

- (C) Half of that of Q
 (D) $2/3$ rd of that of Q
 Answer: Option C

08. Pick out the wrong statement.

- (A) Visible radiation provides the necessary activation energy in photochemical reactions
 (B) The order and molecularity of a complex reaction may not be the same
 (C) For a second order reaction, the slope of the graph/plot between rate and (concentration) is equal to the rate constant (k)
 (D) Molecularity of the reaction is always a whole number greater than zero
 Answer: Option B

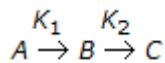
09. In a first order reaction, the time required to reduce the concentration of reactant from 1 mole/litre to 0.5 mole/litre will be _____ that required to reduce it from 10 moles/litre to 5 moles/litre in the same volume.

- (A) More than
 (B) Less than
 (C) Same as
 (D) Data insufficient; can't be predicted
 Answer: Option C

10. An irreversible first order reaction is being carried out in a CSTR and PFR of same volume. The liquid flow rates are same. The relative conversion will

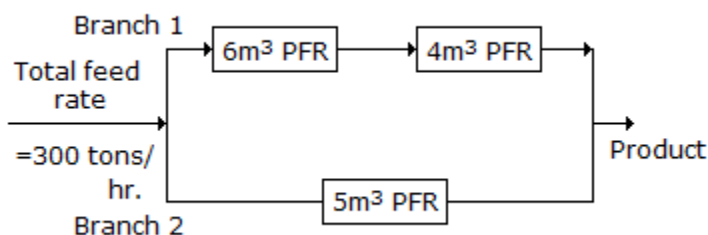
- (A) Be more in CSTR than in PFR
 (B) Be more in PFR than in CSTR
 (C) Be same in both cases
 (D) Depend on the temperature
 Answer: Option B

11. The first order series reaction as shown in the bellow figure is conducted in a batch reactor. The initial concentrations of A, B and C (C_{A0} , C_{B0} , C_{C0} respectively) are all non-zero. The variation of C_B with reaction time will not show a maximum, if



- (A) $k_2 C_{B0} > k_1 C_{A0}$
 (B) $k C_{A0} > k_2 \cdot C_{B0}$
 (C) $C_{B0} > C_{A0}$
 (D) $C_{A0} > C_{B0}$
 Answer: Option A

12. Three plug flow reactors (PFR's) of 4, 5 & 6 m³ volumes are arranged in two branches as shown below in the figure.



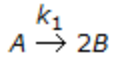
If the total feed rate is 300 tons/hr, then for the same conversion in each branch, the feed rate through branch II should be _____ tons/hr.

- (A) 100
 (B) 150
 (C) 200
 (D) 225
 Answer: Option A

13. Participation of _____ is involved in the occurrence of a chemical reaction.

- (A) Protons
 (B) Neutrons
 (C) Electrons
 (D) None of these
 Answer: Option C

14. The first order gas phase reaction as shown in the bellow figure is conducted isothermally in batch mode. The rate of change of conversion with time is given by



- (A) $dX_A/dt = k_1 (1 - X_A)^2 (1 + 2X_A)$
 (B) $dX_A/dt = k_1 (1 - X_A) (1 + 0.5X_A)$
 (C) $dX_A/dt = k_1 (1 - X_A)$
 (D) $dX_A/dt = k_1 (1 - X_A)/(1 + X_A)$

Answer: Option C

15. A photochemical reaction is _____ light.

- (A) Initiated by
 (B) Accompanied with emission of
 (C) Catalysed by
 (D) Used to convert heat energy into

Answer: Option A

16. The mean conversion in the exit stream, for a second order, liquid phase reaction in a non-ideal flow reactor is given by

(A) $\int_0^{\infty} \frac{k_2 \cdot C_{A0} \cdot t}{1 + k_2 \cdot C_{A0} \cdot t} E(t) \cdot dt$ (B) $\int_0^{\infty} \frac{1}{1 + k_2 \cdot C_{A0} \cdot t} E(t) \cdot dt$

(C) $\int_0^{\infty} \frac{1}{1 + k_2 \cdot C_{A0} \cdot t} [1 - E(t)] dt$ (D) $\int_0^{\infty} \frac{\exp(-k_2 C_{A0} \cdot t)}{1 + k_2 \cdot C_{A0} \cdot t} E(t) \cdot dt$

Answer: Option A

17. Fluid flow in a real packed bed can be approximated as _____ model.

- (A) Plug flow
 (B) Dispersion
 (C) Mixed flow
 (D) Tank in series

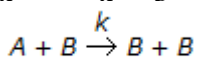
Answer: Option B

18. The value of 'n' for a chemical reaction $A \rightarrow B$, whose reaction rate is $\rightarrow C_A^n$, will be _____ if the rate of the reaction increases by a factor of 8, when the concentration of is doubled.

- (A) 0
 (B) 1
 (C) 2
 (D) 3

Answer: Option D

19. The rate of an autocatalytic reaction as shown in the bellow figure, is given by - $r_A = k \cdot C_A \cdot C_B$. In this case, the



- (A) Plot of $-r_A$ Vs C_A is a straight line with slope k
 (B) Plot of $-r_A$ Vs C_A is a hyperbola
 (C) Rate of disappearance of reactant A is maximum, where $C_A = C_B$
 (D) Both 'b' & 'c'

Answer: Option D

20. _____ resistance is not involved in the combustion of a carbon particle.

- (A) Gas film
 (B) Ash
 (C) Chemical reaction
 (D) None of these

Answer: Option B

21. A stirred tank reactor compared to tubular-flow reactor provides

- (A) More uniform operating conditions
- (B) Permits operation at the optimum temperature for a long reaction time
- (C) Higher overall selectivity for a first order consecutive reaction
- (D) All (A), (B) and (C)

Answer: Option D

22. A first order reaction is to be treated in a series of two mixed reactors. The total volume of the two reactors is minimum, when the reactors are

- (A) Equal in size
- (B) Of different sizes
- (C) Of such size that the ratio of their volumes is < 5
- (D) None of these

Answer: Option A

23. Half life period of a first order irreversible reaction $A \rightarrow B$ is

- (A) $k/2$
- (B) $\ln k/2$
- (C) $\ln 2/k$
- (D) $\ln 0.5/k$

Answer: Option C

24. An example of autothermal reactor operation is

- (A) Sulphur dioxide oxidation
- (B) Ethylene oxidation
- (C) Benzene oxidation
- (D) Ammonia synthesis

Answer: Option B

25. The value of Steric factor 'P' in the equation $k = PZe^{E/RT}$ usually ranges from

- (A) 1.0 to 10^{-8}
- (B) 1.1 to 10^2
- (C) 0.1 to 0.9
- (D) None of these

Answer: Option A

26. Brunauer, Emmet and Teller (BET) equation is used to determine the specific surface area of a porous particle but not the pore volume & the porosity of the catalyst bed. Which of the following postulates is not used to derive BET equation?

- (A) Langmuir's assumption applies to every adsorbed layer
- (B) There is no dynamic equilibrium between successive layer
- (C) The adsorbed layer may be polymolecular in thickness and the heat of adsorption in each layer (except the first one) is involved in each of the evaporation process
- (D) None of these

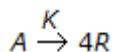
Answer: Option B

27. 'Unreacted core model' represents the reaction involving

- (A) Combustion of coal particles
- (B) Roasting of sulphide ores
- (C) Manufacture of carbon disulphide from elements
- (D) None of these

Answer: Option B

28. Volume change for unimolecular type first order reaction as shown in the bellow figure, increases _____ with time.



- (A) Linearly
- (B) Exponentially
- (C) Parabolically
- (D) Logarithmically

Answer: Option B

29. The effectiveness factor for large value of Thiele modulus $[L\sqrt{(K/D_1)}]$ of a solid catalysed first order reaction is equal to (where, L = length of the reactor, cm, D_1 = diffusion co-efficient, $\text{cm}^2/\text{second}$).

- (A) $L\sqrt{(K/D_1)}$
- (B) $1/[L\sqrt{(K/D_1)}]$
- (C) 1
- (D) ∞

Answer: Option B

30. In case of the irreversible unimolecular type, first order reaction, the fractional conversion at any time for constant volume system as compared to variable volume system is

- (A) More
- (B) Less
- (C) Same
- (D) Either (A) or (B), depends on other factors

Answer: Option C

31. For the same residence time, which one will give the maximum conversion?

- (A) Single stirred tank ($v = 5$ litres)
- (B) Two stirred tank (each of 2.5 litres) in series
- (C) Stirred tank followed by tubular flow reactor (each of 2.5 litres)
- (D) Single tubular flow reactor ($v = 5$ litres)

Answer: Option D

32. In a zero order reaction, reactants concentration does not change with time and the

- (A) Time for half change is half the time taken for completion of the reaction
- (B) Time for half change is independent of the initial concentration
- (C) Time for completion of the reaction is independent of the initial concentration
- (D) Reaction rate is trebled when the initial concentration is trebled

Answer: Option A

33. The conversion for a first order liquid phase reaction. $A \rightarrow B$ in a CSTR is 50%. If another CSTR of the same volume is connected in series, then the % conversion at the exit of the second reactor will be

- (A) 60
- (B) 75
- (C) 90
- (D) 100

Answer: Option B

34. Variables affecting the rate of homogeneous reactions are

- (A) Pressure and temperature only
- (B) Temperature and composition only
- (C) Pressure and composition only
- (D) Pressure, temperature and composition

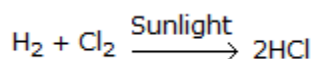
Answer: Option D

35. For a _____ order reaction, the units of rate constant and rate of reaction are the same.

- (A) Zero
- (B) First
- (C) Second
- (D) Fractional

Answer: Option A

36. The order of the reaction as shown in the bellow figure, is



- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option A

37. A chemical reaction occurs, when the energy of the reacting molecules is _____ the activation energy of reaction.

- (A) Less than
- (B) Equal to
- (C) More than
- (D) Equal to or more than

Answer: Option D

38. If a solid-gas non-catalytic reaction occurs at very high temperature, the rate controlling step is the _____ diffusion.

- (A) Film
- (B) Ash layer
- (C) Pore
- (D) None of these

Answer: Option A

39. Space velocity

- (A) Describes the extensive operating characteristics of a tubular flow reactor
- (B) Is the maximum feed rate per unit volume of reactor for a given conversion
- (C) Is a measure of the ease of the reaction
- (D) All (A), (B) and (C)

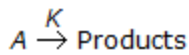
Answer: Option D

40. The heat of reaction

- (A) Depends on the pressure only
- (B) Depends on the mechanism of reaction only
- (C) Depends on both pressure and mechanism of reaction
- (D) Is independent of the mechanism of reaction

Answer: Option D

41. The half life period 't' of a zero order reaction as shown in the bellow figure, is equal to



- (A) $C_{A0}/2K$
- (B) C_{A0}/K
- (C) $0.693/K$
- (D) $1/K$

Answer: Option A

42. The conversion of a reactant, undergoing a first order reaction, at a time equal to three times the half life of the reaction is:

- (A) 0.875
- (B) 0.5
- (C) 0.425
- (D) Data insufficient to calculate

Answer: Option A

43. Semibatch reactor is preferred, when a/an

- (A) A highly exothermic reaction is to be controlled
- (B) Undesirable side reaction (at high concentration of one of the reactants) is to be avoided
- (C) A gas is to be reacted with liquid (e.g. hydrogenation of fat)
- (D) All (A), (B), and (C)

Answer: Option D

44. Photo-chemical reactions occur in presence of

- (A) Sunlight
- (B) Darkness
- (C) Solid catalysts
- (D) Monochromatic radiation only

Answer: Option A

45. In an exothermic reaction, the energy of the reacting substances as compared to that of products is

- (A) More

- (B) Less
 - (C) Same
 - (D) Either (A) or (B), depends on order of reaction
- Answer: Option A

46. Effectiveness factor (E) of a catalyst pellet is defined as, $E = (\text{actual rate within pore of the catalyst})/(\text{rate if not snowed by pore diffusion})$, Effectiveness factor for a first order reaction is given by (where, $T = \text{Thiele modulus}$)

- (A) $\tan hT/T$
 - (B) $\tan T/T$
 - (C) $\tan hT/\tan T$
 - (D) None of these
- Answer: Option A

47. B.E.T. method can be used to determine the _____ of a porous catalyst.

- (A) Solid density
 - (B) Pore volume
 - (C) Surface area
 - (D) All (A), (B) and (C)
- Answer: Option C

48. The exit age distribution of a fluid leaving a vessel (denoted by E) is used to study the extent of non-ideal flow in the vessel. The value of $\int_0^\infty E \cdot dt$ is

- (A) 0
- (B) 1
- (C) ∞
- (D) $\sqrt{2\pi}$

Answer: Option B

49. On application of pressure to the equilibrium system, $\text{ice} \rightleftharpoons \text{water}$; which of the following phenomenon will occur?

- (A) Water will evaporate
- (B) Equilibrium will not be attained
- (C) More ice will be formed
- (D) More water will be formed

Answer: Option D

50. Molecularity of an elementary reaction, $P + Q \rightarrow R + S$ is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Answer: Option D

51. Rate of a chemical reaction is not affected by the

- (A) Catalyst
- (B) Temperature
- (C) Reactant's concentration
- (D) Number of molecules of reactants taking part in the reaction

Answer: Option D

52. The ' E ' curve for a non-ideal reactor defines the fraction of fluid having age between t and $t + dt$

- (A) At the inlet
- (B) At the outlet
- (C) In the reactor
- (D) Averaged over the inlet and outlet

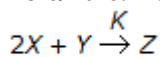
Answer: Option B

53. Batch process is preferred over continuous process, when the

- (A) Product yields and quality cannot be achieved in continuous process, because of long residence time
- (B) Sales demand of product is not steady
- (C) Same equipment cannot be used for several processes of the same nature
- (D) All (A), (B) & (C)

Answer: Option D

54. For the reaction as shown in the bellow figure, the rate of formation of Z is 0.2 gm mole/litre.hr. What is the rate of disappearance of X in gm mole/litre.hr?



- (A) 0.4
 - (B) 0.1
 - (C) 0.2
 - (D) None of these
- Answer: Option A

55. For a first order isothermal chemical reaction in a porous catalyst, the effectiveness factor is 0.3. The effectiveness factor will increase if the

- (A) Catalyst size is reduced or the catalyst diffusivity is reduced
 - (B) Catalyst size is reduced or the catalyst diffusivity is increased
 - (C) Catalyst size is increased or the catalyst diffusivity is reduced
 - (D) Catalyst size is increased or the catalyst diffusivity is increased
- Answer: Option B

56. The conversion X_A and residence time data are collected for zero order liquid phase reaction in a stirred tank reactor. Which of the following will be a straight line?

- (A) $X_A V_S \cdot \tau$
 - (B) $X_A V_S \ln \tau$
 - (C) $X_A/(1 - X_A)V_S \tau$
 - (D) $X_A(1 - X_A)V_S \tau$
- Answer: Option A

57. A second order liquid phase reaction, $A \rightarrow B$, is carried out in a mixed flow reactor operated in semi batch mode (no exit stream). The reactant A at concentration C_{AF} is fed to the reactor at a volumetric flow rate of F . The volume of the reacting mixture is V and the density of the liquid mixture is constant. The mass balance for A is

- (A) $d(V_{CA})/dt = -F(C_{AF} - C_A) - kC_A^2V$
 - (B) $d(V_{CA})/dt = F(C_{AF} - C_A) - kC_A^2V$
 - (C) $d(V_{CA})/dt = -FC_A - kC_A^2V$
 - (D) $d(V_{CA})/dt = FC_{AF} - kC_A^2V$
- Answer: Option D

58. Which of the following is not a dimension-less group used in catalysis? (Where, D = dispersion co-efficient, cm^2/sec . D_1 = diffusion co-efficient; cm^2/sec L = length of the reactor, cm t = time, sec , v = volumetric flow rate, cm^3/sec . V = volume, cm^3 .)

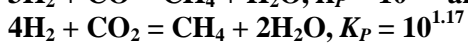
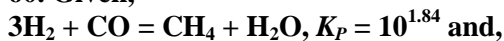
- (A) Reactor dispersion number (D/vL)
 - (B) Reduced time (vt/V)
 - (C) Thiele modulus $L \sqrt{(k/D_1)}$
 - (D) None of these
- Answer: Option D

59. Following isothermal kinetic data are obtained in a basket type of mixed flow reactor for a porous catalyst. Determine the role of pore diffusion and external mass transfer processes.

