (B) High temperature and low pressure
- c. (C) Low temperature and low pressure
- d. (D) High temperature and high pressure

27. The rate of a reaction quadruples when the temperature changes from 300 to 310 K. The activation energy of this reaction is : (Assume activation energy and pre-exponential factor are independent of temperature; $\ln 2 = 0.693$; $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$) (+4, -1)

- a. $107.2 \text{ kJ mol}^{-1}$
- b. 53.6 kJ mol^{-1}
- c. 26.8 kJ mol^{-1}
- d. $214.4 \text{ kJ mol}^{-1}$

28. The rate constant of a zero order reaction is $2.0 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$. If the concentration of the reactant after 25 seconds is 0.5 M. What is the initial concentration ? (+4, -1)

- a. 0.5 M
- b. 1.25 M
- c. 12.5 M
- d. 1.0 M

29. The rate coefficient (k) for a particular reactions is $1.3 \times 10^{-4} \text{ M}^{-1} \text{ s}^{-1}$ at 100°C , and $1.3 \times 10^{-3} \text{ M}^{-1} \text{ s}^{-1}$ at 150°C What is the energy of activation (E_a) (in kJ) for this reaction ? ($R = \text{molar gas constant} = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$) (+4, -1)

- a. 16
- b. 60

c. 99

d. 132

30. N_2O_5 decomposes to NO_2 and O_2 and follows first order kinetics. After 50 minutes, the pressure inside the vessel increases from 50 mm Hg to 87.5 mm Hg . The pressure of the gaseous mixture after 100 minute at constant temperature will be : (+4, -1)

a. 175.0 mm Hg

b. 116.25 mm Hg

c. 136.25 mm Hg

d. 106.25 mm Hg



Answers

1. Answer: 75 – 75

Explanation:

The correct answer is 75

$$\lambda = \frac{2.303}{t} \log \frac{A_0}{A}$$

$$\frac{0.693}{200} = \frac{2.303}{83} \log \frac{A_0}{A}$$

$$\frac{A}{A_0} = 0.75$$

Therefore, percentage of original activity remaining after 83 days is 75%.

Concepts:

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Rate of a Chemical Reaction:

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Read More: [Chemical Kinetics MCQ](#)

Factors Affecting The Reaction Rate:

- **The concentration of Reactants** – According to **collision theory**, which is discussed later, reactant molecules collide with each other to form products.
- **Nature of the Reactants** – The reaction rate also depends on the types of substances that are reacting.
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- **Surface Area of Reactants** – When two or more reactants are in the same phase of fluid, their particles collide more often than when either or both are in the solid phase or when they are in a heterogeneous mixture. In a heterogeneous medium, the collision between the particles occurs at an interface between phases. Compared to the homogeneous case, the number of collisions between reactants per unit time is significantly reduced, and so is the reaction rate.
- **Temperature** – If the temperature is increased, the number of collisions between reactant molecules per second. Increases, thereby increasing the rate of the reaction.
- **Effect Of Solvent** – The nature of the **solvent** also depends on the reaction rate of the solute particles.
- **Catalyst** – **Catalysts** alter the rate of the reaction by changing the reaction mechanism.

2. Answer: 59 – 59

Explanation:

The correct answer is 59

$T_1 = 300$ K (Rate constant)

$K_2 = 2K_1$, on increase temperature by 9K

$T_2 = 309$ K

$E_a = ?$

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.3R} \left[\frac{T_2 - T_1}{T_2 \cdot T_1} \right]$$

$$\log 2 = \frac{E_a}{2.3 \times 8.3} \left[\frac{9}{309 \times 300} \right]$$

$$E_a = \frac{0.3 \times 309 \times 300 \times 2.3 \times 8.3}{9}$$

$$= 58988.1 \text{ J/mole} \approx 59 \text{ kJ/mole}$$

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Read More: [Chemical Kinetics MCQ](#)

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3. Answer: 166 – 166

Explanation:

Given that,

$$\ln k = 33.24 - \frac{2.0 \times 10^4 K}{T}$$

$$\text{So, } \frac{E_a}{R} = 2 \times 10^4$$

The activation energy for the reaction,

$$E_a = 2 \times 10^4 \times 8.3$$

$$E_a = 166 \times 10^3 \text{ J/mol}$$

$$E_a = 166 \text{ kJ/mol}$$

So, the answer is 166 kJ/mol .

