

Nepal Engineering Council Registration Examination

Model Question for Chemical Engineering

Section A (100*1 = 100)

1. What is the unit of the reaction activation energy in Arrhenius law?
 - a) J/mol
 - b) J
 - c) J/s
 - d) J/m²
2. If the pressure and temperature remain constant but volume of a gas increases, what will happen to the viscosity?
 - a) remain constant
 - b) it increases slightly
 - c) it increases exponentially
 - d) it decreases
3. In steady-state, open processes, input must be equal to the output in both conditions of chemical reaction and without chemical reaction in:
 - a) total mole balance
 - b) component balance of the mass of a pure compound
 - c) component balance of the moles of a pure compound
 - d) component balance of the moles of an atomic species
4. Under which condition will the general energy balance reduce to $Q = -W$ for a closed system?
 - a) $\Delta KE = 0$
 - b) $\Delta PE = 0$
 - c) $\Delta U = 0$
 - d) $\Delta KE = 0, \Delta PE = 0, \Delta U = 0$
5. What are the raw materials used for the manufacture of polyester?
 - a) urea and formaldehyde
 - b) vinyl chloride
 - c) glycol and terephthalic acid
 - d) phenol and formaldehyde

6. If a chemical engineer wants to simulate the process start-up and shutdown of a plant, what type of model will be the most suitable?
- stochastic
 - dynamic
 - discrete-event
 - steady-state
7. In which one of the following conditions must a reaction be spontaneous? All symbols given are standard symbols of the Gibbs-Helmholtz equation.
- ΔH is positive and ΔS is negative
 - ΔH is negative and ΔS is positive
 - ΔH is positive and ΔS is positive
 - ΔH is negative and ΔS is negative
8. It is true that energy can be transferred to or from a control volume by heat transfer, doing various forms of work, and by
- entropy
 - compression
 - mass flow
 - expansion
9. An ideal gas is undergoing a polytropic process where $pV^n = \text{constant}$. When $n = 1$, the process is
- isenthalpic
 - isothermal
 - isobaric
 - isochoric
10. For gas/porous catalyst systems slow reactions are influenced by
- pore diffusion
 - particle ΔT
 - film ΔT
 - surface reaction
11. The thermodynamic equilibrium constant is affected by:
- pressure
 - temperature
 - inerts
 - kinetics

12. Which one of the following directly implies that it is impossible to construct a refrigeration cycle that operates without a power input?
- a) Entropy statement
 - b) Kelvin-Planck statement
 - c) Clausius statement
 - d) First law of thermodynamics
13. Which fluid can resist a small shear stress indefinitely?
- a) Viscoelastic
 - b) Dilatant
 - c) Pseudoplastics
 - d) Bingham plastics
14. Which type of container has the least metal in the walls to store high-pressure fluids?
- a) cylindrical
 - b) capsule-shaped
 - c) spherical
 - d) rectangular
15. Which equipment uses a fixed pressure difference, and a variable geometry?
- a) rotameter
 - b) venturi-meter
 - c) orifice-meter
 - d) pitot tube
16. The mean distance apart of two parallel lines which are tangential to the particle in an arbitrarily fixed direction is called
- a) Equivalent diameter
 - b) Feret's diameter
 - c) Nominal aperture
 - d) Sieve diameter
17. Which process is really a reverse sedimentation process?
- a) screening
 - b) sieving
 - c) elutriation
 - d) laser diffraction
18. To avoid channeling in compressible filter cakes, what can be done?
- a) diffusional washing with an immiscible liquid

