CET(PG)-2015

Sr. No. : 240039

Question Booklet Series : A

Important : Please consult your Admit Card / Roll No. Slip before filling your Roll Number on the Test Booklet and Answer Sheet.

Roll No.   *In Figures*   *In Words*

O.M.R. Answer Sheet Serial No.

Signature of the Candidate : _____

Subject : M.Tech. (Polymer)

Time : 90 minutes   Number of Questions : 75   Maximum Marks : 75

DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO

INSTRUCTIONS

1. Write your Roll No. on the Question Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Subject and Series Code of Question Booklet on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Ball Point / Black Gel pen.**
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. To open the Question Booklet remove the paper seal gently when asked to do so.
5. Please check that this Question Booklet contains **75** questions. In case of any discrepancy, inform the Assistant Superintendent within 10 minutes of the start of test.
6. Each question has four alternative answers (A, B, C, D) of which only one is correct. For each question darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Ball Point / Black Gel pen.**
7. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Sheet. No marks will be deducted in such cases.
8. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the questions given in the Question Booklet.
9. Negative marking will be adopted for evaluation i.e., 1/4th of the mark of the question will be deducted for each wrong answer. A wrong answer means incorrect answer or wrong filling of bubble.
10. For calculations, use of simple log tables is permitted. Borrowing of log tables and any other material is not allowed.
11. For rough work only the sheets marked "Rough Work" at the end of the Question Booklet be used.
12. The Answer Sheet is designed for **computer evaluation.** Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e., not following the instructions completely, shall be of the candidate only.**
13. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
14. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so, would be expelled from the examination.
15. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistance or found giving or receiving assistance or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent/Observer whose decision shall be final.
16. **Telecommunication equipment such as pager, cellular phone, wireless, scanner, etc., is not permitted inside the examination hall. Use of calculator is not allowed.**

1. The velocity distribution in turbulent flow in a pipe is given approximately by Prandtl :

   (A) $\dfrac{u}{u_{max}} = \left(\dfrac{y}{R}\right)^{1/3}$

   (B) $\dfrac{u}{u_{max}} = \left(\dfrac{y}{R}\right)^{1/5}$

   (C) $\dfrac{u}{u_{max}} = \left(\dfrac{y}{R}\right)^{1/7}$

   (D) $\dfrac{u}{u_{max}} = 1 - \left(\dfrac{y}{R}\right)^{1/7}$

   Where y is the distance measured from the pipe wall and R is pipe radius.

2. For turbulent flow in a pipe, the value of kinetic energy correction factor (α) :

   (A) is 0.75
   (B) is 2
   (C) varies from 1.01 to 1.10
   (D) is more than 2

3. Solvent used in azeotropic distillation known as entrainers :

   (A) is of low volatility
   (B) forms a low-boiling azeotrope
   (C) forms a high-boiling azeotrope
   (D) does not alter the relative volatility of the original components

4. A measure of the effect of compressibility in fluid flow is the magnitude of a dimensionless parameter known as :

   (A) Reynolds number
   (B) Weber number
   (C) Euler number
   (D) Mach number

5. The chemical formula for Glauber's salt is :

   (A) $Na_2CO_3.10H_2O$
   (B) $Na_2SO_4.10H_2O$
   (C) $Na_2CO_3.H_2O$
   (D) $Na_2SO_4.5H_2O$

6. The Prandtl number of a fluid is the ratio of :

   (A) Thermal diffusivity to momentum diffusivity
   (B) Momentum diffusivity to thermal diffusivity
   (C) Conductive resistance to convective resistance
   (D) Thermal diffusivity to kinematic diffusivity

7. In the sulphate pulp process, the digestor conditions are :
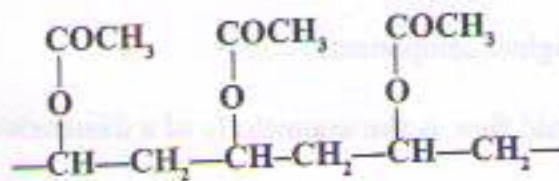
   (A) 120-130°C and 5 atm
   (B) 120-130°C and 1 atm
   (C) 70-80°C and 15 atm
   (D) 175-180°C and 10 atm

