TS PGECET 2026 Chemical Engineering (CH)

Question Paper

Conducted by JNTU, Hyderabad

General Instructions

(i) The test is of 2 hours duration.

(ii) This test paper consists of 120 questions. The maximum marks are 120.

(iii) Each question carries +1 marks for correct answer and there is no negative marking for wrong answer.

1. If $A = \begin{bmatrix} 2 & 1 & 2 \\ 6 & 2 & 11 \\ 3 & 3 & 2 \end{bmatrix}$ **and** $P = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 1 & 2 \\ 0 & 1 & 5 \end{bmatrix}$**, then** $\left|P^{-1}AP - 2I\right| =$

(A) 55

(B) 69

(C) 96

(D) 38

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2. The system of equations $2x + y = 2z$, $y + z = 0$, $3y + \alpha z = x$ **has:**

(A) No solution for any value of α

(B) Infinite number of solutions for $\alpha = \frac{7}{2}$

(C) Only trivial solution for $\alpha = \frac{9}{2}$

(D) Infinite solutions of the form $(3k, -2k, 2k)$

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3. A function satisfying the conditions of Lagrange's mean value theorem on the interval $[1, 5]$ **is:**

(A) $f(x) = |x-1| + |x-5|$

(B) $g(x) = x - [x]$ $\quad$ ($[x]$ represents integral part of x)

(C) $h(x) = \begin{cases} 3x-1, & 0 \le x \le 1 \\ x^2+1, & 1 \le x \le 4 \\ 17, & 4 \le x \le 6 \end{cases}$

(D) $k(x) = \begin{cases} x^2, & -\infty < x \le 1 \\ x, & 1 \le x \le \infty \end{cases}$

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4. The value of $\oint_C x\,dy - y\,dx$, where C is the boundary of the rectangular region formed by $x = 5$, $x = 12$, $y = 0$, and $y = 8$ is:

(A) 56

(B) 28

(C) 112

(D) 72

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5. If the integrating factor of $\frac{dy}{dx} + \left[(x^2-2x)\cos x + 2(x-1)\sin x\right]y = x^2$ is $e^{f(x)}$, then $f(3) =$

(A) $3\cos 3 + 4\sin 3$

(B) $4\cos 3$

(C) $3\sin 3$

(D) $4\sin 3 + \cos 3$

---

6. Laplace transform of $\int_0^t u^2 \sin(t-u)\,du$ is:

(A) $\frac{2}{s(s+1)}$

(B) $\frac{1}{s^2(s^3+1)}$

(C) $\frac{2}{s^3(s^2+1)}$

(D) $\frac{2}{s(s^2+1)}$

---

7. Two dice are thrown simultaneously. Let X be the random variable representing the absolute difference of the numbers appeared on the dice. The mean of X is:

(A) $\frac{35}{18}$

(B) $\frac{13}{36}$

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(C) $\frac{7}{12}$

(D) 3

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8. If $f(x)$ is the probability density function of an exponential distribution and $\frac{1}{\lambda}$ is its mean, then $\int_0^\infty x^2 f(x)\,dx =$

(A) $\frac{1}{\lambda^2}$

(B) $\frac{3}{\lambda^2}$

(C) $\frac{2}{\lambda^2}$

(D) None of these

---

9. The solution of $\frac{dy}{dx} - y - 2x + x^2 = 0$, $y(0) = 1$ at $x = 0.2$ using Euler's method is:

(A) 1.229

(B) 1.1

(C) 1.37

(D) 1.521

---

10. By assuming that the solution to the equation $x^4 - x - 10 = 0$ lies between $x = 1.8$ and $x = 2$, then the next approximate solution by Regula-falsi method is (Take $f(1.8) = -1.3024$):

(A) 1.8491

(B) 1.9932

(C) 1.8001

(D) 1.9091

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11. A butane isomerization process produces 70 kmol/h of pure iso-butane. A purge stream removed continuously contains 85% n-butane and 15% impurity (mole %). The feed stream is n-butane containing 1% impurity (mole %). The flow rate of the purge stream will be:

(A) 3 kmol/h

(B) 4 kmol/h

(C) 5 kmol/h

(D) 6 kmol/h

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12. The weight fraction of methanol in an aqueous solution is 0.64**. The mole fraction of methanol** X_M **satisfies:**

(A) $X_M < 0.5$
(B) $X_M = 0.5$
(C) $0.5 < X_M < 0.64$
(D) $X_M > 0.64$

---

13. The composition of Air in weight percent is:

(A) $N_2 - 77\%, O_2 - 23\%$
(B) $N_2 - 21\%, O_2 - 79\%$
(C) $N_2 - 79\%, O_2 - 21\%$
(D) $N_2 - 23\%, O_2 - 77\%$

---

14. The net heat evolved or absorbed in a chemical process is the same whether the reaction takes place in one or in several steps is known as:

(A) Kirchhoff's law
(B) Le Chatelier's principle
(C) Beer's law
(D) Hess's law

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15. The molar composition of a gas is 10% H_2**,** 10% O_2**,** 30% CO_2 **and balance** H_2O**. If** 50% **of the** H_2O **condenses, the final mole percent of** H_2 **in the gas on a dry basis will be:**

(A) 10%
(B) 5%
(C) 18.18%
(D) 20%

---

16. Absolute zero temperature is:

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(A) 273° C

(B) 0° C

(C) −273° C

(D) None of these

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17. Which one of the following does not change during a phase change such as melting, vaporization and sublimation?

(A) Specific internal energy

(B) Specific enthalpy

(C) Specific entropy

(D) Specific Gibbs Free energy

---

18. Clapeyron equation deals with:

(A) Rate of change of vapour pressure with temperature

(B) Effect of an inert gas on vapour pressure

(C) Calculation of ΔF for spontaneous phase change

(D) Temperature dependence of heat phase transition

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19. Ideal refrigeration cycle is:

(A) Same as Carnot cycle

(B) Same as reverse Carnot cycle

(C) Dependent on the refrigerant's properties

(D) None of these

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20. Which one of the following is true for a throttling process?

(A) A gas may have more than one inversion temperature

(B) The inversion temperature is different for different gases

(C) The inversion temperature is same for all gases

(D) The inversion temperature is the temperature at which Joule-Thomson co-efficient is infinity

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21. A process flow sheet analysis results in the degree of freedom having a value of 2. Which one of the following steps must be carried out?

(A) Identify and add two new independent equations from process model
(B) Remove two equations that have been wrongly assumed to be independent
(C) Assign values of two variables in the process
(D) Assign value to one variable and remove one equation that was wrongly assumed to be independent

---

22. A cyclic engine exchanges heat with two reservoirs maintained at 100° C and 300° C respectively. The maximum work (in J) that can be obtained from 1000 J of heat extracted from the hot reservoir is:

(A) 349 J
(B) 651 J
(C) 200 J
(D) 500 J

---

23. The thermal efficiency of a reversible heat engine operating between two given thermal reservoirs is 0.4. The device is used either as a refrigerator or as a heat pump between the same reservoirs. Then the coefficient of performance as a refrigerator $(\text{COP})_{\text{R}}$ and the coefficient of performance as a heat pump $(\text{COP})_{\text{HP}}$ are:

(A) $(\text{COP})_{\text{R}} = (\text{COP})_{\text{HP}} = 0.6$
(B) $(\text{COP})_{\text{R}} = 2.5; (\text{COP})_{\text{HP}} = 1.5$
(C) $(\text{COP})_{\text{R}} = 1.5; (\text{COP})_{\text{HP}} = 2.5$
(D) $(\text{COP})_{\text{R}} = (\text{COP})_{\text{HP}} = 2.5$

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24. High pressure steam is expanded adiabatically and reversibly through a well-insulated turbine which produces some shaft work. If the enthalpy change and entropy change across the turbine are represented by ΔH and ΔS respectively for this process, then:

(A) $\Delta H = 0$ and $\Delta S = 0$
(B) $\Delta H \neq 0$ and $\Delta S = 0$

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(C) $\Delta H \neq 0$ and $\Delta S \neq 0$