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4. Answer: 216 - 216

Explanation:

The correct answer is 216

$$k = Ae^{\frac{-E_a}{RT}}$$

$$\frac{E_a}{RT} = \frac{26000}{T}$$

$$E_a = 26000 \times 8.314$$

$$= 216164 \text{ J}$$

$$= 216 \text{ kJ}$$

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5. Answer: 2 - 2

Explanation:

$$t_{\frac{1}{2}} \propto \frac{1}{(\alpha_0)^{n-1}}$$

$$t_{\frac{1}{2}} = 100 \text{ sec } \alpha_0 = 0.5$$

$$t_{\frac{1}{2}} = 50 \text{ sec } \alpha_0 = 1$$

$$\frac{100}{50} = \left(\frac{1}{0.5}\right)^{n-1}$$

$$(2) = (2)^{n-1}$$

$$n-1 = 1$$

$$n = 2$$

So, the order of the reaction is 2.

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-

6. Answer: a

Explanation:

Urea is used as a stabilizer for the storage of H_2O_2 .

So, the correct option is (A): Urea.

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Read More: [Chemical Kinetics MCQ](#)

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7. Answer: 1 - 1

Explanation:

$$(t_{\frac{1}{2}})_A = 240 \text{ s when } P = 500 \text{ torr}$$

$$(t_{\frac{1}{2}})_A = 4 \text{ minutes} = 4 \times 60 = 240 \text{ seconds when } P = 500 \text{ torr}$$

If means half-life is independent of the concentration of reactant present.

\therefore Order of reaction = 1

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- **Temperature** - If the temperature is increased, the number of collisions between reactant molecules per second. Increases, thereby increasing the rate of the reaction.
- **Effect Of Solvent** - The nature of the [solvent](#) also depends on the reaction rate of the solute particles.
- **Catalyst** - [Catalysts](#) alter the rate of the reaction by changing the reaction mechanism.

8. Answer: a

Explanation:

The correct option is (A): (A), (B), (C) only

Concepts:

1. Chemical Kinetics:

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Rate of a Chemical Reaction:

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Read More: [Chemical Kinetics MCQ](#)

Factors Affecting The Reaction Rate:

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Explanation:

The correct option is (B): (a) , (b) and (d).

Concepts:

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reaction.

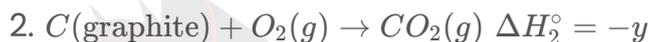
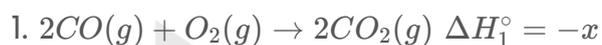
- **Effect Of Solvent** - The nature of the **solvent** also depends on the reaction rate of the solute particles.
- **Catalyst** - **Catalysts** alter the rate of the reaction by changing the reaction mechanism.

10. Answer: b

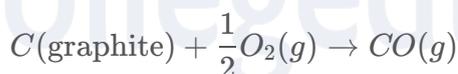
Explanation:

Step 1: Equations and Their Enthalpy Changes

We are given:

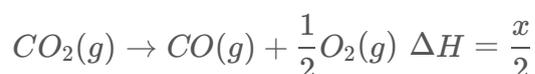


The target equation is:

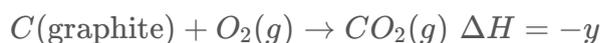


Step 2: Manipulate the Given Equations

Reverse and divide equation (1) by 2:

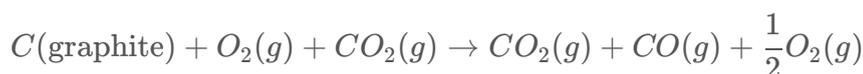


Keep equation (2) as is:

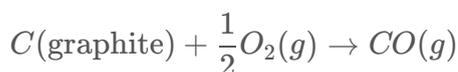


Step 3: Add the Modified Equations

Combine the two equations:



Cancel out $CO_2(g)$:



Step 4: Calculate the Enthalpy Change

Add the enthalpy changes of the modified equations:

$$\Delta H^\circ = \frac{x}{2} - y$$

Reorganize the terms:

$$\Delta H^\circ = \frac{x - 2y}{2}$$

Final Answer:

The enthalpy change for the reaction is:

$$\Delta H^\circ = \frac{x - 2y}{2}$$

Concepts:

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- **Catalyst** – **Catalysts** alter the rate of the reaction by changing the reaction mechanism.

