

CODE: AE-CH

M.Tech. Common Entrance Test, PG CET – 2010

Chemical Engineering

Time: 2 Hours

Max. Marks: 100

Read the following instructions before answering the test

- i) Write / Darken the particulars of your identity, Test Seat Number and affix your signature on the OMR Response Sheet before the start of the test.
- ii) All Questions have multiple choices of answers, of which only one is correct.
- iii) Mark the correct answer by completely darkening only one oval against the Question number using Black Ink Ball Point pen only.
- iv) There will be no negative evaluation with regard to wrong answers. Marks will not be awarded if multiple answers are given.
- v) Do not make any stray mark on the OMR Response sheet. For rough work, use blank page on the question paper.
- vi) Taking the question paper out of the test hall is permitted only after the full duration of the test.
- vii) Use of only non-programmable calculator is permitted.
- viii) **START ANSWERING ONLY AT THE SPECIFIED TIME WHEN THE INVIGILATOR GIVES INSTRUCTIONS.**

MARKS DISTRIBUTION

PART – I	50 Questions :	50 x 1 =	50 Marks
PART – II	25 Questions :	25 x 2 =	50 Marks
		Total =	100 Marks

Each question carries one mark

50 × 1 = 50 Marks

- 1 Numerical value of the gas constant R, in cal/gmol K, is
 - a. 82.05
 - b. 1.987
 - c. 62.36
 - d. 1.013

- 2 The unit of force in cgs system is
 - a. Erg
 - b. Dyne
 - c. Newton
 - d. Slug

- 3 For vapour gas mixtures, the %RH is
 - a. Always greater than the % Humidity
 - b. Always less than the % Humidity
 - c. % RH and % Humidity are equal
 - d. Which is more depends on nature of the mixture

- 4 The weight ratio of acetone and air in a mixture is 1:2, the mole ratio is
 - a. 1:2
 - b. 2:1
 - c. 4:1
 - d. 1:4

- 5 Certain amount of ideal gas occupies $v \text{ m}^3$ at 27°C and 100 kPa. Its volume at 177°C and 150 kPa will be
 - a. $1.5 v \text{ m}^3$
 - b. $6.5 v \text{ m}^3$
 - c. $4.3 v \text{ m}^3$
 - d. $v \text{ m}^3$

- 6 The upper surface of the weir over which water flows is known as
 - a. V- Notch
 - b. Crest
 - c. Tip
 - d. Notch

- 7 Potential flow is the flow of
 - a. Compressible fluids with shear
 - b. Compressible fluids with no shear
 - c. Incompressible fluids with shear
 - d. Incompressible fluids with no shear

For turbulent flow in smooth pipe of diameter D , the transition length is taken as

- $0.005 D$
- $150 D$
- $50 D$
- $0.5 D$

Boundary layer separation is caused by

- Reduction of pressure gradient to zero
- An adverse pressure gradient
- Sudden entrapping of air
- Rough surface conditions

The velocity of air flowing through 2 in pipe is 10 m/s. The pipe is suddenly expanded to 3 in size. The velocity of the air in enlarged section in m/s would be

- 10
- 4.44
- 15
- 6.67

A Propeller agitator

- Produces mainly axial flow
- Is used for mixing high viscous pastes
- Runs at very low speed, 2 rpm
- All the above

For incompressible filter cakes, resistance depends on

- Rate of deposition
- The nature of particles
- The force between the particles
- All of the above

Addition of filter aid to slurry before filtration is done to

- Increase porosity of the cake
- Decrease the porosity of the cake
- Increase the mass of the cake
- To substitute the filter cloth

For a given screen, the two factors, i.e., capacity and efficiency are

- Independent factors
- Opposing factors
- Complementary factors
- Depends on the screen size

The critical speed of a 1 m dia. ball mill with a small size grinding elements is approximately

