بسم الله الرحمن الرحيم

جامعة تكريت – كلية الهندسة - قسم الهندسة الكيمياوية

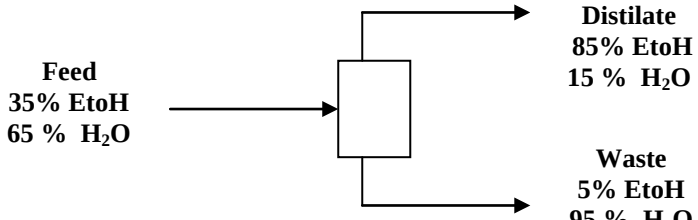
اسئلة الامتحان التنافسي للطلبة المتقدمين لدراسة الماجستير للعام الدراسي2013 – 2014

Part One: Choose the correct answer in the following: (60% , 2 marks for each question)

1. The average molecular weight of a gas of the following composition is:
CH_4 30% , H_2 10% , N_2 60% [M.wt: CH_4=16 , Mwt. H_2 = 2 , Mwt. N_2 =28].
a) 18.8 b) 20.7 c) 21.8 d) 23.7

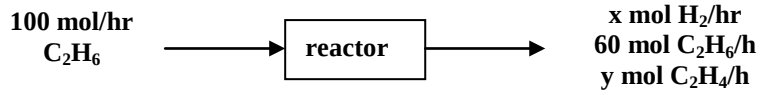
2. In SI units, the nano prefix multiplication factor is:
a) 1,000,000,000 b) 0.000000001 c) 1,000,000 d) 0.000001

3. A typical distillation column is shown in fig. below. The amount of distillate per kg of feed is:



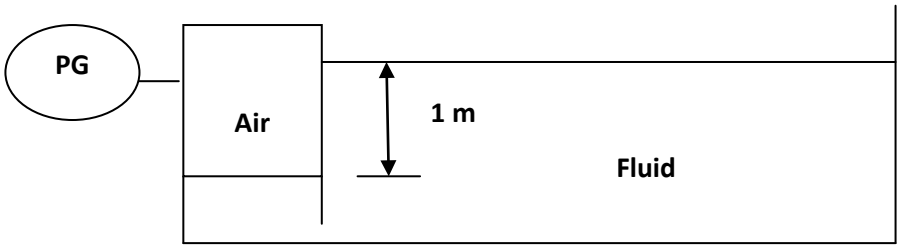
a) 0.25 b) 0.275 c) 0.375 d) 0.5

4. The dehydrogenation of ethane in a steady state continuous reaction is represented in the figure, below. The fractional conversion of ethane (C_2H_6) is:



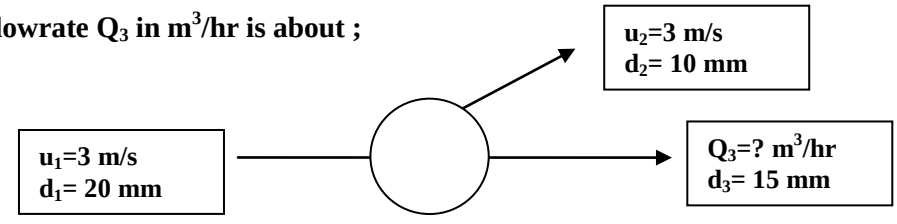
a) 0.3 b) 0.4 c) 0.5 d) 0.6

5. The reading of the pressure gauge is 7.9 kPa. The density in kg/m^3 of the fluid is :



(a) 800 (b) 900 (c) 1000 (d) 1100

6. The water flowrate Q_3 in m^3/hr is about ;



(a) 1 (b) 1.5 (c) 2 (d) 2.5

7. The column used for liquid dispersion in a continuous gas phase is:
a) Packed b) Pulse c) Bubble cap d) Sieve plate
8. Which of the following is the most suitable for extraction in a system having very low density difference ?
a) Mixer-settler extractor b)Centrifugal extractor c)Pulsed extractor d)Packed extractor

9. Overall efficiency of the distillation column is
a) the ratio of number of ideal plates to actual plates
b) the ratio of number of actual plates to ideal plates
c) same as the Murphree efficiency
d) always more than the point efficiency