11. Answer: c

Explanation:

The correct option is (C): 2, 3, and 4

$$k = Ae^{-E_a/RT}$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

Clearly,

if $E_a = 0$, k is temperature independent

if $E_a > 0$, k increases with increase in temperature

if $E_a < 0$, k decreases with increase in temperature

Therefore, 2, 3, and 4 is the right option.

Concepts:

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Rate of a Chemical Reaction:

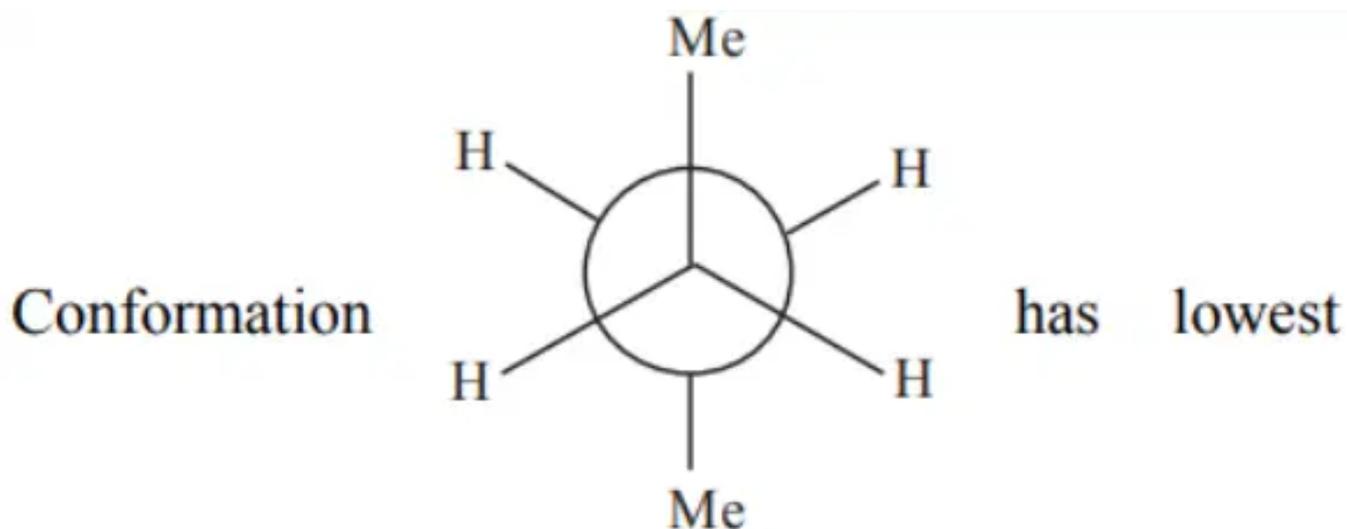
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Explanation:



Vanderwaal and torsional strain. Hence it must be most stable.

So, the correct option is (A).

Concepts:

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Read More: [Chemical Kinetics MCQ](#)

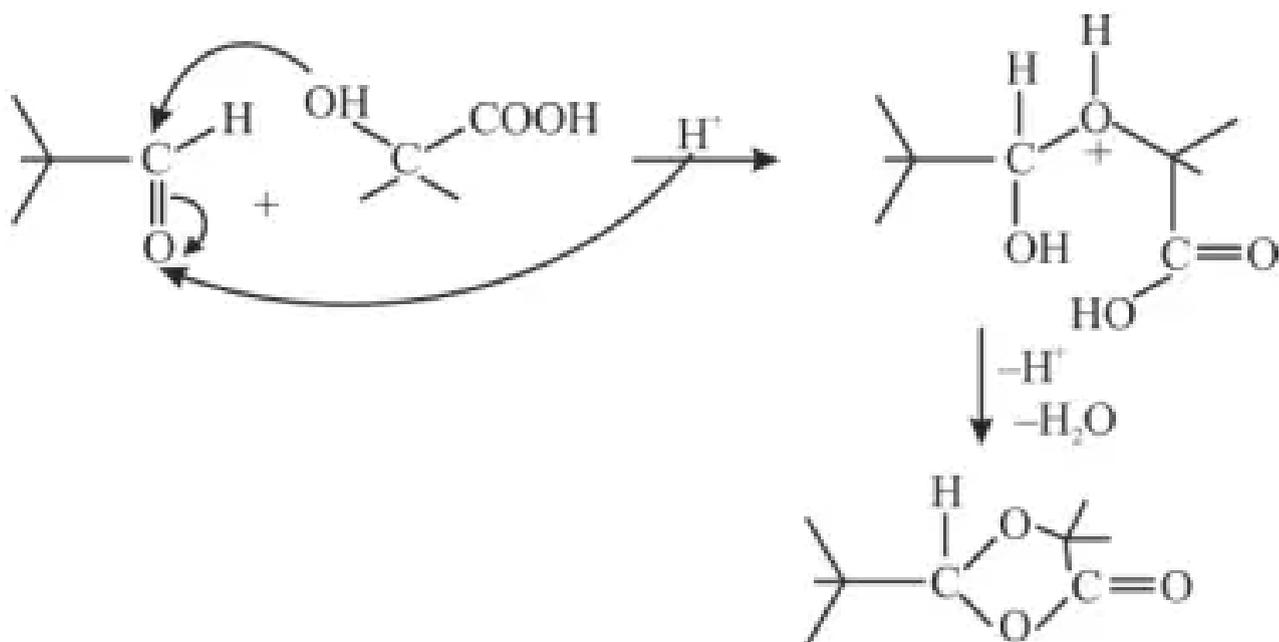
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13. Answer: d