Pellet diameter	Leaving concentration of the reactant	Spinning rate of basket	$(-r_A^1)$
1	1	high	2
2	1	low	1
3	1	high	1

- (A) Strong pore diffusion control and mass transfer not controlling
 - (B) Both pore diffusion and mass transfer not controlling
 - (C) Both pore diffusion and mass transfer controlling
 - (D) Mass transfer controlling
- Answer: Option A

60. Given,



the K_P for the reaction $\text{CO} + \text{H}_2\text{O} = \text{CO}_2 + \text{H}_2$ is

(A) $10^{3.01}$

(B) $10^{-0.67}$

(C) $10^{-3.01}$

(D) $10^{0.67}$

Answer: Option D

61. The equilibrium constant of a catalytic chemical reaction _____ due to the presence of a catalyst.

(A) Increases

(B) Decreases

(C) Remain unaffected

(D) Unpredictable from the data

Answer: Option C

62. The sequence in which three CSTR's of volumes 5, 10 and 15 m³ will be connected in series to obtain the maximum production in a second order irreversible reaction is

(A) 15, 10, 5

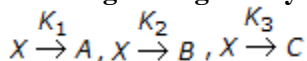
(B) 5, 10, 15

(C) 10, 5, 15

(D) 10, 15, 5

Answer: Option A

63. Decomposition rate of a liquid 'X' which decomposes as per the reaction as shown in the bellow figure is given by:



(A) $K_1 \cdot C_X$

(B) $(K_1 + K_2 + K_3) C_X$

(C) $(K_1 + K_2) C_X$

(D) $(K_2 + K_3) C_X$

Answer: Option C

64. What is the dispersion number for a CSTR?

(A) 0

(B) 1

(C) < 1

(D) ∞

Answer: Option D

65. A first order gaseous phase reaction is catalysed by a non-porous solid. The kinetic rate constant and the external mass transfer co-efficients are k and k_g respectively. The effective rate constant (k_{eff}) is given by

(A) $k_{eff} = k + k_g$

(B) $k_{eff} = (k + k_g)/2$

(C) $k_{eff} = (kk_g)^{1/2}$

(D) $1/k_{eff} = 1/k + 1/k_g$

Answer: Option D

66. _____ gas is normally employed in B.E.T. method of finding out the surface area of catalyst.

(A) N₂

(B) H₂

(C) CO₂

(D) He

Answer: Option A

67. For the non-catalytic reaction of particles with surrounding fluid, the time needed to achieve the same fractional conversion for particles of different but unchanging sizes is proportional to the square of particle diameter, when the _____ is the controlling resistance.

(A) Film diffusion

- (B) Diffusion through ash layer
 - (C) Chemical reaction
 - (D) Either (A), (B) or (C)
- Answer: Option B

68. Catalyst is a substance, which _____ chemical reaction.

- (A) Increases the speed of a
 - (B) Decreases the speed of a
 - (C) Can either increase or decrease the speed of a
 - (D) Alters the value of equilibrium constant in a reversible
- Answer: Option C

69. A chemical reaction occurs when the energy of the reacting molecules is _____ the activation energy of the reaction.

- (A) Less than
 - (B) Equal to
 - (C) More than
 - (D) Equal to or more than
- Answer: Option D

70. The rate constant of a chemical reaction increases by increasing the

- (A) Temperature
 - (B) Pressure
 - (C) Reactant's concentration
 - (D) None of these
- Answer: Option A

71. Pure A in gas phase enters a reactor 50% of this A is converted to B through the reaction, $A \rightarrow 3B$. Mole fraction of A in the exit stream is

- (A) 1/2
- (B) 1/3
- (C) 1/4
- (D) 1/5

Answer: Option B

72. Arrhenius equation shows the variation of _____ with temperature.

- (A) Reaction rate
- (B) Rate constant
- (C) Energy of activation
- (D) Frequency factor

Answer: Option B

73. A second order reaction of the form $A + B \rightarrow C$ is called a pseudo-first order reaction, when

- (A) $C_{A0} = C_{B0}$
- (B) $C_{A0} > C_{B0}$
- (C) $C_{B0} > C_{A0}$
- (D) $C_{B0} \geq C_{A0}$

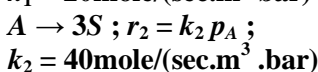
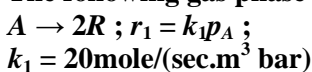
Answer: Option D

74. The rate of the chemical reaction $A \rightarrow B$ doubles as the concentration of A i.e., C_A is doubled. If rate of reaction is proportional to C_A^n , then what is the value of n for this reaction?

- (A) 0
- (B) 0.5
- (C) 1
- (D) 2

Answer: Option C

75. The following gas phase reactions are carried out isothermally in a CSTR.



What is the maximum possible value of F_R (mole/sec.)?

- (A) 1/3
- (B) 1/2

(C) $2/3$

(D) 2

Answer: Option C

76. In case of calcination of limestone, $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$, the addition of more of CaO will result in _____ in the concentration of CO_2 .

(A) No change

(B) Increase

(C) Decrease

(D) Unpredictable from the data

Answer: Option A

77. Concentration of the limiting reactant (with initial concentration of a moles/litre) after time t is $(a-x)$. Then ' t ' for a first order reaction is given by

(A) $k \cdot t = \ln a/(a-x)$

(B) $k \cdot t = x/a(a-x)$

(C) $k \cdot t = \ln(a-x)/a$

(D) $k \cdot t = \ln a(a-x)/x$

Answer: Option A

78. Exposure of a photographic plate to produce a latent image is an example of _____ reaction.

(A) Very slow

(B) Very fast

(C) Photochemical

(D) Both (B) and (C)

Answer: Option D

79. A batch reactor is characterised by

(A) Constant residence time

(B) Variation in extent of reaction and properties of the reaction mixture with time

(C) Variation in reactor volume

(D) Very low conversion

Answer: Option B

80. Knudsen diffusion is directly proportional to

(A) T

(B) \sqrt{T}

(C) $1/\sqrt{T}$

(D) T^2

Answer: Option B

81. Promoter is added to the catalyst to improve its

(A) Porosity

(B) Sensitivity

(C) Surface area

(D) None of these

Answer: Option B

82. In a chemical reaction, represented by as shown in the bellow figure, it is observed that the



(i) Rate of reaction increases by a factor of 4 on doubling the concentration of the reactant.

(ii) Rate of reaction increases by a factor of 9 on trebling the concentration of the reactant.

Then the rate of the reaction is proportional to (where, C_A = concentration of the reactant)

(A) C_A

(B) C_A^2

(C) C_A^3

(D) C_A^4

Answer: Option B

83. Which of the following curves shows the effect of temperature on the extent of gas-solid adsorption at a given pressure?

(A) Langmuir adsorption isotherm

(B) Adsorption isobar

- (C) Freundlich adsorption isotherm
(D) None of these
Answer: Option B

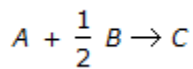
84. Mean residence time is equal to the space time, when

- (A) The feed rate is measured at temperature and pressure in the reactor
(B) The temperature, pressure and the density of reaction mixture remains constant throughout the reactor
(C) There is no change in number of moles in gaseous reaction
(D) All (A), (B) and (C)
Answer: Option D

85. Calcination reaction of limestone ($\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$) goes to completion in the rotary kiln, because

- (A) CaO is not dissociated
(B) CO_2 escapes continuously
(C) Of high calcination temperature
(D) CaO is more stable than CaCO_3
Answer: Option B

86. The following gas phase reaction is taking place in a plug flow reactor.



A stoichiometric mixture of A and B at 300 K is fed to the reactor. At 1 m along the length of the reactor, the temperature is 360 K. The pressure drop is negligible and an ideal gas behaviour can be assumed. Identify the correct expression relating the concentration of A at the inlet (C_{A0}), concentration of A at 1m (C_A) and the corresponding conversion of A (X).

- (A) $C_A = 1.2 C_{A0} (1 - X)/(1 - 0.33X)$
(B) $C_A = 1.2 C_{A0} (1 - X)/(1 - 0.5X)$
(C) $C_A = 0.83 C_{A0} (1 - X)/(1 - 0.33X)$
(D) $C_A = 0.83 C_{A0} (1 - X)/(1 - 0.5X)$
Answer: Option C

87. A catalyst inhibitor

- (A) Lessens its selectivity
(B) May be useful for suppressing undesirable side reactions
(C) Is added in small quantity during the catalyst manufacture itself
(D) All (A), (B) and (C)
Answer: Option D

88. A catalyst in a chemical reaction

- (A) Decreases the activation energy
(B) Alters the reaction mechanism
(C) Increases the frequency of collisions of reacting species
(D) All (A), (B) and (C)
Answer: Option D

89. A batch reactor suffers from following disadvantage.

- (A) Poor product quality control
(B) High labour and handling cost
(C) High shutdown time requirement for emptying, cleaning and refilling
(D) All (A), (B) and (C)
Answer: Option D

90. An irreversible aqueous phase reaction, $A + B \rightarrow P$, is carried out in an adiabatic mixed flow reactor. A feed containing 4kmole/m^3 of each A and B enters the reactor at $8\text{m}^3/\text{hr}$. If the temperature of the exit stream is never to exceed 390 K, what is the maximum inlet feed temperature allowed?

Data: Heat of reaction = - 50 kJ/mole

Density of the reacting mixture = 1000kg/m^3

Specific heat of reacting mixture = 2kJ/kg.K

The above data can be assumed to be independent of temperature and composition.

- (A) 190
(B) 290
(C) 390

(D) 490

Answer: Option B

91. Rate of a chemical reaction is independent of the concentration of the reactants for a _____ reaction.

- (A) Zero order
- (B) Third order
- (C) Consecutive
- (D) None of these

Answer: Option A

92. The rate expression for a heterogeneous catalytic reaction is given by, $-r_A = K.K_A P_A(1 + K_A P_A + K_R P_R)$, where K is surface reaction rate constant and K_A and K_R are adsorption equilibrium constants of A and R respectively. If $K_R P_R \gg (1 + K_A P_A)$, the apparent activation energy E_A is equal to (given E is the activation energy for the reaction and ΔH_R and ΔH_A are the activation energies of adsorption of R and A)

- (A) E
- (B) $E + \Delta H_A$
- (C) $E + \Delta H_A - \Delta H_R$
- (D) $\Delta H_A + \Delta H_R$

Answer: Option C

93. Which of the following is not a unit of reaction rate?

- (A) Moles for med/(surface of catalyst) (time)
- (B) Moles formed/volume of reactor) (time)
- (C) Mole formed/volume of catalyst) (time)
- (D) None of these

Answer: Option D

94. Which of the following fixes the volume of a batch reactor for a particular conversion and production rate?

- (A) Operating conditions (e.g. pressure and temperature)
- (B) Rate constant
- (C) Density of mixture
- (D) None of these

Answer: Option C

95. The residence time distribution of an ideal CSTR is

- (A) $(1/\tau) \exp(-t/\tau)$
- (B) $\tau \exp(-t/\tau)$
- (C) $\exp(-t/\tau)$
- (D) $(1/\tau)(-t/\tau)$

Answer: Option C

96. Limiting reactant in a chemical reaction decides the

- (A) Rate constant
- (B) Conversion
- (C) Reaction speed
- (D) Equilibrium constant

Answer: Option B

97. _____ catalytic reaction is involved in the thermal cracking of gas oil.

- (A) Homogeneous
- (B) Non-Homogeneous
- (C) Heterogeneous
- (D) Non-Heterogeneous

Answer: Option A

98. The exit age distribution curve $E(t)$ for an ideal CSTR with the average residence time, τ , is given by

- (A) $e^{-t/\tau}$
- (B) $e^{-t/\tau}/\tau$
- (C) $1 - e^{-t/\tau}$
- (D) $1 - (e^{-t/\tau}/\tau)$

Answer: Option B

99. If ΔG (free energy change) for a chemical reaction is very large and negative, then the reaction is

- (A) Not feasible
- (B) Just feasible
- (C) Very much feasible
- (D) Unpredictable as ΔG is no measure of feasibility of a reaction

Answer: Option C

100. What is the value of 'n' if the reaction rate of the chemical reaction $A \rightarrow B$, is proportional to C_A^n and it is found that the reaction rate triples, when the concentration of 'A' is increased 9 times?

- (A) 1/2
- (B) 1/3
- (C) 1/9
- (D) 3

Answer: Option A

101. A reaction which is catalysed by a base is catalysed by all substances which have a tendency to

- (A) Lose a proton
- (B) Gain a proton
- (C) Gain an electron
- (D) None of these

Answer: Option B

102. For all positive reaction orders for a particular duty,

- (A) Mixed reactor is always larger than the plug-flow reactor
- (B) Ratio of the volume of the mixed reactor to that of the plug-flow reactor decreases with order
- (C) Reactor size is independent of the type of flow
- (D) Density variation during reaction affects design

Answer: Option A

103. When a catalyst increases the rate of chemical reaction, the rate constant

- (A) Decreases
- (B) Increases
- (C) Remain constant
- (D) Become infinite

Answer: Option B

104. In which of the following gaseous phase reactions, the equilibrium of the reaction remains unaffected by pressure changes?

- (A) $2O_3 \rightleftharpoons 3O_2$
- (B) $N_2 + O_2 \rightleftharpoons 2NO$
- (C) $2NO_2 \rightleftharpoons N_2O_4$
- (D) $2SO_2 + O_2 \rightleftharpoons 2SO_3$

Answer: Option B

105. What is the order of a chemical reaction whose rate is determined by the variation of one concentration term only?

- (A) Zero
- (B) First
- (C) Second
- (D) Third

Answer: Option B

106. Non-catalytic fluid-solid reactions are represented by _____ model.

- (A) Continuous reaction
- (B) Unreacted core
- (C) Both (A) and (B)
- (D) Neither (A) and (B)

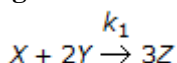
Answer: Option C

107. Which of the following is the optimum operating condition for an exothermic reversible reaction taking place in a plug-flow reactor?

- (A) Temperature should be high in the beginning and decreased towards the end of the reaction
- (B) Very low temperature should be used throughout the reaction
- (C) Very high temperature should be used throughout the reaction
- (D) None of these

Answer: Option A

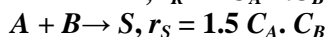
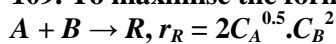
108. Which of the following holds good for an elementary reaction as shown in the bellow figure?



- (A) The rate of disappearance of 'Y' is equal to the rate of appearance of 'Z'
- (B) The rate of disappearance of 'Y' is equal to the rate of disappearance of 'X'
- (C) Three times the rate of disappearance of 'X' is equal to the rate of appearance of 'Z'
- (D) The rate of disappearance of 'X' is equal to the rate of appearance of 'Z'

Answer: Option C

109. To maximise the formation of R in the simultaneous reaction



We should have

- (A) Low C_A , low C_B
- (B) Low C_A , high C_B
- (C) High C_A , low C_B
- (D) High C_A , high C_B

Answer: Option B

110. The exit age distribution of fluid leaving a vessel is used to know the

- (A) Activation energies of a reaction
- (B) Reaction mechanism
- (C) Extent of non-ideal flow in the vessel
- (D) None of these

Answer: Option C

111. The gas phase reaction $2A \rightleftharpoons B$ is carried out in an isothermal plug flow reactor. The feed consists of 80 mole % A and 20 mole % inerts. If the conversion of A at the reactor exit is 50%, then C_A/C_{A0} at the outlet of the reactor is

- (A) 2/3
- (B) 5/8
- (C) 1/3
- (D) 3/8

Answer: Option B

112. Pick out the wrong statement.

- (A) For a first order consecutive reaction, a tubular flow reactor as compared to a stirred tank reactor provides higher overall selectivity
- (B) For an ideal mixed reactor at steady state, the exit stream has the same composition as fluid within the reactor and the space time is equivalent to holding time for constant density system
- (C) Plug flow reactor (PFR) is always smaller than mixed reactor for all positive reaction orders for a particular duty
- (D) Reaction rate does not decrease appreciably as the reaction proceeds in case of an autocatalytic reaction

Answer: Option A

113. The preferred reacting system for oxidation of o-xylene to phthalic anhydride is

- (A) Jacketed liquid phase CSTR
- (B) Jacketed steam heated multitubular reactor
- (C) Multitubular reactor with cooling
- (D) Multistage multitubular reactor with interstage cooling

Answer: Option A

114. For a zero order reaction, the concentration of product increases with the

- (A) Increase of reaction time
- (B) Increase in initial concentration
- (C) Total pressure

(D) Decrease in total pressure

Answer: Option A

115. The equilibrium constant 'K' of a chemical reaction depends on

(A) Temperature only

(B) Pressure only

(C) Temperature and pressure

(D) Ratio of reactants

Answer: Option A

116. The space time is equivalent to the holding time in a steady state mixed reactor for

(A) Non-isothermal gas reaction

(B) Variable fluid density systems

(C) Constant fluid density systems

(D) Gas reactions with changing number of moles

Answer: Option C

117. With increase in temperature, the rate constant obeying Arrhenius equation

(A) Increases

(B) Decreases

(C) Decreases exponentially

(D) Can either increase or decrease; depends on the frequency factor

Answer: Option C

118. The reaction $A \rightarrow B$ is conducted in an isothermal batch reactor. If the conversion of A increases linearly with holding time, then the order of the reaction is

(A) 0

(B) 1

(C) 1.5

(D) 2

Answer: Option A

119. The time needed to achieve the same fractional conversion for particles of different sizes (D) when chemical reaction controls, is proportional to

(A) d

(B) \sqrt{d}

(C) $d^{1.5}$

(D) d^2

Answer: Option A

120. The rate constant of a reaction depends on the

(A) Initial concentration of reactants

(B) Time of reaction

(C) Temperature of the system

(D) Extent of reaction

Answer: Option C

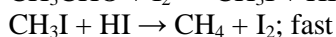
121. Pick out the wrong statement.