(D) $\Delta H = 0$ and $\Delta S \neq 0$

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25. Generalized compressibility factor chart is a plot of:

(A) Compressibility factor versus reduced temperature with reduced pressure as parameter

(B) Compressibility factor versus reduced pressure with reduced temperature as parameter

(C) Compressibility factor versus reduced pressure with absolute temperature as parameter

(D) Compressibility factor versus reduced temperature with absolute pressure as parameter

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26. For a fully turbulent flow (Re $> 10^5$) in a pipe of diameter d, with a constant pressure gradient, the volumetric flow rate (Q) of an incompressible fluid varies with the diameter as:

(A) d

(B) d^2

(C) $d^{2.5}$

(D) d^4

---

27. Applying a pressure drop across a capillary results in a volumetric flow rate 'Q' under laminar flow conditions. The flow rate, for the same pressure drop, in a capillary of the same length but half the radius is:

(A) $\frac{Q}{2}$

(B) $\frac{Q}{4}$

(C) $\frac{Q}{8}$

(D) $\frac{Q}{16}$

---

28. For an ideal fluid flow the Reynolds number is

(A) one

(B) zero

(C) infinity

(D) 4000

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29. When the water flows over a rectangular suppressed weir, the pressure beneath the nappe is

(A) Very high

(B) Slightly above atmospheric

(C) Atmospheric

(D) Negative

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30. The velocity distribution in the turbulent boundary layer follows

(A) Straight line law

(B) Parabolic law

(C) Hyperbolic law

(D) Logarithmic law

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31. For a centrifugal pump with a specific impeller diameter, operating at a fixed speed and handling a fluid of constant density

(A) NPSH required decreases with increase in the capacity

(B) NPSH available increases with increase in the capacity

(C) NPSH required increases with increase in the capacity

(D) NPSH available decreases with decrease in the capacity

---

32. Fluids which show an apparent increase in viscosity with time are called

(A) rheopectic

(B) thixotropic

(C) ideal fluid

(D) dilatant fluid

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33. Cavitation can be prevented by

(A) suitably designing the pump

(B) maintaining the suction head sufficiently greater than the vapor pressure

(C) maintaining the suction head equal to developed head

(D) maintaining the suction head lower than the vapor pressure

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34. A rotameter

(A) Incurs constant and small permanent pressure drop

(B) Incurs constant but very large permanent pressure drop

(C) Is inaccurate for low flow rates

(D) Need not be mounted always vertically

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35. Weber number is the ratio of

(A) Surface tension forces to pressure forces

(B) Inertial forces to Surface tension forces

(C) Pressure forces to viscous forces

(D) Viscous forces to gravity forces

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36. For continuous reverse air cleaning in a fabric filter, gas-to-fabric ratio normally varies from

(A) 8 to 15 cfm/sq ft

(B) 0.2 to 0.5 cfm/sq ft

(C) 50 to 60 cfm/sq ft

(D) 0.01 to 0.1 cfm/sq ft

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37. Sorting classifier uses a sink-and-float method to separate particles based on the

(A) Particle size

(B) Difference in terminal velocities

(C) Difference in the densities of the particles

(D) Centrifugal force

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38. During size reduction, the optimum speed of ball mill must be

(A) 10 -15% of critical speed

(B) 30 -35% of critical speed

(C) 50 - 75% of critical speed

(D) more than 90% of critical speed

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39. In a gyratory crusher, the size reduction is effected primarily by

(A) Attrition

(B) Compression

(C) Impact

(D) Cutting action

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40. If the frequency of the stirrer in a mixing tank is increased by a factor of 2 while all other parameters are kept constant, by what factor is the power requirement increased at high Reynolds number?