- 0.25 s^{-1}
- 0.50 s^{-1}
- 0.75 s^{-1}
- 0.15 s^{-1}

- 16 The shape of T – S diagram for Carnot cycle is
- Rectangle
 - Rhombus
 - Trapezoid
 - Circle
- 17 Which of the following acts as a homogeneous system
- Water + Steam
 - Ice + Steam
 - Water + Nitric acid
 - None of the above
- 18 For an ideal solution the activity coefficient is
- Zero
 - One
 - Less than one
 - Greater than one
- 19 In a carnot engine if the temperature of the sink is decreased then the efficiency of the engine.
- Increases
 - Decreases
 - Remain constant
 - Information insufficient
- 20 For a three phase system in equilibrium made up of three non-reacting chemical species, the number of degrees of freedom is
- 0
 - 1
 - 2
 - 3
- 21 In a multi-pass shell and tube heat exchanger, tube side return pressure loss is equal to
- Twice the velocity head
 - Four times the velocity head
 - Square root of the velocity head
 - Square of the velocity head
- 22 The highest value of thermal conductivity is expected for
- Solid ice
 - Water
 - Steam
 - Super heated steam
- 23 Heat transfer co-efficient (h_i) for liquids increases with
- Increasing temperature
 - Decreasing temperature
 - Decreasing Reynolds number
 - None of these

4. Steady state heat transfer is occurring through a flat surface of two layers, $k_1 = 1.2 k_2$. The temperature drop across the first surface is 30°C and its thickness is 15 mm. If the total temperature drop is to be restricted to 50°C , what should be the thickness of the second layer?
- 9.4 mm
 - 5.8 mm
 - 7.5 mm
 - 8.3 mm
5. A hot cylinder of 2 m dia. and 3 m height is losing heat to the surroundings by natural convection. The hot surface and surrounding temperatures are respectively 430°C and 24°C . Considering air as ideal gas, its coefficient of thermal expansion in this situation in K^{-1} is
- 1.4×10^{-3}
 - 3.4×10^{-3}
 - 2.0×10^{-3}
 - 1.0×10^{-3}
6. Positive deviation from Raoult's law means a mixture whose total pressure is
- Greater than that computed for ideality
 - Less than that computed for ideality
 - Less than the sum of the vapour pressures of the components
 - None of these
7. The process of obtaining pure crystals from the solution of two solutes is called
- Differential Crystallization
 - Evaporative Crystallization
 - Vacuum Crystallization
 - Fractional Crystallization
8. For the liquid in plug flow the eddy diffusivity must be
- 0
 - Infinity
 - 1
 - > 0
9. Lewis number (Le) is
- Sc/Pr
 - Pr/Sc
 - ScXPr
 - StXSh
10. For a binary immiscible liquid mixture, the equilibrium vapour composition
- Is the same as that of the liquid mixture
 - Depends only on the VPs of the two components
 - Depends on the composition of the liquid mixture
 - None of the above

- 31 H_2S from petroleum refinery streams is recovered by scrubbing with
- Ethanol
 - Ethanolamines
 - Water
 - 98.5% H_2SO_4
- 32 A high space velocity means that a given
- Reaction can be accomplished with a small reactor
 - Conversion can be obtained with a high feed rate
 - Both 'a' and 'b'
 - None of these
- 33 A second order reaction of the form $\text{A} + \text{B} \rightarrow \text{C}$ is called a pseudo-first order reaction when
- $C_{\text{A}0}$ is equal to $C_{\text{B}0}$
 - $C_{\text{A}0}$ is greater than $C_{\text{B}0}$
 - $C_{\text{A}0}$ is less than $C_{\text{B}0}$
 - $C_{\text{A}0}$ is very large compared to $C_{\text{B}0}$
- 34 In a homogenous chemical reaction, the rate of reaction can be affected by
- Temperature Only
 - Pressure Only
 - Both Temperature & Pressure
 - Temperature, pressure & composition
- 35 Rate of a chemical reaction is independent of the concentration of the reactants for
- Zero order Reaction
 - First order Reaction
 - Third order Reaction
 - None of these
- 36 Final control element is a
- Valve
 - Switch
 - Signal
 - None of these
- 37 The order of a system with transfer function $(2S/4) + 1$ is
- 0
 - 1
 - 2
 - 3
- 38 The characteristic equation of a control system is given by $s^3 + 6s^2 + 6s + k$. The system stable for
- All values of k
 - All values of k less than 36
 - All values of k greater than 6
 - All values of k less than 6

Critically damped system means that the damping coefficient is

- One
- Less than one
- Greater than one
- Zero

In an exothermic chemical reactor, the manipulated variable is the flow rate of

- Reactants
- Product
- Coolant
- None of these

An ionic reaction proceeds in

- Solid state only
- Liquid state only
- Any state
- Solution

What does RDF stands for?