(A) For the same conversion, the holding time required in a batch reactor, is always equal to the space time required in a PFR

(B) Two mixed reactors of unequal size are available for producing a specified product, formed by a homogenous second order reaction. To achieve maximum production rate, the smaller reactor should be placed in series before the larger reactor

(C) Arrhenius equation describing the effect of temperature on rate constant is given by,
 $K = A.e^{-E_a/RT}$

(D) The mechanism for the decomposition of CH_3CHO into CH_4 and CO in presence of I_2 is:



Then the rate of disappearance of CH_3CHO is equal to $K.C_{\text{CH}_3\text{I}}.C_{\text{HI}}$ and acts as a catalyst

Answer: Option D

122. The enzyme which can catalyse the conversion of glucose to ethyl alcohol is

(A) Invertase

(B) Maltase

(C) Diastase

(D) Zymase
Answer: Option D

123. For a homogeneous reaction of nth order, the dimension of the rate constant is given by

- (A) $1/(\text{time})^n$
- (B) $(\text{Concentration})^{1-n}/(\text{time})$
- (C) $(\text{Concentration})^{n-1}/(\text{time})$
- (D) None of these

Answer: Option B

124. In a CSTR _____ varies with time.

- (A) Reaction rate
- (B) Concentration
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option D

125. A catalyst promoter

- (A) Improves the activity of a catalyst
- (B) Acts as a catalyst support
- (C) Itself has very high activity
- (D) All (A), (B) and (C)

Answer: Option A

126. The rate of a gas phase reaction is given by $K \cdot C_A \cdot C_B$. If the volume of the reaction vessel is reduced to 1/4th of its initial volume, then the reaction rate compared to the original rate will be _____ times.

- (A) 4
- (B) 16
- (C) 8
- (D) 2

Answer: Option B

127. The vessel dispersion number ($D/\mu L$) for plug flow is

- (A) 0
- (B) 500
- (C) 750
- (D) ∞

Answer: Option A

128. A plug-flow reactor is characterised by

- (A) High capacity
- (B) Presence of axial mixing
- (C) Presence of lateral mixing
- (D) Constant composition and temperature of reaction mixture

Answer: Option C

129. The rate constant of a reaction is a function of the

- (A) Time of reaction
- (B) Temperature of the system
- (C) Extent of reaction
- (D) Initial concentration of the reactants

Answer: Option B

130. In which of the following reactions, the equilibrium will shift to the right, if the total pressure is increased?

- (A) $\text{H}_2 + \text{Cl}_2 \rightleftharpoons 2\text{HCl}$
- (B) $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$
- (C) $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$
- (D) $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$

Answer: Option B

131. Cold shot cooling is only practical when the feed temperature is _____ than the reaction temperature.

- (A) Higher

- (B) Much higher
 - (C) Lower
 - (D) Much lower
- Answer: Option D

132. A chemical reaction, $A \rightarrow 3B$, is conducted in a constant pressure vessel. Starting with pure A, the volume of the reaction mixture increases 3 times in 6 minutes. The fractional conversion is

- (A) 0.33
- (B) 0.5
- (C) 1
- (D) Data insufficient, can't be predicted

Answer: Option C

133. Autocatalytic reactions are best carried out in a

- (A) CSTR
- (B) CSTR in series
- (C) Plug flow reactor
- (D) Recycle reactor

Answer: Option D

134. In the fluid catalytic cracker (FCC), the cracking reaction is _____ (i) and the regeneration is _____ (ii) _____.

- (A) (i) exothermic (ii) endothermic
- (B) (i) exothermic (ii) exothermic
- (C) (i) endothermic (ii) endothermic
- (D) (i) endothermic (ii) exothermic

Answer: Option D

135. Bulk diffusion in catalyst pore _____ with increase in pressure.

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) Increases exponentially

Answer: Option B

136. Effectiveness factor of a catalyst pellet is a measure of the _____ resistance.

- (A) Pore diffusion
- (B) Gas film
- (C) Chemical reaction
- (D) None of these

Answer: Option A

137. For the reversible reaction $A \rightleftharpoons 2B$, if the equilibrium constant K is 0.05 mole/litre; starting from initially 2 moles of A and zero moles of B, how many moles will be formed at equilibrium?

- (A) 0.253
- (B) 0.338
- (C) 0.152
- (D) 0.637

Answer: Option B

138. BET apparatus is used to determine the

- (A) Specific surface of a porous catalyst
- (B) Pore size distribution
- (C) Pore diameter
- (D) Porosity of the catalyst bed

Answer: Option A

139. The extent of a reaction is

- (A) Different for reactants and products
- (B) Dimensionless
- (C) Depends on the stoichiometric co-efficient
- (D) All of the above

Answer: Option D

140. A rise in temperature

- (A) Normally tends to increase the reaction rate
- (B) Does not affect a catalysed reaction
- (C) Does not affect photo-chemical reaction rates
- (D) All (A), (B) and (C)

Answer: Option D

141. Arrhenius equation represents graphically the variation between the _____ and temperature.

- (A) Rate of reaction
- (B) Frequency factor
- (C) Rate constant
- (D) Activation energy

Answer: Option C

142. Pick out the wrong statement.

- (A) A catalyst does not alter the final position of equilibrium in a reversible reaction
- (B) A catalyst initiates a reaction
- (C) A catalyst is specific in reaction
- (D) A catalyst remains unchanged in chemical composition at the end the reaction

Answer: Option B

143. For a heterogeneous catalytic reaction, $A + B \rightarrow C$, with equimole feed of A and B, the initial rate - r_{A0} is invariant with total pressure. The rate controlling step is

- (A) Surface $K_c/(1 + T_S)$ reaction between absorbed A and B in the gas phase
- (B) Surface reaction between absorbed A and absorbed B
- (C) Surface reaction between A in the gas phase and absorbed B
- (D) Desorption of C

Answer: Option D

144. Pick out the wrong statement.

- (A) In a first order reaction, $A \rightarrow$ products; the reaction becomes slower as it proceeds, because the concentration of A decreases and the rate is proportional to the concentration of A
- (B) Transition state theory approaches the problem of calculating reaction rates by concentrating on the idea of activated complexes
- (C) According to the penetration theory, the mass transfer co-efficient decreases, if the exposure time of an eddy to the solute decreases
- (D) If the rate of an irreversible reaction, $A + B \rightarrow 2C$ is $k.C_A.C_B$, then the reaction is always elementary

Answer: Option C

145. The fractional volume change between no conversion and complete conversion, for the isothermal gas phase reaction, $2A \rightarrow R$, is

- (A) 0.5
- (B) -0.5
- (C) 1
- (D) 1.5

Answer: Option B

146. If 'n' is the order of reaction, then unit of rate constant is

- (A) $1/(\text{time})(\text{concentration})^{n-1}$
- (B) $(\text{Time})^{-1} (\text{concentration})^{n-1}$
- (C) $(\text{Time})^{n-1} (\text{concentration})$
- (D) None of these

Answer: Option A

147. Half life period of decomposition of a liquid 'A' by irreversible first order reaction is 12 minutes. The time required for 75% conversion of 'A' is _____ minutes.

- (A) 18
- (B) 24
- (C) 6
- (D) 12

Answer: Option B

148. Kinetics of a solid catalysed reaction can best be studied in a _____ reactor.

- (A) Batch
 - (B) Plug-flow
 - (C) Mixed
 - (D) None of these
- Answer: Option C

149. For a packed bed reactor; the presence of a long tail in the residence time distribution curve is an indication of:

- (A) Ideal plug flow
- (B) Bypass
- (C) Dead zone
- (D) Channelling

Answer: Option C

150. For a tubular reactor with space time ' τ ' and residence time ' θ ', the following statement holds good.

- (A) τ and θ are always equal
- (B) $\tau = \theta$, when the fluid density changes in the reactor
- (C) $\tau = \theta$, for an isothermic tubular reactor in which the density of the process fluid is constant
- (D) $\tau = \theta$, for a non-isothermal reactor

Answer: Option C

151. The irreversible reaction, $X \rightarrow Y$, is the special case of the reversible reaction, $X \rightleftharpoons Y$, in which the

- (A) Equilibrium constant is infinite
- (B) Fractional conversion of 'A' at equilibrium is unity
- (C) Concentration of 'A' at equilibrium is zero
- (D) All (A), (B) and (C)

Answer: Option D

152. The catalyst in a first order chemical reaction changes the

- (A) Equilibrium constant
- (B) Activation energy
- (C) Heat of formation of the product
- (D) Heat of reaction

Answer: Option B

153. Pick out the correct statement.

- (A) A chemical reaction accompanied by absorption of heat is called an exothermic reaction
- (B) A chemical reaction accompanied by evolution of heat is called an endothermic reaction
- (C) The rate constant for a first order reaction does not change on changing the concentration units
- (D) Chemical equilibrium state is dynamic in nature

Answer: Option C

154. In chamber process of sulphuric acid manufacture in industry, the gas phase oxidation of SO_2 to SO_3 is accomplished by a _____ reaction.

- (A) Non-catalytic homogeneous
- (B) Non-catalytic heterogeneous
- (C) Catalytic homogeneous
- (D) Catalytic heterogeneous

Answer: Option C

155. For identical flow rate and feed composition, X plug flow reactors (PFR) in series with a total volume V gives the same conversion as single

- (A) CSTR of volume V
- (B) PFR of volume V
- (C) CSTR of volume V/X
- (D) PFR of volume V/X

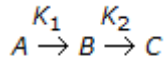
Answer: Option B

156. For a tubular flow reactor with uniform concentration and temperature, the independent variable is

- (A) Time
- (B) Length

- (C) Diameter
 - (D) None of these
- Answer: Option B

157. In case of unimolecular type elementary reaction as shown in the bellow figure, plug flow reactor as compared to mixed reactor is:



- (A) More
 - (B) Same
 - (C) Less
 - (D) Unpredictable
- Answer: Option A

158. Differential method for analysing the kinetic data is used

- (A) For testing complicated mechanisms
 - (B) When the data are scattered
 - (C) When rate expressions are very simple
 - (D) None of these
- Answer: Option A

159. Fractional conversion _____ for an exothermic reversible chemical reaction, when the temperature is maximum.

- (A) Increases
 - (B) Remains unchanged
 - (C) Decreases
 - (D) Unpredictable from the data
- Answer: Option C

160. Which of the following is not endothermic in nature?

- (A) Combustion of sulphur
 - (B) Gasification of carbon
 - (C) Thermal cracking of fuel oil
 - (D) Steam reforming of naphtha
- Answer: Option A

161. Overall rate of reaction in a heterogeneous catalytic reaction depends upon the mass and energy transfer from the fluid to solid surface and its rate of reaction is usually _____ the concentration of catalyst, if it does not entail a chain mechanism.

- (A) Proportional to
 - (B) Independent of
 - (C) Inversely proportional to
 - (D) Proportional to the square of
- Answer: Option A

162. The reaction in which one of the products of reaction acts as a catalyst is called a/an _____ reaction.

- (A) Biochemical
 - (B) Photochemical
 - (C) Catalytic
 - (D) Autocatalytic
- Answer: Option D

163. The use of space time is preferred over the mean residence time in the design of a/an

- (A) Batch reactor
 - (B) Ideal tubular-flow reactor
 - (C) Slurry reactor
 - (D) CSTR
- Answer: Option B

164. Oil is hydrogenated using nickel catalyst in a _____ reactor.

- (A) Batch
- (B) Slurry
- (C) Fluidised bed

(D) Fixed bed
Answer: Option B

165. A first order reaction $A \rightarrow B$ occurs in an isothermal porous catalyst pellet of spherical shape. If the concentration of A at the centre of the pellet is much less than at the external surface, the process is limited by

- (A) Diffusion within the pellet
- (B) Reaction
- (C) External mass transfer
- (D) None of the above

Answer: Option A

166. Rate of an autocatalytic chemical reaction is a function of

- (A) Temperature only
- (B) Pressure only
- (C) Composition only
- (D) All (A), (B) and (C)

Answer: Option D

167. Time required for 50% decomposition of a liquid in an isothermal batch reactor following first order kinetics is 2 minutes. The time required for 75% decomposition will be about _____ minutes.

- (A) 3
- (B) 4
- (C) 6
- (D) 10

Answer: Option B

168. The reactions with low activation energy are

- (A) Always spontaneous
- (B) Slow
- (C) Fast
- (D) Non-spontaneous

Answer: Option C

169. The concentration of A in a first order reaction, $A \rightarrow B$, decreases

- (A) Linearly with time
- (B) Exponentially with time
- (C) Very abruptly towards the end of the reaction
- (D) Logarithmically with time

Answer: Option B

170. A reaction which is catalysed by an acid is also catalysed by any substance, which has a tendency to

- (A) Lose a proton
- (B) Gain a proton
- (C) Lose an electron
- (D) None of these

Answer: Option A

171. ' n ' number of plug flow reactors (P.F.R) in series with a total volume ' V ' gives the same conversion as one P.F.R. of volume

- (A) V/n
- (B) V
- (C) $V.n$
- (D) $1/V$

Answer: Option B

172. Chemical kinetics can predict the _____ of a chemical reaction.

- (A) Rate
- (B) Feasibility
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option A

173. Pick out the correct statement.

- (A) A catalyst speeds up the forward reaction but slows down the reverse reaction
- (B) Addition of catalyst changes the equilibrium constant
- (C) Pressure changes do not change the equilibrium concentrations
- (D) The composition of equilibrium is changed by catalyst

Answer: Option C

174. The reaction in which the rate equation corresponds to a stoichiometric equation, is called a/an _____ reaction.

- (A) Elementary
- (B) Non-elementary
- (C) Parallel
- (D) Autokinetic

Answer: Option A

175. Half life period of a chemical reaction is proportional to C_{A0}^{-1} , if the reaction is of _____ order.

- (A) First
- (B) Zero
- (C) Second
- (D) Third

Answer: Option C

176. Reaction rate of a first order reaction, which is half completed in 23 minutes will be

- (A) 0.03 sec^{-1}
- (B) 0.03 min^{-1}
- (C) 0.03 hr^{-1}
- (D) 0.05 min^{-1}

Answer: Option B

177. B.E.T. method of finding out surface area of a catalyst, uses the extension of _____ isotherm.

- (A) Langmuir
- (B) Freundlich
- (C) Temkin
- (D) None of these

Answer: Option A

178. A typical example of an exothermic reversible reaction conducted at high pressure in industry is

- (A) Dehydration of ethanol
- (B) Methanol synthesis
- (C) Reformation of methane
- (D) Polymerisation of ethylene

Answer: Option A

179. Vegetable oils are hydrogenated in a _____ reactor.

- (A) Slurry
- (B) Plug flow
- (C) Homogeneous catalytic
- (D) None of these

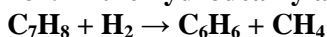
Answer: Option A

180. Pick out the wrong statement.

- (A) Autocatalytic reactions are exemplified by microbial fermentation reactions
- (B) The slowest step has the greatest influence on the overall reaction rate in case of an irreversible series reaction
- (C) The fractional conversion at any time is same for both the constant as well as the variable volume system in case of an irreversible unimolecular type first order reaction
- (D) Hydrolysis of ester in presence of alkali or acid is a zero order reaction

Answer: Option D

181. In the hydrodealkylation of toluene to benzene, the following reactions occur:



Toluene and hydrogen are fed to a reactor in a molar ratio 1:5.80% of the toluene gets converted and the selectivity of benzene(defined as moles of benzene formed/moles of toluene converted) is 90%. The fractional conversion of hydrogen is

- (A) 0.16
- (B) 0.144
- (C) 0.152
- (D) 0.136

Answer: Option B

182. For an ideal mixed flow reactor (CSTR), the exit age distribution $E(t)$ is given by

- (A) A Dirac delta function
- (B) A step function
- (C) A ramp function
- (D) None of the above

Answer: Option D

183. Promoter

- (A) Initiates a chemical reaction and is a catalyst by itself
- (B) Alters the position of equilibrium in a reversible reaction
- (C) Increases the number of active centres by increasing the unevenness of catalyst surface and by creating discontinuities in the crystals
- (D) All (A), (B) and (C)

Answer: Option C

184. In case of a P.F.R., there

- (A) May be lateral mixing of fluid
- (B) Should not be any mixing along the flow path
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

185. In an ideal P.F.R. at steady state conditions

- (A) The composition of reactants remains constant along a flow path
- (B) The conversion of the reactant varies from point to point along a flow path
- (C) There is no lateral mixing of fluid
- (D) There may be diffusion along the flow path

Answer: Option B

186. The rate of the reaction, $X \rightarrow Y$, quadruples when the concentration of 'X' is doubled. The rate expression for the reaction is, $r = K C_x^n$, the value of 'n' in this case will be

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option C

187. The reaction rate almost gets doubled for 10°C rise in temperature. This is due to the fact that the

- (A) Increased temperature reduces the activation energy
- (B) Fraction of molecules having threshold energy increases
- (C) Collision frequency increases
- (D) Value of threshold energy decreases

Answer: Option B

188. The rate of a homogeneous reaction is a function of

- (A) Temperature and pressure only
- (B) Temperature and composition only
- (C) Pressure and composition only
- (D) All temperature, pressure and composition

Answer: Option D

189. The order of a chemical reaction is

- (A) An experimentally determined quantity
- (B) Always equal to the total stoichiometric number of reactants
- (C) Never fractional

(D) None of these
Answer: Option A

190. In autocatalytic reactions,

- (A) One of the reactants acts as a catalyst
 - (B) One of the products acts as a catalyst
 - (C) Catalysts have very high selectivity
 - (D) No catalyst is used
- Answer: Option B

191. The rate of reaction does not decrease appreciably as the reaction proceeds in case of _____ reactions.

- (A) Autocatalytic
 - (B) Exothermic
 - (C) Endothermic
 - (D) Autothermal
- Answer: Option A

192. The dispersion number of perfect mixed flow is

- (A) 0
 - (B) > 150
 - (C) ∞
 - (D) < 2100
- Answer: Option C

193. Space time in flow reactor is

- (A) Usually equal to the residence time
 - (B) The reciprocal of the space velocity
 - (C) A measure of its capacity
 - (D) Both (A) and (B)
- Answer: Option D

194. For series reaction, the relative yield

- (A) Is always greater for plug-flow reactor than for the single CSTR of the same volume
 - (B) Statement in (A) is wrong
 - (C) Decreases with increasing conversion
 - (D) Both (A) and (C) hold good
- Answer: Option D

195. With the same reaction time, initial concentration and feed rate, the reaction $2A \rightarrow B$ is carried out separately in CSTR and P.F. reactor of equal volumes. The conversion will be

- (A) Higher in P.F. reactor
 - (B) Higher in CSTR
 - (C) Same in both the reactors
 - (D) Data insufficient; can't be predicted
- Answer: Option A

196. Pick out the correct statement.

- (A) A catalyst does not change ΔH of the reaction
 - (B) A catalyst changes the equilibrium point
 - (C) Law of mass action was suggested by Le-Chatelier
 - (D) The difference between the energy of reactants and that of the products is the activation energy
- Answer: Option A

197. If pore diffusion is the controlling step in a solid catalysed reaction, the catalyst

- (A) Porosity is very important
 - (B) Porosity is of less importance
 - (C) Internal surface area is utilised efficiently
 - (D) None of these
- Answer: Option B

198. For identical flow rate, feed composition and for elementary first order reactions, ' N ' equal sized mixed reactors in series with a total volume ' V ' gives the same conversion as a single plug flow reactor of volume ' V ' for constant density systems. This is true, when the value of ' N ' is

- (A) 1
- (B) > 1
- (C) ∞
- (D) ≥ 1

Answer: Option C

199. Which of the following does not produce a change in the value of rate constant of a reaction?

- (A) Pressure
- (B) Temperature
- (C) Concentration and catalyst
- (D) None of these

Answer: Option C

200. The energy of activation of a chemical reaction:

- (A) Is same as heat of reaction at constant pressure
- (B) Is the minimum energy which the molecules must have before the reaction can take place
- (C) Varies as fifth power of the temperature
- (D) Both (B) and (C)

Answer: Option B

201. Inversion of cane sugar is an example of

- (A) Unimolecular reaction with first order
- (B) Bimolecular reaction with second order
- (C) Bimolecular reaction with first order
- (D) Unimolecular reaction with second order

Answer: Option C

202. If the rate of a chemical reaction becomes slower at a given temperature, then the

- (A) Initial concentration of the reactants remains constant
- (B) Free energy of activation is lower
- (C) Entropy changes
- (D) Free energy of activation is higher

Answer: Option D

203. A pulse tracer is introduced in an ideal CSTR (with a mean residence time τ) at time, $t = 0$. The time taken for the exit concentration of the tracer to reach half of its initial value will be

- (A) 2τ
- (B) 0.5τ
- (C) $\tau/0.693$
- (D) 0.693τ

Answer: Option A

204. With increase in the space time of an irreversible isothermal reaction being carried out in a P.F. reactor, the conversion will

- (A) Increase
- (B) Decrease
- (C) Remain same
- (D) Data is insufficient; can't be predicted

Answer: Option A

205. Integral method for analysing the kinetic data is used

- (A) When the data are scattered
- (B) For testing specific mechanisms with simple rate expressions
- (C) Both (A) and (B)
- (D) None of these

Answer: Option C

206. Helium-mercury method is used for the measurement of the _____ of the catalyst.

- (A) Surface area
- (B) Porosity
- (C) Pore volume
- (D) Both (B) & (C)

Answer: Option D

207. As the chemical reaction proceeds, the rate of reaction

- (A) Increases
- (B) Decreases
- (C) Remain same
- (D) May increase or decrease depending on the type of reaction

Answer: Option B

208. When a high liquid hold up is required in a reactor for gas liquid reaction, use _____ column.

- (A) Packed
- (B) Spray
- (C) Tray
- (D) Bubble

Answer: Option D

209. Pick out the wrong statement.

- (A) 'Hold back' is defined as the fraction of material that stays longer than the mean residence time
- (B) Study of non-ideal flow reactor is done experimentally by stimulus-response technique
- (C) For studying a chemical reaction, it is desirable to monitor the reactants during initial stages and the products during the final stages of reaction
- (D) A batch reactor cannot be used to study the kinetics of catalytic reaction

Answer: Option D

210. For any reaction, we may write conversion as a function of

- (A) Time
- (B) Temperature
- (C) Concentration
- (D) All (A), (B) & (C)

Answer: Option D

211. Higher free energy of activation of a chemical reaction (at a given temperature) implies

- (A) Slower rate of reaction
- (B) Higher rate of reaction
- (C) Higher equilibrium conversion
- (D) Both (B) and (C)

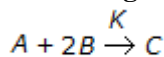
Answer: Option A

212. The rate at which a chemical substance reacts is proportional to its

- (A) Active mass
- (B) Equivalent weight
- (C) Molecular weight
- (D) None of these

Answer: Option A

213. What is the order of a chemical reaction of the bellow figure, if the rate of formation of 'C', increases by a factor of 2.82 on doubling the concentration of 'A' and increases by a factor of 9 on trebling the concentration of 'B'?



- (A) 7/2
- (B) 7/4
- (C) 5/2
- (D) 5/4

Answer: Option A

214. For the gaseous reaction $2A \rightarrow B$, where the feed consists of 50 mole % A and 50 mole % inerts, the expansion factor is

- (A) 1
- (B) -0.5
- (C) -0.25
- (D) 0

Answer: Option C

215. The optimum performance for reactors operating in parallel is obtained when the feed stream is distributed in such a way, that the

- (A) Space time for each parallel line is same
- (B) Space time for parallel lines is different
- (C) Larger reactors have more space time compared to smaller ones
- (D) None of these

Answer: Option A

216. Organic catalysts differ from the inorganic catalyst in the sense that the former is

- (A) Active at cryogenic temperatures only
- (B) Prohibitively costly
- (C) Proteinous in nature
- (D) Active at very high temperature only

Answer: Option C

217. A first order reaction requires two equal sized CSTR. The conversion is

- (A) Less when they are connected in series
- (B) More when they are connected in series
- (C) More when they are connected in parallel
- (D) Same whether they are connected in series or in parallel

Answer: Option B

218. For the liquid phase parallel reactions:

$$R, r_R = K_1 \cdot C_{A2}; E_1 = 80 \text{ KJ/mole}$$

$$S, r_s = K_1 \cdot C_A; E_2 = 120 \text{ KJ/mole}$$

The desired product is R. A higher selectivity of R will be achieved, if the reaction is conducted at

- (A) Low temperature in a CSTR
- (B) High temperature in a CSTR
- (C) Low temperature in a PFR
- (D) High temperature in a PFR

Answer: Option D

219. The conversion for a second order, irreversible reaction (constant volume) as shown in the bellow figure, in batch mode is given by



- (A) $1/(1 + k_2 \cdot C_{A0} \cdot t)$
- (B) $(k_2 \cdot C_{A0} \cdot t) / (1 + k_2 \cdot C_{A0} \cdot t)$
- (C) $(k_2 \cdot C_{A0} \cdot t)^2 / (1 + k_2 \cdot C_{A0} \cdot t)$
- (D) $(k_2 \cdot C_{A0} \cdot t) / (1 + k_2 \cdot C_{A0} \cdot t)^2$

Answer: Option B

220. The size of plug flow reactor (PFR) for all positive reaction orders and for any given duty, is _____ that of mixed reactor.

- (A) Greater than
- (B) Equal to
- (C) Smaller than
- (D) Unpredictable from the data

Answer: Option C

221. 6 gm of carbon is burnt with an amount of air containing 18 gm oxygen. The product contains 16.5 gms CO₂ and 2.8 gms CO besides other constituents. What is the degree of conversion on the basis of disappearance of limiting reactant?

- (A) 100%
- (B) 95%
- (C) 75%
- (D) 20%

Answer: Option B

222. The reaction rate constants at two different temperatures T_1 and T_2 are related by

- (A) $\ln(k_2/k_1) = (E/R) (1/T_2 - 1/T_1)$
- (B) $\ln(k_2/k_1) = (E/R) (1/T_1 - 1/T_2)$
- (C) $\exp(k_2/k_1) = (E/R) (1/T_2 - 1/T_1)$

$$(D) \exp(k_2/k_1) = (E/R)(1/T_1 - 1/T_2)$$

Answer: Option B

223. Which of the following is not a theory of homogeneous reaction?

- (A) Collision theory and activated complex theory
- (B) Chain reaction theory
- (C) Radiation hypothesis
- (D) None of these

Answer: Option D

224. For the reaction, $A + B \rightarrow 2B + C$,

- (A) $r_A = r_B$
- (B) $r_A = -r_B$
- (C) $r_A = 2r_B$
- (D) $r_A = r_B/2$

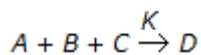
Answer: Option B

225. The reaction between oxygen and organic material is a/an _____ reaction.

- (A) Exothermic
- (B) Endothermic
- (C) Biochemical
- (D) Photochemical

Answer: Option A

226. What is the order of chemical reaction as shown in the bellow figure, if it is found that the reaction rate doubles on doubling the concentration of B and also the reaction rate doubles when the concentrations of both A & B were doubled and quadrupled when the concentrations of both B & C were doubled?



- (A) 1
- (B) 2
- (C) 3
- (D) 4

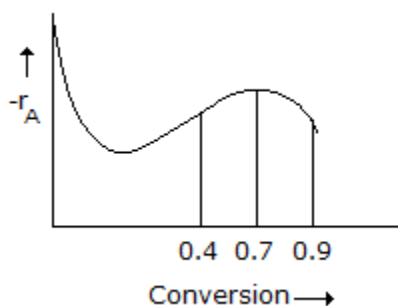
Answer: Option B

227. Most important characteristics of gas-liquid reactors are the

- (A) Specific inter-facial area
- (B) Liquid hold-up
- (C) Both (A) and (B)
- (D) None of these

Answer: Option C

228. A liquid phase reaction is to be carried out under isothermal conditions. The reaction rate as a function of conversion has been determined experimentally and is shown in the figure given below. What choice of reactor or combination of reactors will require the minimum overall reactor volume, if a conversion of 0.9 is desired?



- (A) CSTR followed by a PFR
- (B) PFR followed by a CSTR
- (C) CSTR followed by a PFR followed by a CSTR
- (D) PFR followed by a CSTR followed by a PFR

Answer: Option D

229. The rate constant of a chemical reaction increases by 100 times when the temperature is increased from 400 °K to 500 °K. Assuming transition state theory is valid, the value of ' E/R ' is

- (A) 8987°K
- (B) 9210°K
- (C) 8764°K
- (D) 8621°K

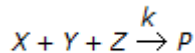
Answer: Option B

230. With an increase in pressure in gaseous phase chemical reactions, the fractional conversion _____ when the number of moles decreases.

- (A) Increases
- (B) Decreases
- (C) Remain unaffected
- (D) Unpredictable from the data

Answer: Option A

231. In a chemical reaction as shown in the bellow figure, it is observed that the



- (i) Rate of formation of ' P ' is doubled on doubling the concentration of ' X '
- (ii) Rate of formation of ' P ' is quadrupled on doubling the concentration of ' Y '
- (iii) Doubling the concentration of ' Z ' does not affect the rate of formation of ' P '

What is the order of the above chemical reaction?

- (A) Zeroth order
- (B) First order
- (C) Second order
- (D) Third order

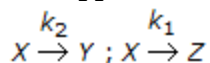
Answer: Option D

232. For a first order chemical reaction in a porous catalyst, the Thiele modulus is 10. The effectiveness factor is approximately equal to

- (A) 0
- (B) 1
- (C) 0.1
- (D) 0.5

Answer: Option C

233. For the irreversible elementary reactions in parallel as shown in the bellow figure, the rate of disappearance of ' X ' is equal to



- (A) $C_A (K_1 + K_2)$
- (B) $C_A (K_1 + K_2)/2$
- (C) $C_A \cdot K_1/2$
- (D) $C_A \cdot K_2/2$

Answer: Option A

234. The catalytic converter for conversion of SO_2 to SO_3 by contact process should have a feed with SO_2 content between

- (A) 2-5 %
- (B) 7-10 %
- (C) 12-15 %
- (D) 20-25 %

Answer: Option B

235. According to the 'law of mass action', the rate of reaction is directly proportional to the

- (A) Equilibrium constant
- (B) Volume of the reaction vessel
- (C) Nature of the reactants
- (D) Molar concentration of the reactants

Answer: Option D

236. In a semi-batch reactor

- (A) Velocity of reaction can be controlled
- (B) Maximum conversion can be controlled
- (C) Both the reactants flow counter-currently
- (D) Residence time is constant

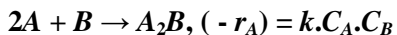
Answer: Option A

237. Pick out the correct statement.

- (A) In catalytic reactions, the catalyst reacts with the reactants
- (B) A catalyst initiates a chemical reaction
- (C) A catalyst lowers the activation energy of the reacting molecules
- (D) A catalyst cannot be recovered chemically unchanged at the end of the chemical reaction

Answer: Option C

238. Find a mechanism that is consistent with the rate equation and reaction given below:



- (A) $A + B \rightleftharpoons AB; AB + A \rightarrow A_2B$
- (B) $A + B \rightarrow AB; AB + A \rightarrow A_2B$
- (C) $A + A \rightarrow AA; AA + B \rightarrow A_2B$
- (D) $A + A \rightleftharpoons AA; AA + B \rightarrow A_2B$

Answer: Option D

239. A chemical reaction is of zero order, when the reaction rate is (where, C_A = concentration of reactant).

- (A) $\propto C_A$
- (B) $\propto 1/C_A$
- (C) Independent of temperature
- (D) None of these

Answer: Option D

240. Shift conversion reaction

- (A) Converts N_2 and H_2 into NH_3
- (B) Converts CO to CO_2 with steam
- (C) Is non-catalytic
- (D) Is highly exothermic

Answer: Option B

241. Fractional conversion _____ with increase in pressure for ammonia synthesis reaction *i.e.*, $N_2 + 3H_2 \rightleftharpoons 2NH_3$.

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) Unpredictable from the data

Answer: Option A

242. Velocity of a chemical reaction

- (A) Decreases with increase in temperature
- (B) Increases with increase of pressure of reactants for all reactions
- (C) Decreases with increase of reactant concentration
- (D) None of these

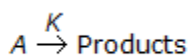
Answer: Option D

243. Which of the following is used for calcination of limestone and dolomite in industrial practice?

- (A) Fluidised bed reactor
- (B) Moving bed reactor
- (C) Fixed bed reactor
- (D) None of these

Answer: Option B

244. For a _____ order chemical reaction as shown in the bellow figure, the half life period is independent of the initial concentration of the reactant A.



- (A) Zero

- (B) First
 - (C) Second
 - (D) Third
- Answer: Option B

245. A first order irreversible reaction, $A \rightarrow B$ is carried out separately in a constant volume as well as in a variable volume reactor for a particular period. It signifies that _____ in the two reactors.

- (A) Both conversion as well as concentration are same
- (B) Conversion in both will be the same but concentrations will be different
- (C) Both the conversion as well as concentrations will be different
- (D) None of these

Answer: Option B

246. Fluidised bed reactor is characterised by

- (A) Uniformity of temperature
- (B) Comparatively smaller equipment
- (C) Very small pressure drop
- (D) Absence of continuous catalyst regeneration facility

Answer: Option A

247. Threshold energy in a reaction is equal to the

- (A) Activation energy
- (B) Normal energy of reactants
- (C) Sum of (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

248. The rate expression for the gaseous phase reaction, $\text{CO} + 2\text{H}_2 \rightleftharpoons \text{CH}_3\text{OH}$, is given by as shown in the bellow figure. Which of the following is not possible?

$$r = k_1 P_{\text{CO}}^\alpha \cdot P_{\text{H}_2}^\beta - k_2 \cdot P_{\text{CH}_3\text{OH}}^\gamma$$

- (A) $\alpha = 1, \beta = 1, \gamma = 1$
- (B) $\alpha = 1, \beta = 2, \gamma = 1$
- (C) $\alpha = 1/3, \beta = 2/3, \gamma = 1/3$
- (D) $\alpha = 1/2, \beta = 1, \gamma = 1/2$

Answer: Option A

249. Which of the following will give maximum gas conversion?

- (A) Fixed bed reactor
- (B) Fluidised bed reactor
- (C) Semi-fluidised bed reactor
- (D) Plug-flow catalytic reactor

Answer: Option C

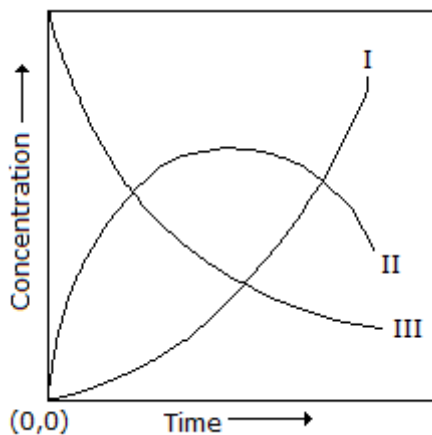
250. A liquid decomposes by irreversible first order kinetics and the half life period of this reaction is 8 minutes. The time required for 75% conversion of the liquid will be _____ minutes.

- (A) 4
- (B) 8
- (C) 12
- (D) 16

Answer: Option D

251. A first order homogeneous reaction of the type $X \rightarrow Y \rightarrow Z$ (consecutive reaction) is carried out in a CSTR. Which of the following curves respectively show the variation of the

concentration of X, Y and Z with time?



- (A) I, II, III
 (B) III, II, I
 (C) III, I, II
 (D) II, III, I

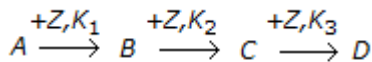
Answer: Option B

252. The minimum energy required to allow a chemical reaction to proceed is termed as the 'threshold energy'. Chemical reactions with low activation energy are:

- (A) Always irreversible
 (B) Insensitive to temperature changes
 (C) Mostly irreversible
 (D) Highly temperature sensitive

Answer: Option B

253. A non-catalytic chemical reaction of the type as shown in the bellow figure is called a _____ reaction.



- (A) Parallel
 (B) Series
 (C) Series-parallel
 (D) None of these

Answer: Option C

254. Which of the following resistances is not involved in a gas phase catalytic (gas-solid) reaction?

- (A) Ash resistance
 (B) Gas film and pore surface diffusion resistances for reactants
 (C) Surface phenomenon resistance
 (D) Gas film and pore surface diffusion resistances for products

Answer: Option A

255. In Langmuir treatment of adsorption,

- (A) Whole surface of the catalyst does not have the same activity for adsorption and there is attraction between the adsorbed molecule
 (B) Whole surface of the catalyst is essentially uniform and the adsorbed molecule has no effect on the rate of adsorption per site
 (C) All the adsorption does not take place by the same mechanism
 (D) Extent of adsorption is more than one complete monomolecular layer on the surface

Answer: Option B

256. For every 10°C rise in temperature, the rate of chemical reaction doubles. When the temperature is increased from 30 to 70°C, the rate of reaction increases _____ times.

- (A) 8
 (B) 12
 (C) 16
 (D) 32

Answer: Option C

257. A pollutant P degrades according to first order kinetics. An aqueous stream containing P at 2 kmole/m^3 and volumetric flow rate $1 \text{ m}^3/\text{h}$ requires a mixed flow reactor of volume V to bring down the pollutant level to 0.5 kmole/m^3 . The inlet concentration of the pollutant is now doubled and the volumetric flow rate is tripled. If the pollutant level is to be brought down to the same level of 0.5 kmole/m^3 , the volume of the mixed flow reactor should be increased by a factor of:

- (A) 7
- (B) 6
- (C) 3
- (D) $7/3$

Answer: Option A

258. For the non catalytic reaction of particles with surrounding fluid, the same needed to achieve the same fractional conversion for particles of different unchanging sizes is proportional to the particle diameter, when the _____ is the controlling resistance.

- (A) Film diffusion
- (B) Diffusion through ash layer
- (C) Chemical reaction
- (D) Either (A), (B) or (C)

Answer: Option C

259. Equilibrium of a chemical reaction as viewed by kinetics is a _____ state.

- (A) Dynamic steady
- (B) Static steady
- (C) Dynamic unsteady
- (D) None of these

Answer: Option A

260. Pick out the wrong statement pertaining to space velocity of flow reactors.

- (A) The unit of space velocity is $(\text{time})^{-1}$
- (B) The space velocity of 3 hr^{-1} means that three reactor volumes of feed at specified conditions are being fed into the reactor every hour
- (C) The space velocity of 3 hr^{-1} means that one third reactor volume of feed at specified conditions are being fed into the reactor
- (D) None of these

Answer: Option C

261. Kinetics of a catalytic reaction can be best studied on a/an _____ reactor.

- (A) Mixed
- (B) Integral (plug flow)
- (C) Differential (flow)
- (D) Either (A), (B) and (C)

Answer: Option D

262. The reaction $A \rightarrow B$ is conducted in an adiabatic plug flow reactor (PFR). Pure A at a concentration of 2 kmol/m^3 is fed to the reactor at the rate of $0.01 \text{ m}^3/\text{s}$ and at a temperature of 500 K . If the exit conversion is 20% , then the exit temperature (in K) is (Data: Heat of reaction at $298 \text{ K} = -50000 \text{ kJ/kmole}$ of A reacted Heat capacities $C_{PA} = C_{PB} = 100 \text{ kJ/kmole.K}$ (may be assumed to be independent of temperature))

- (A) 400
- (B) 500
- (C) 600
- (D) 1000

Answer: Option C

263. In a continuous flow stirred tank reactor, the composition of the exit stream

- (A) Is same as that in the reactor
- (B) Is different than that in the reactor
- (C) Depends upon the flow rate of inlet stream
- (D) None of these

Answer: Option A

264. Rate of a gaseous phase reaction is given by the reaction shown in the bellow figure. The unit of rate constant is

$$-\frac{dp_A}{dt} = K \cdot p^2 A$$

- (A) $(\text{atm})^{-1}$
- (B) $(\text{hr})^{-1}$
- (C) $(\text{atm})^{-1} \cdot (\text{hr})^{-1}$
- (D) $\text{atm} \cdot (\text{hr})^{-1}$

Answer: Option C

265. A space velocity of 5 hr^{-1} means that

- (A) Five reactor volumes of feed (at specified conditions) are being fed into the reactor per hour
- (B) After every 5 hours, reactor is being filled with the feed
- (C) Cent per cent conversion can be achieved in at least 5 hours
- (D) A fixed conversion of a given batch of feed takes 5 hours

Answer: Option A

266. Half life period of a chemical reaction is

- (A) The time required to reduce the concentration of the reacting substance to half its initial value
- (B) Half of the space time of a reaction
- (C) Half of the residence time of a reaction
- (D) None of these

Answer: Option A

267. Maximum equilibrium conversion for endothermic reaction is obtained at the _____ temperature.

- (A) Highest possible
- (B) Lowest possible
- (C) Intermediate
- (D) Room

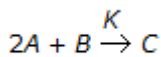
Answer: Option A

268. Which of the following is the most suitable for very high pressure gas phase reaction?

- (A) Batch reactor
- (B) Tubular flow reactor
- (C) Stirred tank reactor
- (D) Fluidised bed reactor

Answer: Option B

269. The order of the chemical reaction as shown in the bellow figure, whose rate equation is given as $-r_A = K C_A^2 \cdot C_B$ is



- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option D

270. For an ideal gas mixture undergoing a reversible gaseous phase chemical reaction, the equilibrium constant

- (A) Is independent of pressure
- (B) Increases with pressure
- (C) Decreases with pressure
- (D) Increases /decreases with pressure depending on the stoichiometric co-efficients of the reaction

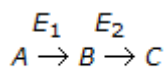
Answer: Option B

271. Helium-mercury method can be used to determine the _____ of the catalyst particle.

- (A) Pore volume
- (B) Solid density
- (C) Porosity
- (D) All (A), (B), & (C)

Answer: Option D

272. In a consecutive reaction system of the given figure bellow, when E_1 is much greater than E_2 , the yield of B increases with the



- (A) Increase of temperature
 - (B) Decrease of temperature
 - (C) Increase in initial concentration of A
 - (D) Decrease in initial concentration of A
- Answer: Option A

273. Collision theory gives the rate constant for bimolecular reaction as

- (A) $K \propto \sqrt{T} \cdot e^{-E/RT}$
- (B) $K \propto e^{E/RT}$
- (C) $K \propto e^{-E/RT}$
- (D) None of these

Answer: Option C

274. Pick out the wrong statement.

- (A) Catalytic activity of enzyme catalysed reactions which is affected by temperature, pH value & chemical agents, is maximum at a temperature of about 45°C
- (B) Most of the enzyme catalysed reactions involve at least two substrates
- (C) Enzymes help in increasing the activation energy of the reaction
- (D) Equilibrium concentrations in enzyme catalysed reactions can be calculated by using the thermodynamic properties of substrates & products

Answer: Option C

275. What is the order of a chemical reaction in which doubling the initial concentration of the reactants doubles the half life time of the reaction?

- (A) 0
- (B) 1
- (C) 2
- (D) 3

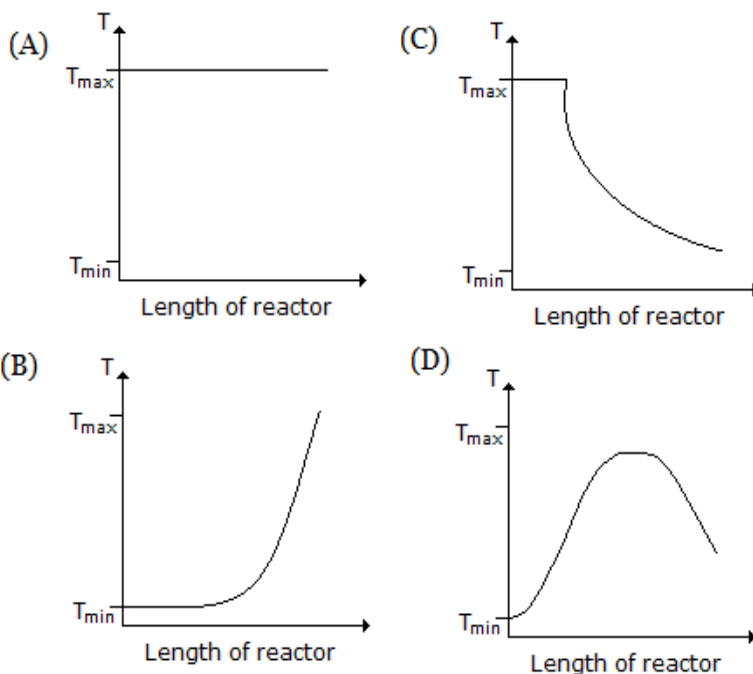
Answer: Option A

276. The increase in the rate of reaction with temperature is due to

- (A) Increase in the number of effective collisions
- (B) Decrease in activation energy
- (C) Increase in the average kinetic energy of the reacting molecules
- (D) None of these

Answer: Option B

277. Consider a reversible exothermic reaction in a plug flow reactor. The maximum and minimum permissible temperatures are T_{max} and T_{min} respectively. Which of the following temperature (T) profiles will require the shortest residence time to achieve the desired conversion.



Answer: Option B

278. Which of the following is a characteristic of an ideal plug flow reactor?

- (A) Axial dispersion
- (B) Flat velocity profile
- (C) Uniform mixing
- (D) None of these

Answer: Option B

279. A back mix reactor is

- (A) Suitable for gas phase reactions
- (B) Ideal at very low conversion
- (C) Same as plug flow reactor (PFR)
- (D) Same as ideal stirred tank reactor

Answer: Option D

280. For an isothermal variable volume batch reactor, the following relation is applicable for a first order irreversible reaction.

- (A) $X_A = k \cdot t$
- (B) $[C_{A0}/(1 + \epsilon_A X_A)] (dX_A/dt) = k$
- (C) $-\ln(1 - X_A) = kt$
- (D) $\epsilon_A \cdot \ln(1 - X_A) = k \cdot t$

Answer: Option B

281. Rate constant 'k' and absolute temperature 'T' are related by collision theory (for bimolecular) as

- (A) $k \propto T^{1.5}$
- (B) $k \propto \exp(-E/RT)$
- (C) $k \propto \sqrt{T}$
- (D) $k \propto T$

Answer: Option C

282. If the time required to change the concentration of reactant to half its original value is independent of the initial concentration, the order of reaction is:

- (A) Zero
- (B) One
- (C) Two
- (D) Three

Answer: Option B

283. The response curve for a step input signal from a reactor is called C-curve. The variance of C-curve in a 'tanks in series model' comprising of 'm' tanks is equal to

- (A) m
- (B) $1/m$
- (C) \sqrt{m}
- (D) m^2

Answer: Option B

284. The excess energy of reactants in a chemical reaction required to dissociate into products is termed as the _____ energy.

- (A) Activation
- (B) Potential
- (C) Binding
- (D) Threshold

Answer: Option A

285. The following half life data are available for the irreversible liquid phase reaction $A \rightarrow$ products. The overall order of reaction is:

Initial concentration (K.mol/m ³)	Half-life
2	2
8	1

- (A) 0.5
- (B) 1

(C) 1.5

(D) 2

Answer: Option C

286. A catalyst is said to be a negative catalyst, if it

(A) Retards the rate of reaction

(B) Reduces the value of equilibrium constant

(C) Does not initiate the reaction

(D) All (A), (B) and (C)

Answer: Option A

287. For multiple reactions, the flow pattern within the vessel affects the

(A) Size requirement

(B) Distribution of reaction products

(C) Both (A) and (B)

(D) Neither (A) nor (B)

Answer: Option C

288. Pick out the wrong statement.

(A) The vessel dispersion number (D/UL) for plug flow and mixed flow approaches zero and infinity respectively

(B) Space time in a flow reactor is a measure of its capacity and is equal to the residence time when the density of reaction mixture is constant

(C) Mixed reactor is always smaller than the plug flow reactor for all positive reaction orders for a particular duty

(D) In an ideal tubular flow reactor, mixing takes place in radial direction and there is no mixing in longitudinal direction

Answer: Option C

289. The irreversible reaction is a special case of reversible reaction, if the

(A) Equilibrium constant is 1

(B) Conversion of the reactant at equilibrium condition is zero

(C) Reactant concentration at equilibrium condition is zero

(D) All (A), (B) and (C)

Answer: Option C

290. Rate of a chemical reaction is not influenced by the

(A) Catalyst

(B) Temperature

(C) Reactants concentration

(D) Number of molecules of reactants taking part in a reaction

Answer: Option D

291. If Thiele modulus is _____, then the pore diffusion resistance in a catalyst may be considered as negligible.

(A) 0

(B) ∞

(C) < 0.5

(D) > 0.5

Answer: Option C

292. _____ explains the mechanism of catalysis.

(A) Activated complex theory

(B) Collision theory

(C) Thermodynamics

(D) None of these

Answer: Option A

293. Which of the following factors control the design of a fluid-solid reactor?

(A) Reaction kinetics for single particle

(B) Size distribution of solids being treated

(C) Flow patterns of solids and fluid in the reactor

(D) All (A), (B) and (C)

Answer: Option D

294. For an autocatalytic reactor, the suitable reactor set up is

- (A) P.F. reactors in series
- (B) CSTR in series
- (C) CSTR followed by P.F. reactor
- (D) P.F. reactor followed by CSTR

Answer: Option C

295. Pick out the wrong statement.

- (A) Exit age description function (E) and internal age distribution function (I) are related as, $E = - (dI/d\theta)$
- (B) Chemisorption studies are useful in the determination of catalyst surface area and pore size distribution
- (C) A higher temperature favours the reaction of higher activation energy
- (D) A catalyst increases the potential energy barrier over which the reactants must pass to form products

Answer: Option D

296. A reactor is generally termed as an autoclave, when it is a

- (A) High pressure batch reactor
- (B) Atmospheric pressure tank reactor
- (C) High pressure tubular reactor
- (D) Atmospheric pressure CSTR

Answer: Option A

297. If n = overall order of a chemical reaction. a = initial concentration of reactant. t = time required to complete a definite fraction of the reaction. Then pick out the correct relationship.

- (A) $t \propto 1/a^n$
- (B) $t \propto 1/a^{n-1}$
- (C) $t \propto 1/a^{n+1}$
- (D) $t \propto a^n$

Answer: Option B

298. A CSTR is to be designed in which an exothermic liquid phase first order reaction of the type, $A \rightarrow R$, is taking place. The reactor is to be provided with a jacket in which coolant is flowing. Following data is given: $C_{A0} = 5 \text{ kmole/m}^3$; $X_A = 0.5$; Feed temperature = reactor temperature = 40°C . Rate constant at $40^\circ\text{C} = 1 \text{ min}^{-1}$; $(\Delta H) = -40 \text{ kJ/mole}$; $\rho = 1000 \text{ kg/m}^3$ $C_p = 4 \text{ J/gm} \cdot ^\circ\text{C}$; $q = 10^{-3} \text{ m}^3/\text{min}$ (ρ and C_p are same for the reactant and product streams). The amount of heat to be removed is:

- (A) 2/3 kW
- (B) 1 kW
- (C) 5/3 kW
- (D) 4 kW

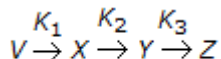
Answer: Option C

299. A space time of 3 hours for a flow reactor means that

- (A) The time required to process one reactor volume of feed (measured at specified conditions) is 3 hours
- (B) Three reactor volumes of feed can be processed every hour
- (C) It takes three hours to dump the entire volume of the reactor with feed
- (D) Conversion is cent per cent after three hours

Answer: Option A

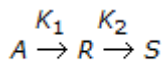
300. For a reaction of the type of bellow given figure, the rate of reaction ($-r_x$) is given by



- (A) $(K_1 + K_1) C_X$
- (B) $(K_1 + K_2 + K_3) C_X$
- (C) $K_1 C_V - K_2 C_X$
- (D) $(K_1 - K_2) C_X$

Answer: Option C

301. With increase in K_2/K_1 in case of a unimolecular type elementary reactions as shown in the bellow figure, the fractional yield of 'R' in mixed reactor (for a given conversion of 'A').



- (A) Decreases
 - (B) Increases
 - (C) Increases linearly
 - (D) Remain same
- Answer: Option A

302. For a first order reaction carried out in a plug flow reactor, the space time is

- (A) $(1/k) \ln C_0/C$
- (B) $(1/k) \ln C/C_0$
- (C) $k \ln C_0/C$
- (D) $k \ln C/C_0$

Answer: Option A

303. Pick out the wrong statement.

- (A) Use of different catalysts in a reversible catalytic chemical reaction does not change the equilibrium composition
- (B) Alumina is added as a promoter to iron catalyst in ammonia synthesis reaction
- (C) Activation energy for a reaction is obtained from the intercept of the Arrhenius plot
- (D) Presence of inerts affects the equilibrium conversion of reactants in a chemical reaction

Answer: Option C

304. Specific rate constant for a second order reaction

- (A) Is independent of temperature
- (B) Varies with temperature
- (C) Depends on the nature of the reactants
- (D) Both (B) and (C)

Answer: Option D

305. If helium is introduced in a reactor containing O_2 , SO_2 and SO_3 at equilibrium, so that total pressure increases while volume and temperature remains constant. In this case the dissociation of SO_3 (as per Le Chatelier's principle).

- (A) Decreases
- (B) Increases
- (C) Remains unaltered
- (D) Changes unpredictably

Answer: Option A

306. A spherical porous catalyst particle of radius R is subjected to reactant A which reacts to form B by a zero order surface reaction $A \rightarrow B$. Film mass transfer resistance is negligible and pore diffusion of A is rate controlling. The effectiveness factor of the catalyst is reported as 7/8. Which of the following statement is true?

- (A) Inner catalyst core of radius $R/8$ does not participate in reaction
- (B) Inner catalyst core of radius $R/2$ does not participate in reaction
- (C) Inner catalyst core of radius $7R/8$ does not participate in reaction
- (D) Effectiveness factor for a zero order reaction cannot be $7/8$ as it must always be 1

Answer: Option A

307. Chemical reaction rate of a component depends upon the

- (A) Composition of the component only
- (B) Temperature of the system
- (C) Pressure of the system
- (D) All (A), (B) and (C)

Answer: Option D

308. If the time required to complete a definite fraction of reaction varies inversely as the concentration of the reactants, then the order of reaction is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Answer: Option B

309. Space time equals the mean residence time

- (A) When the density of the reaction mixture is constant
- (B) For large diameter tubular reactor
- (C) For narrow diameter tubular reactor
- (D) For CSTR

Answer: Option A

310. Velocity of a reaction depends upon the

- (A) Nature of the reactants
- (B) Concentration of the reactants
- (C) Temperature at which the reaction is carried
- (D) All (A), (B) and (C)

Answer: Option D

311. The ratio of moles of a reactant converted into the desired product to that converted into unwanted product is called

- (A) Operational yield
- (B) Relative yield
- (C) Selectivity
- (D) None of these

Answer: Option C

312. From among the following, choose one which is not an exothermic process.

- (A) Methanol synthesis
- (B) Catalytic cracking
- (C) Ammonia synthesis
- (D) Oxidation of sulphur

Answer: Option B

313. The unit of frequency factor in Arrhenius equation is

- (A) Same as that of rate constant
- (B) Same as that of activation energy
- (C) Dimensionless
- (D) None of these

Answer: Option A

314. A batch adiabatic reactor at an initial temperature of 373°K is being used for the reaction, $A \rightarrow B$. Assume the heat of reaction is - 1kJ/mole at 373°K and heat capacity of both A and B to be constant and equal to 50J/mole.K. The temperature rise after a conversion of 0.5 will be:

- (A) 5°C
- (B) 10°C
- (C) 20°C
- (D) 100°C

Answer: Option B

315. From collision theory, the reaction rate constant is proportional to

- (A) $\exp(-E/RT)$
- (B) $\exp(-E/2RT)$
- (C) \sqrt{T}
- (D) $T^m \exp(-E/RT)$

Answer: Option D

316. The most unsuitable reactor for carrying out reactions in which high reactant concentration favours high yields is

- (A) Backmix reactor
- (B) Plug flow reactor
- (C) Series of CSTR
- (D) PFR in series

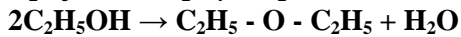
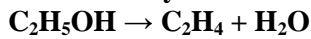
Answer: Option A

317. The synthesis of proteins and metabolism in biological objects occur in the presence of biocatalyst called

- (A) A ferment or an enzyme
- (B) Haemoglobin

- (C) Fungi
(D) None of these
Answer: Option C

318. Pure ethanol vapor is fed to a reactor packed with alumina catalyst, at the rate of 100 kmole / hr. The reactor products comprise: ethylene: 95 kmole / hr, water vapour: 97.5 kmole / hr and diethyl ether: 2.5 kmole/hr. The reactions occurring can be represented by:



The percent conversion of ethanol in the reactor is

- (A) 100
(B) 97.5
(C) 95
(D) 2.5

Answer: Option A

319. If the time required for half change is inversely proportional to the square of initial concentration and the velocity depends on the units in which the concentration term is expressed, then the order of reaction is

- (A) 0
(B) 1
(C) 2
(D) 3

Answer: Option D

320. 'If the catalyst pore size is small in comparison with the mean free path, collisions with the pore wall controls the process'. The diffusivity under this condition is called 'Knudsen diffusivity', which is affected by the

- (A) Pressure
(B) Temperature
(C) Both (A) & (B)
(D) Neither (A) nor (B)

Answer: Option B

321. In case of a/an _____ chemical reaction, conversion increases with the rise in temperature.

- (A) Reversible exothermic
(B) Irreversible exothermic
(C) Irreversible endothermic
(D) Reversible endothermic

Answer: Option D

322. In a semi-batch reactor,

- (A) Mixing takes place in axial direction only
(B) Velocity of reaction can be controlled
(C) Condition similar to plug flow reactor exists
(D) Residence time is constant

Answer: Option B

323. Transition state theory gives the rate constant as

- (A) $K \propto e^{-E/RT}$
(B) $K \propto e^{E/RT}$
(C) $K \propto T \cdot e^{-E/RT}$
(D) $K \propto \sqrt{T} \cdot e^{-E/RT}$

Answer: Option C

324. A catalyst loses its activity due to

- (A) Loss in surface area of the active component
(B) Agglomeration of metal particles caused by thermal sintering of the solid surface
(C) Covering of the catalytic active sites by a foreign substance
(D) All (A), (B) and (C)

Answer: Option D

325. What is the dispersion number for a plug flow reactor?

- (A) 0

- (B) ∞
- (C) 1
- (D) -1

Answer: Option A

326. Transition state theory relates the above quantities as

- (A) $k \propto e^{-E/RT}$
- (B) $k \propto T.e^{E/RT}$
- (C) $k \propto \sqrt{T}$
- (D) $k \propto T^{1.5}$

Answer: Option B

327. The rate equation for the reaction represented by as shown in the bellow figure, is given by $-r_x = K_1 \cdot C_x / (1 + K_2 C_x)$. At high value of C_x (i.e., $K_2 C_x > 1$), the order of the reaction and the rate constant are respectively



- (A) Zero order & K_1/K_2
- (B) Zero order & K_1
- (C) First order & K_1
- (D) First order & K_1/K_2

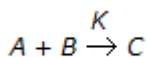
Answer: Option A

328. The dimensions of rate constant for reaction $3A \rightarrow B$ are (l/gm mole)/min. Therefore the reaction order is

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option C

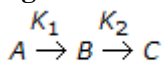
329. For a _____ order chemical reaction as shown in the bellow figure, the fractional conversion of reactant 'A' is proportional to time.



- (A) Zero
- (B) First
- (C) Second
- (D) Third

Answer: Option A

330. Second order consecutive irreversible reaction as shown in the bellow figure, were carried out in a constant volume isothermal batch reactor with different initial feed compositions. Reactor temperature was same in all the cases. In experiments where the ratio of concentration of B to that of A in the initial feed was less than 0.5, the concentration of B increased first, reached a maximum and then declined with time. However, for all experiments where this concentration ratio was 0.5 or above, concentration of B decreased monotonically with time right from the beginning. What is the ratio of the two rate constants (k_1/k_2)?



- (A) 1/4
- (B) 1/2
- (C) 2
- (D) 4

Answer: Option A

331. The rate of the heterogeneous catalytic reaction $A(g) + B(g) \rightarrow C(g)$ is given by $-r_A = k \cdot K_A \cdot p_A \cdot P_B / (1 + K_A \cdot P_A + K_c \cdot p_c)$, where K_A and K_c are the adsorption equilibrium constants. The rate controlling step for this reaction is

- (A) Absorption of A
- (B) Surface reaction between absorbed A and absorbed B
- (C) Surface reaction between absorbed A and B in the gas phase
- (D) Surface reaction between A in the gas phase and absorbed B

Answer: Option C

332. The fractional volume change of the system for the isothermal gas phase reaction, $A \rightarrow 3B$, between no conversion and complete conversion is

- (A) 0.5
- (B) 1
- (C) 2
- (D) 3

Answer: Option C

333. With increase in the order of reaction (for all positive reaction orders), the ratio of the volume of mixed reactor to the volume of plug flow reactor (for identical feed composition, flow rate and conversion).

- (A) Increases
- (B) Decreases
- (C) Remain same
- (D) Increases linearly

Answer: Option A

334. For the chemical reaction $P \rightarrow Q$, it is found that the rate of reaction doubles as the concentration of 'P' is doubled. If the reaction rate is proportional to C_p^n , then what is the value of 'n' for this chemical reaction?

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option B

335. For a mixed flow reactor operating at steady state, the rate of reaction is given by

- (A) $(F_{A0}/V) - (dC_A/dt)$
- (B) $(F_{A0}/V) + (dC_A/dt)$
- (C) $(F_{A0}/V) X_A$
- (D) $-(dC_A/dt)$

Answer: Option C

336. The rate constant of a chemical reaction decreases by decreasing the

- (A) Pressure
- (B) Concentration of reactants
- (C) Temperature
- (D) Duration of reaction

Answer: Option C

337. A Catalyst

- (A) Increases the equilibrium concentration of the product
- (B) Changes the equilibrium constant of the reaction
- (C) Shortens the time to reach the equilibrium
- (D) None of these

Answer: Option C

338. If C_A is the quantity of reactants initially present, the quantity left after 'n' half periods will be equal to

- (A) $(C_A/2)^n$
- (B) $(1/2)^n C_A$
- (C) $(C_A/2)^{1/n}$
- (D) $(C_A)^{1/2n}$

Answer: Option B

339. The conversion in a mixed reactor/accomplishing a reaction $A \rightarrow 3R$ is 50% when gaseous reactant 'A' is introduced at the rate of 1 litre/second and the leaving flow rate is 2 litres/second. The holding time for this operation is _____ second.

- (A) 0.5
- (B) 1
- (C) 2
- (D) 3

Answer: Option A

340. In an exothermic chemical reaction, the reactants compared to the products have

- (A) Higher temperature
- (B) More energy
- (C) Less energy
- (D) Same energy

Answer: Option B

341. Reactions with high activation energy are

- (A) Very temperature sensitive
- (B) Temperature insensitive
- (C) Always irreversible
- (D) Always reversible

Answer: Option A

342. Pick out the wrong statement:

- (A) Chemical reactions with high activation energy are very temperature sensitive
- (B) A flat velocity profile exists in a plug flow reactor
- (C) The residence time for all the elements of fluid in case of a P.F.R. need not be same
- (D) Half life of a reaction increases with increased initial concentration for reaction orders more than one

Answer: Option C

343. When an exothermic reversible reaction is conducted adiabatically, the rate of reaction

- (A) Continuously increases
- (B) Continuously decreases
- (C) Passes through a maximum
- (D) Passes through a minimum

Answer: Option C

344. BET apparatus

- (A) Measures the catalyst surface area directly
- (B) Operates at very high pressure
- (C) Is made entirely of stainless steel
- (D) None of these

Answer: Option D

345. If the pore diffusion controls in a catalytic reaction, the apparent activation energy E_a is equal to

- (A) The intrinsic activation energy E
- (B) $(E + E_D)$ where E_D is activation due to diffusion
- (C) $(E + E_D)/2$
- (D) $E_D/2$

Answer: Option D

346. The half life period of a first order reaction is given by (where, K = rate constant.)

- (A) $1.5 K$
- (B) $2.5 K$
- (C) $0.693/K$
- (D) $6.93 K$

Answer: Option C

347. In a/an _____ vessel, the fluid enters and leaves following plug flow.

- (A) Open
- (B) Closed
- (C) Open-closed
- (D) Close-opened

Answer: Option B

348. The reason why a catalyst increases the rate of reaction is that, it

- (A) Decreases the energy barrier for reaction
- (B) Increases the activation energy
- (C) Decreases the molecular collision diameter
- (D) None of these

Answer: Option A

349. In which of the following gaseous phase reversible reactions, the product yield cannot be increased by the application of high pressure?

- (A) $N_2 + O_2 \rightleftharpoons 2NO$
- (B) $PCl_3 + Cl_2 \rightleftharpoons PCl_5$
- (C) $N + 3H_2 \rightleftharpoons 2NH_3$
- (D) $2SO_2 + O_2 \rightleftharpoons 2SO_3$

Answer: Option A

350. There is no correspondence between stoichiometric and the rate equation in case of a/an _____ reaction.

- (A) Elementary
- (B) Multiple
- (C) Autocatalytic
- (D) Non-elementary

Answer: Option D

351. The eddy diffusivity for a liquid in plug flow must be

- (A) 1
- (B) 0
- (C) ∞
- (D) Between 0 and 1

Answer: Option B

352. A catalyst

- (A) Initiates a reaction
- (B) Lowers the activation energy of reacting molecules
- (C) Is capable of reacting with any one of the reactants
- (D) Cannot be recovered chemically unchanged at the end of a chemical reaction

Answer: Option B

353. Reaction of benzene with chlorine gas to produce tri-chlorobenzene exemplifies a/an _____ reaction.

- (A) Elementary
- (B) Parallel
- (C) Consecutive
- (D) None of these

Answer: Option C

354. The rate controlling step for the heterogeneous irreversible catalytic reaction $A(g) + B(g) \rightarrow C(g)$ is the surface reaction of adsorbed A with adsorbed B to give adsorbed C. The rate expression for this reaction can then be written as (where, K_A , K_B and K_C are the equilibrium constants and k is the rate constant of the rate controlling step.)

- (A) $k K_A p_A p_B / (1 + K_A p_A + K_B p_B)$
- (B) $k K_A K_B p_A p_B / (1 + K_A p_A + K_B p_B)$
- (C) $k K_A K_B p_A p_B / (1 + K_A p_A + K_B p_B + K_C p_C)$
- (D) $k K_A K_B p_A p_B / (1 + K_A p_A + K_B p_B + K_C p_C)^2$

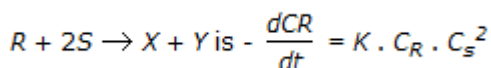
Answer: Option D

355. Catalytic action in a catalytic chemical reaction follows from the ability of catalyst to change the

- (A) Activation energy
- (B) Equilibrium constant
- (C) Heat of reaction
- (D) None of these

Answer: Option A

356. Reaction rate equation for the below figure reaction, If S is present in large excess, what is the order of this reaction?



- (A) Zero
- (B) One
- (C) Two
- (D) Three

Answer: Option B

357. In case of a _____ reactor, the composition in the reactor and at the exit of the reactor is the same.

- (A) Semi-batch
- (B) Tubular
- (C) Batch
- (D) Back-mix

Answer: Option D

358. In the gaseous phase ammonia formation reaction ($N_2 + 3H_2 \rightleftharpoons 2NH_3$), the value of the equilibrium constant depends on the

- (A) Total pressure of the system
- (B) Volume of the reactor
- (C) Temperature
- (D) Initial concentration of N_2 and H_2

Answer: Option C

359. Recycling back of outlet stream to the reactor from an ideal CSTR carrying out a first order liquid phase reaction will result in _____ in conversion.

- (A) Decrease
- (B) Increase
- (C) No change
- (D) Either (A) or (B), depends on the type of reaction

Answer: Option C

360. For a heterogeneous catalytic reaction

- (A) Free energy of activation is lowered in the presence of catalyst, which remains unchanged at the end of reaction
- (B) A relatively small amount of catalyst can cause the conversion of large amount of reactants which does not mean that catalyst concentration is important
- (C) The catalyst does not form an intermediate complex with the reactant
- (D) The surface of the catalyst does not play an important role during reaction

Answer: Option A

361. Half-life period for a first order reaction is _____ the initial concentration of the reactant.

- (A) Directly proportional to
- (B) Inversely proportional to
- (C) Independent of
- (D) None of these

Answer: Option C

362. For an isothermal second order aqueous phase reaction, $A \rightarrow B$, the ratio of the time required for 90% conversion to the time required for 45% conversion is:

- (A) 2
- (B) 4
- (C) 11
- (D) 22

Answer: Option C

363. In solid catalysed reactions the diffusional effects are more likely to affect the overall rate of reaction for

- (A) Fast reactions in catalyst of small pore diameter
- (B) Fast reaction in catalyst of large pore diameter
- (C) Slow reactions in catalyst of small pore diameter
- (D) Slow reactions in catalyst of large pore diameter

Answer: Option C

364. Pick out the correct statement.

- (A) Reactions with high activation energies are very temperature sensitive
- (B) Chemical equilibrium is a static state
- (C) A photochemical reaction is catalysed by light
- (D) A chemical reaction occurs when the energy of the reacting molecule is less than the activation energy of the reaction

Answer: Option A

365. The temperature dependence of reaction rate constant (K) by Arrhenius law is given by

- (A) $K \propto e^{-E/RT}$
- (B) $K \propto e^{E/RT}$
- (C) $K \propto T \cdot e^{-E/RT}$
- (D) $K \propto \sqrt{T} \cdot e^{-E/RT}$

Answer: Option A

366. A photochemical reaction is

- (A) Accompanied with emission of light
- (B) Catalysed by light
- (C) Initiated by light
- (D) All (A), (B) & (C)

Answer: Option C

367. Which one is the rate controlling step in a solid-gas non-catalytic reaction occurring at very high temperature?

- (A) Pore diffusion
- (B) Film diffusion
- (C) Ash layer diffusion
- (D) Chemical reaction

Answer: Option B

368. For high conversion in a highly exothermic solid catalysed reaction, use a _____ bed reactor.

- (A) Fixed
- (B) Fluidised bed reactor followed by a fixed
- (C) Fixed bed reactor followed by a fluidised
- (D) Fluidised

Answer: Option B

369. The molecularity and the order of reaction respectively, for the hydrolysis of methyl acetate in presence of acids are

- (A) 2 & 1
- (B) 1 & 2
- (C) 2 & 2
- (D) 1 & 1

Answer: Option A

370. Sometimes, batch process is preferred over continuous process, when the product

- (A) Quality & yield cannot be achieved in continuous processes, because of long residence time
- (B) Sales demand is fluctuating
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

371. An endothermic aqueous phase first order irreversible reaction is carried out in an adiabatic plug flow reactor. The rate of reaction:

- (A) Is maximum at the inlet of the reactor
- (B) Goes through a maximum along the length of the reactor
- (C) Goes through a minimum along the length of the reactor
- (D) Is maximum at the exit of the reactor

Answer: Option A

372. A reversible liquid phase endothermic reaction is to be carried out in a plug flow reactor. For minimum reactor volume, it should be operated such that the temperature along the length

- (A) Decreases
- (B) Increases
- (C) Is at the highest allowable temperature throughout
- (D) First increases and then decreases

Answer: Option C

373. With increase in initial concentration, the fractional conversion of a first order reaction in a given time

- (A) Increases
 - (B) Decreases
 - (C) Remain constant
 - (D) Unpredictable
- Answer: Option C

374. A batch reactor is

- (A) Suitable for gas-phase reactions on commercial scale
 - (B) Suitable for liquid phase reactions involving small production rate
 - (C) Least expensive to operate for a given rate
 - (D) Most suitable for very large production rate
- Answer: Option B

375. In a reversible reaction, a catalyst increases the rate of forward reaction

- (A) Only
 - (B) To a greater extent than that of the backward reaction
 - (C) And decreases that of the backward reaction
 - (D) And the backward reaction equally
- Answer: Option D

376. Radioactive decay follows _____ order kinetics.

- (A) First
 - (B) Second
 - (C) Third
 - (D) Zero
- Answer: Option A

377. A gaseous reactant is introduced in a mixed reactor of 3 litres volume at the rate of 1 litre/second. The space time is _____ seconds.

- (A) 1
 - (B) 3
 - (C) 1/3
 - (D) 32
- Answer: Option B

378. Pick out the wrong statement.

- (A) The integral method of analysing kinetic data is used when the data is scattered
 - (B) The differential method of analysing kinetic data requires more accurate or larger amounts of data
 - (C) When the reaction rate is independent of temperature, the reaction is said to be of zero order
 - (D) The ratio of volumes of plug flow reactor to that of mixed reactor is always less than one for identical feed composition, flow rate, conversion and for all positive reaction orders
- Answer: Option C

379. The importance of diffusion in a catalyst are increased by

- (A) Large catalyst particle size
 - (B) An active surface of the catalyst
 - (C) Small pore diameter
 - (D) All (A), (B) and (C)
- Answer: Option D

380. The single parameter model proposed for describing non-ideal flow is the _____ model.

- (A) Tank in series
 - (B) Dispersion
 - (C) Both (A) & (B)
 - (D) Neither (A) nor (B)
- Answer: Option C

381. In an ideal mixed reactor (at steady state), the

- (A) Space time is equivalent to holding time for constant density systems
 - (B) Composition throughout the reactor remains same
 - (C) Exit stream has the same composition as the fluid within the reactor
 - (D) All (A), (B) and (C)
- Answer: Option D

382. Photochemical reaction rate does not depend significantly on temperature, because

- (A) It is a reversible reaction
- (B) It is an exothermic reaction
- (C) The energy of reacting molecules exceeds the activation energy by absorption of light
- (D) None of these

Answer: Option C

383. For an ideal plug flow reactor, the value of Peclet number is

- (A) 0
- (B) 1
- (C) 10
- (D) ∞

Answer: Option A

384. A batch reactor is suitable for

- (A) Achieving cent percent conversion of reactants into products
- (B) Large scale gaseous phase reactions
- (C) Liquid phase reactions
- (D) Obtaining uniform polymerisation products in highly exothermic reactions

Answer: Option C

385. Carbon particles accumulated on the catalyst used in the gas oil cracking lies in the category of _____ poison.

- (A) Deposited
- (B) Chemisorbed
- (C) Selectivity
- (D) Stability

Answer: Option A

386. A backmix reactor

- (A) Is same as plug-flow reactor
- (B) Is same as ideal stirred tank reactor
- (C) Employs mixing in axial direction only
- (D) Is most suitable for gas phase reaction

Answer: Option B

387. Which of the following factors control the deactivation of a porous catalyst pellet?

- (A) Decay reactions
- (B) Pore diffusion
- (C) Form of surface attack by poison
- (D) All (A), (B) and (C)

Answer: Option D

388. For a solid catalysed chemical reaction, the effectiveness of solid catalyst depends upon the _____ adsorption.

- (A) Physical
- (B) Chemical
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option B

389. The knowledge of initial concentration and rate constant is necessary to determine the half life time of a reaction of _____ order.

- (A) Zero
- (B) First
- (C) Second
- (D) None of these

Answer: Option C

390. In the reversible reaction of the type, $A + B \rightleftharpoons AB$, in general

- (A) Both forward and backward reactions will be exothermic
- (B) Neither of the reactions will be endothermic
- (C) The combination reaction will be exothermic, while the dissociation reaction will be endothermic

(D) The combination reaction will be endothermic, while the dissociation reaction will be exothermic

Answer: Option C

391. The excess energy of the reactants required to dissociate into products is known as the _____ energy.

- (A) Thermal
- (B) Activation
- (C) Threshold
- (D) Binding

Answer: Option B

392. In case of physical adsorption, the heat of adsorption is of the order of _____ kcal/kg.mole.

- (A) 100
- (B) 1000
- (C) 10000
- (D) 100000

Answer: Option B

393. The decomposition of A into B is represented by the exothermic reaction, $A \rightleftharpoons 2B$. To achieve maximum decomposition, it is desirable to carry out the reaction.

- (A) At high P and high T
- (B) At low P and high T
- (C) At low P and low T
- (D) At high P and low T

Answer: Option C

394. Which of the following is a controlling factor in very fast heterogeneous reaction?

- (A) Heat and mass transfer effects
- (B) Pressure
- (C) Temperature
- (D) Composition of reactant

Answer: Option A

395. An endothermic second order reaction is carried out in an adiabatic plug flow reactor. The rate of heat generation is:

- (A) Maximum at the inlet of the reactor
- (B) Maximum at the exit of the reactor
- (C) Maximum at the centre of the reactor
- (D) Constant throughout the reactor

Answer: Option A

396. For a zero order chemical reaction, the

- (A) Half life period is directly proportion to the initial concentration of the reactants
- (B) Plot of products concentration with time is a straight line through the origin
- (C) Products concentration increases linearly with time
- (D) All (A), (B) and (C)

Answer: Option D

397. Pick out the wrong statement.

- (A) A particular chemical reaction is more temperature sensitive at low temperatures
- (B) A very high value of equilibrium constant, K ($K \gg 1$) indicates that the reaction is practically irreversible in nature
- (C) The intercept of the Arrhenius plot is called the 'activation energy'
- (D) Non-ideal flow takes place in reactors due to recycling, channeling or by creation of stagnant regions

Answer: Option C

398. An imbalanced chemical reaction equation is against the law of

- (A) Multiple proportion
- (B) Conservation of mass
- (C) Constant proportion
- (D) None of these

Answer: Option B

399. For the chemical reaction $X \rightarrow Y$, it is observed that, on doubling the concentration of 'X', the reaction rate quadruples. If the reaction rate is proportional to C_x^n , then what is the value of 'n'?

- (A) 1/4
- (B) 2
- (C) 4
- (D) 16

Answer: Option C

400. _____ is the response curve for a step input signal from a reactor.

- (A) S-curve
- (B) C-curve
- (C) I-curve
- (D) None of these

Answer: Option B

401. Backmixing is most predominant in

- (A) A well stirred batch reactor
- (B) A plug-flow reactor
- (C) A single CSTR
- (D) CSTR's connected in series

Answer: Option C

402. Enzymes are destroyed, when the

- (A) Temperature is very high
- (B) Reactant's concentration is very high
- (C) Reactant's concentration is very low
- (D) Reaction rate is independent of the reactant's concentration

Answer: Option A

403. The experimentally determined overall order of the reaction, $A + B \rightarrow C + D$, is two. Then the

- (A) Reaction is elementary with a molecularity of 2
- (B) Molecularity of the reaction is 2, but the reaction may not be elementary
- (C) Reaction may be elementary with molecularity of 2
- (D) Reaction is elementary but the molecularity may not be 2

Answer: Option A

404. 'N' plug flow reactors in series with a total volume 'V' gives the same conversion as a single plug flow reactor of volume 'V' for _____ order reactions.

- (A) First
- (B) Second
- (C) Third
- (D) Any

Answer: Option D

405. Exothermic reactions are best carried out in

- (A) A CSTR
- (B) CSTR in series
- (C) A plug flow reactor followed by CSTR
- (D) CSTR followed by a plug flow reactor

Answer: Option D

406. Ionic reactions occur in

- (A) Solid state only
- (B) Liquid state only
- (C) Solutions
- (D) Any state

Answer: Option C

407. The energy balance equation over a tubular reactor under transient conditions is

- (A) An ordinary non-linear differential equation
- (B) An algebraic differential equation
- (C) A linear partial differential equation

(D) A non-linear partial differential equation

Answer: Option C

408. With decrease in temperature, the equilibrium conversion of a reversible endothermic reaction

(A) Decreases

(B) Increases

(C) Remain unaffected

(D) Increases linearly with temperature

Answer: Option A

409. The rate of reaction of a/an _____ reaction is not affected by temperature rise.

(A) Autocatalytic

(B) Photochemical

(C) Consecutive

(D) Zero order

Answer: Option B

410. In a chemical reaction, _____ are conserved.

(A) Ions

(B) Masses

(C) Atoms

(D) Both (B) & (C)

Answer: Option D

411. A trickle bed reactor is the one, which

(A) Has altogether three streams either entering or leaving

(B) Processes three reactants at different flow rates

(C) Processes three reactants with same flow rate

(D) Employs all the three phases (i.e. solid, liquid and gas)

Answer: Option D

412. Sulphuric acid is used as a catalyst in the

(A) Hydrogenation of oils

(B) Gas phase oxidation of SO_2 in chamber process

(C) Alkylation of hydrocarbons

(D) None of these

Answer: Option C

413. In a reaction, the threshold energy is equal to (where, A = activation energy N = normal energy of reactants)

(A) A

(B) N

(C) $A + N$

(D) $A - N$

Answer: Option C

414. An autothermal reactor is

(A) Most suitable for a second order reaction

(B) Most suitable for a reversible reaction

(C) Completely self-supporting in its thermal energy requirements

(D) Isothermal in nature

Answer: Option C

415. Consider the ' n ' th order irreversible liquid phase reaction $A \rightarrow B$. Which one of the following plots involving half life of the reaction ($t_{1/2}$) and the initial reactant concentration (C_{A0}) gives a straight line plot?

(A) $C_{A0} V_S t_{1/2}$

(B) $\ln C_{A0} V_S t_{1/2}$

(C) $C_{A0} V_S \ln t_{1/2}$

(D) $\ln C_{A0} V_S \ln t_{1/2}$

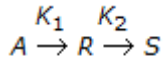
Answer: Option C

416. Which of the following will favour the reverse reaction in a chemical equilibrium reaction?

(A) Increasing the concentration of one of the reactants

- (B) Increasing the concentration of one or more of the products
 - (C) Removal of at least one of the products at regular interval
 - (D) None of these
- Answer: Option B

417. In case of a consecutive unimolecular types first order reaction as shown in the bellow figure, the concentration of component _____ increases continuously with time.



- (A) S
 - (B) R
 - (C) A
 - (D) None of these
- Answer: Option A

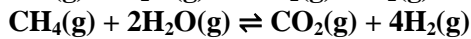
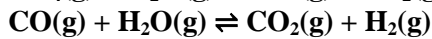
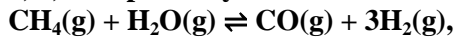
418. For a vapour phase catalytic reaction ($A + B \rightarrow P$) which follows the Ridel mechanism and the reaction step is rate controlling, the rate of reaction is given by (reaction rate is irreversible, product also absorbs).

- (A) $-r_A = (k \cdot P_A \cdot P_B)/(1 + K_A P_A + K_P P_P)$
 - (B) $-r_A = (k \cdot P_A^2 - k_1 P_P)/(1 + K_A P_A + K_P P_P)$
 - (C) $-r_A = (k \cdot P_A \cdot P_B)/(1 + K_A P_B + K_B P_B \cdot K_P P_P)$
 - (D) $-r_A = (k \cdot P_A \cdot P_B)/(1 + K_A P_A)$
- Answer: Option A

419. In the converter of the contact process for the manufacture of H_2SO_4 the equilibrium conversion of SO_2 _____ (i) _____ with increase in temperature and _____ (ii) _____ with increase in the mole ratio of SO_2 to air.

- (A) (i) increases (ii) decreases
 - (B) (i) decreases (ii) increases
 - (C) (i) increases (ii) increases
 - (D) (i) decreases (ii) decreases
- Answer: Option B

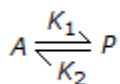
420. At a given temperature, K_1 , K_2 and K_3 are equilibrium constants for the following reactions 1, 2, 3 respectively.



Then K_1 , K_2 and K_3 are related as:

- (A) $K_3 = K_1 \cdot K_2$
 - (B) $K_3 = (K_1 \cdot K_2)^{0.5}$
 - (C) $K_3(K_1 + K_2)/2$
 - (D) $K_3 = (K_1 \cdot K_2)^2$
- Answer: Option A

421. The equilibrium constant for the reversible reaction as shown in the bellow figure, is affected by the



- (A) Temperature of the system
 - (B) Presence or absence of inerts
 - (C) Pressure of the system
 - (D) Kinetics of the reaction
- Answer: Option C

422. For reactions in parallel viz $A \rightarrow P$ (desired product) and $A \rightarrow Q$ (unwanted product), if the order of the desired reaction is higher than that of the undesired reaction, a

- (A) Batch reactor is preferred over a single CSTR for high yield
 - (B) Tubular reactor is preferred over a single CSTR for high yield
 - (C) Both (A) and (B)
 - (D) Single CSTR is the most suitable
- Answer: Option C

423. When the reaction is dominated by intraparticle diffusion, the apparent order of reaction (n_D) as measured is related to the true order (n) as

(A) $n_D = (n + 1)/2$

(B) $n_D = n/2$

(C) $n_D = n + 1$

(D) None of these

Answer: Option A

424. A first order reaction requires two unequal sized CSTR. Which of the following gives higher yield?

(A) Large reactor followed by smaller one

(B) Smaller reactor followed by larger one

(C) Either of the arrangement (A) or (B) will give the same yield

(D) Data insufficient, can't be predicted

Answer: Option C

425. According to Arrhenius equation of temperature dependency of rate constant for an elementary reaction

(A) $k \propto \sqrt{T}$

(B) $k \propto e^{-E/RT}$

(C) $k \propto T e^{-E/RT}$

(D) None of these

Answer: Option B

426. The rate of a chemical reaction is almost doubled for every 10°C rise in temperature. The rate will increase _____ times, if the temperature rises from 10 to 100°C.