- b) displacement washing with high pressure difference
 - c) washing with low pressure difference
 - d) washing with air for partial drying
19. The amount of desired product obtained divided by amount of the key reactant consumed is:
- a) yield
 - b) limiting reactant
 - c) selectivity
 - d) conversion
20. For irreversible reactions in series, what is the key to the formation of intermediates?
- a) mixing of fluid of different composition
 - b) Reynolds number
 - c) Peclet number
 - d) plug flow of fluid
21. Consider a two-step first-order irreversible reactions in series. Because laminar flow represents a deviation from plug flow, the amount of intermediate formed will be _____ for plug flow.
- a) equal
 - b) less than
 - c) greater than
 - d) initially greater than and then less than
22. Which is the simplest way to represent enzyme catalyzed reactions?
- a) competitive inhibition
 - b) non-competitive inhibition
 - c) total inhibition
 - d) Michaelis-Menten equation
23. Which one of the following is the simplest way to find RTD experimentally?
- a) pulse
 - b) periodic
 - c) reactive
 - d) random

24. What acts as a shuttle for phosphate groups bound with high energies in metabolism?
- a) NAD
 - b) NADP
 - c) ADP
 - d) ATP
25. What can a chemical engineering use to convert organic waste into biogas?
- a) gasification
 - b) anaerobic digestion
 - c) electrochemical reaction
 - d) landfilling
26. Thermal conductivities of insulating materials such as rock wool approach that of air since the insulating materials contain _____
- a) reflective materials
 - b) spacers
 - c) air trapped in void spaces
 - d) superconductors in layers
27. What does the convective heat transfer coefficient depend upon besides fluid properties, flow velocity and temperature difference?
- a) pressure
 - b) ambient humidity
 - c) system geometry
 - d) condensation and boiling
28. What is the ratio of the emissive power of a surface to that of a black body?
- a) transmissivity
 - b) absorptivity
 - c) reflectivity
 - d) emissivity
29. Viscosity correction factor for kerosene can be neglected while designing a heat exchanger because of its:
- a) high viscosity
 - b) low viscosity
 - c) high pressure drop
 - d) low pressure drop

30. Which one of the following evaporators contain submerged combustion units?
- a) agitated
 - b) long-tube
 - c) direct-heated
 - d) short-tube
31. What is the dimensionless ratio of the molecular momentum diffusivity to the molecular mass diffusivity?
- a) Prandtl number
 - b) Schmidt number
 - c) Sherwood number
 - d) Nusselt number
32. For flow past a flat plate or in a pipe, where no form drag is present, which one of the following is valid?
- a) $J_H = J_D = f$
 - b) $J_H = J_D = f/2$
 - c) $J_H = f^2$
 - d) $J_H = J_D = Pr^{2/3}$
33. An example of the distillation method without rectification is:
- a) fractional distillation
 - b) binary distillation
 - c) flash distillation
 - d) reflux distillation
34. In a packed tower, optimum economic gas velocity is about one-half or more of the _____
- a) loading point
 - b) flooding velocity
 - c) terminal velocity
 - d) volumetric flowrate
35. The solubility of a small crystal is greater than that of a larger-size crystal because ____
- a) small particle has a large amount of surface energy per unit mass than large particle.
 - b) large particle has a large amount of surface energy per unit mass than small particle.
 - c) nucleation is more dominant in small crystals than in large crystals.
 - d) small particle has more numbers than large particles.

36. Which type of packing is more beneficial for cooling towers?
- a) stacked rings
 - b) Intalox
 - c) saddles
 - d) grids
37. Which is the most widely used catalyst in Contact process?
- a) platinum
 - b) vanadium pentoxide
 - c) molybdenum
 - d) wolfram
38. In cement production, the function of gypsum is to:
- a) start the setting of cement
 - b) stop the hydration of cement
 - c) retard the setting action of cement
 - d) provide strength to cement
39. In the production of urea from ammonium carbamate, an undesirable side reaction can produce:
- a) ammonium sulfate
 - b) water
 - c) biuret
 - d) carbon monoxide
40. What is the role of metal oxides in soap production?
- a) fat splitting
 - b) saponification
 - c) removal of excess steam
 - d) removal of oil
41. Which process produces a thermoplastic?
- a) chlorination
 - b) nitration
 - c) condensation
 - d) chain polymerization