Explanation:

Correct answer is (d)



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14. Answer: c

Explanation:

Step 1: Analyze Statement I

Sulfanilic acid contains an amine group ($-\text{NH}_2$) which is attached to the benzene ring, and a sulfonic acid group ($-\text{SO}_3\text{H}$). It does not contain a carboxyl group ($-\text{COOH}$). Esterification is a characteristic reaction of carboxylic acids. Therefore, Statement I is incorrect.

Step 2: Analyze Statement II

Lassaigne's test is used to detect the presence of nitrogen, sulfur, halogens, and phosphorus in organic compounds. Sulfanilic acid contains sulfur and nitrogen. The red color in Lassaigne's test is due to the formation of ferric thiocyanate $[\text{Fe}(\text{SCN})_3]$ when sulfur is present. Thus, Statement II is correct.

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-

15. Answer: d

Explanation:

For a reaction, the half-life $t_{1/2}$ is related to the initial pressure (P_0) by:

$$t_{1/2} \propto (P_0)^{1-n},$$

where n is the order of the reaction.

Taking the ratio of half-lives at different pressures:

$$\frac{t_{1/2}(P_1)}{t_{1/2}(P_2)} = \left(\frac{P_2}{P_1}\right)^{n-1}.$$

Using the given data:

$$\frac{t_{1/2}(50)}{t_{1/2}(100)} = \left(\frac{100}{50}\right)^{n-1}.$$

Substitute $t_{1/2}(50) = 4$ s and $t_{1/2}(100) = 2$ s:

$$\frac{4}{2} = (2)^{n-1}.$$

Simplify:

$$2 = 2^{n-1}.$$

Taking the logarithm:

$$n - 1 = 1 \implies n = 2.$$

Thus, the order of the reaction is $n = 2$.