- Recycle derived fuels
- Redox fuels
- Recycle distilled fuel
- Refuse derived fuel

The lowest layer of atmosphere is known as

- Troposphere
- Ionosphere
- Stratosphere
- None of these

The pH of acid rain is

- Above 7.0
- About 10.5
- Below 5.5
- Around 0.0

Zeolite used in water softening process is regenerated by washing with

- Brine
- Lime slurry
- Sodium bisulphate
- Caustic solution

Percentage of carbon is same in

- Cast iron and pig iron
- Cast iron and steel
- Pig iron and steel
- Pig iron and wrought iron

47 Anabolism is the process of

- a. Synthesis
- b. Growth
- c. Degradation
- d. Nutrient uptake

48 Ziegler process

- a. Produces high density polyethylene
- b. Produces low density polyethylene
- c. Uses no catalyst
- d. Employs very high pressure

49 Pure rectified spirit contains alcohol about

- a. 45%
- b. 70%
- c. 95%
- d. 99%

50 Which of the following is the most adverse factor challenging the choice of mercury electrolyte cell process for the production of caustic soda?

- a. High cost of mercury
- b. High specific gravity of mercury
- c. Non-availability of high purity mercury
- d. Pollution of water stream by mercury

Part - II

Each question carries two marks

25 × 2 = 50 Marks

Note: Select the nearest answer. For example, 0.67 for 0.66667

51 8 furlongs, each of 660 ft make a mile and 4840 square yards makes an acre. How many acres are there in a square mile?

- a. 640
- b. 660
- c. 484
- d. 528

52 In a crystallization process, Glauber's salt is crystallized from 1000 kg of 30% solution of Na_2SO_4 until the final concentration is 18.4% Na_2SO_4 . What is the quantity of salt crystallized in kg?

- a. 142
- b. 322
- c. 180
- d. 116

The gas obtained from hydrochloric acid manufacture contains 25% HCl and is passed through an absorber in which 98% of HCl is removed. If the inlet and outlet conditions of the absorber are assumed to be the same, what is the volume of gas coming out of the absorber per 10 m^3 of original gas entering in it?

- 9.85 m^3
- 2.98 m^3
- 7.55 m^3
- 6.87 m^3

The deflection of a mercury (Specific Gravity = 13.6) U-Tube manometer connected across a water pipe is 1.0 cm. For the same pressure drop the deflection of Carbon tetra chloride (Specific Gravity = 1.6) manometer in cm is

- 13.6
- 1.6
- 21
- 12

The velocity of water flowing through a pipe of 100 mm dia. is 1 m/min at the centre and the flow is laminar. The velocity at 30 mm from the centre will be

- 0.30 m/min
- 0.36 m/min
- 0.91 m/min
- 0.64 m/min

In a fluidization process, the porosity and bed height at the incipient fluidization are 0.384 and 100 mm respectively. What will be the porosity when the bed length is 1000 mm under particulate fluidization?

- 0.3840
- 0.9384
- 0.0384
- 0.0616

42.25g of a solid sample has an average particle size of 1.5mm. Its sphericity is 0.65. If specific gravity of the material is 2.6, the total surface area of the sample in cm^2 is

- 100
- 1000
- 500
- None of the above

The radius of rolls in a Roll crusher is 15 cm and the gap between the rolls is 28 mm. The limiting size of particles that can be nipped by the rolls in mm is