8. The action of a catalyst follows its ability to change the :
   (A) heat of reaction
   (B) heat of formation of the product
   (C) activation energy
   (D) equilibrium constant

9. Styrene is produced by :
   (A) Catalytic oxidation of cumene
   (B) Catalytic oxidation of toluene
   (C) Dehydrogenation of ethylbenzene
   (D) Catalytic oxidation of O-xylene

10. Measuring lag of a first order instrument is taken as :
    (A) Zero
    (B) One time constant
    (C) Two time constant
    (D) Half time constant

11. Phenol and Formaldehyde are polymerised to a resultant product known as :
    (A) PVC
    (B) bakelite
    (C) polyester
    (D) teflon

12. PVA has the chain structure

$$\begin{array}{ccc} COCH_3 & COCH_3 & COCH_3 \\ | & | & | \\ O & O & O \\ | & | & | \\ -CH-CH_2-CH-CH_2-CH-CH_2- \end{array}$$

The monomer that this is made from is :
    (A) $HO-CH=CH-COCH_3$
    (B) $CH_2=CH-O-COCH_3$
    (C) $CH_3-CH_2-O-COCH_3$
    (D) $CH-O-COCH_3-CH_2$

13. The Reynolds Analogy :
    (A) applies only to fluids for which the Prandtl number is unity
    (B) applies over a range of Prandtl numbers from 0.6 to 120
    (C) can be used for situations where form drag appears
    (D) cannot be used for situations where wall drag appears

14. 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 :
    (A) Directly proportional to the solid thickness
    (B) Independent of the solid thickness
    (C) Inversely proportional to the solid thickness
    (D) Directly proportional to the square of solid thickness

15. Which one of the following is an addition polymer with the same structure as polyethylene except that one hydrogen on every other carbon is replaced by a benzene ring ?

    (A) polyvinyl chloride

    (B) polypropylene

    (C) polystyrene

    (D) polyurethane

16. Which of the following is NOT a biopolymer ?

    (A) protein

    (B) polysaccharide

    (C) polyurethane

    (D) RNA

17. Advantages to replacement of metal parts used in high-temperature applications with ceramics include :

    1. Ceramics are easily manufactured free of defects.

    2. Ceramics are less dense than metals.

    3. Ceramics are less brittle than metals.

    4. Ceramics are more resistant to corrosion than metals.

    (A) 2, 4

    (B) 1, 2, 3, 4

    (C) 2, 3, 4

    (D) 1, 3, 4

18. An elastomer will fail to regain its original dimensions following a distortion beyond its :

    (A) glass transition

    (B) phase boundary

    (C) crystallinity

    (D) elastic limit

19. The catalyst used for olefin polymerization is :

    (A) Ziegler-Natta catalyst

    (B) Wilkinson catalyst

    (C) Raney nickel catalyst

    (D) Merrifield resin

20. Natural rubber is too soft and chemically reactive for practical applications. Vulcanization of natural rubber entails :

    (A) conversion of an addition polymer to a condensation polymer

    (B) increasing the average molecular weight of a condensation polymer

    (C) decreasing the average molecular weight of an addition polymer

    (D) cross-linking reactive polymer chains with sulfur atoms

21. Dynamic error for a ramp input (At) in a critically damped second-order instruments is :

(A) AT

(B) ½ AT

(C) $\sqrt{AT}$

(D) 2 AT

Where T = time constant of an instrument.

