THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

Ph. D. ENTRANCE TEST (PET) –27th January 2019

Signature of Invigilators

_____

Roll. No. | | | | | | |

(in figures as in Hall Ticket)

Chemical Engineering
(19/34)

Roll No. _____

_____

(in words)

Maximum Marks: 50No. Of Printed Pages :8

Instruction for the Candidate:

1. Write your Roll Number in the space provided on the top of this page.
2. This paper consists of **FIFTY (50)**multiple choice type questions. Each Question carries**ONE (1)** mark.
3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as below:
    a. To have access to the Question Booklet, tear off the paper seal on the edge of this cover page, Do not accept a booklet without sticker seal and do not accept an open booklet.
    b. Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faculty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.
    c. After this verification is over, the Test Booklet Number should be entered on the OMR Answer Sheet and the OMR Answer Sheet Number should be entered on this Test Booklet.
4. Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.

Example: Ⓐ ● Ⓒ Ⓓ where (B) is correct response.

5. Your responses to the items are to be indicated on the OMR Answer Sheet under Paper – II only. If you mark your response at any place other than in the circle in the OMR Answer Sheet, it will not be evaluated.
6. Read instructions given inside carefully.
7. Rough Work is to be done in the end of this booklet.
8. If you write your Name, Roll Number, Phone Number or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, such as change of response by scratching or using white fluid, you will render yourself liable to disqualification.
9. You have to return the original OMR Answer Sheet to the invigilator at the end of the examination compulsorily and must not carry it with you outside the Examination Hall. You are however, allowed to carry original question booklet and duplicate copy of OMR Answer Sheet on conclusion of examination
10. Use only Blue/ Black Ball point pen.
11. Use of any calculator or log table etc., is prohibited.
12. There shall be no negative marking.

Chemical Engineering

(19/34)

Note: This paper contains **FIFTY (50)** multiple-choice questions. Each Question carries**ONE (1)** mark.

1. If the degree of freedom of a system is greater than zero, then the system is
   (A) Underspecified (B) Correctly specified
   (C) Overspecified (D) Unspecified

2. On doubling the concentration of reactant, the rate of reaction triples. The order of the reaction will be:
   (A) 0.631 (B) 1
   (C) 1.585 (D) 2

3. The role of baffles in a shell and tube heat exchanger is:
   (A) To support the tubes (B) Induce turbulence
   (C) To increase the area for heat transfer (D) Both (A) and (B)

4. The hydrogenation of acetylene to form ethane is given by

$$C_2H_2 + 2H_2 \rightarrow C_2H_6$$

   If 20 kmol/h of acetylene and 50 kmol/h of hydrogen are fed to the reactor, the percentage excess of hydrogen in feed is
   (A) 10% (B) 20% (C) 25% (D) 30%

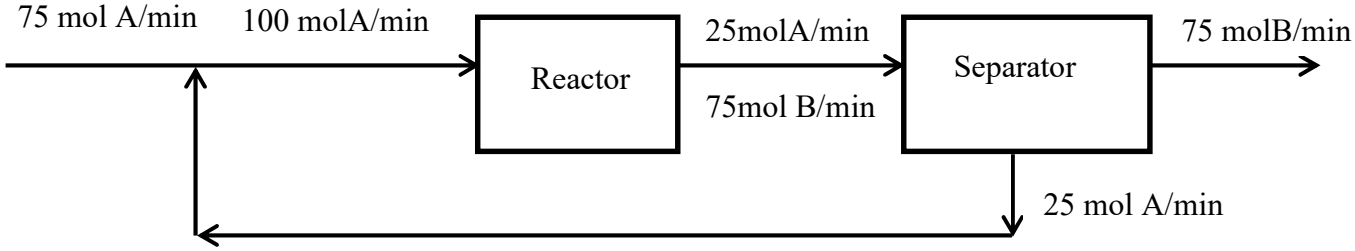
5. The standard heat combustion is
   (A) The heat of combustion in which reactants of reaction are at 25^0C and 1atm pressure.
   (B) The heat of combustion in which all reactants and products of reaction are at 25^0C and 1atm pressure.
   (C) The heat of combustion in which reactants and products of reaction are at 0^0C and 1atm pressure
   (D) The heat of combustion in which reactants and products of reaction are at 25^0C and actual pressure of the reaction.

