B.TECH DEGREE EXAMINATIONS: OCTOBER/NOVEMBER-2008

Third Semester

BIOTECHNOLOGY

U07BT308 - Principles of Chemical Engineering

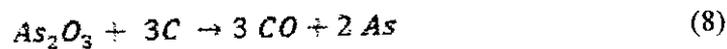**Time: Three Hours**   **Maximum Marks: 100**

Answer ALL Questions:-

Part-A (20x1 = 20 Marks)

1. The temperature of a chemical process was found to be 80°C. What is the temperature in °F?

    a) 353°F   b) 636°F   c) 176°F   d) -193°F

2. Which one of the following is a derived unit in SI system?

    a) Mass   b) Volume   c) Time   d) Length

3. The area of an irregular surface can be determined by using

    a) Newton's Forward Difference Formula
    b) Newton's Backward Difference Formula
    c) Simpson's $1/3^{rd}$ rule
    d) Numerical Differentiation

4. In which of the following reactions, Law of conservation of mass becomes invalid?

    a) Ammonia synthesis   b) Fermentation of Ethanol
    c) Combustion reactions   d) Nuclear Fission reactions

5. A process is said to be at steady state if its conditions

    a) Do not change with respect to position
    b) Change with respect to position
    c) Change with respect time
    d) Do not Change with respect to time

6. An aqueous solution of NaCl has a concentration of 24 wt% NaCl with a density of 1.178 g/cm^3 at 25°C. The mole fraction of water in the solution is

    a) 0.0886   b) 0.9114   c) 4.22   d) 0.41

7. The stream which skips one or more intermediate stages of a process is known as

    a) Purge stream   b) Bypass stream   c) Recycle stream   d) None of these

8. Steady state temperature reached by a small amount of liquid evaporating into a large amount of unsaturated vapor-gas mixture is\

    a) Dry-bulb temperature   b) Wet-bulb temperature
    c) Dew point   d) Adiabatic saturation temperature

9. Second law of thermodynamics is concerned with

    a) Amount of energy transferred   b) Direction of energy transfer
    c) Irreversible processes only   d) Non-cyclic processes only

10. Which of the following is a thermodynamic property of a system?

    a) Concentration   b) Mass   c) Temperature   d) Vapour pressure

11. The quantity of heat that can not be measured by using a temperature measuring device is known as

    a) Latent heat   b) Sensible heat   c) Specific heat   d) Preheat

12. When a solute is added to a solvent, its vapour pressure

    a) Increases   b) Decreases
    c) is not affected   d) Initially increases but then start to decrease.

13. The head loss in turbulent flow in a pipe varies

    a) Directly as the velocity
    b) Inversely as the square of the velocity
    c) Directly as the square of the velocity
    d) Inversely as the square of the diameter

14. Which of the following is a Newtonian fluid?

    a) Rubber latex   b) Sewage sludge   c) Quick sand   d) Non-colloidal solution

15. Which of the flowing pipe fittings will incur largest pressure drop?

    a) U-bend   b) 30° bend   c) 45° bend   d) 90° bend

16. Which of the following denotes the effect of compressibility in fluid flow?

    a) Weber Number
    b) Mach Number
    c) Euler Number
    d) Reynolds Number

17. Cavitation in a centrifugal pump results from

    a) High discharge pressure
    b) Low barometric pressure
    c) High Discharge velocity
    d) High Discharge rate

18. For pumping slurry, one can use a _____ pump.

    a) Reciprocating
    b) Diaphragm
    c) Centrifugal
    d) Pneumatic

19. In case of a fluidized bed, the pressure drop

    a) increases with the fluid velocity
    b) decreases with the fluid velocity
    c) remains constant
    d) Initially increases, but then start to decrease.

20. A centrifugal pump used to pump water is used to pump an oil of specific gravity 0.8 at the same rate. The power consumption will now

    a) Increase
    b) Decrease
    c) Remain same
    d) Data insufficient to predict

Part-B (5 x 16 = 80 Marks)

21. a) i) From the following table, determine the value of velocity in m/hr at time

    t= 0.15hr by using Newton's Backward Difference formula.   (10)

Time(Hour)	0.1	0.2	0.3	0.4	0.5
Velocity (m)	0.09983	0.19867	0.29552	0.38942	0.47943

    ii) Explain various system of units used in engineering calculations.   (6)

(OR)

    b)   i) Approximate $\int_2^3 \frac{dx}{x+1}$ using Simpson's Rule with $n = 4$.   (10)

    ii) Write short notes on Curve fitting.   (6)

22. a) In a process producing KNO_3 salt, 1000kg/h of a feed solution containing 20 wt% KNO_3 is fed to an evaporator, which evaporates some water at 422 K to produce a 50 wt% KNO_3 solution. This is then fed to a crystallizer at 311K, where crystals containing 96 wt% KNO3 are removed. The saturated solution containing 37.5 wt% KNO_3 is recycled to the evaporator. Calculate the amount of recycle stream R in kg/h and the product stream of crystals P in kg/h.

                                                                                 (16)

(OR)

b) i) Define the following: Mole, Molarity, Percentage Humidity and Saturation Humidity.

(4x2=8)

ii) For the following reaction, how many grams of charcoal is required to reduce 1500 kg of arsenic trioxide? (Atomic weight of Arsenic = 75)

$$As_2O_3 + 3C \rightarrow 3CO + 2As$$

(8)

23. a) Write short notes on Clasius-Clapeyron equation, Watson's equation, Antoine equation, and Riedel equation.

(4x4=16)

(OR)

b) A liquid fermentation medium at 30° C is pumped at a rate of 2000 kg/h through a heater, where it is heated to 70° C under pressure. The waste heat water used to heat this medium enters at 95° C and leaves at 85° C. The average heat capacity of the fermentation medium is 4.06 kJ/kg.K. and that for water is 4.21 ° kJ/kg.K. The fermentation medium and the waste water stream are separated by a metal surface through which heat is transferred and do not physically mix with each other. Make a complete heat balance on the system. Calculate the water flow and the amount of heat added to the fermentation medium assuming no heat losses.

(16)

24. a) i) Give Newton's law of viscosity and explain various types of fluids based on this law.

(10)

ii) Explain Briefly about Reynold's Number and its significance in Fluid flow.   (6)

(OR)

b) i) A liquid having a density of 801 kg/m^3 and a viscosity of 1.49 x 10^{-3} Pa.S is flowing through a horizontal straight pipe at a velocity of 4.57 m/s. The diameter of the pipe is 50 mm. For a length of pipe of 61m, determine the type of low and the frictional head loss. (10)

ii) State Pascal's law and its applications in Chemical engineering.   (6)

25. a) What is fluidization? Explain and the behavior of a fluidized bed and its applications in detail.   (16)

(OR)

b) i) Explain the working of a Centrifugal pump with a neat sketch   (10)

ii) Explain briefly about Characteristic and operating curves of a Centrifugal pump

(6)

****