KUMARAGURU
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Register Number: ……..

B.TECH DEGREE EXAMINATIONS: JUNE 2015

(Regulation 2009)

Third Semester

BIOTECHNOLOGY

BTY106: Principles of Chemical Engineering

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Absolute pressure = _____ + barometric pressure
   a) Gauge Pressure b) Atmospheric Pressure
   c) Over Pressure d) Manometric Pressure
2. Gypsum is chemically _____.
   a) Calcium chloride b) Calcium oxalate
   c) Calcium sulphate d) Melatonin oxide
3. Unsaturated oils compared to saturated oils have _____.
   a) Higher melting point & lower reactivity b) Lower melting point & lower reactivity
   c) Lower melting point & higher reactivity d) Higher melting point & higher reactivity
4. Which of the following is a thermodynamic property of a system?
   a) Energy b) Mass
   c) Entropy d) Volume
5. Exothermic reaction refers to _____.
   a) Release of liquid b) Imbibes heat
   c) Release of heat d) Release of kinetic work
6. Recycling in a chemical process facilitates _____.
   a) Product validation b) Process enrichment
   c) Product enrichment d) Process validation
7. A liquid which does not flow at all until a threshold stress is attained is _____.
   a) Newtonian b) Pseudoplastic
   c) Bingham plastic d) Thixotropic

8. Under ordinary conditions the flow in a pipe or tube is turbulent when Reynolds number is above_____.

a) 2100 < 10000 b) less than 2100 and greater than 10000

c) 10000 d) 2100

9. Bernoulli's equation cannot be applied when the flow is _____.

a) Potential b) Irrotational

c) Rotational d) Incompressible

10. The pump used for irrigation purpose is generally designed for _____.

a) Small capacity and high head b) Large capacity and high head

c) Large capacity and low head d) Small capacity and low head

PART B (10 x 2 = 20 Marks)

11. Write the Redlich-Kwong equation.
12. What is the dimensions and units of kinematic viscosity.
13. Name the purpose of recycling in process industries.
14. Contrast the term conversion from yield for a chemical reaction.
15. Define critical moisture content and equilibrium moisture content.
16. Define loss coefficient of a valve or pipe fitting.
17. In a stagnant liquid, how does pressure vary in horizontal and vertical directions?
18. State the working principle of a centrifugal pump.
19. Compare the porosity of a packed bed and that of a fluidized bed.
20. What is NPSH?

PART C (5 x 14 = 70 Marks)

21. a) (i) A chemist is interested in preparing 500 ml of 1 normality, 1 molarity, 1 molality solution of H_2SO_4. Assuming the density of the acid solution to be 1.075 g/cubic centimeter. Calculate the quantities of acid. (6)

(ii) Sodium chloride weighing 200 kg is mixed with 600 kg pottasium chloride. Calculate the composition of the mixture in weight% and mole%. (4)

(iii) Find the molality, molarity and normality of a 15% solution of sulphuric acid (density: 1.1 g/mol). (4)

(OR)

b) A cylinder with a capacity of 6 litres contains a mixture consisting of CO_2, 4 g of O_2 and 1.5 g of CH_4 at 0ºC. Calculate the,

(i) composition of the mixtures by volume (6)

(ii) partial pressure of each gas (4)

(iii) the total pressure of the mixture. (4)

22. a) The waste acid from a nitrating process containing 20% HNO_3, 55% H_2SO_4 and 25% H_2O by weight is to be concentrated by the addition of concentrated H_2SO_4 containing 95% H_2SO_4 and concentrated HNO_3 containing 90% HNO_3 to get desired mixed acid containing 26% HNO_3 and 60% H_2SO_4. Calculate the quantities of waste and concentrated acids required for 1000 kg of desired mixed acid.

(OR)

b) An evaporator is fed with 15,000 kg/hr of a solution containing 10% NaCl, 15% NaOH, and the rest water. In the operation, water is evaporated and NaCl is precipitated as crystals. The thick liquor leaving the evaporator contains 45% NaOH, 2% NaCl, and the rest water. Calculate:

(i) kg/hr of water evaporated (5)

(ii) kg/hr of salt precipitated (5)

(iii) kg/hr of thick liquor. (4)

23. a) (i) Standard enthalpies of formation are: C_2H_5OH -228, CO_2 -394 and $H_2O(l)$ -286 kJ/mol. Calculate the enthalpy of the reaction,

$C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$

(ii) Calculate the enthalpy of the reaction, $CH_4 + 2\ O_2 = CO_2 + 2\ H_2O$, from the enthalpies of formation: CH_4 -75 kJ/mol, CO_2 -394, and $H_2O(l)$ -286 kJ/mol.

(iii) Calculate the standard enthalpy of formation for glucose, given the following values:

$\Delta H°_{comb,\ glucose} = -2800.8$ kJ/mol

$\Delta H°_{f,\ CO2} = -393.5$

$\Delta H°_{f,\ H2O} = -285.8$

(OR)

b) A 4.40 g lead bullet moving at 250.0 m/s strikes a steel plate and stops. If all the bullet's kinetic energy is converted to thermal energy (No energy transfer to the steel plate), what is the bullet's temperature change?

24. a) (i) Derive the Bernoulli equation for steady flow of an incompressible fluid and mention its application. (8)

(ii) Discuss on the correction factors to be considered in the equation for practical applications. (6)

(OR)

b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine the dynamic viscosity of the oil and the kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95.

25. a) Classify pumps and discuss in detail about the working, principle and characteristics of reciprocating pump.

(OR)

b) A bed containing 35000 kg of sand particles (DP = 0.16mm) is to be fluidized with air at 400^{o}C and 20 kgf/cm^2 pressure in a cylindrical vessel of 3m in diameter. The density of sand particles is 2.7g/cc. The viscosity of air at operating condition is 0.032 cP. Calculate (a) the minimum height of the fluidized bed, (b) the pressure drop in the fluidized bed, and (c) the critical superficial velocity assuming, eM = 0.55.

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