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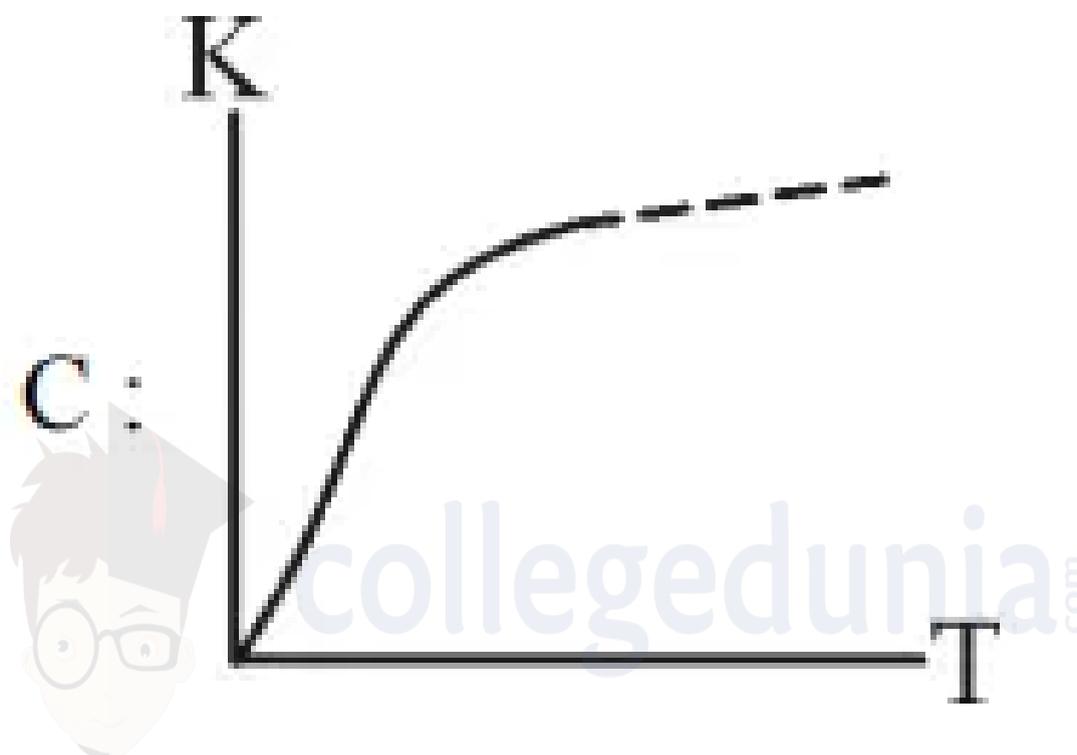
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-

16. Answer: 3 – 3

Explanation:

The correct answer is 3



A: $k = A e^{-E_a/RT}$

As E_a increases k decreases

B : Temperature coefficient $= \frac{k_{T+10}}{k_T}$

Option (C) is wrong. Δk may be greater or lesser depending on temperature.

D: $\ln k = \ln A - E_a/RT$

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17. Answer: 0 – 0

Explanation:

The correct answer is 2
For first order reaction

$$k = \frac{1}{t} \ln \left(\frac{P_0}{P} \right)$$

$$\ln \left(\frac{P_0}{P} \right) = kt$$

$$t_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{3.465 \times 10^4} = 2 \times 10^{-5}$$

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18. Answer: 2 – 2

Explanation:

The correct answer is 2.

$$t_{10\%} = \frac{1}{K} \ln \left(\frac{a}{a-x} \right) = \frac{1}{K} \ln \left(\frac{100}{90} \right)$$

$$t_{10\%} = \frac{2.303}{K} (\log 10 - \log 9)$$

$$t_{10\%} = \frac{2.093}{K} \times (0.04)$$

Similarly

$$t_{90\%} = \frac{1}{K} \ln \left(\frac{100}{10} \right)$$

$$t_{90\%} = \frac{2.303}{K}$$

$$\frac{t_{90\%}}{t_{10\%}} = \frac{1}{0.04} = 25$$

$$e^{kt} = \frac{a}{a-x}$$

$$\frac{a-x}{a} = e^{-kt}$$

$$1 - \frac{x}{a} = e^{-kt}$$

$$x = a (1 - e^{-kt})$$

$$\alpha = \frac{x}{a} = (1 - e^{-kt})$$

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19. Answer: 1350 – 1350

Explanation:

$$\frac{t_1}{t_2} = \frac{\frac{1}{K} \ln \frac{a_0}{0.4a_0}}{\frac{1}{K} \ln \frac{a_0}{0.1a_0}}$$
$$\frac{540}{t_2} = \frac{\ln \frac{10}{4}}{\ln 10}$$
$$\frac{540}{t_2} = \frac{\log 10 - \log 4}{\log 10}$$

$$\frac{540}{t_2} = \frac{1-0.6}{1}$$
$$\Rightarrow \frac{540}{t_2} = 0.4$$
$$\Rightarrow t_2 = \frac{540}{0.4} = 1350 \text{ sec}$$

So, the answer is 1350.

Concepts:

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Read More: [Chemical Kinetics MCQ](#)

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20. Answer: 60 – 60

Explanation:

1. For a first-order reaction, the time required for completion is given by:

$$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$$

2. For 75% completion, $[A] = \frac{1}{4}[A]_0$. Substituting:

$$t = \frac{2.303}{k} \log \frac{[A]_0}{\frac{1}{4}[A]_0} = \frac{2.303}{k} \log 4.$$

3. Use the relation between half-life and rate constant:

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{30}.$$

4. Substituting k and $\log 4 = 0.602$:

$$t = \frac{2.303 \times 0.602}{0.693/30} = 60 \text{ min.}$$

Thus, the time taken is **60 min**. For first-order reactions, the time for completion depends logarithmically on the fraction of the reaction completed.

