CHEMISTRY

BOOKS - DISHA PUBLICATION CHEMISTRY (HINGLISH)

CHEMICAL KINETICS

Jee Main 5 Years At A Glance

1. If 50% of a reaction occurs in 100 second and 75% of the reaction occurs in 200 second, the order of this reaction is :

A. 2

B. 3

C. Zero

D. 1

Answer: D

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2. N_2O_5 decomposes to NO_2 andO_2 and follows first order kinetics. After 50 minutes the pressure inside the vessel increases from 50 mm Hg to $87.5 mmHg$. The pressure of the gaseous mixture afte 100 minute at constant temperature will be :

A. 136,25 mm Hg

B. 106.25 mm Hg

C. 175.0 mm Hg

D. 116.25 mm Hg

Answer: B

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3. At $518^{\circ} C$ the rate of decomposition of a sample of gaseous acetaldehyde initially at a pressure of 363 Torr, was $1.00 T$ or rs^{-1} when 5% had reacted and $0.5 T$ or rs^{-1} when 33% had reacted. The order of the reaction is

A. 2

B. 3

C. 1

D. 0

Answer: A

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4. The rate of a reaction A doubles on increasing the temperature from 300 to 310 K. By how much, the temperature of reaction B should be increased from 300 K so that rate doubles if activation energy of the reaction B is twice to that of reaction A

A. 9.84K

B. 4.92 K

C. 2.45K

D. 19.67K

Answer: B

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5. 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, $\ln(2) = 0.693, R = 8.314J - mol^{-1}K^{-1}$)

A. $107.2kJmol^{-1}$

B. $53.6kJmol^{-1}$

C. $26.8kJmol^{-1}$

D. $214.4kJmol^{-1}$

Answer: A

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6. Two reactions R_2 and R_2 have identical pre - exponential factors. Activations enery of R_1 exceeds that of R_2 by 10 kJ mol_{-1} . If k_1 and k_2 are rate constants for rate constants for reactions R_1 and R_2

respectively at 300k , then In $\left(\frac{k_2}{k_1}\right)$ is equal to

$(R = 8.314 J mol^{-1} K^{-1})$

A. 8

B. 12

C. 6

D. 4

Answer: D

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7. The reaction of ozone with oxygen atoms in the presence of chlorine atoms can occur by a two step process shown below:

$O_3(g) + Cl^{\cdot} \rightarrow O_2(g) + ClO^{\cdot}(g) \ldots (i)$

$k_i = 5.2 \times 10^9 \;\; \mathrm{L\,mol}^{-1}s^{-1}$

$ClO^{\cdot}(g) + O^{\cdot}(g) \rightarrow O_2(g) + Cl^{\cdot}(g) \ldots\ldots. (ii)$

$k_{ii} = 2.6 \times 10^{10} \mathrm{L\,mol}^{-1}s^{-1}$

The closest rate constant for the overall reaction

$O_3(g) + O^{\cdot}(g) \rightarrow 2O_2(g)$ is :

A. $1.4 \times 10^{20} Lmol^{-1}s^{-1}$

B. $3.1 \times 10^{10} Lmol^{-1}s^{-1}$

C. $5.2 \times 10^9 Lmol^{-1}s^{-1}$

D. $2.6 \times 10^{10} Lmol^{-1}s^{-1}$

Answer: A

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8. The rate law for the reaction below is given by the expresssion $K[A][B]$.

$A + B \rightarrow$ product

If the concentration of B is increased from 0.1 to 0.3 mole, keeping the value of A at 0.1, mole the rate constant will be :

A. 3k

B. 9k

C. $k/3$

D. k

Answer: D

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9. Decomposition of H_2O_2 follows a first order reactions. In 50 min the concentration of H_2O_2 decreases from 0.5 to 0.125 M in one such decomposition . When the concentration of H_2O_2 reaches 0.05 M, the rate of formation of O_2 will be

A. $366L \min^{-1}$ at STP

B. $1.34 \times 10^{-2} mol \min^{-1}$

C. $6.96 \times 10^{-2} mol \min^{-1}$

D. $6.93 \times 10^{-4} mol \min^{-1}$

Answer: D

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10. The reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ follows first order kinetics. The pressure of a vessel containing only N_2O_5 was found to increase from 50 mm Hg to 87.5 mm Hg in 30 mim. The pressure exerted by the gases after 60 min. will be (Assume temperature remains constant):

A. 106.25 mm Hg

B. 150 mm Hg

C. 125 mm Hg

D. 116.25 mm Hg

Answer: A

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11. A + 2B `rarr C, the rate equation for this reaction is given as

Rate = k[A] [B].

If the concentration of A is kept the same but that of B is doubled what will happen to the rate itelf?

A. halved

B. the same

C. doubled

D. quadrupled

Answer: C

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12. Higher order (> 3) reaction are rare due to :

A. shifting of equilibrium towards reactants due to elastic collisions.

B. loss of active species on collision.

C. low probability of simultaneous collision of all the reacting species.

D. increase in entropy and activation energy as more molecules are involved.

Answer: C

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13. The half-life period of a first order reaction is 15 minutes. The amount of substance left after one hour will be:

A. $\frac{1}{4}$ of the original amount

B. $\frac{1}{8}$ of the original amount

C. $\frac{1}{16}$ of the original amount

D. $\frac{1}{32}$ of the original amount

Answer: C

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14. In the formation of sulphur trioxide by the contact process,

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

The rate of reaction is expressed as

$$-\frac{d(O_2)}{dt} = 2.5 \times 10^{-4} mol L^{-1} s^{-1}$$

The rate of disappearance of (SO_2) will be

A. -1.25×10^{-4}

B. -2.50×10^{-4}

C. -3.75×10^{-4}

D. -5.00×10^{-4}

Answer: D

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15. The rate of reaction.

$$2N_2O_5 \rightarrow 4NO_2 + O_2$$

can be written in three ways.

$$\frac{-d[N_2O_5]}{dt} = k[N_2O_5]$$

$$\frac{d[N_2O_5]}{dt} = \left(k'[N_2O_5]\right)$$

$$\frac{d[O_2]}{dt} = \left(k'[N_2O_5]\right)$$

The relation between k and k' are:

A. k=k

B. 2k=k

C. k=2k'

D. k=4k'

Answer: B

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

A. 16

B. 60

C. 99

D. 132

Answer: B

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17. For the reaction,

$3A + 2B \rightarrow C + D$,

the differential rate law can be written as:

A. $\frac{1}{3}\frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$

B. $-\frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$

C. $+\frac{1}{3}\frac{d[A]}{dt} = -\frac{d[C]}{dt} = k[A]^n[B]^m$

D. $-\frac{1}{3}\frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$

Answer: D

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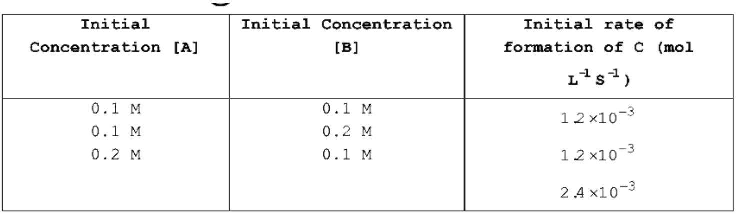
18. For the non-stoichiometric reaction $2A + B \to C + D$, The following data were obtained in three separate experiments, all at 298 K.



Initial Concentration [A]	Initial Concentration [B]	Initial rate of formation of C (mol $L^{-1}s^{-1}$)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

The rate law for the formation of C is:

A. $\frac{dc}{dt} = k[A][B]$

B. $\frac{dc}{dt} = k[A]^2[B]$

C. $\frac{dc}{dt} = k[A][B]^2$

D. $\frac{dc}{dt} = k[A]$

Answer: D

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Exercise 1 Concept Builder Topicwise Topic 1 Rate Of Reaction Rate Laws And Rate Constant

1. Which of the following will react at the highest rate ?

A. 1 mole of A and I mole of Bin a 1-L vessel

B. 2 mole of A and 2 mole of B in a 2-L vessel

C. 3 mole of A and 3 mole of Bin a 3-L vessel

D. All would react at the same rate

Answer: D

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2. Burning of coal is represented as $C(s) + O_2(g) \rightarrow CO_2(g)$. The rate of this reaction is increased by

A. decrease in the concentration of oxygen

B. powdering the lumps of coal

C. decreasing the temperature of coal

D. providing inert atmosphere

Answer: B

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3. If n_A and n_B are the number of moles at any instant in the reaction : $2A(g) \rightarrow 3Bg$ (carried out in a vessel of VL, the rate of the reaction at that instant is given by

A. $-\frac{1}{2}\frac{dn_A}{dt} = \frac{1}{3}\frac{dn_B}{dt}$

B. $-\frac{1}{V}\frac{dn_A}{dt} = \frac{1}{V}\frac{dn_B}{dt}$

C. $-\frac{1}{2V}\frac{dn_A}{dt} = \frac{1}{3V}\frac{dn_B}{dt}$

D. $-\frac{1}{V}\frac{n_A}{t} = \frac{1}{V}\frac{n_B}{t}$

Answer: C

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4. Rate of a reaction

A. decreases with increase in temperature.

B. increases with increase in temperature.

C. may increase or decrease with increase in temperature.

D. does not depend on temperature.

Answer: B

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5. If $3A \rightarrow 2B$, then the rate of reaction of $+\frac{dB}{dt}$ is equal to

A. $-\frac{3}{2}\frac{d[A]}{dt}$

B. $-\frac{2}{3}\frac{d[A]}{dt}$

C. $-\frac{1}{3}\frac{d[A]}{dt}$

D. $+2\frac{d[A]}{dt}$

Answer: B

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6. for the reaction, $2A+B \rightarrow 3C+D$, which of the following does not express the reaction rate

A. $-\frac{d[B]}{dt}$ |

B. $\frac{d[D]}{dt}$ |

C. $-\frac{1}{2}\frac{d[A]}{dt}$ |

D. $-\frac{1}{3}\frac{d[C]}{dt}\Bigg|$

Answer: D

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7. For the reaction, $N_2O_5(g) \rightarrow 2NO_2(g) + 1/2O_2(g)$, the value of rate of disappearance of N_2O_5 is given as $6.25 \times 10^{-3} \text{mol L}^{-1} s^{-1}$. The rate of formation of NO_2 and O_2 is given respectively as

A. $6.25 \times 10^{-3} molL^{-1}s^{-1}$ and $6.25 \times 10^{-3} molL^{-1}s^{-1}$

B. $1.25 \times 10^{-2} molL^{-1}s^{-1}$ and $3.125 \times 10^{-3} molL^{-1}s^{-1}$

C. $6.25 \times 10^{-3} molL^{-1}s^{-1}$ and $3.125 \times 10^{-3} molL^{-1}s^{-1}$

D. $1.25 \times 10^{-2} molL^{-1}s^{-1}$ and $6.25 \times 10^{-3} molL^{-1}s^{-1}$

Answer: B

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8. The rate of a reaction increases four-fold when the concentration of reactant is increased 16 times. If the rate of reaction is $4 \times 10^{-6} molL^{-1}s^{-1}$ when the concentration of the reactant is $4 \times 10^{-4} mol L^{-1}$. The rate constant of the reaction will be

A. $2 \times 10^{-4} mol^{1/2} L^{-1/2} s^{-1}$

B. $1 \times 10^{-2} s^{-1}$

C. $2 \times 10^{-4} mol^{-1/2} L^{1/2} s^{-1}$

D. $25 mol^{-1} L \min^{-1}$

Answer: A

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9. $\frac{k_{34^\circ}}{k_{35^\circ}} < 1$, then

A. rate increases with the rise in temperature

B. rate decreases with rise in temperature

C. rate does not change with rise in temperature

D. none of these

Answer: A

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10. The rate of the reaction

$2NO + CI_2 \rightarrow 2NOCI$

is given by the rate equation

$Rate = k[NO]^2[CI_2]$

The value of the rate constant can be increased by

A. increasing the concentration of NO.

B. increasing the temperature.

C. increasing the concentration of the CI_2

D. doing all of these

Answer: B

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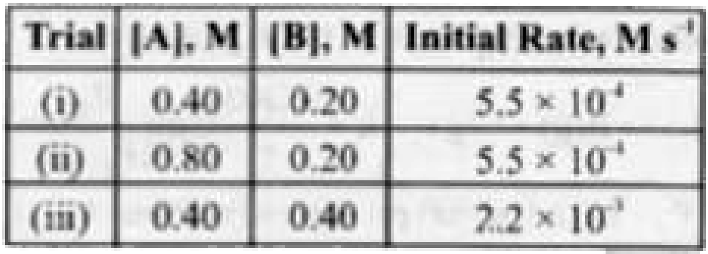
11. For a reaction $A+B \rightarrow C+2D$, experimental results were collected for three trials and the data obtained are given below:



Trial	[A], M	[B], M	Initial Rate, M s^{-1}
(i)	0.40	0.20	5.5×10^{-4}
(ii)	0.80	0.20	5.5×10^{-4}
(iii)	0.40	0.40	2.2×10^{-3}

The correct rate law of the reaction is

A. $\text{rate} = k[A]^0[B]^2$

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

C. $\text{rate} = k[A][B]$

D. $\text{rate} = k[A][B]^0$

Answer: A

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Exercise 1 Concept Builder Topicwise Topic 2 Order Of Reaction And Half Life Period

1. Cyclopropane rearranges to form propane :

$$\Delta \rightarrow CH_3 - CH = CH_2$$

This follows first order kinetics. The rate constant is $2.174 \times 10^{-3}\text{sec}^{-1}$. The initial concentration of cyclopropane is $0.29M$. What will be the concentration of cyclopropane after 100 sec

A. 0.035M

B. 0.22 M

C. 0.145 M

D. 0.0018M

Answer: B

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2. The rate constant of the reaction $A \rightarrow B$ is 0.6×10^{-3} mole per second. If the concentration of A is $5M$, then concentration of B after 20 minutes is:

A. 1.08 M

B. 3.60 M

C. 0.36 M

D. 0.72 M

Answer: D

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3. A Geiger Muller counter is used to study the radioactive process. In the absence of radioactive substances A, it counts 3 disintegration per second (dps). At the start in the presence of A, it records 23 dps, and after $10m$ in $13dps$,

i. What does it count after $20m$ in ?

A. 8 dps, 10 min

B. 5 dps, 10 min

C. 5 dps, 20 min

D. 5 dps, 5 min

Answer: A

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4. The rate constant of a reaction is $0.0693 \min^{-1}$. Starting with $10 mol$, the rate of the reaction after $10 \min$ is

A. $0.0693 mol \min^{-1}$

B. $0.0693 \times 2 mol \min^{-1}$

C. $0.0693 \times 5 mol \min^{-1}$

D. $0.0693 \times (5)^2 mol \min^{-1}$

Answer: C

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5. The hydrolysis of ester in alkaline medium is a

A. first order reaction with molecularity 1

B. second order reaction with molecularity > 2

C. first order reaction with molecularity 2

D. second order reaction with molecularity 1

Answer: B

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6. Which of the following expression is correct for first order reaction (c_0 refers to initial concentration of reactant)

A. $t_{1/2} \propto c_0$

B. $t_{1/2} \propto c_0^{-1}$

C. $t_{1/2} \propto c_0^{-2}$

D. $t_{1/2} \propto c_0^0$

Answer: D

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7. If a is the initial concentration of the rectant, the half life period of the reaction of n^{th} order is inversely proportional to :

A. a^{n-1}

B. a^n

C. a^{1-n}

D. a^{n+1}

Answer: A

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8. For the zero order reaction $A \rightarrow B + C$, initial concentration of A is 0.1 M. If [A]=0.08 M after 10 minutes,then its half-life and completion time are respectively :

A. 10 min, 20 min

B. 2×10^{-3} min, 4×10^{-3} min

C. 25 min, 50 min

D. 250 min, 500 min

Answer: C

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9. In the presence of acid, the initial concentration of cane sugar was reduced from 0.2 M to 0.1 M in 5 h and to 0.05 M in 10 h. The reaction must be of

A. zero order

B. first order

C. Second order

D. third order

Answer: B

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10. For the reaction $3A(g) \xrightarrow{k} B(g) + C(g)$ k is $10^{-4} L/mol.\ \min$.

If [A] = 0.5M then the value of $-\frac{d[A]}{dt}$(in ms^{-1} is:

A. 7.5×10^{-5}

B. 3×10^{-4}

C. 2.5×10^{-5}

D. 1.25×10^{-6}

Answer: D

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11. 99% at a first order reaction was completed in 32 min. When will 99.9% of the reaction complete.

A. 50min

B. 46 min

C. 48 min

D. 49 min

Answer: C

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12. Which of the following represent the expression for $\frac{3}{4}$th life of first order reaction

A. $\frac{k}{2.303}\log 4/3$

B. $\frac{2.303}{k}\log 3/4$

C. $\frac{2.303}{k}\log 4$

D. $\frac{2.303}{k}\log 3$

Answer: C

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13. A hypothetical reaction $A_2 + B_2 \rightarrow 2AB$ follows the mechanism as given below:

$A_2 \Leftrightarrow A + A(\text{fast})$

$A + B_2 \rightarrow AB + B$ (slow)

$A + B \rightarrow AB$ (fast)

The order of the overall reaction is

A. 0

B. 1

C. 2

D. $3/2$

Answer: D

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14. The time taken for 90% of a first order reaction to be completed is approximately

A. 1.1 times that of half-life

B. 2.2 times that of half-life

C. 3.3 times that of half-life

D. 4.4 times that of half-life

Answer: C

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15. A substance 'A' decomposes by a first order reaction starting initially with $[A] = 2.00M$ and after 200 min, [A] becomes $0.15M$. For this reaction, $t1/2$ is

A. 53.72 min

B. 50.49 min

C. 48.45 min

D. 46.45 min

Answer: A

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16. Half life of a first order reaction is 4s and the initial concentration of the reactant is 0.12 M. The concentration of the reactant left after 16 s is

A. 0.0075 M

B. 0.06M

C. 0.03 M

D. 0.015M

Answer: A

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17. $3A \rightarrow B + C$, it would be a zero order reaction when

A. the rate of reaction is proportional to square of concentration of A.

B. the rate of reaction remains same at any concentration of A

C. the rate remains unchanged at any concentration of B and C.

D. the rate of reaction doubles if concentration of B is increased to double.

Answer: B

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18. The reaction A $\rightarrow$ B follows first order reaction. The time taken for 0.8 mole of A to produce 0.6 mole of B is 1 hour. What is the time taken for conversion of 0.9 mole of A to produce 0.675 moles of B?

A. 2 hours

B. 1 hour

C. 0.5 hour

D. 0.25 hour

Answer: B

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19. For a first-order reaction $A \rightarrow B$ the reaction rate at reactant concentration of $0.10M$ is found to be $2.0 \times 10^{-5} \mathrm{mol} L^{-1} s^{-1}$. The half-life period of the reaction is

A. 30 s

B. 220 s

C. 300 s

D. 347 s

Answer: D

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20. For a reaction $A + 2B \rightarrow C$, rate is given by $R = K[A][B]^2$. The order of reaction is:

A. 3

B. 6

C. 5

D. 7

Answer: A

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21. In a first order reaction, the concentration of the reactant, decreases from 0.8 M to 0.4 M in 15 minutes.

The time taken for the concentration to change from 0.1 M to 0.025 M is -

A. 7.5 minutes

B. 15 minutes

C. 30 minutes

D. 60 minutes

Answer: C

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22. In a reaction, when the concentration of reactant is increased two times, the increase in rate of reaction was four times. Order of reaction is:

A. zero

B. 1

C. 2

D. 3

Answer: C

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23. The rate constant of a first order reaction is $6.9 \times 10^{-3} s^{-1}$. How much time will it take to reduce the initial concentration to its $1/8^{\text{th}}$ value?

A. 100 s

B. 200 s

C. 300 s

D. 400 s

Answer: C

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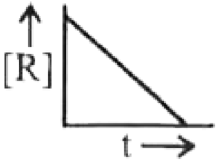
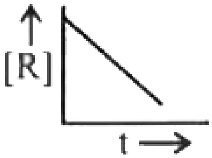
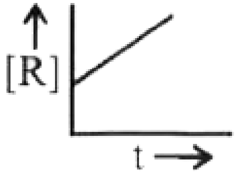
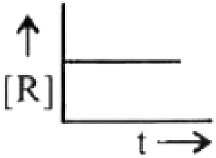
24. The plot that represents the zero order reaction is:

A. 

B. 

C. 

D. 

Answer: D

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25. For a chemical reaction $t_{1/2}$ is 2.5 hours at room temperature. How much of the reactant will be left after 7.5 hours if initial weight of reactant was 160 g?

A. 10g

B. 40g

C. 80 g

D. 20g

Answer: D

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26. Point out the wrong statement:

For a first order reaction

A. time for half-change $(t_{1/2})$ is independent of initial concentration

B. change in the concentration unit does not change the rate constant (k)

C. time for half-change rate constant =0.693

D. the unit of k is $\text{mole}^{-1}\text{min}^{-1}$

Answer: D

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27. For a reaction $\frac{dx}{dt}=K\left[H^{+}\right]^{n}$. If pH of reaction medium changes from two to one rate becomes 100 times of value at $pH=2$, The order of reaction is

A. 1

B. 2

C. 0

D. 3

Answer: B

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28. Ethylene is produced by $C_4H_8 \xrightarrow{\Delta} 2C_2H_4$

The rate constant is $2.3 \times 10^{-4} \sec^{-1}$. Approximately in what time will the molar ratio of ethylene to cyclobutane in mixture attain the value equal to one?

(log 2=0.3, log 3 =0.47)

A. 1700 sec

B. 1600 sec

C. 2000 sec

D. 1200 sec

Answer: A

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29. Which one of the following statements for the order of a reaction is incorrect ?

A. Order can be determined only experimentally.

B. Order is not influenced by stoichiometric coefficient of the reactants.

C. Order of reaction is sum of power to the concentration terms of reactants to express the rate of reaction.

D. Order of reaction is always whole number.

Answer: D

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30. The rate of a first-order reaction is $0.04 mol L^{-1} s^{-1}$ at 10 seconds and $0.03 mol L^{-1} s^{-1}$ at 20 seconds after initiation of the reaction. The half-life period of the reaction is

A. 24.1 s

B. 34.1 s

C. 44.1 s

D. 54.15 s

Answer: A

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31. Mechanism of a hypothetical reaction

$X_2 + Y_2 \rightarrow 2XY$ is given below:

(i) $X_2 \rightarrow X + X$ (fast)

(ii) $X + Y_2 \Leftrightarrow XY + Y$ (slow)

(iii) $X + Y \rightarrow XY$ (fast)

The overall order of the reaction will be :

A. 2

B. 0

C. 1.5

D. 1

Answer: C

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32. A first order reaction has a specific reaction rate of $10^{-2} \sec^{-1}$. How much time will it take for $20g$ of the reactant to reduce to $5g$?

A. 138.6 sec

B. 346.5 sec

C. 693.0 sec

D. 238.6 sec

Answer: A

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Exercise 1 Concept Builder Topicwise Topic 3 Theories Of Rate Of Reaction

1. Rate constant $k = 1.2 \times 10^3 mol^{-1} Ls^{-1}$ and $E_a = 2.0 \times 10^2 kJmol^{-1}$. When $T \rightarrow \infty$:

A. $A = 2.0 \times 10^2 kJmol^{-1}$

B. $A = 1.2 \times 10^3 mol^{-1} L^{-1} s^{-1}$

C. $A = 1.2 \times 10^3 molL^{-1}s^{-1}$

D. $A = 2.4 \times 10^3 kJmol^{-1}s^{-1}$

Answer: B

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2. An exothermic reaction $A \rightarrow B$ has an activation energy of $17kJ$ per mole of A. The heat of the reaction is $40kJ$. Calculate the activation energy for the reverse reaction $B \rightarrow A$.

A. 60kJ

B. 57 kJ

C. 75kJ

D. 90kJ

Answer: B

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3. A catalyst only

A. decreases activation energy

B. increases activation energy

C. both (a) and (b)

D. comes to equilibrium

Answer: C

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4. An example of autocatalytic reaction is

A. decomposition of nitroglycerine

B. thermal decomposition of $KCIO_3$ and MnO_2 mixture

C. breakdown of $^{14}C\ _6$

D. hydrogenation of vegetable oil using nickel catalysts

Answer: B

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5. For an endothermic reaction, where ΔH represents the enthalpy of reaction in $kJmol^{-1}$, the minimum value for the energy of activation will be

A. less than ΔH

B. more than ΔH

C. equal to ΔH

D. zero

Answer: B

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6. The activation energies of the forward and backward reactions in the case of a chemical reaction are 30.5 and 45.5 KJ/mol , respectively . The reaction is:

A. exothermic

B. endothermic

C. neither exothermic nor endothermic

D. independent of temperature

Answer: A

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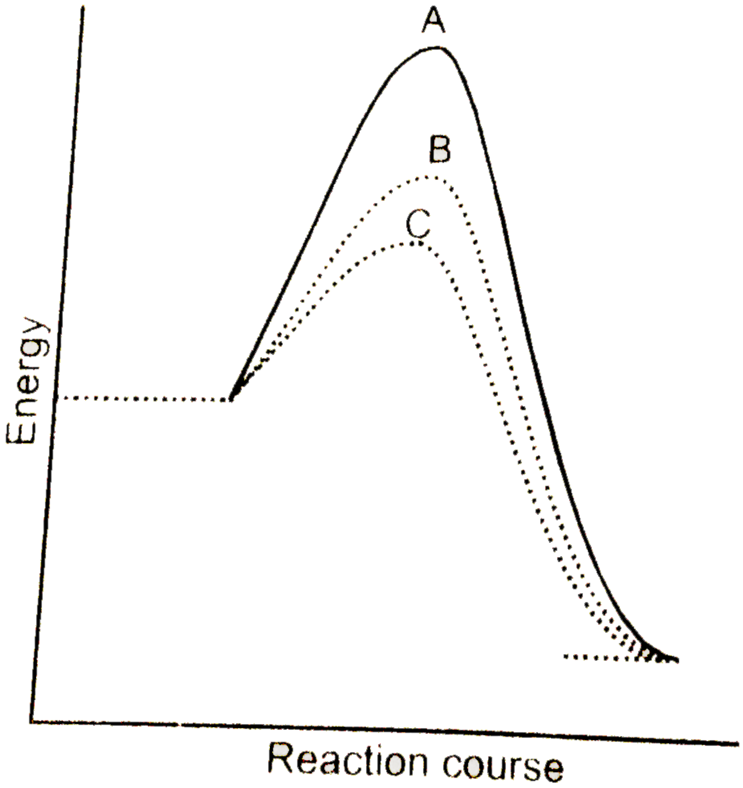
7. A homogenous catalytic reaction takes place through the three alternative plots A, B, and C shown in the given figure. Which one of the following indicates the relative ease with which the reaction cant take place?



A. $A > B > C$

B. $C > B > A$

C. $A > C > B$

D. A = B = C

Answer: B

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8. For an exothermic reaqction, the energy of activation of the reactants is

A. equal to the energy of activation of products

B. less than the energy of activation of products

C. greater than the energy of activation of products

D. sometimes greater and sometimes less than that of the products

Answer: B

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9. The activation energy for a simple chemical reaction $A \to B$ is E_a in the forward reaction: The activation of the reverse reaction

A. is always double of E_a

B. is negative of E_a

C. is always less than E_a

D. can be less than or more than E_a

Answer: D

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10. For a reaction the activation energy $E_a = 0$ and the rate constant=$3.2 \times 10^6 \sec^{-1}$ at 300K. What is the value of rate constant at 310K?

A. $3.2 \times 10^{-12} s^{-1}$

B. $3.2 \times 10^{-6} s^{-1}$

C. $6.4 \times 10^{12} s^{-1}$

D. $6.4 \times 10^6 s^{-1}$

Answer: B

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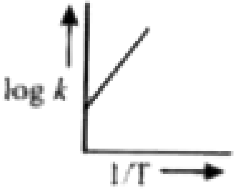
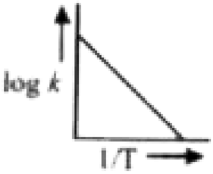
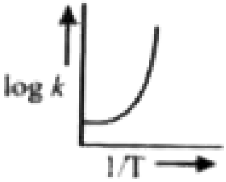
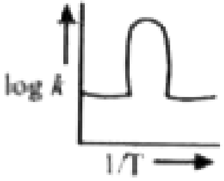
11. A graph plotted between $\log k$ versus $1/T$ for calculating activation energy is shown by

A. 

B. 

C. 

D. 

Answer: B

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12. When a biochemical reaction is carried out in laboratory from outside of human body in the absence of enzyme, the rate of reaction obtained is 10^{-6} times, then activation energy of the reaction in the presence of enzyme is

A. $\frac{6}{RT}$

B. different from E_a obtained in laboratory

C. P is required

D. can't say anything

Answer: B

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13. For an endothermic reaction, energy of activation is E_a and enthalpy of reaction is ΔH (both of these in kJ/mol). Minimum value of E will be

A. less than ΔH

B. equal to ΔH

C. more than ΔH

D. equal to zero

Answer: B

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14. In a zero-order reaction for every 10° rise of temperature, the rate is doubled. If the temperature is increased from $10^{\circ}C$ to $100^{\circ}C$, the rate of the reaction will become

A. 256 times

B. 512 times

C. 64 times

D. 128 times

Answer: B

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15. Activation energy (E_a) and rate constants (k_1 and k_2) of a chemical reaction at two different temperatures (T_1 and T_2) are related by

A. $In\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$

B. $In\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)$

C. $In\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2}+\frac{1}{T_1}\right)$

D. $In\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1}+\frac{1}{T_2}\right)$

Answer: B

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16. What is the activation energy for a reaction if its rate doubles when the temperature is raised from $20^{\circ}C$ to $35^{\circ}C$? $\left(R = 8.314J\text{mol K}^{-}\right)$

A. $269kJmol^{-1}$

B. $34.7kJmol^{-1}$

C. $15.1kJmol^{-1}$

D. $342kJmol^{-1}$

Answer: B

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17. The activation energy of a reaction can be determined from the slope of which of the following graphs ?

A. $\frac{InK}{T}$ vs. T

B. In K vs. $\frac{1}{T}$

C. $\frac{T}{InK}$ vs. $\frac{1}{T}$

D. In K vs. T

Answer: B

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Exercise 2 Concept Applicator

1. For the reaction $R - X + OH^{-} \rightarrow ROH + X^{-}$, the rate is given as :

$$\text{Rate} = 5.0 \times 10^{-5}[R - X]\left[OH^{-}\right] + 0.20 \times 10^{-5}[R - X]$$

.

What percentage of R-X react by S_N2 mechanism when $\left[OH^{-}\right] = 1.0 \times 10^{-2} M$?

A. $96.1\ \%$

B. $3.9\ \%$

C. $80\ \%$

D. $20\ \%$

Answer: D

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2. Consider the reaction,

$Cl_2(aq) + H_2S(aq) \rightarrow S(s) + 2H^+(aq) + 2Cl^-(aq)$

The rate equation for this reaction is,

Rate $= k[Cl_2][H_2S]$

Which of these mechanisms is / are consistent with this rate equation ?

