



Time: 3 Hours

Date : 13 / 8 / 2015

الاسم :

الرقم السري

الرقم السري

Part One: Choose the correct answer of the following: (60% , 3 marks per each question)

- The average molecular weight of a gas mixture 16% O₂ , 4% CO , 17% CO₂ , & 63% N₂ by weight is :
a) 28.5 b) 29.5 c) 30.5 d) 31.5
- The mass fraction of 0.5 molar aqueous solution of H₂SO₄ (Sp. Gr. 1.03) is :
a) 0.038 b) 0.048 c) 0.058 d) 0.068
- The heat duty (q) in kw of a heat exchanger to cool 50 m³/h oil (Sp. Gr. =0.9 & Cp= 2 kJ/kg.K) from 120 °C to 40 °C is about :
a) 500 b) 1000 c) 1500 d) 2000
- The heat duty (q) in kw of a heat exchanger consuming 810 m³/h steam at 10 bar and 150 °C (ΔH_v=2400 kJ/kg) is about:
a) 10⁵ b) 10⁶ c) 10⁷ d) 10⁸
- Information on a name plate of a pump, 20 m³/h and 50 m head. The expected pump power is about:
a) 1 kw b) 2 kw c) 3 kw d) 4 kw
- The kinematic viscosity of water in units m²/s is equal to :
a) 1 b) 10⁻³ c) 10⁻⁶ d) 10⁻⁹
- The settling velocity of Stokes law depends on particle diameter as :
a) d_p^{0.5} b) d_p c) d_p² d) d_p³
- A packed bed column of 1.13 m diameter, contains sand (bulk density ρ_B=1000 kg/m³) and 1 m height, fluidized with flowing fluid . the expected pressure drop of the column is about:
a) 5000 N/m² b) 10000 N/m² c) 15000 N/m² d) 20000 N/m²
- Which of the following processes is isolated system?
a) Adiabatic process b) Isobaric process c) Isothermal process d) Isochoric process
- Which of the following is not a state function?
a) Internal energy b) Enthalpy c) Work d) Free energy

11. Which of the following processes is Non-equimolar counter diffusion of gases

- a) At different number of moles of the gases diffusing counter-current to each other.
- b) An equal number of moles of the gases diffusing counter-current to each other.
- c) If the gas is diffusing through the stagnant film.

12. Which of the following separation processes is required the heat

- a) Absorption b) Leaching c) Distillation d) Extraction

13. Which of the following is true:

- a) The measurement element is used for controlling the output variable.
- b) The controller is used for actuating the load variable.
- c) The control valve is used for regulating the manipulating variable.
- d) The transmitter is used for regulating the control variable.

14. The Response of a control system for a change in load variable is called

- a) Cascade b) Servo c) Regulator d) Frequency

15. Two parallel black plates 0.5 by 1.0 m. One plate is maintained at 1000 °C and the other at 500 °C. What is the net radiant heat exchange between the two plates?

- a) 8.97 W b) 18.33 W c) 120 W d) 515 W

16. An outside wall of a building consists of 0.1m layer of common brick [$k=0.69 \text{ W/m.K}$] and 25mm layer of fiber glass [$k=0.05 \text{ W/m.K}$]. The heat flow with through the wall for a 45°C temperature differences will be

- a) 11.87 W/m² b) 33.67 W/m² c) 69.78 W/m² d) 87.56 W/m²

17. Which of the following reactors can give the maximum gas conversion?

- a) Fixed bed reactor b) Fluidised bed reactor c) Semi-fluidised bed reactor d) Plug-flow catalytic reactor

18. For every 10°C rise in temperature, the rate of chemical reaction doubles. When the temperature is increased from 30 to 70°C, the rate of reaction increases by

- a) 8 times b) 16 times c) 32 times d) 64 times

19. One of the most typical diesel additives that should be added to improve the performance of diesel fuel is

- a) Solvents b) Anti-oxidation c) CCD d) Heptane

20. A petroleum fraction has API of 33.5, the density of such fraction will be

- a) 0.7763 g/cm³ b) 0.6754 g/cm³ c) 0.9123 g/cm³ d) 0.8575 g/cm³

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

1.

A mixture of gases has the following composition by mass:

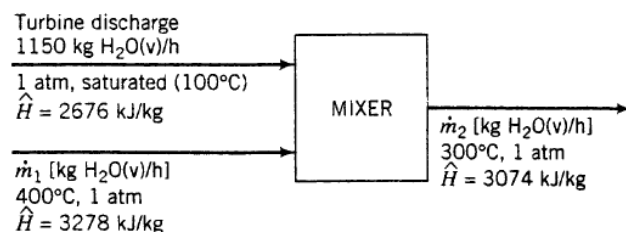
O ₂	16%	(x _{O₂} = 0.16 g O ₂ /g total)
CO	4.0%	
CO ₂	17%	
N ₂	63%	

What is the molar composition?

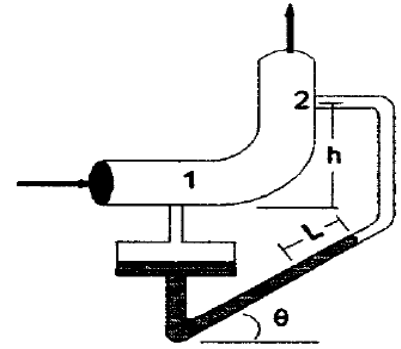
2.

Saturated steam at 1 atm is discharged from a turbine at a rate of 1150 kg/h. Superheated steam at 300°C and 1 atm is needed as a feed to a heat exchanger; to produce it, the turbine discharge stream is mixed with superheated steam available from a second source at 400°C and 1 atm. The mixing unit operates adiabatically. Calculate the amount of superheated steam at 300°C produced and the required volumetric flow rate of the 400°C steam.

Specific enthalpies of the two feed streams and the product stream are obtained from the steam tables and are shown below on the flowchart.



3. Find the pressure drop ($P_1 - P_2$) for the following manometer arrangement and information : Water fluid SG=1 manometer fluid SG = 1.15, $L = 75$ mm, $h = 150$ mm, $\theta = 30^\circ$



4. What are the most important factors effect the rate of filtration, and write the main equation relating these factors?

5. For a water at 350 K and 1 bar, the isothermal compressibility " κ " = $50 \times 10^{-6} \text{ bar}^{-1}$. To what pressure must water be compressed at 350 K to change its density by 0.5 if the temperature is constant?

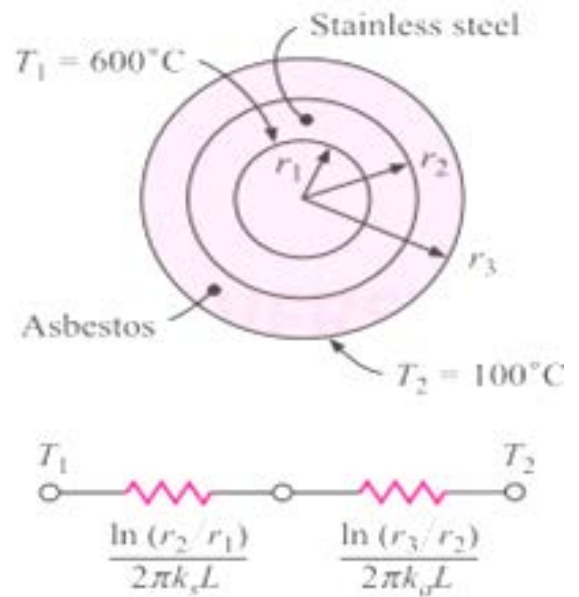
6. Hydrochloric acid (A) diffuses through a thin film of water (B) 4.0 mm thick at 283 K. The concentration of HCl at point 1 on one boundary of the film is 12 wt% and on the other boundary, at point 2 is 4 wt%. The diffusivity of HCl in water is $2.5 \times 10^{-9} \text{ m}^2/\text{s}$. Calculate the flux of HCl considering water to be stagnant. Density of the solutions at points 1 and 2 are 1060.7 kg/m^3 and 1020.15 kg/m^3 respectively. (The Molecular weight of HCl= 36.5)

7. List the basic mode of controller and give its output equation.

8. What is the order of the decomposition of N_2O ?, and find the rate constant and half-life.

$\text{N}_2\text{O}, \text{ mol/dm}^3 (10^3)$	100	61	37	10
Time, s	0	50	100	230

9. A thick-walled tube of stainless steel ($k = 19 \text{ W/m.}^\circ\text{C}$) with 2 cm inner diameter (ID) and 4 cm outer diameter (OD) is covered with a 3 cm layer of asbestos insulation ($k = 0.2 \text{ W/m.}^\circ\text{C}$). If the inside wall temperature of the pipe is maintained at 600°C , calculate the heat loss per meter of length. Also calculate the tube insulation interface temperature.



10. What are the main products obtained by the vacuum distillation unit?

Asst. Prof. Zaid A. Abdel-Rahman

Asst. Prof. Duraid Fadhil Ahmed

Head of Dept. : Dr. Aysar T. Jarullah