6. For a black body:
   (A) Emissivity = 0 (B) Emissivity = 1
   (C) Emissivity = ∞ (D) None of these

7. During combustion the adiabatic flash temperature is the greatest when stoichiometric fuel to oxygen ratio is equal to
   (A) 1 (B) 1.5 (C) 0.5 (D) 0.25

8. The steady state gain term in the case of first order system arises due to:
   (A) Dimensional inconsistency (B) Reaction
   (C) Assumption of steady state (D) Both (A) and (B)

9. Consider the following flowchart for a chemical process based on reaction $A \rightarrow B$.
   The overall conversion and single pass conversion of A is



   (A) 100% and 75%, (B) 100% and 30%,
   (C) 100% and 25% (D) 75% and 25%

10. The following information is available for a reaction being conducted in a CSTR: V = 4 m^3, F_{A0}= 0.4 mol/s, C_{A0} = 2 mol/m^3. The space velocity will be:

(A) 5 s^{-1} (B) 20 s^{-1}
(C) 0.05 s^{-1} (D) 0.8 s^{-1}

11. For the reaction $A \rightarrow B + C$, with increase in pressure the equilibrium constant will:
(A) Increase (B) Decrease
(C) Remain constant (D) Become 1

12. Steam distillation is based on
(A) Raoult's Law, (B) Amagat's Law
(C) Dalton's Law (D) Hess's Law.

13. If relative volatility is not constant, the value that one should use in the Fenske equation is
(A) The value at the distillate
(B) The value at the bottoms
(C) The arithmetic average of distillate and bottoms
(D) The geometric average of distillate and bottoms

14. For the reaction $A \rightarrow 3R$ the fractional change in the volume (ε_A) will be:
(A) 3 (B) 2
(C) 1 (D) 0

15. The analogy which is totally derived from the universal velocity profile in all the three regions i.eviscious sublayer, buffer layer and turbulent core is
(A) Prandtl Taylor Analogy (B) Von Karman Analogy,
(C) Martenilli Analogy (D) Reynolds analogy

16 A cooling tower is fed with hot water at 41.7^{0}C. The cold water is drawn at 28.1^{0}C and the wet bulb temperature is 22.7^{0}C, then the range is
(A) 13.6 ^{0}C (B) 19^{0}C
(C) 5.4^{0}C (D) 3.5^{0}C

17. In which of the following equipments does extraction occur by the percolation process?
(A) Pachuka extractor (B) Bollman Extractor
(C) Moving belt extractor (D) Hildebrand extractor

18. For natural convection in horizontal and vertical pipes of the same diameter, which of the following is true?
(A) Heat transfer coefficient for vertical pipe is greater than that for horizontal pipe
(B) Heat transfer coefficient for horizontal pipe is greater than that for vertical pipe
(C) Heat transfer coefficient for both the pipes will be same
(D) None of these

19. Which of the following is not included under Fixed charges?
(A) Depreciation (B) Insurance
(C) Hospital and medical services (D) Property taxes

20. The advantages of wet grinding are:
(A) The power consumption is reduced.
(B) The capacity of the plant is increased.
(C) Dust formation is eliminated.
(D) All A, B and C

21. The anode in the membrane cell for the manufacture of caustic soda is made of:
(A) Platinum (B) Graphite
(C) Metal oxides (D) None of these

22. The three laws of crushing can be derived from a basic differential equation $\frac{dE}{dL} = -CL^p$, which states that the energy dErequired to effect a small change dLin the size of unitmass of material is a simple power function of the size. The equation reduces to Rittinger's law when
(A) p = (-1), (B) p = (-2)
(C) p = (-1.5), (D) p = (1)

23. Which of the following is not a tumbling mill?
(A) Pebble mill (B) Rod mill
(C) Tube mill (D) Bowl mill

24. The critical radius of insulation for a cylindrical geometry having thermal conductivity of 1.5 kCal/hr-m-^{0}C and heat transfer coefficient of 5 kCal/hr-m^2-^{0}C will be:
(A) 3.33 m (B) 1 m
(C) 7.5 m (D) 0.3 m

25. Match the following

(P) Blake Jaw crusher	(1) Pivoted at top
(Q) Dodge crusher	(2) Pivoted at bottom
(R) Gyratory crusher	(3) Circular jaws

(A) P1Q2R3 (B) P2Q1R3
(C) R1Q3P2 (D) P1Q3R2

26. With reference to the factors influencing the size of product obtained in a ball mill, which of the following statements is not true
(A) Small balls facilitate the production of fine material
(B) Increase in slope of mill produces fine material
(C) Low level of material in mill results in undersize material.
(D) High feed rate results in less size reduction

27. Sticky material is transported through a screw conveyer having
(A) Ribbon flights (B) Cut flights
(C) Short pitch (D) Screw with pitch equal to diameter

28. The arrangement of the liquids in the increasing order of thermal conductivity will be:
(A) Mercury, Molten sodium, Water, Ethanol
(B) Molten sodium, Mercury, Water, Ethanol
(C) Water, Ethanol, Mercury, Molten sodium
(D) Ethanol, Mercury, Molten sodium, Water

29. Allocation for unforeseen events is termed as:
(A) Contingency (B) Interest
(C) Operating cost (D) Maintenance cost

30. Match the dimensionless parameters with the area of application

(P) Froude Number	(1) Flow involving free liquid surfaces
(Q) Weber Number	(2) Flow with significant surface tension effects
(R) Mach Number	(3) Flow with significant compressibility effects
	(4) Widely applicable in a host of fluid flow situations