Concepts:

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21. Answer: 623 – 623

Explanation:

Step 1: Reaction and First-Order Kinetics Formula

The reaction is:



At $t = 0$, the concentration of A is 7 g. At $t = t$, the concentration of A reduces to 2 g.

For first-order reactions:

$$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]_t}.$$

Step 2: Substitute the Values

Substitute $k = 2.011 \times 10^{-3} \text{ s}^{-1}$, $[A]_0 = 7$, and $[A]_t = 2$:

$$t = \frac{2.303}{2.011 \times 10^{-3}} \log \frac{7}{2}.$$

$$\log \frac{7}{2} = \log 7 - \log 2 = 0.845 - 0.301 = 0.544.$$

Step 3: Calculate the Time

Substitute the values:

$$t = \frac{2.303}{2.011 \times 10^{-3}} \cdot 0.544.$$

$$t = \frac{2.303 \times 0.544}{2.011 \times 10^{-3}} = \frac{1.252832}{2.011 \times 10^{-3}}.$$

$$t = 622.989 \text{ seconds} \approx 623 \text{ seconds}.$$

Conclusion: The time taken by A to reduce from 7 g to 2 g is **623** seconds.

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22. Answer: 17 – 17

Explanation:

$$C = \frac{C_0}{2^n} = \frac{C_0}{32}$$

$$n = 5$$

$$t = 5t_{1/2}$$

$$= \frac{5 \times 0.693}{2.303} = \frac{0.693}{4}$$

$$= 0.17325 \text{ min} = 17.325 \times 10^{-2} \text{ min}$$

So, the correct answer is 17.

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23. Answer: 2520 - 2520

Explanation:

The correct answer is 2520.

$$\log \frac{K_{300}}{K_{200}} = \frac{E_a}{2.3 \times 8.314} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\log \frac{0.05}{0.03} = \frac{E_a}{2.305 \times 8.314} \times \left[\frac{1}{200} - \frac{1}{300} \right]$$

$$E_a = 2519.88J \Rightarrow E_a = 2520J$$

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24. Answer: 75 - 75

Explanation:

For a zero-order reaction, the integrated rate law is given by:

$$[A]_t = [A]_0 - kt,$$

where $[A]_t$ is the concentration of A at time t , $[A]_0$ is the initial concentration of A , and k is the rate constant.

The half-life ($t_{1/2}$) of a zero-order reaction is given by:

$$t_{1/2} = \frac{[A]_0}{2k}.$$

Given that $t_{1/2} = 50$ min, we can find the rate constant k :

$$k = \frac{[A]_0}{2 \cdot t_{1/2}} = \frac{[A]_0}{2 \cdot 50} = \frac{[A]_0}{100}.$$

We are asked to find the time taken for the concentration of A to reduce to one-fourth of its initial value. Let this time be t . So, $[A]_t = \frac{[A]_0}{4}$. Substituting this into the integrated rate law:

$$\frac{[A]_0}{4} = [A]_0 - kt.$$

$$\frac{3[A]_0}{4} = kt.$$

Substituting the value of k we found earlier:

$$\frac{3[A]_0}{4} = \frac{[A]_0}{100} \cdot t.$$

Simplify:

$$t = \frac{3[A]_0}{4} \cdot \frac{100}{[A]_0} = 3 \cdot 25 = 75 \text{ min.}$$

Final Answer:

The time taken is $t = 75$ min.

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25. Answer: 15 – 15

Explanation:

Calculation of Time for Equal Concentrations of A and B:

The decay of a substance follows the formula:

$$N(t) = N_0 \times (1/2)^{t/t_{1/2}}$$

Where:

- $N(t)$: Concentration at time t
- N_0 : Initial concentration
- $t_{1/2}$: Half-life of the substance

Let the initial concentration of A be N_A and the initial concentration of B be $N_B = 4N_A$.