(A) 4

(B) 8

(C) 16

(D) 32

---

41. Crushing efficiency is the ratio of

(A) Surface energy created by the crushing to the energy absorbed by the solid

(B) The energy absorbed by the solid to that fed to the machine

(C) The energy fed to the machine to the surface energy created by the crushing

(D) The energy absorbed by the solid to the surface energy created by the crushing

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42. In a fertilizer plant, in which of the following equipment, molten ammonium nitrate is mixed with ground lime-stone

(A) Pug mill

(B) Mixer-extruder

(C) Banbury mixer

(D) Muller mixer

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43. In continuous filtration (at a constant pressure drop), filtrate flow rate varies inversely as

(A) The square root of the velocity

(B) The square square of viscosity

(C) The filtration time only

(D) The washing time only

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44. Which one of the following is valid for a laminar flow of filtrate through a cake deposited on septum?

(A) Kozney-Carman equation

(B) Leva's equation

(C) Blake-Plummer equation

(D) Hagen – Poiseuille equation

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45. The most efficient equipment for removal of sub-micron dust particles from blast furnace gas is

(A) Venture atomiser

(B) Gravity settling chamber

(C) Electro-static precipitator

(D) Cyclone separator

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46. In a feed forward multiple effect evaporator unit

(A) Viscosity of liquid is highest in first effect

(B) Transfer from effect to effect is done by pumps

(C) No pump is required to withdraw the product from the last effect

(D) No pump is required to transfer liquid from effect to effect

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47. Baffles in the shell side of a shell and tube heat exchanger

(A) Increase the cross-section of the shell side liquid

(B) Force the liquid to flow parallel to the bank

(C) Increase the shell side heat transfer co-efficient

(D) Decrease the shell side heat transfer co-efficient

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48. The thermal conductivity is minimum for

(A) Copper

(B) Water

(C) Silver

(D) Air

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49. In a heat exchanger, floating head is provided to

(A) Facilitate cleaning of the exchanger

(B) Increase the heat transfer area

(C) Increase the log mean temperature gradient

(D) Relieve stresses caused by thermal expansion

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50. LMTD for counter flow and parallel flow heat exchanger will be the same, when

(A) A cold fluid is heated to a certain temperature by condensing steam (isothermal fluid)

(B) The outlet temperature of both the hot and cold fluids are same

(C) The outlet temperature of hot fluid is less than the outlet temperature of the cold fluid

(D) One of the fluids undergoes a phase change

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51. For a blackbody, the wavelength at which the maximum monochromatic emissive power occurs is

(A) Independent of the absolute temperature of the blackbody

(B) Directly proportional to absolute temperature of the blackbody

(C) Inversely proportional to the absolute temperature of the blackbody

(D) Proportional to the fourth power of the absolute temperature of the blackbody

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52. A composite wall consists of two plates A and B placed in series normal to the flow of heat. The thermal conductivities are k_A and k_B and the specific heat capacities are C_{pA} and C_{pB}, for plates A and B respectively. Plate B has twice the thickness of plate A. At steady state, the temperature difference across plate A is greater than that across plate B when:

(1) $C_{pA} > C_{pB}$

(2) $C_{pA} < C_{pB}$

(3) $k_A < 0.5\,k_B$

(4) $k_A > 2\,k_B$

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53. For laminar film condensation on vertical surface, the film thickness:

(1) cumulatively decreases from top to bottom

(2) cumulatively increases from top to bottom

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(3) the surface conductance increase from top to bottom

(4) remains constant from top to bottom

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54. If the baffle spacing in a shell and tube heat exchanger increases, then the Reynolds number of the shell side fluid:

(1) Remains unchanged

(2) Decreases

(3) Increases

(4) First increases then decreases

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55. The Sieder-Tate correlation for heat transfer in turbulent flow in a pipe gives Nu $\propto$ Re$^{0.8}$, where Nu is the Nusselt number and Re is the Reynolds number for the flow. Assuming that this relation is valid, the heat transfer coefficient varies with the pipe diameter (D) as:

(1) $D^{-1.8}$

(2) $D^{-0.2}$

(3) $D^{0.2}$

(4) $D^{1.8}$

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56. Prandtl number in heat transfer is analogous to the following dimensionless number in mass transfer:

(1) Stanton number

(2) Schmidt number

(3) Sherwood number

(4) Peclet number

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57. Unsaturated air (with dry bulb temperature and dew point being 35°C and 18°C respectively) is passed through a water spray chamber maintained at 15°C. The air will be:

(1) Cooled and humidified

(2) Cooled and dehumidified with increase in wet bulb temperature

(3) Cooled at the same relative humidity

(4) Cooled and dehumidified with decrease in wet bulb temperature

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58. Which one of the following forms minimum boiling azeotrope at one atmosphere?