22. The WLF Equation is :

(A) A combination of Voigt and Maxwell models that describes creep

(B) A four parameter model for stress relaxation

(C) An expression for the shift factor that is used in the time-temperature superposition principle

(D) The relationship between intrinsic viscosity and molecular weight

23. Flow rate of sludge is commonly determined by :

(A) Orifice meter

(B) Venturi meter

(C) Open weir

(D) Rotameter

24. If pH = 5, then [H+] ions concentration in moles per litre is :

(A) 5×10^{-1}

(B) 0.0005

(C) 6×10^{-5}

(D) 0.00001

25. The inverse Laplace transform of $s/(s^2 - k^2)$ is :

(A) sin kt

(B) cos kt

(C) sinh kt

(D) cosh kt

26. Time constant of a first order system is numerically equal to :

(A) Resistance/capacitance

(B) Capacitance/resistance

(C) Capacitance × resistance

(D) Resistance × $\sqrt{capacitance}$

27. A first order unimolecular irreversible reaction $A \xrightarrow{k} P$ is occurring in a CSTR. The time constant of the system is :

(A) Equal to the hold up time

(B) Less than the hold up time

(C) Greater than the hold up time

(D) (1/k) times the hold up time

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28. Two interacting first order systems connected in series will behave as :
    (A) an overdamped second order system
    (B) an underdamped second order system
    (C) critically damped second order system
    (D) a first order system

29. Urea is formed in a low pressure stripping operation by dehydration of :
    (A) Ammonium bicarbonate
    (B) Ammonium carbamate
    (C) Biuret
    (D) Ammonium nitrate

30. Ammonium nitrate is made by reacting liquid ammonia and 60% nitric acid. The reaction is :
    (A) Endothermic
    (B) Exothermic
    (C) Catalytic
    (D) Reversible

31. The Sherwood number is defined as :

    (A) $\dfrac{D_{AB}}{k_c d}$

    (B) $\dfrac{k_c}{D_{AB} d}$

    (C) $\dfrac{D_{AB} k_c}{d}$

    (D) $\dfrac{k_c d}{D_{AB}}$

    Where k_c = mass transfer coefficient for equimolar counter diffusion with concentration as the driving force

    d = hydraulic diameter

    D_{AB} = diffusivity

32. The Chilton-Colburn Analogy for mass transfer states that :

   (A) $N_{St} N_{Sc}^{1/3} = f/8$

    (B) $N_{St} N_{Sc}^{2/3} = f/2$

    (C) $N_{St} N_{Sc}^{3/2} = f/2$

    (D) $N_{St} N_{Sc}^{2/3} = f/8$

    Where f = Fanning Friction factor

33. Consider a composite wall consisting of three layers of insulation of length L1, L2 and L3, and thermal conductivities k_1, k_2 and k_3 respectively. The insulating layers are placed in sequence 1, 2 and 3 and a certain rate of heat transfer results. If the order is now reversed to 3, 2, 1, rate of heat transfer through the wall under otherwise uniform conditions :
    (A) will decrease
    (B) will increase
    (C) will remain unchanged
    (D) cannot be predicted, more information required

34. Gasoline is siphoned from a car tank, as shown in the figure below. The atmospheric pressure is the same at either end, and the height difference from the top of the tank to the bottom of the siphon is 1.0 m. Utilize Bernoulli's equation to determine the velocity of flow of gasoline out of the tube.
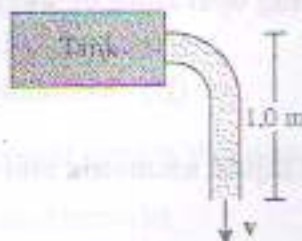
(A) 1.1 m/s   (B) 4.4 m/s

(C) 2.2 m/s   (D) 8.8 m/s

35. The ethanol water azeotrope at 1 atm occurs at :

(A) 89.4 mole percent ethanol at 78.2°C   (B) 89.4 mole percent water at 78.2°C

(C) 96.0 mole percent ethanol at 78.2°C   (D) 96.0 percent ethanol at 100°C

36. To ensure reasonably uniform distribution of liquid flow on single pass tray in the distillation column, a weir length used is about :