42. Textile wastewater treatment uses graphene-based _____ for turbidity removal.
- a) filtration
 - b) nanomaterials
 - c) adsorption towers
 - d) scrubber
43. If the measured temperature is added to the set point, it leads to an undesirable situation and frequently leads to instability. This phenomenon is called:
- a) disturbance rejection
 - b) offset
 - c) positive feedback
 - d) negative feedback
44. In a jacketed kettle system, which includes two controllers and two measuring elements, the output of the primary controller is used to adjust the set point of a secondary controller, which is used to control the jacket temperature. This kind of control is classified as:
- a) cascade control
 - b) feedforward control
 - c) ratio control
 - d) internal model control
45. How does a second-order system generally form in chemical engineering?
- a) making non-interacting system
 - b) making interacting system
 - c) using thermometer
 - d) adding controller
46. For which one of the following does the control system forces the system to track the requested set point changes?
- a) regulator problem
 - b) servo problem
 - c) negative feedback problem
 - d) positive feedback problem
47. In Ziegler-Nichols controller settings, if K_u is ultimate gain, proportional gain for PID controller is:
- a) $0.2 K_u$
 - b) $0.5 K_u$
 - c) $0.45 K_u$
 - d) $0.6 K_u$

48. A measuring device that changes the type of signal between its input and output is called:
- a) controller
 - b) transducer
 - c) control valve
 - d) transfer function
49. An explosion in which the reaction front moves at a speed less than the speed of sound in the unreacted medium is called:
- a) mechanical explosion
 - b) deflagration
 - c) detonation
 - d) confined explosion
50. What refers to airborne concentrations that correspond to conditions under which no adverse effects are normally expected during a worker's lifetime?
- a) TWA
 - b) TLV
 - c) LEL
 - d) IDLH
51. Which pollution control device may have a cut diameter of $0.4\ \mu$?
- a) cyclone
 - b) hydroclone
 - c) ESP
 - d) gravity settler
52. Which method compares a no-project scenario with the various alternative scenarios in which the activities at different stages of the project have potential negative effects on human health and natural resources?
- a) ethical analysis
 - b) cost-benefit analysis
 - c) risk assessment
 - d) environmental impact assessment
53. As per ISO 14001, what does PDCA stand for?
- a) Plan, Do, Check, Act
 - b) Plan, Do, Confirm, Amend
 - c) Prepare, Do, Check, Act
 - d) Prepare, Do, Confirm, Action

54. For a process which is six sigma complaint, what is the number of defects allowed per million opportunities?
- a) 0
 - b) 3.4
 - c) 9.7
 - d) 233
55. Standard dimensions (mm x mm) of A3 drawing sheet is
- a) 11.69×16.54
 - b) 29.7×42
 - c) 297×420
 - d) 420×280
56. Which of the following methods of charging depreciation of an asset has increased amount of depreciation as the age of asset increases
- a) sum-of-year digit
 - b) sinking fund
 - c) diminishing balance
 - d) straight line
57. The process of optimizing the project's limited resources without extending the project duration is known as
- a) project crashing
 - b) resource levelling
 - c) resource smoothing
 - d) networking
58. The process of composing/raising the required fund from different sources such as equity, preferred stock, bond and debenture is known as
- a) capital structure planning
 - b) project financing
 - c) capital budgeting decision
 - d) deducing earning per share
59. In which of the following society, people used to seek their existence on growing plants for their cattle and domestic animals
- a) pastoral society
 - b) tribal society
 - c) horticultural society
 - d) agricultural society