(A) 256

(B) 512

(C) 112

(D) 612

Answer: Option B

427. The performance of a cascade of CSTR's can be improved by adding

(A) A P.F. reactor in series

(B) A P.F. reactor in parallel

(C) More CSTR's in series

(D) More CSTR's in parallel

Answer: Option C

428. For the liquid phase zero order irreversible reaction $A \rightarrow B$, the conversion of A in a CSTR is found to be 0.3 at a space velocity of 0.1 min^{-1} . What will be the conversion for a PFR with a space velocity of 0.2 min^{-1} ? Assume that all the other operating conditions are the same for CSTR and PFR.

(A) 0.15

(B) 0.30

(C) 0.60

(D) 0.90

Answer: Option C

429. Pick out the wrong statement.

(A) In a multistep reaction, the slowest step is the rate determining step

(B) In general, the rate of a reaction becomes triple for every 10°C rise in temperature

(C) Slow chemical reactions have generally high values of activation energy

(D) Molecularity of a reaction cannot be zero but the order of a reaction can be zero

Answer: Option B

430. When the density of the reaction mixture is constant in a chemical reaction, the ratio of the mean residence time to space time is

(A) > 1

(B) < 1

(C) 1

(D) 0

Answer: Option C

431. An isothermal aqueous phase reversible reaction, $P \rightleftharpoons R$, is to be carried out in a mixed flow reactor. The reaction rate in $\text{k.mole/m}^3 \cdot \text{h}$ is given by, $r = 0.5C_P - 0.125C_R$. A stream containing only P enters the reactor. The residence time required (in hours) for 40% conversion of P is

- (A) 0.80
- (B) 1.33
- (C) 1.60
- (D) 2.67

Answer: Option C

432. A reaction in which one of the products of reaction acts as a catalyst is called a/an _____ reaction.

- (A) Catalytic
- (B) Autocatalytic
- (C) Photochemical
- (D) None of these

Answer: Option B

433. Which of the following chemical reactions will be favoured by low pressure?

- (A) $2\text{HI} \rightleftharpoons \text{H}_2 + \text{I}_2$
- (B) $\text{N}_2\text{O}_2 \rightleftharpoons 2\text{NO}_2$
- (C) $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$
- (D) None of these

Answer: Option B

434. Pick out the wrong statement.

- (A) In a batch reactor, which is exclusively used for liquid phase reactions; temperature pressure and composition may vary with time
- (B) In a semi-batch reactor, one reactant is charged batch wise, while the other reactant is fed continuously
- (C) In a continuous flow reactor, uniform concentration cannot be maintained throughout the vessel even in a well agitated system
- (D) In a continuous flow reactor, both the reactants and the products flow out continuously

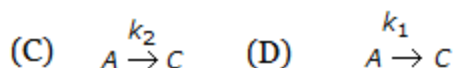
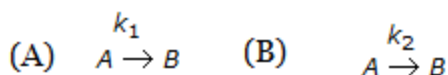
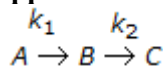
Answer: Option C

435. Enzymes (a protein) are catalysts found in organisms. Its efficiency of catalysing a reaction is due to its capacity to lower the activation energy of the reaction. The enzyme *ptyalin* used for food digestion is present in

- (A) Blood
- (B) Saliva
- (C) Intestine
- (D) Gland

Answer: Option B

436. For a series of reactions of the bellow figure, having $k_1 \ll k_2$, the reaction system can be approximated as



Answer: Option A

437. A balanced chemical reaction equation conforms to the law of

- (A) Conservation of mass
- (B) Avogadro's hypothesis
- (C) Gaseous volumes
- (D) None of these

Answer: Option A

438. Which of the following is an independent variable for a batch tank reactor with uniform concentration and temperature?

- (A) Time
- (B) Useful volume of the tank
- (C) Diameter of the reactor
- (D) None of these

Answer: Option A

439. Molecularity of a reaction

- (A) Is always equal to the overall order of reaction
- (B) May not be equal to the order of reaction
- (C) Can't have a fractional value
- (D) Both (B) and (C)

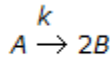
Answer: Option D

440. Pick out the correct statement.

- (A) A lower temperature favours the reaction of lower activation energy
- (B) The dispersion number for a reactor/vessel is uL/D
- (C) The rate controlling step in a reaction involving many steps is the fastest step
- (D) Pore volume and porosity of a catalyst is measured by Brunauer-Emmett-Teller (BET) technique

Answer: Option A

441. An elementary liquid phase decomposition reaction as shown in the bellow figure is to be carried out in a CSTR. The design equation is:



- (A) $k\tau = X_A/(1 - X_A)$
- (B) $k\tau = X_A(1 + X_A)/(1 + X_A)$
- (C) $k\tau = X_A/(1 - X_A)^2$
- (D) None of these

Answer: Option A

442. When all the limiting reactant is consumed in the reaction, the operational yield _____ the relative yield.

- (A) Is greater than
- (B) Is smaller than
- (C) Equals
- (D) Can be either greater or smaller than (depends on the type of reaction)

Answer: Option C

443. A multiple reaction may be classified as a _____ reaction.

- (A) Consecutive or side
- (B) Parallel or side
- (C) Mixed
- (D) All (A), (B) and (C)

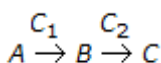
Answer: Option D

444. In flow reactors, the performance equations interrelate the rate of reaction to the

- (A) Feed rate
- (B) Reactor volume
- (C) Extent of reaction
- (D) All (A), (B) and (C)

Answer: Option D

445. A consecutive reaction, as shown in the bellow figure, is characterised by



- (A) Maxima in the concentration of A
- (B) Maxima in the concentration of B
- (C) Maxima in the concentration of C
- (D) High exothermicity

Answer: Option B

446. In an ideal tubular-flow reactor

- (A) There is no mixing in longitudinal direction
- (B) Mixing takes place in radial direction
- (C) There is a uniform velocity across the radius
- (D) All (A), (B) and (C)

Answer: Option D

447. Slurry reactors are characterised by the

- (A) Lack of intraparticle diffusion resistance
- (B) Presence of two mobile phases
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

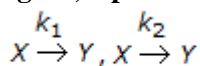
Answer: Option C

448. In a/an _____ reactor, there is exchange of heat with the surroundings with sizeable temperature variation.

- (A) Adiabatic
- (B) Isothermal
- (C) Non-adiabatic
- (D) None of these

Answer: Option C

449. For the irreversible elementary first order reaction in parallel as shown in the bellow figure, a plot of C_y Vs. C_x will give a straight line having a slope of



- (A) K_2/K_1
- (B) K_1/K_2
- (C) $K_1 \cdot K_2$
- (D) $K_1 + K_2$

Answer: Option B

450. For nearly isothermal operation involving large reaction time in a liquid-phase reaction, the most suitable reactor is a _____ reactor.

- (A) Stirred tank
- (B) Tubular flow
- (C) Batch
- (D) Fixed bed

Answer: Option A

451. The role of a catalyst in a chemical reaction is to change the

- (A) Equilibrium constant
- (B) Activation energy
- (C) Final products
- (D) Heat of reaction

Answer: Option B

452. For a gaseous phase reaction, rate of reaction is equal to $K \cdot C_A \cdot C_B$. If the volume of the reactor is suddenly reduced to 1/4th of its initial volume, then the rate of reaction compared to the original rate will be _____ times.

- (A) 8
- (B) 16
- (C) 1/8
- (D) 1/16

Answer: Option B

453. The reactions of high molecularity are rare, because

- (A) Of very large activation energy of many bodies
- (B) Of low probability of many body collisions
- (C) Many body collisions are not favoured energetically
- (D) Of requirement of very large concentration for such reactions

Answer: Option B

454. The effect of increasing pressure on the gaseous equilibrium of the reaction

$2X + 3Y \rightleftharpoons 3X + 2Y$ indicates that

- (A) Pressure has no effect
- (B) Backward reaction is favoured
- (C) Forward reaction is favoured
- (D) None of these

Answer: Option A

455. Holding time for flow reactors is _____ the space time, for constant fluid density

- (A) Double
- (B) Triple
- (C) Equal to
- (D) None of these

Answer: Option C

456. Signal normally used to study non-ideal flow by stimulus response technique is _____ input.

- (A) Pulse
- (B) Step
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

457. Design of heterogamous catalytic reactor involves consideration of _____ steps.

- (A) Only chemical
- (B) Only physical
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

458. A high space velocity means that a given

- (A) Reaction can be accomplished with small reactor
- (B) Conversion can be obtained with a high feed rate
- (C) Both (A) and (B)
- (D) None of these

Answer: Option C

459. Pick the WRONG design guideline for a reactor in which the reactions, $A \rightarrow R$ (desired) and $A \rightarrow S$ (undesired) are to take place. The ratio of the reaction rates is $r_R/r_S = (k_1/k_2) \cdot C_A^{a-b}$

- (A) Use high pressure and eliminate inerts, when $a > b$
- (B) Avoid recycle, when $a > b$
- (C) Use batch reactor or plug flow reactor, when $a > b$
- (D) Use CSTR with a high conversion, when $a > b$

Answer: Option B

460. At a given value of E/R (ratio of activation energy and gas constant), the ratio of the rate constants at 500°K and 400°K is 2, if Arrhenius law is used. What will be this ratio, if transition state theory is used with the same value of ' E/R '?

- (A) 1.6
- (B) 2
- (C) 2.24
- (D) 2.5

Answer: Option D

461. From Arrhenius law, a plot of $\log_e K$ versus $1/T$ gives a straight line with a slope of $(-E/R)$. The unit of E/R is

- (A) k cal
- (B) k cal/ $^\circ\text{K}$
- (C) $^\circ\text{K}$
- (D) k cal. $^\circ\text{K}$

Answer: Option C

462. Effective diffusivity (D_E) in a catalyst pellet is related to molecular diffusivity (D_N) and Knudsen diffusivity (D_K) as

- (A) $D_E = D_M + D_K$
- (B) $1/D_E = 1/D_N + D_K$

(C) $D_E = D_M \cdot D_E$

(D) $D_E = D_N/D_E$

Answer: Option B

463. During manufacture of H_2SO_4 , the oxidation of SO_2 to SO_3 by oxygen is an endothermic reaction. The yield of SO_3 will be maximised, if the

- (A) Temperature is increased
- (B) Pressure is reduced
- (C) Temperature is increased and pressure is reduced
- (D) Temperature is reduced and pressure is increased

Answer: Option D

464. Which of the following is not a chemical step in a fluid solid catalytic reaction?

- (A) Surface chemical reaction
- (B) Adsorption
- (C) Desorption
- (D) None of these

Answer: Option D

465. An isothermal irreversible reaction is being carried out in an ideal tubular flow reactor. The conversion in this case will _____ with decrease in space time.

- (A) Increase
- (B) Increase exponentially
- (C) Decrease
- (D) Remain unchanged

Answer: Option C

466. In a reversible chemical reaction having two reactants in equilibrium, if the concentration of the reactants are doubled, then the equilibrium constant will

- (A) Remain the same
- (B) Be halved
- (C) Also be doubled
- (D) Become one fourth

Answer: Option A

467. Which of the following is an autocatalytic reaction?

- (A) Photochemical reactions
- (B) Microbial fermentation reaction
- (C) Enzyme fermentation reaction
- (D) Ammonia synthesis reaction

Answer: Option B

468. When a catalyst increases the rate of forward reaction, the value of rate constant

- (A) Increases
- (B) Decreases
- (C) Remain same
- (D) Becomes infinite

Answer: Option A

469. What is the unit of the rate constant in a chemical reaction in which 10% of the reactant decomposes in one hour, 20% in two hours, 30% in three hours and so on?

- (A) Litre/mole.second
- (B) Moles/litre.second
- (C) Litre/mole
- (D) Litre/second

Answer: Option A

470. Catalyst carriers

- (A) Have very high selectivity
- (B) Increase the activity of a catalyst
- (C) Provide large surface area with a small amount of active material
- (D) Inhibit catalyst poisoning

Answer: Option C

471. With increase in temperature, the equilibrium _____ rises in case of endothermic reaction.

- (A) Constant
- (B) Conversion
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option B

472. Rate determining step in a reaction consisting of a number of steps in series is the _____ step.

- (A) Fastest
- (B) Slowest
- (C) Intermediate
- (D) Data insufficient; can't be predicted

Answer: Option B

473. Reverse reaction in a chemical equilibrium is favoured by the

- (A) Removal of one of the products regularly
- (B) Increase in the concentration of one of the products
- (C) Increase in the concentration of one of the reactants
- (D) None of these

Answer: Option B

474. _____ is the controlling step in a highly temperature sensitive fluid-solid non-catalytic reaction.

- (A) Gas film diffusion
- (B) Ash diffusion
- (C) Chemical reaction
- (D) None of these

Answer: Option C

475. When the reaction occurs in the diffusion controlled region, the apparent activation energy as measured is only _____ the true value.

- (A) Twice
- (B) Half
- (C) Equal
- (D) None of these

Answer: Option B

476. What is the Thiele modulus of the solid catalysed first order reaction as shown in the bellow figure, if the pore diffusion offers negligible resistance to reaction?



- (A) < 5
- (B) < 0.5
- (C) > 1
- (D) 5

Answer: Option B

477. For a first order chemical reaction, the rate constant

- (A) Changes on changing the concentration units
- (B) Is not a function of the unit of time
- (C) Has unit of time^{-1}
- (D) None of these

Answer: Option C

478. If in the gaseous phase reaction, $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$, x is the part of N_2O_4 which dissociates, then the number of molecules at equilibrium will be

- (A) $(1 + x)$
- (B) $(1 - x)$
- (C) $(1 + x)^2$
- (D) $(1 - x)^2$

Answer: Option A

479. For a fluidised bed reactor, the most suitable/relevant model is a _____ model.

- (A) Tank in series
- (B) Bubbling bed
- (C) Plug flow
- (D) None of these

Answer: Option B

480. The catalyst in a second order reversible reaction increases the rate of the forward reaction

- (A) And decreases that of backward reaction
- (B) And backward reaction equally
- (C) Only
- (D) To a greater extent than that of the backward reaction

Answer: Option B

481. The rate of forward reaction, at chemical equilibrium is _____ the rate of backward reaction.

- (A) More than
- (B) Less than
- (C) Equal to
- (D) Either (B) or (C)

Answer: Option C

482. The rate constant of a first order reaction depends on the

- (A) Concentration of the reactant
- (B) Temperature
- (C) Concentration of the product
- (D) Time

Answer: Option B

483. An exothermic reaction takes place in an adiabatic reactor. The product temperature _____ reactor feed temperature.

- (A) Is always equal to
- (B) Is always greater than
- (C) Is always less than
- (D) May be greater or less than

Answer: Option B

484. The units of frequency factor in Arrhenius equation

- (A) Are the same as those of the rate constant
- (B) Depend on the order of the reaction
- (C) Depend on temperature, pressure etc. of the reaction
- (D) Are cycles per unit time

Answer: Option A

485. Which of the following is the most suitable for isothermal operation?

- (A) Batch reactor
- (B) Back-mix reactor
- (C) Plug-flow reactor
- (D) Fixed bed reactor

Answer: Option B

486. Rate constant for a first order reaction does not depend upon reaction time, extent of reaction and the initial concentration of reactants; but it is a function of reaction temperature. In a chemical reaction, the time required to reduce the concentration of reactant from 100 gm moles/litre to 50 gm moles/litre is same as that required to reduce it from 2 gm moles/litre to 1 gm mole/litre in the same volume. Then the order of this reaction is:

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option B

487. The rate at which a chemical substance reacts is proportional to its

- (A) Active mass
- (B) Molecular weight

- (C) Equivalent weight
 - (D) Atomic weight
- Answer: Option A

488. A catalyst in a chemical reaction _____ free energy change in the reaction.

- (A) Increases
- (B) Decreases
- (C) Either (A) or (B); depends on the type of catalyst
- (D) Neither (A) nor (B)

Answer: Option C

489. Sum of the powers of the concentration terms in the rate equation is called the _____ of the reaction.

- (A) Order
- (B) Overall order
- (C) Molecularity
- (D) None of these

Answer: Option B

490. The ratio of volume of mixed reactor to the volume of P.F.R. (for identical flow rate, feed composition and conversion) for zero order reaction is:

- (A) ∞
- (B) 0
- (C) 1
- (D) > 1

Answer: Option C

491. Thermodynamic equilibrium constant in a system is affected by

- (A) Inerts
- (B) Pressure
- (C) Temperature
- (D) All (A), (B) & (C)

Answer: Option C

492. In case of _____ reactions, the reaction rate does not decrease appreciably as the reaction proceeds.

- (A) Catalytic
- (B) Parallel
- (C) Series
- (D) Auto catalytic

Answer: Option D

493. Considering the endothermic dissociation of CaCO_3 in a closed vessel ($\text{CaCO}_3 \rightleftharpoons \text{CaO} + \text{CO}_2$), the pressure of CO_2 increases, if

- (A) A catalyst is added
- (B) The temperature is increased
- (C) An inert gas is pumped keeping the temperature constant
- (D) None of these

Answer: Option B

494. The catalytic activity of enzymes is due to their capacity to lower the _____ energy.

- (A) Activation
- (B) Potential
- (C) Kinetic
- (D) None of these

Answer: Option A

495. Conversion increases with increase in temperature in case of a/an _____ reaction.

- (A) Autocatalytic
- (B) Irreversible
- (C) Reversible endothermic
- (D) Reversible exothermic

Answer: Option C