10. Relative humidity is the ratio of the
a) partial pressure of the vapour to the vapour pressure of the liquid at room temperature
b) partial pressure of the vapour to the vapour pressure of the liquid at gas temperature
c) actual humidity to saturation humidity d) none of these

11. The equipment frequently used for adiabatic humidification-cooling operation with recirculating liquid is
a) natural draft cooling tower b) induced draft cooling tower c) spray chamber
d) none of these

12. A catalyst
a) initiates a reaction b) lowers the activation energy of reacting molecules
c) is capable of reacting with any one of the reactants
d) can not be recovered chemically unchanged at the end of a chemical reaction

13. Which of the following is the most suitable for very high pressure gas phase reaction ?
a) Batch reactor b) Tubular flow reactor c) Stirred tank reactor d) Fluidised bed reactor

14. Pick out the wrong statement pertaining to space velocity of flow reactors
a) The unit of space velocity is (time)$^{-1}$
b) The space velocity of 3 hr^{-1} means that three reactor volumes of feed at specified conditions are being fed into the reactor every hour
c) The space velocity of 3 hr^{-1} means that one third reactor volume of feed at specified conditions are being fed into the reactor
d) none of these

15. A reversible liquid phase endothermic reaction is to be carried out in a plug flow reactor. For minimum reactor volume, it should be operated such that the temperature along the length
a) decreases b) increases c) is at the highest allowable temperature throughout
d) first increases and then decreases

16. The second law of thermodynamics says that
a. energy cannot be created or destroyed.
b. heat flows from a hotter to a colder surface.
c. for every action there is an opposite and equal reaction.
d. systems tend to gravitate toward a condition of greater order.

17. In an isothermal process
a. dU=0 b. dH=0 c. dT=0 d. All

18. Which of the following statements is true
a) The work done in reversible expansion is less than the work done in irreversible expansion.
b) The work done in reversible expansion is equal to the work done in irreversible expansion.
c) The work done in reversible expansion is greater than the work done in irreversible expansion.
d) All.
e)

19. The amount of heat exchanged between system and surroundings under constant pressure is called
a. Entropy b. Free energy c. Internal energy d. Enthalpy

20. Choose the incorrect statement
a. Open systems can exchange both energy and matter with its surroundings.
b. Closed systems can only exchange energy and do not exchange matter with its surroundings.
c. Isolated systems can exchange energy and matter with its surroundings.
d. None.

21. The transfer function for an ideal proportional plus derivative controller (reset time T) is
a) $K_C(1+\tau s)$ **b)** $K_C(1+\frac{1}{\tau s})$ **c)** K_C **d)** $\frac{K_C}{1+\tau S}$

22. The thermometer is exemplifies a system of order:
a) zero b) first b) second d) third

23. Response of a linear control system for a change in set point is called
a) Frequency response b) Transient response b) Servo system d) Regulator system

24. A non-linear chemical system is exemplified by a/an
a) Isothermal CSTR b) Mixing tank c) Non-isothermal CSTR d) None of these

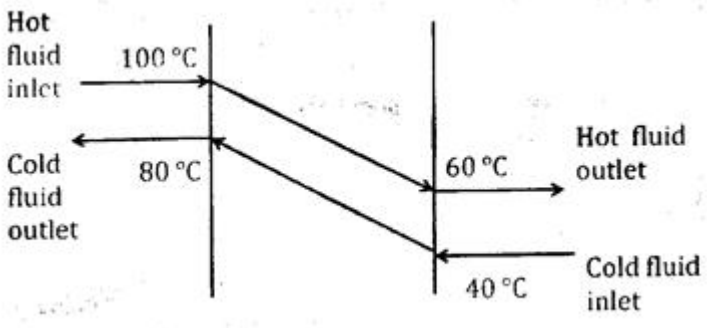
25. Newton's law of cooling is
a. $q = h\,A\,(T_s - T_\infty)$ $b.\ q = \sigma A\,T^4$ $c.\ q = -kA\,\frac{dt}{dx}$.

26. The rate of heat transfer through a unit thickness of the material per unit area per unit temperature difference is called
a) Thermal conductivity b) Heat transfer coefficient c) Stefan-Boltzmann constant

27. Centrifugal acceleration is:
a) greater than gravity acceleration b) less than gravity acceleration c) same

28. A wet solid is dried over a long period of time by unsaturated air of nonzero constant relative humidity. The moisture content eventually attained by the solid is termed as the
a) unbound moisture content b) bound moisture content
c) free moisture content d) equilibrium moisture content

29. In a double pipe counter-current heat exchanger, the temperature profiles shown in the figure as observed. During operation, due to fouling inside the pipe, the heat transfer rate reduces to half of the original value. Assuming that the flow rates and the physical properties of the fluids; do not change, the LMTD (in °C) in the new situation is



a) 0 b) 20 c) 40 d) indeterminate

30. The forced convective heat transfer coefficient for a hot fluid flowing over a cool surface is 225 W/m^2 °C for a particular problem. The fluid temperature upstream of the cool surface is 120 °C, and the surface is held at 10 °C. Determine the heat transfer rate per unit surface area from the fluid to the surface.
a) 247500 b) 24750 c) 2475 d) 247.5

Part Two: Answer the following questions : (40% , 4 marks per each question)

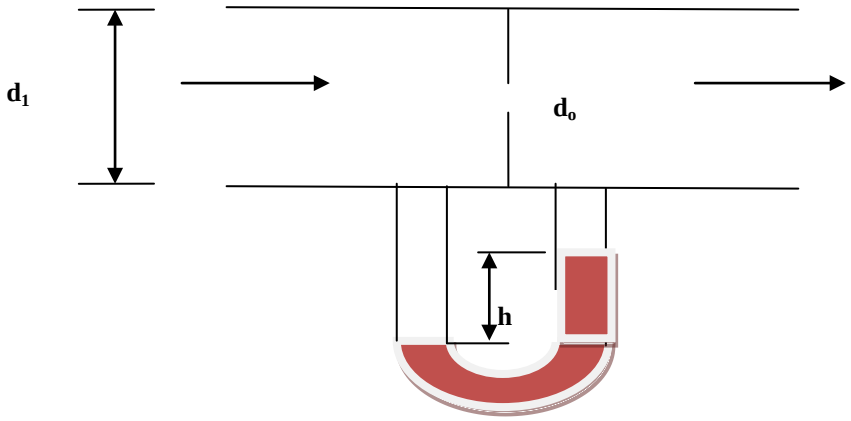
1. Consider the following pair of reactions

A ⟶ B (desired) A ⟶ C (undesired)

100 moles of A are fed to the reactor and the final product contains 10 moles of A and 15 moles of C. Calculate :

a) The fractional conversion of A
b) The yield of B based on feed
c) The yield of B based on reactant consumption
d)The selectivity of B relative to C

2. What is the volumetric flow rate of water as measured by an orifice plate flowmeter , d_1=400 mm , d_o=50 mm , h= 20 mm , C_D=0.65 , ρ_w=1000 kg/m^3, ρ_{Hg}=13600 kg/m^3



3. During a chemical reaction, the following concentrations of species A at various times were observed. Determine:

a) The reaction order and reaction rate constant, k
b)The concentration of A after 20hrs.

Time, hours	Concentration, mg/L
0	50.8
7.5	32
15	19.7
22.5	12.3
30	7.6

4. Determine the diffusivity of CO_2 (1), O_2 (2) and N_2 (3) in a gas mixture having the composition: CO_2 : 28.5 %, O_2 : 15%, N_2 : 56.5%,
The gas mixture is at 273 k and 1.2 * 10^5 Pa. The binary diffusivity values are given as: (at 273 K)
$D_{12}P$ = 1.874 m^2 Pa/sec , $D_{13}P$ = 1.945 m^2 Pa/sec , $D_{23}P$ = 1.834 m^2 Pa/sec

5. Draw the interacting two tanks system in series and non-interacting two tanks system in series.

6. Explain with equations the third law of thermodynamics.

7. Describe the cracking process with a proper flow diagram.

8. Determine the steady state rate of heat transfer per unit area through a 4.0 cm thick homogeneous slab with its two faces maintained at uniform temperatures of 38 °C and 21 °C. The thermal conductivity of the material is 0.19 W/m-K

9. Define :- API gravity, Aniline point, Octane number, LPG

10. Calculate the power of propeller mixer of water at 500 RPM speed and 50 mm impeller diameter.