60. According to Nepal Engineering Council Act, 2055 (Revised, 2079), all engineering academic institutions shall be in the Council.
- a) affiliated
 - b) united
 - c) recognized
 - d) associated
61. In a chemical reactor where the reversible reaction $2A \rightleftharpoons B + C$ is governed by chemical equilibrium. ξ_{eq} is the extent of reaction at equilibrium. If the reactor is fed $n_{A,0}$ moles of reactant A, what is the number of moles of A leaving the reactor at equilibrium?
- a) $n_{A,0} - \xi_{eq}$
 - b) $n_{A,0} + 2 \xi_{eq}$
 - c) $2(n_{A,0} - \xi_{eq})$
 - d) $n_{A,0} - 2 \xi_{eq}$
62. In a multicomponent ideal liquid mixture undergoing distillation, the relative volatility (α_{ij}) between a light key component (i) and a heavy key component (j) is defined by the ratio of their K-values. If $\alpha_{ij} > 1$, which of the following statements about the component distribution in the separation process is correct?
- a) j will remain in the vapor phase.
 - b) i will concentrate in the vapor phase.
 - c) the separation of i and j by distillation is not possible.
 - d) i is the heavy key component.
63. In a mass balance of a chemical process with a recycle loop, what is the primary function of a purge stream?
- a) increase the single-pass conversion of the limiting reactant in the reactor.
 - b) adjust the overall composition of the final product stream to meet purity specifications.
 - c) remove an accumulation of inert contaminants that enter the system with the fresh feed.
 - d) recover and recycle unreacted raw materials back to the reactor inlet.
64. In the industrial manufacture of Trinitrotoluene, the nitrating agent is composed of concentrated nitric acid and concentrated sulfuric acid. What is the primary chemical role of the concentrated sulfuric acid in this process?
- a) it acts as the solvent for both the organic substrate and the final nitro compound.
 - b) it serves as a dehydrating agent.
 - c) it is the sole source of the electrophilic nitronium ion.
 - d) it reduces the reaction temperature.
65. Which of the following describes a lumped parameter model in chemical engineering?
- a) the model is exclusively based on empirical data fitting without any reference to fundamental physical or chemical laws.
 - b) the model accounts for variations in process variables in both time and all three spatial coordinates.
 - c) the model's complexity is so high that it can only be solved analytically without the need for numerical methods.
 - d) the model assumes that the process variables are only a function of time, meaning they are

uniform throughout the physical space.

66. The decomposition of solid calcium carbonate is represented by the heterogeneous equilibrium reaction: $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$. How is the equilibrium constant for this reaction defined in terms of the component partial pressures?
- a) $(P_{\text{CaO}}) (P_{\text{CO}_2}) / P_{\text{CaCO}_3}$
 - b) $P_{\text{CO}_2} / P_{\text{CaCO}_3}$
 - c) P_{CO_2}
 - d) P_{CaCO_3}
67. For a pure, simple compressible substance, what is the minimum number of independent intensive thermodynamic properties required to completely fix the state of the substance when it is in the superheated vapor region?
- a) 0
 - b) 1
 - c) 2
 - d) 3
68. Which statement correctly describes the maximum theoretical efficiency of a heat engine operating between a high-temperature source (TH) and a low-temperature sink (TC)?
- a) 100% if the heat engine is perfectly reversible and operates as a closed system.
 - b) $1 - T_C / T_H$ where temperatures are in absolute scale.
 - c) $1 - T_C / T_H$ where temperatures are in degrees Celsius.
 - d) independent of the operating temperatures.
69. In chemical engineering and HVACR systems, an eco-friendly refrigerant is primarily characterized by which two environmental parameters?
- a) viscosity and thermal conductivity
 - b) saturation pressure and flammability index
 - c) Coefficient of Performance and latent heat of vaporization
 - d) Ozone Depletion Potential and Global Warming Potential
70. Which of the following equations correctly defines a Newtonian fluid, where τ is the shear stress, τ_0 is the yield stress, μ is the constant dynamic viscosity, n is empirical constant, and du/dy is the shear rate (velocity gradient)?
- a) $\tau = \tau_0 + \mu du/dy$
 - b) $\tau = \mu du/dy$
 - c) $\tau = \mu (du/dy)^n$
 - d) $\tau = \tau_0 + \mu (du/dy)^n$
71. Bernoulli's equation is an expression of the conservation of what principle for an ideal fluid along a streamline?
- a) momentum
 - b) energy
 - c) mass
 - d) viscosity