(I) $Cl_2 + H_2S \rightarrow H^+ + Cl^- + Cl^+ + HS^-$ (slow)

$Cl^+ + HS^- \rightarrow H^+ + Cl^- + S$ (fast)

(II) $H_2S \Leftrightarrow H^+ + HS^-$ (fast equilibrium)

$Cl^+ + HS^- \rightarrow 2Cl^- + H^+ + S$ (slow)

A. B only

B. Both A and B

C. Neither A nor B

D. A only

Answer: D

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3. In a reversible reaction $2NO_2 \underset{k_2}{\overset{k_1}{\Longleftrightarrow}} N_2O_4$, the rate of disappearance of NO_2 is equal to

A. $\frac{2k_1}{k_2}[NO_2]^2$

B. $2k_1[NO_2]^2 - 2k_2[N_2O_4]$

C. $2k_1[NO_2]^2 - k_2[N_2O_4]$

D. $(2k_1 - k_2)[NO_2]$

Answer: B

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4. For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$ if $\frac{\Delta[NH_3]}{\Delta t} = 2 \times 10^{-4} mol L^{-1} s^{-1}$, the value of $\frac{-\Delta[H_2]}{\Delta t}$ would be

A. $1 \times 10^{-4} mol L^{-1} s^{-1}$

B. $3 \times 10^{-4} mol L^{-1} s^{-1}$

C. $4 \times 10^{-4} mol L^{-1} s^{-1}$

D. $6 \times 10^{-4} mol L^{-1} s^{-1}$

Answer: B

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5. The mechanism of the reaction

$2NO + O_2 \rightarrow 2NO_2$ is

$$NO + NO \underset{k_{-1}}{\overset{k_1}{\Longleftrightarrow}} N_2O_2(\text{fast})$$

$$N_2O_2 + O_2 \xrightarrow{k_2} 2NO_2(slow)$$

The rate constant of the reaction is

A. k_2

B. $k_2k_1(k_{-1})$

C. k_2k_1

D. $k_2\left(\frac{k_1}{k_{-1}}\right)$

Answer: D

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6. For a reaction initial rate is given as : $R_0 = k[A_0]^2[B_0]$. By what factor, the initial rate of reaction will increase if initial concentration is taken 1.5 times and B is tripled?

A. 4.5

B. 2.25

C. 6.75

D. none of these

Answer: C

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7. When ethyl acetate was was hydrolysedin presemce of 0.1 M HCl, the rate constant was found to be $5.4 \times 10^{-5} s^{-1}$. But in presence of 0.1 M H_2SO_4 the rate constant was found to be $6.25 \times 10^{-5} s^{-1}$. Thus it may be concluded that:

A. H_2SO_4 furnishes more H^{+} than HCl.

B. H_2SO_4 furnishes less H^{+} than HCl.

C. both have the same strength.

D. will depend on concentration of ethyl acetate.

Answer: A

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8. The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation, $k = Ae^{-E_a/RT}\Big)$ Activation energy (E_a) of the reaction can be calculate by plotting

A. log k vs $\frac{1}{\log T}$

B. k vs T

C. k vs $\frac{1}{\log T}$

D. log k vs $\frac{1}{T}$

Answer: D

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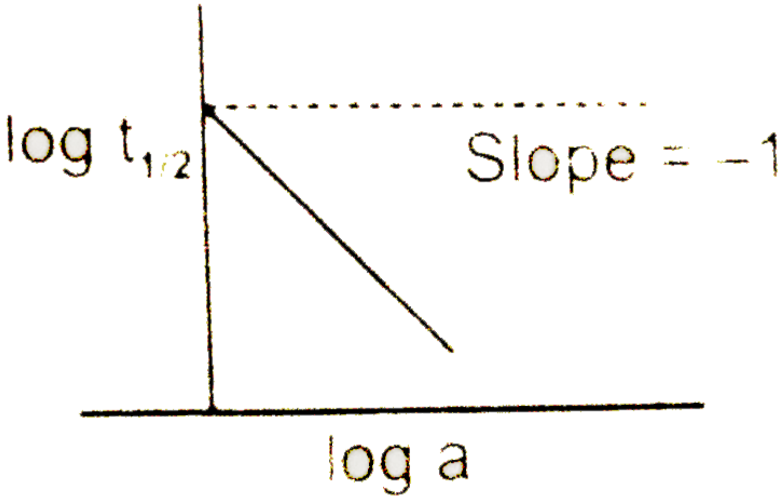
9. A graph between $\log t_{\frac{1}{2}}$ and log a (abscissa), a being the initial concentration of A in the reaction For reaction $A \rightarrow$ Product, the rate law is :



A. $\frac{-d[A]}{dt} = k$

B. $\frac{-d[A]}{dt} = k[A]$

C. $\frac{-d[A]}{dt} = k[A]^2$

D. $\frac{-d[A]}{dt} = k[A]^3$

Answer: C

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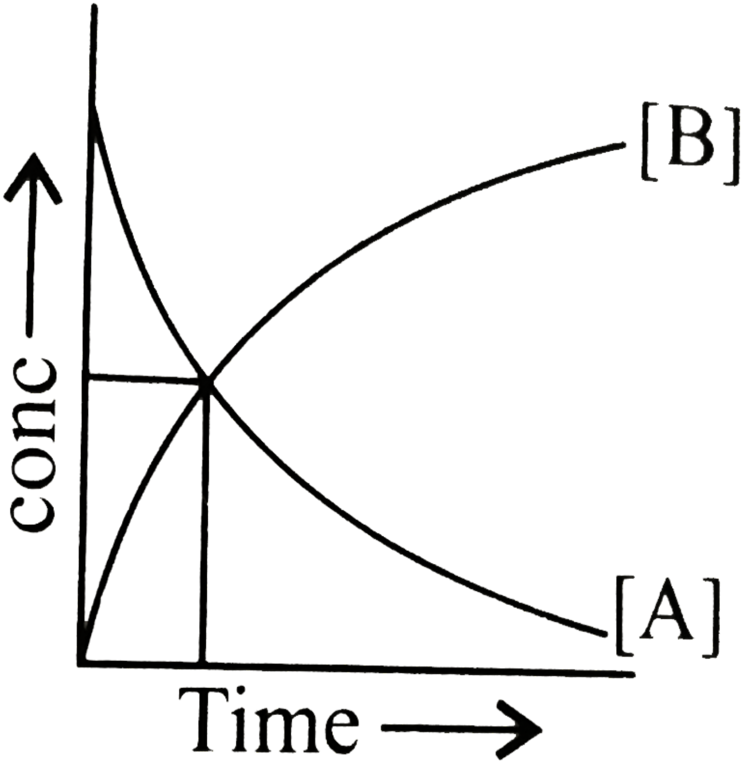
10. The accompanying figure depicts a change in concentration of species A and B for the reaction $A \to B$, as a function of time. The point of inter section of the two curves represents



A. $t_{1/2}$

B. $t_{3/4}$

C. $t_{2/3}$

D. Data insufficient to predict

Answer: A

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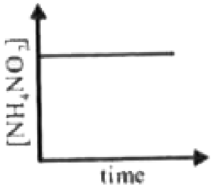
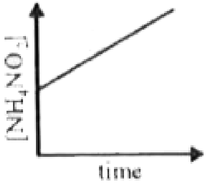
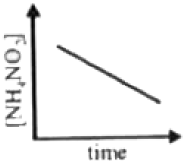
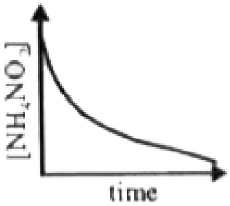
11. Decomposition of $NH_4NO_2(aq$ into $N_2(g)$ and $2H_2O(l)$ is first order reaction.

A. 

B. 

C. 



D.

Answer: D

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12. For a reaction $A \xrightarrow{k_r = 0.6M \min^{-1}} 2B$

starting with 1 M of 'A' only, concentration of B (in M) after 100 sec. and 200 sec. is respectively?

A. 2 and 4

B. 1 and 2

C. 2 and 3

D. none of these

Answer: D

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13. For an elementary reaction , $X(g) \rightarrow Y(g) + Z(g)$ the half life period is 10 min. In what period of time would the concentration of X be reduced to 10% of original concentration?

A. 20 Min

B. 33 Min

C. 15 Min

D. 25 Min

Answer: B

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14. Consider following two competing first ordr reactions,

$P \xrightarrow{k_1} A + B, Q \xrightarrow{k_2} C + D$

if $50\,\%$ of the reaction oof P wascompleted when $96\,\%$ of Q was complete ,then the ratio (k_2 / k_1) will be :

A. 4.06

B. 0.215

C. 1.1

D. 4.65

Answer: D

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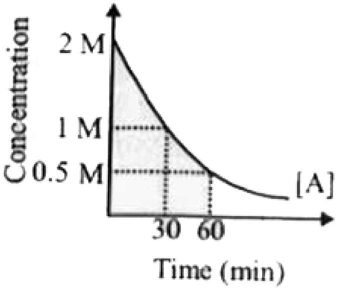
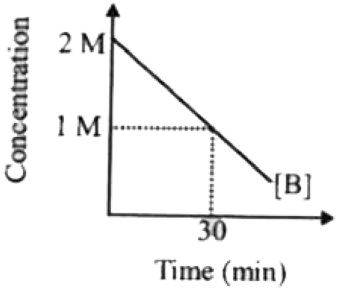
15. For the reaction

(i) $A \xrightarrow{k_1} P$

(ii) $B \xrightarrow{k_{II}} Q$, following observation is made.





Calculate $\frac{k_I}{k_{II}}$, where k_I and k_{II} are rate constant for the respective reaction.

A. 2.303

B. 1

C. 0.36

D. 0.693

Answer: D

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16. The decomposition of N_2O_5 in carbon tetrachloride was followed by measuring the volume of O_2 gas evolved : $2NO_2O_5(CCl_4) \rightarrow 2N_2O_4(CCl_4) + O_2(g)$. The maximum volume of O_2 gas obtained was $100cm^3$. In 500 minutes, $90cm^3$ of O_2 were evolved. The first order rate constant (in $\min^{-1}$) for the disappearance of N_2O_5 is:

A. $\frac{2.303}{500}$

B. $\frac{2.303}{500}\log\frac{100}{90}$

C. $\frac{2.303}{500}\log\frac{90}{100}$

D. $\frac{100}{10 \times 500}$

Answer: A

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17. The half-life of first order decomposition of NH_4NO_3 is 2.10 hr at 288 K temperature

$NH_4NO_3(aq) \rightarrow N_2O(g) + 2H_2O(l)$. If 6.2 of

NH_4NO_3 is allowed to decompose, the required for NH_4NO_3 to decompose 90 % is :

A. 6.978 hr

B. 0.319

C. 0.319 hr

D. 0.6978 hrs

Answer: A

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18. The hydrolysis of sucrose was studied with the help of calorimeter and following data were

$$\begin{array}{llll} \text{Collected time (min.)} & : 0 & 70 & \infty \\ \text{observed rotation (degrees)} & : 44 & 16.5 & -11 \end{array}$$

the time taken when reaction mixture wil be optically inactive ? (Given : In 2=0.7,in 3=1.1, in 5=1.6)

A. 16 min.

B. 69.47 min.

C. 160 min.

D. 1.6 min.

Answer: C

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19. The value of $\frac{t_{0.875}}{t_{0.50}}$ for n^{th} order reaction is

A. $2^{(2n-2)}$

B. $2^{(2n-2)-1}$

C. $\dfrac{8^{n-1}-1}{2^{n-1}-1}$

D. None of these

Answer: C

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20. In an attempt to compare the half-lives of two radioactive elements A and B, a scientist set aside 400 g of each. After 3 months, the scientist found 25 g of A and 200 g of B. Which one of the following statements is true?