- 20
- 34
- 16
- 28

- 59 Sphericity of a 1 cm particle having volume to surface area ratio of $1.5 \times 10^{-3} \text{ m}^3/\text{m}^2$ is
- 0.5
 - 0.6
 - 0.8
 - 0.9
- 60 How many kilograms of ice at 0°C must be added to 100 kg of water at 20°C , such that the final temperature is 0°C and all the ice melts? (Latent heat of fusion of ice = 80 kcal/kg)
- 15
 - 25
 - 12.5
 - 125
- 61 1kg of a super heated vapour ($H= 2945\text{kJ/kg}$, $S= 6.32 \text{ kJ/kg-K}$) is contained in a piston – cylinder assembly. The unit is kept in ambient condition of 300K and the vapour is condensed to saturated liquid ($H= 845\text{kJ/kg}$, $S= 2.32 \text{ kJ/kg-K}$) at constant pressure. The total change of entropy in kJ/kg-K of the system and surroundings is
- 3
 - 4
 - 3
 - 4
- 62 A system consists of a fluid in a stirred tank. The rate of work done on the system by the stirrer is 2 hp. The heat generated due to stirring is transferred to surroundings and is equal to 2686 kJ/h. The change in internal energy in J/s is
- 746
 - 373
 - 1492
 - None of the above
- 63 In an evaporator 240 kg of water is evaporated in a particular time so that the solution is concentrated from 10 to 25% solids. What is the weight of original solution in kg?
- 400
 - 440
 - 360
 - None of these
- 64 In a counter flow heat exchanger the end temperatures are given below:
Cold fluid: $T_{C1} = 32^\circ\text{C}$, $T_{C2} = 76^\circ\text{C}$, Hot fluid: $T_{H1} = 90^\circ\text{C}$, $T_{H2} = 60^\circ\text{C}$
The LMTD of the heat exchanger in $^\circ\text{C}$ is
- 10
 - 22
 - 32
 - 20

- 5 The temperatures across an insulation layer of thickness 15 mm are 40 and 80 °C respectively. The thermal conductivity of the material at these temperatures is 0.045 W/m-K. The cross sectional area of wall is 2 m². The heat flux across the layer in W/m² is
- 2.4
 - 12
 - 1.2
 - 24
- 6 Substances A and B form an ideal solution. The vapour pressures of A and B at a certain temperature are 1000 and 500 mm Hg respectively. The concentration of A in liquid and vapour phase in equilibrium at 750 mm Hg total pressure are:
- 0.67, 0.5
 - 0.5, 0.67
 - 0.67, 0.75
 - 0.75, 0.67
- 7 In the design of a distillation column by McCabe–Thiele method, the slope and intercept of operating line for enrichment section are 0.667 and 0.3 respectively. The reflux ratio and the mole fraction of A in distillate are
- 2, .98
 - 0.67, 0.9
 - 2, 0.9
 - 0.67, 0.98
- 8 A continuous distillation column is to be designed to separate a mixture of A and B to final products of 95% A and 95% B. The average relative volatility of the system is 1.81. The minimum number of theoretical plates required including reboiler will be
- 8
 - 9
 - 10
 - 7
- 9 A first order liquid phase reaction is taking place in a series of two equal volume mixed flow reactors. The final conversion is found to be 75%. The rate constant for the reaction in min⁻¹ is (Residence time = 10 min)
- 10
 - 5
 - 0.1
 - 0.5
- 10 A first order reaction has half-life of 30 s. The rate constant for the reaction in min⁻¹ is
- 0.3465
 - 2.079
 - 0.693
 - 1.386

- 71 A reversible reaction $A+B = C+D$ is conducted in a vessel until equilibrium is reached using an equimolar mixture of A and B. The equilibrium constant is 1. The content of C in final product is
- 33.3%
 - 25%
 - 50%
 - 75%
- 72 A thermometer was reading a steady state temperature of 30°C . Suddenly it is kept in a water bath maintained at 40°C . It was observed that it took 15 s to read 39.8°C . The time constant of the thermometer when it is placed in liquid bath whose film heat transfer coefficient is 0.5 times the heat transfer coefficient of water film is
- 4 s
 - 2 s
 - 8 s
 - 32 s
- 73 The solution of equations; $(dx/dt) + 3x = 0$, and $x(0) = 2$, using Laplace Transform is
- $2 e^{-3t}$
 - $2+e^{3t}$
 - $3 e^{-2t}$
 - $3 e^{-t}$
- 74 A sample of as collected Municipal Solid Waste (MSW) contains 79.5% of Organic component with 25.8% moisture and rest Inorganic component with 3.4% moisture. What is the overall % moisture content of the sample?
- 14.6
 - 21.2
 - 18.3
 - 11.4
- 75 Technically, the % H_2SO_4 in a 40% oleum (fuming) is
- 120
 - 104
 - 109
 - 140

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