72. Which type of impeller is generally preferred for processes involving very high viscosity fluids that require good radial mixing close to the vessel wall?
- helical ribbon
 - Rushton turbine
 - anchor
 - pitched-blade turbine
73. Compared to dry grinding, wet grinding typically results in:
- higher power consumption and less dust
 - lower power consumption and more dust
 - less dust and a coarser product
 - more dust and a finer product
74. Which method for particle size analysis is most suitable for determining the volume-to-surface mean diameter, and is particularly effective for particles in the sub-sieve to colloidal range?
- sedimentation method
 - microscopy
 - sieve analysis
 - permeability method
75. For an irreversible reaction $A \rightarrow B$ in a Continuous Stirred-Tank Reactor (CSTR), the performance equation relating the reactor volume (V), volumetric flow rate (v_0), and conversion (X_A) is:
- $V = v_0 (-r_A) X_A$
 - $V = v_0 \int_0^{X_A} dX_A / (-r_A)$
 - $V = F A_0 (-r_A)_{avg} / X_A$
 - $V = v_0 C A_0 X_A / (-r_A)$
76. In a fixed-bed reactor packed with catalyst pellets, the pressure drop primarily results from:
- heat exchange with the reactor walls
 - friction between the fluid and the solid packing
 - expansion/contraction due to chemical reaction
 - change in fluid density across the reactor
77. The method of initial rates is preferred for determining rate law parameters primarily because it:
- simplifies the reaction kinetics by maintaining constant temperature.
 - allows direct measurement of the rate before product inhibition occurs.
 - requires a smaller amount of reactant material.
 - only works for first-order irreversible reactions.
78. A substance that binds to a site on the enzyme other than the active site, thereby changing the enzyme's conformation and reducing its activity without affecting the substrate binding, exhibits which type of inhibition?
- competitive
 - uncompetitive

- c) non-competitive
- d) substrate

79. Which of the following is a critical step in the Chemical Vapor Deposition (CVD) process for growing thin films?

- a) physical sputtering of a solid target
- b) solid-liquid precipitation onto the substrate
- c) thermal decomposition and reaction of gaseous precursors
- d) high-pressure mechanical compression of powder

80. In a typical Polymer Electrolyte Membrane (PEM) fuel cell, the primary function of the membrane is to:

- a) block the flow of electrons and allow water vapor to pass.
- b) conduct electrons from the anode to the cathode.
- c) conduct protons from the anode to the cathode.
- d) store the hydrogen gas reactant.

81. Natural convection heat transfer is driven by:

- a) a forced external pump or fan
- b) pressure gradients created by the flow of an external fluid
- c) density differences caused by temperature gradients
- d) mechanical agitation of the fluid

82. The purpose of using baffles in the shell side of a shell and tube heat exchanger is primarily to:

- a) increase the tube surface area.
- b) prevent vibration of the tubes.
- c) direct the shell-side flow across the tubes, increasing turbulence.
- d) reduce the pressure drop in the shell-side fluid.

83. Which feeding method in a multiple-effect evaporator is generally preferred for heat-sensitive materials like fruit juices?

- a) forward feed
- b) backward feed
- c) parallel feed
- d) mixed feed

84. Which of the following conditions must hold true for the direct application of Fick's First Law in the form $J_A = -DAB \frac{dC_A}{dz}$ to be valid?

- a) the diffusion must be unsteady-state.
- b) the diffusion must occur in the presence of bulk fluid motion.
- c) the diffusion must be equimolar counterdiffusion.
- d) the diffusivity must be a strong function of the concentration and distance.