A. Half-life of B is twice that of A

B. Half-life of B is four times that of A

C. Half-life of A is twice that of B

D. Half-life of A is four times that of B

Answer: B

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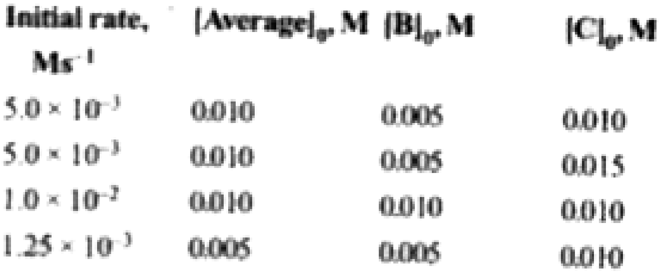
21. The initial rates ofreaction $3A + 2B + C \rightarrow$ Products, at different initial concentrations are given below:



Initial rate, Ms^{-1}	$[Average]_0$, M	$[B]_0$, M	$[C]_0$, M
5.0×10^{-3}	0.010	0.005	0.010
5.0×10^{-3}	0.010	0.005	0.015
1.0×10^{-2}	0.010	0.010	0.010
1.25×10^{-3}	0.005	0.005	0.010

The order with respect to the reactants, A, B and Care respectively

A. 3, 2, 0

B. 3, 2, 1

C. 2, 2, 0

D. 2, 1, 0

Answer: D

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22. The intergrated rate equation is

$Rt = \log, C_0 - \log C_t$. The straight line graph is obtained by plotting:

A. time vs $\log C_t$

B. $\frac{1}{\text{time}}$ vs C_t

C. time vs C_t

D. $\frac{1}{\text{time}}$ vs $\frac{1}{C_t}$

Answer: A

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23. The rate constant for a second order reaction is

$$k = \frac{2.303}{t(a-b)}\log\frac{b(a-x)}{(b-x)}$$

where a and b are initial concentrations of the two reactants A and B involved. If one of the reactants is present in excess, it becomes pseudo unimolecular. Explain how ?

A. first order w.r.t. A

B. zero order w.r.t. A

C. first order w.r.t.B

D. overall zero order

Answer: A

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24. The decomposition of N_2O_5 occurs as, $2N_2O_5 \to 4NO_2 + O_2$ and follows I order kinetics, hence:

A. the reaction is unimolecular

B. the reaction is bimolecular

C. $t_{1/2} \propto a^{0}$

D. none of these

Answer: C

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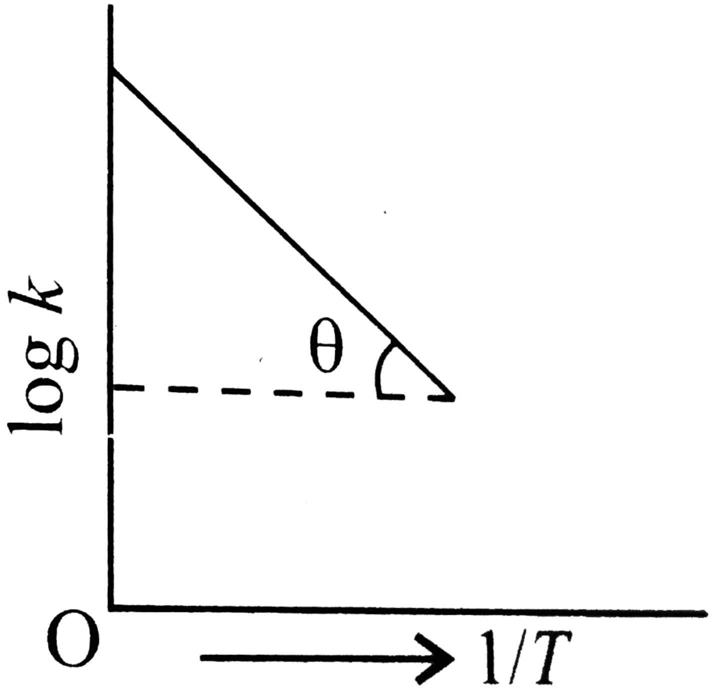
25. Graph between $\log k$ and $1/T$ $[k$ rate constant (s^{-1}) and T and the temperature $(K)]$ is a straight line with

$OX = 5, \theta = \tan^{-1}(1/2.303)$. Hence $-E_a$ will be



A. 2.303×2 cal

B. $2/2.303$ cal

C. 2 cal

D. none

Answer: C

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26. For reaction A $\rightarrow$ B , the rate constant $K_1 = A_1\left(e^{-E_{a_1}/RT}\right)$ and the reaction $X \rightarrow Y$, the rate constant $K_2 = A_2\left(e^{-E_{a_2}/RT}\right)$. If $A_1 = 10^9$, $A_2 = 10^{10}$ and E_{a_1}=1200 cal/mol and E_{a2} =1800 cal/mol , then the temperature at which $K_1 = K_2$ is : (Given , R=2 cal/K-mol)

A. 300K

B. $300 \times 2.303K$

C. $\frac{303}{2.303}K$

D. None of these

Answer: C

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27. The rate constant, the activation energy and the Arrhenius parameter of a chemical reactions at $25^{\circ} C$ are $3.0 \times 10^{-4} s^{-}$, $104.4 \text{ kJ mol}^{-1}$ and $6 \times 10^{14} s^{-1}$ respectively. The value of the rate constant as $T \rightarrow \infty$ is

A. $2.0 \times 10^{18} s^{-1}$

B. $6.0 \times 10^{14} s^{-1}$

C. infinity

D. $3.6 \times 10^{30} s^{-1}$

Answer: B

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28. The racemisation of α - pinene is first order reaction. In the gas the specific reaction rate was found to be $2.2 \times 10^{-5} mmHg^{-1}$ at 457.6 K and $3.07 \times 10^{-3} mmHg^{-1}$ at 510.1 K. The energy of activation is

A. $K(510.1 - 457.6) In\left(3.07 \times 10^{-3} / 2.2 \times 10^{-5}\right)$

B. 3.048×10^{-3}

C. $In 2.2 \times 10^{-5} \times 457.7 kcal.$

D. $(510.1 \times 457.6)(RIn(307/2.2)/52.5$

Answer: D

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29. The activation energy of a reaction is $9.0kcal/mol$.

The increase in the rate consatnt when its temperature is increased from $298K$ to $308K$ is

A. 63%

B. 50%

C. 100%

D. 10%

Answer: A

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30. The rate constant for the decomposition of a certain substance is $2.80 \times 10^{-1} M^{-1} s^{-1}$ at $30^{\circ} C$ and $1.38 \times 10^{-2} M^{-1} s^{-1}$ at $50^{\circ} C$. The Arrhenius parameters (A) of the reaction is:

$(R = 8.314 \times 10^{-3} kJmol^{-1} K^{-1})$.

A. $8.68 \times 10^{8} M^{-1} s^{-1}$

B. $2.16 \times 10^{7} M^{-1} s^{-1}$

C. $4.34 \times 10^{8} M^{-1} s^{-1}$

D. $3.34 \times 10^{8} M^{-1} s^{-1}$

Answer: C

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