University of Baghdad - Chemical Engineering Department - Chem. Eng. Principles
M.Sc. Qualifying Examination

Q.1

1. Validity of the relationship, inputs = outputs, holds good for the system at steady state
   (a) With chemical reaction. (b) Without chemical reaction. (c) Without chemical reaction & losses. (d) None of these.
2. The heat capacity of most substances is greater for the _____ state.
   (a) Solid. (b) Liquid. (c) Gaseous. (d) None of these.
3. How much O_2 (M.wt. 32) can be obtained from 90 kg of water (M.wt. 18) ?
   (a) 32 kg. (b) 64 kg. (c) 90 kg. (d) 80 kg.
4. Heat of reaction is a function of the
   (a) Pressure. (b) Temperature. (c) Both (a) & (b). (d) Neither (a) nor (b)
5. A 'limiting reactant' is the one, which decides the _____ in the chemical reaction.
   (a) Equilibrium constant. (b) Conversion. (c) Rate constant. (d) None of these.
6. The heat change for the reaction, $C(s) + 2S(s) \rightarrow CS_2(l)$, is 104.2 kJ. It represents the heat of
   (a) Formation. (b) Solution. (c) Combustion. (d) Fusion.
7. Real gases approach ideal behaviour at
   (a) High pressure & high temperature. (b) Low pressure & high temperature. (c) High pressure & Low temperature. (d) Low pressure & Low temperature.
8. A bypass stream in a chemical process is useful, because it
   (a) Facilitates better control of the process. (b) Improves the conversion. (c) Increase the yield of products. (d) None of these.
9. The combustion equations of carbon and carbon monoxide are as follows: $C + O_2 = CO_2$, $\Delta H = -394$ kJ/kgmole $CO + 1/2\ O_2 = CO_2$, $\Delta H = -284.5$ kJ/kgmole. The heat of formation of CO is _____ kJ/kgmole.
   (a) + 100 (b) + 109.5 (c) + 180 (d) – 109.5
10. A mixture is reported as 15% water and 85% ethanol. Should the percentage be deemed to be by___
    (a) Mole. (b) Mass. (c) Volume. (d) (a) or (c)

Q.2

(A) Which of these three sets of containers represents respectively one mole of lead (Pb), one mole of zinc (Zn) and one mole of carbon (C)? {Molecular weight: Pb = 207.21, Zn = 65.38, and C = 12.01. Specific gravity: Pb = 11.33, Zn = 7.14, and C = 2.26. Density of water = 1 g/cm^3}.

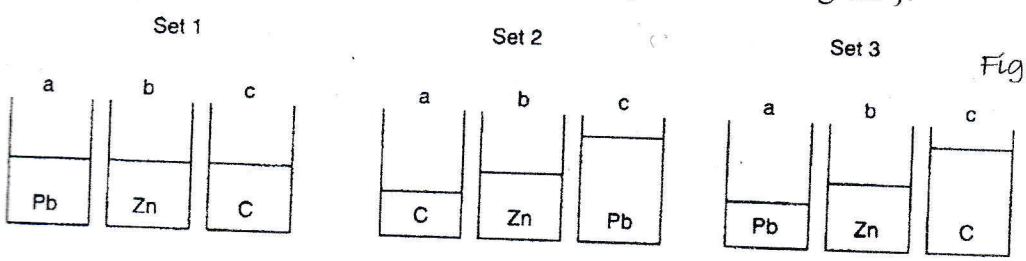

Figure Q.2 (A)

(B) Calculate the enthalpy change for 1 kg of water from -30 °C to 130 °C, using the data in Figure (heat capacity J/gmol: ice = 23.7, liquid water = 75.4, and water vapor = 33.9).

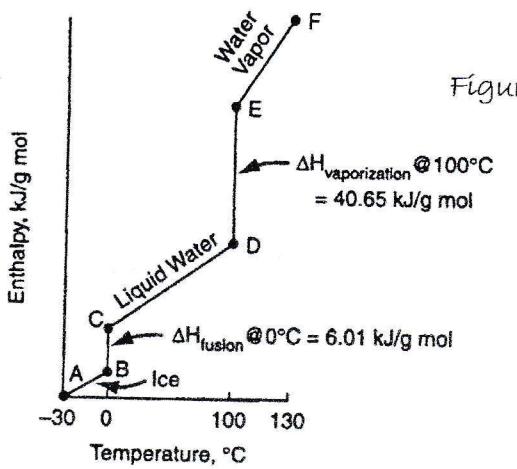

Figure Q.2 (B)

Dr. Ahmed Faiq Al-Alawy
September / 2014

Fluid Flow M Sc

Select the right answer for the followings:

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

a. decreases and then increases. b. remains constant.

c. monotonically decreases. d. increases and then decreases.

2. The velocity profile for turbulent flow through a closed conduit is

a. parabolic b. logarithmic c. hyperbolic d. linear

3. The terminal velocity of a small sphere settling in a viscous fluid varies as the

a. square of the difference in specific weights of solid & fluid.

b. first power of its dimeter.

c. inverse of the fluid viscosity.

d. inverse square of the diameter

4. Laminar flow of a Newtonion fluid ceases to exist, when the Reynolds number exceeds

a. 2100 b. 1500 c. 3000 d. 4000

5. The net positive suction head (NPSH) of a centrifugal pump is defined as the sum of the velocity head and the pressure head at the

a. discharge

b. discharge minus vapor pressure of the liquid at the discharge temperature.

c. suction minus vapor pressure of the liquid at suction temperature.

d. suction

6. Power loss in an orificemeter is _____ that in a venturimeter.

a. more than b. less than c. data insufficient, cannot be predicted

d. same as

7. What causes cavitation in centrifugal pump?

a. High suction pressure b. Low barometric pressure

c. Low suction pressure d. High suction velocity

8. The ratio of average fluid velocity to the maximum velocity in case of laminar flow of a Newtonion fluid in a circular pipe is

a. 0.5 b. 1 c. 2 d. 0.66

9. Very small pressure difference (< 5 mm water coloumn) can be most conveniently measured by a/an _____ manometer

a. U-tube water b. U-tube mercury

c. inclined tube mercury d. inclined tube water

10. Check valve is used for _____ flow.

a. very precise control of b. unidirectional

University of Baghdad - College of Engineering
Chemical Engineering Department
M. Sc. Entry Examination

Reactor Design ***September, 2014***

Q1: The reaction rate value of oxidation reaction occurred in 0.21 m^3 reactor and consumed 15 mole of oxygen per 2 seconds is:

1. $-r_{O2}= 0.03$
2. $-r_{O2}= 1.58$
3. $-r_{O2}= 35.71$
4. $-r_{O2}= 142.86$

Q2: The unit of the reaction rate constant for zero order reaction is:

1. $(time)^{-1}$
2. $(conc.)\,(time)^{-1}$
3. $(conc.)^{-1}(time)^{-1}$
4. Dimensionless

Q3: Define half-life time and then show the ability to find reaction order of irreversible reaction($-r_A = kC_A^n$) from half-life time data.

Q4: The irreversible reaction is simply the special case if the of the reversible reaction in which:

1. $K_c= 0$
2. $X_{Ae}=1$
3. $C_{Ae}= 0$
4. $C_{Ao}=$ maximum

Q5: When activation energy of a certain reaction is very low, the conversion of limiting reactant material is:

1. Highly changing with temperature.
2. Decreasing with temperature.
3. Approximately un-changing with temperature.
4. Reaching maximum at 298 K.

Q6: The activation energies of two reactions (1 and 2) are $E_1=10E_2$. This means that:

1. Rate 1 is more affected by temperature.
2. Rate 2 is more affected by temperature.
3. Rate 1 is larger ten times than rate 2.
4. None of the above!

Q7: A designer made some calculation mistakes by ignoring the fractional change of volume in certain first order gas reaction (which equal to 0.7). What is your prediction for the conversion of the limiting reactant (x_A) that flow out from this reactor?

1. Conversion increasing.
2. Conversion decreasing.
3. Conversion did not affected.
4. Reactor never works!

Q8: A liquid decomposes by second order kinetics, in a batch reactor 50% of A is converted in a 5 minutes run. How much longer would it take to reach 75% conversion?

Q9: Distingush between elementry and non-elementry reactions.

Q10: The performance of infinite number of equal size mixed flow reactors in series is the same as for:

1. Single mixed flow reactor.
2. Single plug flow reactor.
3. Single mixed flow reactor with recycle ratio R=1.
4. Infinite number of plug flow reactors.

...Good Luck

Asst. Prof. Dr. Ammar S. Abbas
September, 2014

University of Baghdad
Chemical Engineering Department

M.Sc. Qualifying Examination

Subject: Engineering Analysis
Examiner: Dr.Hasan F. Makki

Date : 07/09/ 2014

Q.1 Define (with examples):

a) Dependent and independent variables.
b) Order and degree of a differential equation.
c) Simultaneous differential equation.
d) Linear differential equation.
e) Partial differential equation.

Q.2

Liquid inlet and outlet a tank with q_1 and q_2 m^3/s respectively. Initial liquid level in the tank is (H_o). Find the relation of (H) with time that represents the process. Assuming that the outlet flow through the valve is laminar.

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2014/2015
M. Sc.

Thermodynamics

1 For the equation: $\Delta H^o = \Delta H_0^o + R \int_{T0}^{T} \frac{\Delta Cp^o}{R} dT$

a. ΔH^o *and* ΔH_0^o are heats of formation at temperature T and reference temperature T_0.
b. ΔH^o *and* ΔH_0^o are heats of combustion at temperature T and reference temperature T_0
c. Neither of the above.

2 Third law of thermodynamics states that:
a. Absolute entropy is zero for all perfect crystalline substances at absolute zero temperature.
b. Absolute entropy has a definite value for all perfect crystalline substances at absolute zero temperature.
c. Either a or b.

3 For an ideal gas:
a. Cp = Cv + R
b. Cv = Cp + R
c. Cp = Cv

4 For an isothermal process:
a. $w = -RT \ln \frac{V_2}{V_1} = RT \ln \frac{P_2}{P_1}$
b. $w = -nRT \ln \frac{V_2}{V_1} = -nRT \ln \frac{P_2}{P_1}$
c. Neither of the above.

5 First law of thermodynamics applies to:
a. System and Surroundings.
b. System alone.
c. Surroundings alone.

6 Thermal efficiency of a heat engine η equals to:
a. Net heat absorbed/net work output
b. Net work output/ heat absorbed
c. Net heat input/heat absorbed

7 Write an equation to calculate the entropy of a substance starting from temperature T = 0 K undergoing phase changes from solid to liquid to gas.

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Heat Transfer

1 The value of heat transfer coefficient depends on:
a. The mechanism by which heat is transferred.
b. The dynamics of both cooled and heated fluids.
c. The properties of the materials through which heat must pass.
d. All of the above.

2 For heat flow through thick-walled tube with temperatures on both outside and inside are constant, the temperature gradient is:
a. Inversely proportional to the radius.
b. Linearly proportional to the radius.
c. Neither of the above.

3 Nusselt number is defined by:
a. Cp μ/k
b. h d/k
c. ρ u d/μ

4 Emissivity of a body is defined as:
a. Ratio of emitting power of a black body to that of the body itself.
b. 1
c. Ratio of its emitting power to that of a black body.

5 In a one shell pass and several tube passes, the mean temperature difference for counter current flow is:
a. Greater than that for co-current flow.
b. Lower than that for co-current flow.
c. Equal to it.

6 The heat loss per a square meter of a surface through a brick wall of thermal conductivity = 0.7 W/mK and 0.5 m thickness. The inner surface is at 400K and the outside is at 310K, is:
a. 100 W/m^2
b. 126 W/m^2
c. 250 W/m^2

7 A heat exchanger is required to cool continuously 20 kg/s of warm water from 360 K to 335 K by means of 25 kg/s of cold water, inlet temperature 300 K. Assuming that the water velocities are such as to give an overall coefficient of heat transfer of 2 kW/m^2K. Calculate the total area of surface required in a counter flow heat exchanger.

8 Calculate the total heat loss by convection and radiation for a horizontal steam pipe of 50 mm outside diameter at 415 K to air at 290 K. The heat transfer for convection is 8.34 W/m^2K and the emissivity of the pipe is 0.9.

University of Baghdad

Chemical Engineering Department

M.Sc. Qualifying Examination

Subject: Mass Transfer

Examiner: Dr. Wadood T. Mohammed

Date : 07/09/ 2014

Q1: Answer the following:

1) Fenske equation determines the _____.
a. Maximum number of ideal plates.
b. Height of the distillation column.
c. Minimum number of theoretical plates.
d. Optimum reflex ratio.

2) Total reflux in a distillation operation requires minimum _____.
a. Reboiler load.
b. Number of plates.
c. Condenser load.
d. All above.

3) Separation of two or more components of a liquid solution can't be achieved by _____.
a. Fractional distillation.
b. Liquid extraction.
c. Absorption.
d. Evaporation.

4) In case of an absorber, the operating _____.
a. Line always lies above the equilibrium curve.
b. Line always lies below the equilibrium curve.
c. Line can be either above or below the equilibrium curve.
d. Velocity is more than the loading velocity.

5) The rate of solid-liquid extraction is limited by the _____.
a. Phase change of the solute as it dissolves in the solvent.
b. Diffusion of the solute through the solvent in the pores to the outside of the particle.
c. Diffusion of the solute from the solution in contact with the particle to the main bulk of the solution.
d. All above.

6) In distillation, overhead products contain _____.
a. Only one component.
b. Two components.
c. Any number of components.
d. Only saturated liquid.

Q2: Species (A) in a gaseous mixture diffuses through a 3 mm thick film and reaches a catalyst surface where the reaction $A \rightarrow 3B$ takes place. If the partial pressure of (A) in the bulk of the gas is 8.5 kN/m^2 and the diffusivity of (A) is $2*10^{-5}$ m^2/s. Find the mole flux of (A). given P = 101.325 kN/m^2 , T = 297 K and R = 8.314 kJ / kmol.K.