1. For substance A:

$$N_A(t) = N_A \times (1/2)^{t/15}$$

2. For substance B:

$$N_B(t) = 4N_A \times (1/2)^{t/5}$$

3. Set the concentrations equal:

$$N_A \times (1/2)^{t/15} = 4N_A \times (1/2)^{t/5}$$

4. Cancel N_A from both sides:

$$(1/2)^{t/15} = 4 \times (1/2)^{t/5}$$

5. Rewrite 4 as 2^2 :

$$(1/2)^{t/15} = (1/2)^{t/5 - 2}$$

6. Equating the exponents:

$$t/15 = t/5 - 2$$

7. Solve for t :

$$t/15 - t/5 = -2$$

Multiply through by 15 to eliminate the fractions:

$$t - 3t = -30$$

$$-2t = -30$$

$$t = 15 \text{ minutes}$$

Conclusion: It will take **15 minutes** for the concentrations of A and B to become the same.

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-

26. Answer: b

Explanation:

Explanation:

At high temperature and low pressure, the force of attraction among gas molecules is negligible. Also, the volume occupied by gas molecules is very less as compared to the total volume of the gas. So, the real gas will behave as an ideal gas under these conditions. Hence, the correct option is (B).

27. Answer: a

Explanation:

$$4 = e^{\frac{E_a}{R} \left\{ \frac{1}{300} - \frac{1}{310} \right\}} \ln(4) = \frac{E_a}{R} \left\{ \frac{10}{300 \times 310} \right\} \quad E_a = \frac{0.693 \times 2 \times 8.314 \times 300 \times 310}{10} = 107165.79 \text{ J} = 107.165 \text{ KJ}$$

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28. Answer: d

Explanation:

For a zero order reaction Rate constant $= k = \frac{a-x}{t} = 2 \times 10^{-2} = \frac{a-0.5}{25} a = 0.5 \quad a = 1.0 M$

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29. Answer: b

Explanation:

According to Arrhenius equation $\log \frac{k_2}{k_1} = \frac{E_a}{2.303 R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$ $\log \frac{1.3 \times 10^{-3}}{1.3 \times 10^{-4}} = \frac{E_a}{2.303 \times 8.314} \left[\frac{1}{373} - \frac{1}{423} \right]$
 $1 = \frac{E_a}{2.303 \times 8.314} \left[\frac{1}{373} - \frac{1}{423} \right]$ $E_a = 60 \text{ kJ/mole}$

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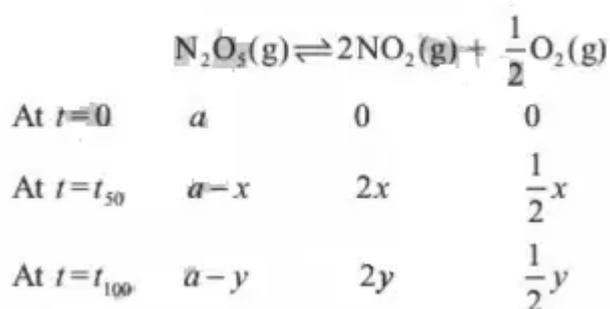
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30. Answer: d

Explanation:

The decomposition reaction is



We know $a = 50 \text{ mm Hg}$ At $t = t_{50 \text{ min}}$ $a - x + 2x + \frac{1}{2}x = 87.5$ $a + \frac{3}{2}x = 87.5$ $\frac{3}{2}x = 87.5 - 50 = 37.5 \Rightarrow x = \frac{37.5 \times 2}{3} = 25$ For first order reaction, $kt = 2.303 \log \left(\frac{a}{a-x} \right)$ At 50 min , $kt = 2.303 \log \left(\frac{50}{50-25} \right)$ $kt = 2.303 \log 2 \Rightarrow k = \frac{2.303 \times 0.3010}{50}$ At 100 min $kt = 2.303 \log \left(\frac{a}{a-y} \right)$ $100 \times \frac{2.303 \times 0.3010}{50} = 2.303 \log \left(\frac{50}{a-y} \right)$ $2 \times 0.3010 = \log \left(\frac{50}{a-y} \right)$ $\frac{50}{a-y} = 4$ $a - y = \frac{50}{4} = 12.5$ $50 - y = 12.5 \Rightarrow y = 37.5$ Therefore, total pressure at 100 min can be calculated as Total pressure = $a - y + 2y + \frac{1}{2}y = a + \frac{3}{2}y = 50 + \frac{3}{2} \times 37.5 = 106.25 \text{ mm Hg}$

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