(A) 25 to 30% of the tower diameter   (B) 60 to 75% of the tower diameter

(C) 15 to 20% of the tower diameter   (D) 5 to 15% of the tower diameter

37. A gaseous solute having mass diffusivity equal to 0.5 cm²/s diffuses into a porous solid having a porosity of 0.5 and a tortuosity of 2. The effective diffusivity in the porous solid is :

(A) 0.25 cm²/s   (B) 0.5 cm²/s

(C) 1 cm²/s   (D) 0.125 cm²/s

38. The energy required per unit mass to grind limestone particles of very large size to 100 Mm is 12.7 kWh/ton. An estimate (using Bond's Law) of the energy to grind the particles from a very large size to 50 Mm is :

(A) 6.35 kWh/ton   (B) 9.0 kWh/ton

(C) 18 kWh/ton   (D) 25.4 kWh/ton

39. Wilson plot is a graph between :

(A) U vs $v^{0.8}$ (B) $1/U$ vs $1/v^{0.8}$

(C) U vs $1/v^{0.8}$ (D) $1/U$ vs $v^{0.8}$

40. In a tray column, separating a binary mixture, with non-ideal stages, ONE of the following statements is TRUE :

(A) Point efficiency can exceed 100%

(B) Murphree efficiency cannot exceed 100%

(C) Murphree efficiency can exceed 100%

(D) Both Murphree and point efficiencies can exceed 100%

41. The value of α in Mark-Houwink equation $[\eta] = KM^{\alpha}$ in theta solvent is :

(A) 1.0

(B) 0

(C) 0.5

(D) 0.8

42. A polymer rod is initially 100 mm long. When subjected to a load of 10,000 kg, it elongates elastically to a final length of 200 mm. The cross-sectional area is 10 square mm. The Young's modulus of the material is :

(A) 50 kg/mm²

(B) 100 kg/mm²

(C) 500 kg/mm²

(D) 1000 kg/mm²

43. In a double pipe heat exchanger the outer diameter of inner pipe is d1 and inner diameter of outer pipe is d2. The equivalent diameter of annulus for pressure drop calculations is :

(A) $(d_2^2 - d_1^2)/d_1$

(B) $4(d_2^2 - d_1^2)/d_1$

(C) $(d_2 - d_1)$

(D) $4(d_2 - d_1)$

44. The equation $DP = 1/1 - p$ relates degree of polymerization to the extent of the reaction is known as :

(A) Huggin's equation

(B) Carother's equation

(C) Mark-Houwink equation

(D) Copolymerization equation

45. Which of the following relates the absorption and evolution of heat at the junctions of a thermocouple to the current flow in the circuit ?

(A) Seebeck effect

(B) Peltier effect

(C) Thomson effect

(D) Joule-Thomson effect

46. Flash distillation operation is suitable for separating components which :

(A) Boil at very close temperature

(B) Boil at widely different temperature

(C) Form minimum boiling azeotrope

(D) Form maximum boiling azeotrope

47. **Cellulose is a condensation polymer of :**

    (A) Maltose

    (B) β-Glucose

    (C) α-Glucose

    (D) β-Fructose

48. **'Nylon 66' is so named because :**

    (A) the average degree of polymerization of the polymer is 1966

    (B) the number of carbon atoms between two nitrogen atoms are 6

    (C) the number of nitrogen atoms between two carbon atoms are 6

    (D) the polymer was first synthesized in 1966

49. **Steam is to be condensed in a shell and tube heat exchanger, 5 m long with a shell diameter of 1 m. Cooling water is to be used for removing the heat. Heat transfer coefficient for the cooling water, whether on shell side or tube side, is made. The best arrangement is :**

    (A) vertical heat exchanger with steam on tube side

    (B) vertical heat exchanger with steam on shell side

    (C) horizontal heat exchanger with steam on tube side

    (D) horizontal heat exchanger with steam on shell side

50. **In a counter current liquid-liquid extraction the solvent B is used to separate solute C from a given solution A and C. The liquids A and B are insoluble. The slope of operating line will be :**

    (A) Zero

    (B) Infinity

    (C) Positive

    (D) Negative

51. **Bound moisture in a solid is that liquid which exerts an equilibrium vapour pressure :**

    (A) Equal to that of the pure liquid at the given temperature

    (B) Less than that of the pure liquid at the given temperature

    (C) Greater than that of the pure liquid at the given temperature

    (D) Equal to or less than that of the pure liquid at the given temperature

52. **For a chemical reaction A → B, it is found that the rate of the reaction increases by a factor 8 when the concentration of A is doubled. If $r \propto C_A^n$, what must be n for this reaction ?**

    (A) 2

    (B) 1/3

    (C) 3

    (D) 4

53. With increasing flow rate, the hydraulic efficiency of a centrifugal pump :

(A) monotonically decreases

(B) decreases and then increases

(C) remains constant

(D) increases and then decreases

54. The rate constant for N_2O_5 decomposition reaction is found to be 6.2×10^{-4} s^{-1}. The time required for one half the N_2O_5 in a sample to be decomposed is :

(A) 6.2×10^{-4} s

(B) 3710 s

(C) 1513 s

(D) 1120 s

55. A body falls freely for distance S from rest. An equation for velocity v could take the form :

(A) $v = K S g$

(B) $v = K\sqrt{Sg}$

(C) $v = K(Sg)^2$

(D) $v = K(Sg)^{1/2}$

56. Navier Stokes equation is useful in the analysis of :

(A) Viscous flows

(B) Non viscous flows

(C) Turbulent flows

(D) Both viscous and turbulent flows

57. Fresh orange juice contains 12% (by weight) solids and the rest water. 90% of the fresh juice is sent to an evaporator to remove water and subsequently mixed with the remaining 10% of fresh juice. The resultant product contains 40% solids. The kg of water removed from 1 kg fresh juice is :

(A) 0.4

(B) 0.5

(C) 0.6

(D) 0.7

58. A rigid vessel, containing three moles of nitrogen gas at 30°C, is heated to 250°C. Assume the average heat capacities of nitrogen to be Cp = 29.1 J/mol"C and Cv = 20.8 J/mol"C. The heat required, neglecting the heat capacity of the vessel, is :

(A) 13728 J

(B) 19206 J

(C) 4576 J

(D) 12712 J

59. End group analysis gives :

(A) Number average mol. wt.

(B) Weight average mol. wt.
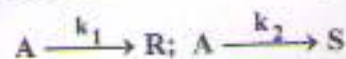
(C) Viscosity average mol. wt.

(D) Z average mol. wt.

60. In a counter-flow double pipe heat exchanger, oil (Mass flow rate = 2 kg/s, $C_p = 2.1$ kJ/kg°C) is cooled from 90°C to 40°C by water (Mass flow rate = 1 kg/s, $C_p = 4.2$ kJ/kg°C) which enters the inner tube at 10°C. The radius of the inner tube is 3 cm and its length is 5 in. Neglecting the wall resistance the overall heat transfer coefficient based on the inner radius, in kW/m².K, is :

(A) 0.743

(B) 74.3

(C) 7.43

(D) 2475

61. The velocity distribution in a turbulent flow of a Newtonian fluid in a smooth pipe is a function of the distance y measured from the wall of the pipe and the friction velocity u* and follows a :

(A) Linear law

(B) Parabolic law

(C) Logarithmic law

(D) Hyperbolic law

62. The loss of energy in a commercial pipe fitting, is generally expressed by

$$h_r = K_r V^2 / 2g_c$$

in which K_r is called loss factor for fitting. Which of the following pipe fitting has the maximum value of K_r ?

(A) Globe valve, wide open

(B) Gate valve, wide open

(C) Tee

(D) Elbow, 90°

63. The equivalent diameter for flow through a rectangular duct of width B and height H is :

(A) $\dfrac{HB}{2(H+B)}$

(B) $\dfrac{HB}{(H+B)}$

(C) $\dfrac{2HB}{(H+B)}$

(D) $\dfrac{4HB}{(H+B)}$

64. The specific speed of a centrifugal pump is defined as the speed of a unit :

(A) Of such size that it delivers unit discharge at unit head

(B) Of such size that it delivers unit discharge at unit power

(C) Of unit size with unit discharge at unit head

(D) Of unit size with unit discharge at unit power

65. For a particle settling in water at its terminal settling velocity, which of the following is true ?

(A) buoyancy = weight + drag

(B) weight = buoyancy + drag

(C) drag = buoyancy + weight

(D) drag = weight

66. If the discharge of a centrifugal pump is throttled, then its suction lift :
    (A) data insufficient to predict
    (B) remains unchanged
    (C) increases
    (D) decreases

67. In distillation column design, the McCabe-Thiele procedure is inadequate and a Ponchon-Savarit procedure is needed when :
    (A) saturated feed is not used
    (B) an azeotrope forms
    (C) the latent heats of vapourisation of the more and less volatile components are greatly different
    (D) a total condenser is used

68. Two monomers M1 and M2 have reactivity ratios r1 = ∞ and r2 = ∞. The most likely structure of the polymer produced from an equimolar mixture of the two monomers will be :
    (A) –M1M2M1M2M1M2M1M2–
    (B) –M1M1M1M1M2M2M2M2–
    (C) –M1M2M2M1M1M1M2M1M2M2M1M2– (random, "coin toss" statistics)
    (D) –M1M1M1M1– and –M2M2M2M2– (homopolymers)

69. Consider a homogeneous reaction of the type $A \xrightarrow{k_1 \text{ (1st order)}} R$ and also $A \xrightarrow{k_2 \text{ (2nd order)}} S$. R is the desired product and its concentration is to be maximized by selection of a proper reactor. Which reactor system will you choose in order to get the highest R-concentration (under otherwise uniform conditions) ?
    (A) Batch reactor
    (B) PFR
    (C) Single CSTR
    (D) Five CSTRs in series

70. For irreversible elementary reactions in parallel
    $$A \xrightarrow{k_1} R; \quad A \xrightarrow{k_2} S$$
    The rate of disappearance of reactant A is given by :
    (A) $(k_1 - k_2) C_A$
    (B) $(k_1 + k_2) C_A$
    (C) $\frac{1}{2}(k_1 + k_2) C_A$
    (D) $k_1 C_A$

71. Which of the following polymers would you expect to have the best barrier properties (i.e., provide the best barrier to diffusion of a gas and hence prove most effective as a beverage container) ?
    (A) Atactic polystyrene
    (B) A random ethylene/propylene copolymer (50/50) composition
    (C) Low density polyethylene
    (D) High density polyethylene

72. The vapour pressure of toluene is 6.811 kPa at 310 K and 24.15 kPa at 340 K. Assuming that the variation of the vapour pressure p with temperature T may be described by the expression

$\log(p) = A - B/T$ p is in kPa

What are the values of A and B ?

(A) A = 7.059, B = 1930 K

(B) A = 5.307, B = 1930 K

(C) A = 6.971, B = 7780 K

(D) A = 5.307, B = 7780 K

73. Stereoregular polymers are :

(A) Isotactic, syndiotactic, atactic

(B) Natural and synthetic

(C) Addition and condensation

(D) Elastomers, plastics and fibres

74. Creep strength is :

(A) another name of tensile strength

(B) another name of yield strength

(C) time-dependent strain occurring under stress

(D) yield strength at elevated temperature, greater than 1000°C

75. Which of the following polymers would you expect to be most suitable for the production of a rubber car bumper guard ?

(A) Atactic polystyrene (Tg ~ 100°C)

(B) A random ethylene/propylene copolymer (50/50 composition) Tg ~ 40°C

(C) Low density polyethylene

(D) High density polyethylene