(1) acetone-chloroform

(2) benzene-toluene

(3) hydrochloric acid-water

(4) ethanol-water

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59. A batch of material is dried under constant drying conditions. When drying is taking place from all the surfaces, the rate of drying during the constant rate period is:

(1) Directly proportional to the solid thickness

(2) Inversely proportional to the solid thickness

(3) Independent of solid thickness

(4) Inversely proportional to the square of solid thickness

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60. Which one of the following tray gives greatest flexibility in distillation column?

(1) Bubble cap tray

(2) Valve tray

(3) Sieve tray

(4) Linde tray

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61. The dew point of an unsaturated mixture of water vapour and air at constant temperature and pressure:

(1) Does not change with change in absolute humidity

(2) Increases with increase in absolute humidity

(3) Decreases with increase in absolute humidity

(4) Decreases linearly with increase in absolute humidity

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62. An azeotropic mixture of two liquids has boiling point higher than either of them when it:

(1) is saturated

(2) shows negative deviation from Raoult's law

(3) shows positive deviation from Raoult's law

(4) shows no deviation from Raoult's law

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63. If there is condensation of carrier steam in the steam distillation of high-boiling organic materials, then:

(1) Both temperature and pressure must be fixed

(2) Either the temperature or the pressure may be fixed

(3) The temperature is always more than 100°C at 1 atm

(4) The temperature is always equal to 100°C at 1 atm

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64. The reason for referring packed towers over plate towers in distillation practice is that the packed tower operation gives:

(1) low pressure drop and high hold up

(2) high pressure drop and low hold up

(3) low pressure drop and low hold up

(4) high pressure drop and high hold up

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65. In binary distillation, the number of bubble cap per tray primarily depends on:

(1) Allowable gas velocity

(2) Allowable liquid velocity

(3) Tray spacing

(4) Purge rate

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66. In distillation column design, the McCabe-Thiele procedure is inadequate and Ponchon-Savarit procedure is needed when:

(1) saturated feed is not used

(2) an azeotrope forms

(3) the latent heats of vaporization of the more and less volatile components are greatly different

(4) a total condenser is used

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67. In an inter-phase mass transfer process, the lesser the solubility of a given solute in a liquid, the higher are the chances that the transfer process will be:

(1) liquid phase resistance controlled

(2) gas phase resistance controlled

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(3) impossible

(4) driven by a non-linear driving force

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68. In an absorber the equilibrium curve is always:

(1) Parallel to the operating line

(2) Above the operating line

(3) Below the operating line

(4) Irrelevant to the operating line

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69. The individual mass transfer coefficients (mol/m$^2 \cdot$ s) for absorption of a solute from a gas mixture into a liquid solvent are $k_L = 4.5$ and $k_G = 1.5$. The slope of the equilibrium line is 3. Which one of the following resistance(s) is/are controlling?

(1) Liquid - side

(2) Gas - side

(3) Interfacial

(4) Both liquid and gas-sides

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70. The molecular diffusivity of a liquid:

(1) decreases with temperature

(2) increases with temperature

(3) may increase or decrease with temperature

(4) is independent of temperature

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

(1) The time required to process one reactor volume of feed (measured at specified conditions) is 3 hours

(2) Three reactor volumes of feed can be processed every hour

(3) After every 3 hours, the reactor needs to be cleaned

(4) The actual residence time of every fluid element is exactly 3 hours

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72. For all positive reaction orders and for a given reactor duty:

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(1) Mixed reactor is always larger than the plug-flow reactor

(2) The ratio of the volume of the mixed reactor to that of the plug-flow reactor decreases with order

(3) Reactor size is independent of the type of flow

(4) Density variation during reaction affects design

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

(1) Operating conditions like pressure and temperature

(2) Rate constant

(3) Density of mixture

(4) Catalyst

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74. For a highly exothermic, solid-catalysed reaction, what reactor configuration should be used to achieve high conversion?

(1) Fixed bed reactor

(2) Fluidised bed reactor followed by a fixed bed reactor

(3) Fixed bed reactor followed by a fluidised bed reactor

(4) Fluidised bed reactor

---

75. The catalyst in a second order reversible reaction increases the rate of the:

(1) Forward reaction and decreases that of backward reaction

(2) Forward and backward reactions equally

(3) Forward reaction only

(4) Forward reaction to a greater extent than that of the backward reaction

---

76. The unit of frequency factor in Arrhenius equation is:

(1) same as that of rate constant

(2) same as that of activation energy

(3) Dimensionless

(4) inverse of that of rate constant

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77. For Arrhenius model of the rate constant $k = k_0 \cdot e^{-E/RT}$, the graph drawn between $\ln(k)$ versus $\frac{1}{T}$ gives the slope of:

(1) $\frac{E}{R}$

(2) $-\frac{E}{R}$

(3) $\frac{R}{E}$

(4) $-\frac{R}{E}$

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78. The gas phase reaction $A \rightarrow B + C$ is carried out in an ideal PFR achieving 40% conversion of A. The feed has 70 mole % A and 30% inerts. The inlet temperature is 300 K and the outlet temperature is 400 K. The ratio of the outlet to inlet molar concentration of A (assuming ideal gas mixture and uniform pressure) is:

(1) 0.60

(2) 0.30

(3) 0.40

(4) 0.35

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

(1) Fast reactions in catalyst of small pore diameter

(2) Fast reactions in catalyst of large pore diameter

(3) Slow reactions in catalyst of small pore diameter

(4) Slow reactions in catalyst of large pore diameter

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80. Molecularity of a reaction:

(1) is always equal to the overall order of the reaction

(2) refers to the empirically found rate constant

(3) cannot have a fractional value

(4) refers only to non-elementary reaction

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

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(1) 2 T

(2) 0.5 T

(3) $\frac{T}{0.693}$

(4) 0.693 T

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82. The E-curve for a non-ideal reactor defines the fraction of fluid having age between t and t + dt:

(1) At the inlet

(2) At the outlet

(3) Inside the reactor

(4) In the bypass stream

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83. A reaction in which one of the products of the reaction acts as a catalyst is called:

(A) a catalytic reaction

(B) a photochemical reaction

(C) an autocatalytic reaction

(D) a biochemical reaction

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84. The rate of reaction of any component is a function of:

(A) Temperature of the system only

(B) Pressure of the system only

(C) Composition of the component only

(D) Temperature, pressure and composition

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85. For the irreversible unimolecular first-order type reaction:

(A) The fractional conversion at any time is same for constant volume systems and variable systems

(B) The fractional conversion at any time is more for constant volume systems than variable-volume systems

(C) The fractional conversion at any time is less for constant volume systems than variable-volume systems

(D) None of the options are correct

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86. Which one of the following is a first-order instrument?

(A) U-tube type mercury manometer

(B) Bimetallic thermometer with covering

(C) Vapour pressure thermometer without any covering

(D) Mercury thermometer with covering

---

87. Which one of the following is the most suitable to measure a temperature of 2000 °C?

(A) Ordinary mercury-in-glass thermometer

(B) Platinum resistance thermometer

(C) Radiation pyrometer

(D) Constant-volume hydrogen thermometer

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88. Ordinary mercury-in-glass thermometer works on the principle of:

(A) Volumetric expansion of mercury with increase in temperature

(B) Increase of vapour pressure with increase in temperature

(C) Increase of electrical resistance with increase in temperature

(D) Decrease of vapour pressure with increase in temperature

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89. In thermistors, the resistance:

(A) Remains unaffected with change in temperature

(B) Increases with increase in temperature

(C) Increases linearly with increase in temperature

(D) Decreases with increase in temperature

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90. Manipulated variable in water heater is:

(A) Flow rate of water

(B) Temperature of outlet water

(C) Heat input

(D) Inlet temperature of water

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91. If response of a control system is to be free of offset and oscillation, then the most suitable controller is:

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(A) Proportional controller

(B) Proportional-derivative (PD) controller

(C) Proportional-integral (PI) controller

(D) Proportional-integral-derivative (PID) controller

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92. A first order system with a time constant of 1 minute is subjected to frequency response analysis. At an input frequency of 1 radian / minute, the phase shift is:

(A) 45°

(B) −90°

(C) −180°

(D) −45°

---

93. Select the correct statement from the following:

(A) The frequency response of a pure capacity process is unbounded

(B) The phase lag of a pure time delay system decrease with increasing frequency

(C) The amplitude ratio of a pure capacity process is inversely proportional to the frequency

(D) The amplitude ratio of a pure time delay system increases with frequency

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94. A typical example of a physical system with second order under-damped characteristics is a:

(A) U-tube manometer

(B) Spring – loaded diaphragm valve

(C) CSTR with first order reaction

(D) Thermocouple kept immersed in a liquid filled thermal well

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95. The closed loop poles of a stable second order system could be

(A) Real and positive

(B) Complex conjugate with positive real part

(C) Real and negative

(D) One real positive and the other real negative

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96. Temperature control of an exothermic chemical reaction taking place in a CSTR is done with the help of cooling water flowing in a jacket around the reactor. The types of valve and controller action to be recommended are

(A) Air to open valve with the controller direct acting

(B) Air to close valve with the controller indirect acting

(C) Air to open valve with the controller indirect acting

(D) Air to close valve with the controller direct acting

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97. The value of ultimate period of oscillation P_u is 3 minutes and that of the ultimate controller gain K_u is 2. Select the correct set of tuning parameters (controller gain K_c, the derivative time constant T_D in minutes and the integral time constant T_I in minutes) for a PID controller using Ziegler-Nichols controller settings

(A) $K_c = 1.1, T_I = 2.1, T_D = 1.31$

(B) $K_c = 1.2, T_I = 1.5, T_D = 0.375$

(C) $K_c = 1.5, T_I = 1.8, T_D = 0.51$

(D) $K_c = 0.9, T_I = 1.2, T_D = 0.25$

---

98. The Laplace transform of the function $f(t) = 3t$ is

(A) $\frac{3}{s^3}$

(B) $\frac{3}{s^4}$

(C) $\frac{3}{s^2}$

(D) $\frac{3}{s}$

---

99. Which of the following is a condition for a stable feedback control system?

(A) Roots of the characteristic equation should be real

(B) Poles of the closed loop transfer function should lie in the left half of the complex plane

(C) Bode plots of the corresponding open loop transfer function should monotonically decrease

(D) Poles of the closed loop transfer function should lie in the right half of the complex plane

---

100. Match the first order system given with the appropriate time constant shown in Table:

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First order system		Appropriate time constant (T)	
P	Thermometer	1	(mCp) / (hA)
Q	Mixing process	2	RC
R	Liquid level system	3	V / q
S	RC circuit	4	AR

(1) $P-4,\ Q-2,\ R-3,\ S-1$

(2) $P-4,\ Q-3,\ R-1,\ S-2$

(3) $P-1,\ Q-2,\ R-3,\ S-4$

(4) $P-1,\ Q-3,\ R-4,\ S-2$

---

101. If 'S' is the amount available for 'n' interest periods for an initial principal 'P' with the discrete compound interest rate 'i', the present worth is given by

(1) $\frac{(1+i)n}{S}$

(2) $\frac{S}{(1+i)^n}$

(3) $\frac{S}{(1+in)}$

(4) $\frac{S}{(1+n)i}$

---

102. In plant design, 'de-bottlenecking' refers to

(1) Increasing capacity of the limiting process step

(2) Reducing labour costs

(3) Adding new reactors

(4) Changing the product specification

---

103. The nominal and effective interest rates are equal when the interest is compounded

(1) monthly

(2) continuously

(3) semi annually

(4) annually

---

104. The 'Payout Time' or 'Payback Period' is best defined as

(1) Time to recover total capital investment from profit

(2) Time to recover fixed capital investment from cumulative cash flow

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(3) Total project life divided by annual revenue

(4) Time to reach break-even point after start-up

---

105. The 'six-tenths rule' is used to estimate

(1) Equipment cost from size

(2) Plant cost from capacity

(3) Operating labor from production rate

(4) Maintenance cost from equipment cost

---

106. Working capital is typically what percentage of total capital investment for a chemical process plant?

(1) $5-10\%$

(2) $10-20\%$

(3) $30-50\%$

(4) $50-70\%$

---

107. For preliminary estimates, the ratio of indirect costs to direct costs for chemical plants is often in the range

(1) $0.1-0.3$

(2) $0.3-0.5$

(3) $0.5-0.8$

(4) $1.0-1.5$

---

108. Discounted cash flow method is mainly used for

(1) Depreciation

(2) Profitability analysis

(3) Payout period

(4) Salvage value

---

109. For a typical project, the cumulative cash flow is zero at the

(1) End of project life'

(2) Break-even point

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(3) Start-up

(4) Design stage

---

110. The 'salvage value' of equipment at the end of project life is

(1) Considered a cash inflow in final year

(2) Ignored in economic analysis

(3) Part of working capital recovery

(4) Added to annual depreciation

---

111. Comparing sulphate process with sulphite process it is found that

(1) Both temperature and pressure in the former is less than that in the later

(2) Both temperature and pressure in the former is more than that in the later

(3) Temperature is more in the former whereas pressure is more in the later

(4) Pressure is more in the former whereas temperature is less in the later

---

112. Styrene-Butadiene rubber is commercially manufactured by

(1) Bulk polymerization

(2) Suspension polymerization

(3) Solution polymerization

(4) Emulsion polymerization

---

113. Poly Tetra Fluoro Ethylene (PTFE) is known as

(1) Bakelite

(2) Teflon

(3) Celluloid

(4) Dacron

---

114. Sodium tripolyphosphate is mainly used in

(1) Plastics

(2) Detergents formulation

(3) Mechanical industries

(4) Fertilizers

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115. In petroleum refining, the process used for conversion of hydrocarbons to aromatics is called

(1) catalytic cracking

(2) catalytic reforming

(3) hydrotreating

(4) alkylation

---

116. In catalytic cracking

(1) Gasoline obtained has a very low octane number

(2) Pressure and temperature is very high

(3) Gasoline obtained has very high aromatic content

(4) Gasoline obtained has very high amount of gum forming compounds

---

117. Excessive use of chemical fertilisers causes shrivelling of the roots and wilting of the plant because the

(1) Osmotic pressure of the soil water becomes less than that of the plant sap

(2) Soil becomes too alkaline

(3) Osmotic pressure of the soil water becomes higher than that of the plant sap

(4) Soil becomes too acidic

---

118. Black liquor is converted into the white liquor by

(1) Evaporation and burning the concentrate followed by causticisation of products

(2) Multi-effect evaporation only

(3) Selective liquid extraction

(4) Extractive distillation

---

119. Cooking conditions in Kraft pulp process are

(1) Time 2-5 hrs, temperature 170-176°C and pressure 660-925 kPa

(2) Time 6-12 hrs, temperature 125-160°C and pressure 620-755 kPa

(3) Time 36-48 minutes, temperature 160-180°C and pressure 660-1100 kPa

(4) Time 60-72 minutes, temperature 170-176°C and pressure 660-1100 kPa

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120. Unsaturated oils compared to saturated oils have

(1) Lower melting point and higher reactivity to oxygen

(2) Higher melting point and higher reactivity to oxygen

(3) Lower melting point and lower reactivity to oxygen

(4) Higher melting point and lower reactivity to oxygen

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