85. According to the two-film theory, the mass transfer resistance between a gas and a liquid phase is assumed to reside entirely within:
- a) the bulk gas phase
 - b) the bulk liquid phase
 - c) a thin film on the gas side and a thin film on the liquid side
 - d) the equilibrium interface
86. In the McCabe-Thiele diagram, the ideal location for the feed stage is determined by the intersection of which three lines?
- a) the rectifying operating line, the stripping operating line, and the q-line.
 - b) the rectifying operating line, the q-line, and the equilibrium curve.
 - c) the rectifying operating line, the stripping operating line, and the $y=x$ line.
 - d) the liquid x-axis, the vapor y-axis, and the equilibrium curve.
87. In a typical counter-current gas absorption tower, the operating line on a y-x plot represents the relationship derived from the:
- a) equilibrium data
 - b) material balance for the solute
 - c) Henry's Law
 - d) Raoult's Law
88. The process where the first stable, minimum-sized aggregate of molecules forms a solid phase nucleus from the supersaturated solution is called:
- a) crystal growth
 - b) secondary nucleation
 - c) primary nucleation
 - d) agglomeration
89. The industrial production of ammonia is commercially performed using the:
- a) Fischer-Tropsch process
 - b) Haber-Bosch process
 - c) Claus process
 - d) Contact process
90. The component in paint that is a solid, finely divided material responsible for color, opacity, and body is the:
- a) binder
 - b) solvent
 - c) pigment
 - d) additive
91. Polyvinyl Chloride (PVC) is primarily manufactured by the polymerization of its monomer using which of the following common methods
- a) condensation polymerization
 - b) solution polymerization
 - c) suspension polymerization

d) interfacial polymerization

92. Which processing technique is widely used in the food, pharmaceutical, and chemical industries to protect sensitive compounds from degradation caused by heat, oxidation, or moisture?

- a) Extrusion
- b) Sublimation
- c) Nano-encapsulation
- d) Crystallization

93. The component of a pneumatic control valve that converts the fluid pressure signal from the controller into a physical force to move the valve stem is the:

- a) plug
- b) actuator
- c) body
- d) positioner

94. In the analysis of a linear open-loop system in chemical engineering, what is the primary effect of dead time on the system's step response?

- a) it introduces oscillation and instability.
- b) it increases the time constant of the system, slowing down the exponential approach to steady state.
- c) it causes the output to remain unchanged for a time interval before the response begins.
- d) it decreases the ultimate steady-state gain of the system.

95. According to the Bode stability criterion, a linear system is stable if, at the frequency where the phase angle is -180° , the amplitude ratio is:

- a) greater than 1
- b) less than 1
- c) exactly equal to 1
- d) independent of 1

96. The standard electrode used in conjunction with a glass electrode for measuring pH in industrial applications is the:

- a) platinum electrode
- b) quinhydrone electrode
- c) reference electrode
- d) ion-selective electrode

97. If noise levels in an industrial plant consistently exceed the exposure limit of 85 dBA, which of the following is considered the most effective engineering control measure to reduce the noise hazard?

- a) enclosing the noisy equipment within a sound-absorbing acoustic barrier.
- b) implementing a strict control that limits worker exposure time to <4 hours per shift.
- c) posting hazard signs.
- d) providing all workers with mandatory dual hearing protection.

98. A key engineering measure for safely storing volatile flammable liquids (Class IA) is the use of:

- a) a pressurized tank with no venting
- b) an open-top tank for rapid pressure relief
- c) a floating-roof tank
- d) a sub-surface cavern storage

99. Which particulate matter abatement system is the most effective among the following for removing very fine particles (sub-micron size) from gas streams?

- a) wet scrubber
- b) cyclone separator
- c) electrostatic precipitator
- d) settling chamber

100. To prescribe the design and form of certificate of standard and of the certification mark, Government of Nepal may form a:

- a) quality control department.
- b) Nepal certification authority.
- c) Nepal standards council.
- d) standards design authority.