(A) P1Q2R3 (B) P4Q1R3
(C) P4Q2R3 (D) P1Q4R2

31. In the case of infinitely long fin, as L $\rightarrow\infty$, fin efficiency with be:
(A) 100% (B) 50%
(C) 0 (D) 70%

32. Tax levied on profits made from the sale of assets such as land, building, equipment etc. is called:
(A) Income tax (B) Capital-gains tax
(C) Surtax (D) Professional tax

33. In an oil refinery, which stream usually goes to the reformer?
(A) Naptha (B) Diesel
(C) Kerosene (D) Petrol

34. Which of the following flow measuring devices measure difference between impact and static pressure
(A) Orifice meter (B) Venturimeter
(C) Nozzle (D) Pitot tube

35. For a first order catalytic reaction $A \rightarrow P$ the Thiele modulus is:
(A) Proportional to concentration of A
(B) Inversely proportional to concentration of A
(C) Proportional to square of concentration of A
(D) Independent of concentration of A

36. The boundary layer thickness for flow over a flat plate under laminar flow conditions is given by
(A) $\partial = \frac{4.91x}{\sqrt{Re_x}}$ (B) $\partial = \frac{0.37x}{\sqrt[5]{Re_x}}$
(C) $\partial = 4.91x\sqrt{Re_x}$ (D) $\partial = 0.37x\sqrt[5]{Re_x}$

37. Series of equal payments occurring at regular time intervals is called:
(A) Present worth (B) Principal
(C) Annuity (D) None of these

38. A binary system forms an azeotrope if:
(A) $\alpha_{12} = 1$ (B) $\alpha_{12} = 0$
(C) $\alpha_{12} < 1$ (D) $\alpha_{12} = \infty$

39. A fluid is heated from 30 ^{0}C to 80 ^{0}C in a double pipe heat exchanger using steam at 120 ^{0}C in the annulus. The LMTD will be approximately:
(A) 62 K (B) 70 K
(C) 65 K (D) None of these

40. The expression for decay ratio is:
(A) $exp\left(\frac{-\pi}{\sqrt{1-\xi^2}}\right)$ (B) $exp\left(\frac{-2\pi\xi}{\sqrt{1-\xi^2}}\right)$
(C) $exp\left(\frac{\sqrt{1-\xi^2}}{-\pi\xi}\right)$ (D) $exp\left(\frac{\sqrt{1-\xi^2}}{-2\pi\xi}\right)$

41. Which process gives higher strength of phosphoric acid?
(A) Dihydrate (B) Hemihydrate
(C) Anhydrite (D) None of these

42. When the rotational speed (n) of a centrifugal pump is changed

(A) Capacity varies with n, head varies with n^2 and Power varies with n^3
(B) Capacity varies with n^3, head varies with n^2 and Power varies with n.
(C) Capacity varies with n^2, head varies with n and Power varies with n^3
(D) Capacity varies with n, head varies with n^3 and Power varies with n^2.

43. Thermistors can be used to measure maximum temperature upto:
(A) 250 ^{0}C (B) 1000 ^{0}C
(C) 650 ^{0}C (D) 100 ^{0}C

44. Urea contains by weight
(A) 56% Nitrogen (B) 46% Nitrogen
(C) 36% Nitrogen (D)26% Nitrogen

45. Parameter 'a' in VanderWaal's equation of state is a correction for:
(A) Volume (B) Temperature
(C) Intermolecular interaction (D) None of these

46. The expression for the exit age distribution (E) as a function of mean time (τ) for CSTR is:
(A)$E = \frac{e^{-t/\tau}}{\tau}$ (B) $E = \tau e^{-t/\tau}$
(C)$\frac{e^{-t/\tau}}{t/\tau}$ (D) $\frac{e^{-t/\tau}}{t}$

47. Laplace transform of $Sin\ \omega t$ is
(A) $\frac{s}{s^2+\omega^2}$ (B) $\frac{\omega}{s^2+\omega^2}$
(C) $\frac{\omega}{(s+a)^2+\omega^2}$ (D) $\frac{s+a}{(s+a)^2+\omega^2}$

48. The modern technology for the separation of m-Xylene and p-Xylene is based on:
(A) Distillation (B) Extraction
(C) Crystallization (D) Adsorption

49. A complex variable $z = x + iy$ is represented as $z = (x, y)$. The multiplication of two complex numbers (x_1, y_1) (x_2, y_2) is given by
(A) $(x_1x_2 + y_1y_2, y_1y_2 + x_1y_2)$ (B) $(x_1x_2 - y_1y_2, y_1y_2 + x_1y_2)$
(C) $(x_1x_2 - y_1y_2, y_1y_2 - x_1y_2)$ (D) $(x_1x_2 + y_1y_2, y_1y_2 - x_1y_2)$

50. The thermal efficiency for work required is given by:
(A) $\frac{W_{ideal}}{W_s}$ (B) $\frac{W_s}{W_{ideal}}$
(C)$\frac{W_{ideal}}{Q}$ (D) $\frac{Q}{W_{ideal}}$

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Rough Work: