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C20-CHOT–305

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BOARD DIPLOMA EXAMINATION, (C-20)

OCTOBER/NOVEMBER—2023

DCHPC - THIRD SEMESTER EXAMINATION

MASS AND ENERGY BALANCE

Time : 3 Hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed five simple sentences.

1. Convert 120 lb/ft^3 into kg/m^3.

2. Define vapour pressure and explain the relation between vapour pressure and boiling point.

3. Define Henry's law for solutions.

4. What are the steps involved to solve material balance problems?

5. Define degree of completion in a chemical reaction system.

6. Define the terms *(a)* limiting reactant and *(b)* % excess.

7. In the equation $CO + 2H_2 \rightarrow CH_3OH$, what is the stoichiometric ratio of H_2 to CO?

8. Define heat capacity and write its units in SI system.

9. Define the terms *(a)* net calorific value and *(b)* gross calorific value.

10. Distinguish between partial and complete combustion.

PART—B

8×5=40

Instructions : (1) Answer **all** questions.

(2) Each question carries **eight** marks.

(3) Answers should be comprehensive and criterion for valuation is the content but not the length of the answer.

11. A force of 20 kgf is applied on a piston of diameter 5 cm. Find the pressure exerted on the piston in kpa.

(OR)

In a double effect evaporator the second effect is maintained under vacuum of 475 mm Hg. Find the absolute pressure in kpa, bar, psi.

12. An aqueous solution of soda ash (Na_2CO_3) contains 20% soda ash (on weight basis). Express the composition as weight % Na_2O.

(OR)

Sodium chloride weighing 200 kg is mixed with 600 kg potassium chloride. Calculate the composition of the mixture in *(a)* weight % and *(b)* mole %.

13. The ground nut seeds containing 45% oil and 45% solids are fed to expeller, the cake coming out of expeller is found to contain 80% solids and 5% oil. Find the percentage recovery of oil.

(OR)

200 kg of wet solids containing 70% solids by weight are fed to a tray dryer where it is dried by hot air. The product finally obtained is found to contain 1% moisture by weight. Calculate *(a)* weight of water removed from wet solids and *(b)* weight of product obtained.

14. A producer gas with the composition –27% CO, 6% CO_2, 1% O_2 and 66% N_2 by volume is burnt with 20% excess air. If the combustion is 98% complete, calculate the composition of the flue gases by volume.

(OR)

The analysis of flue gas shows 10.2% CO_2, 7.9% O_2 and 81.9% N_2 by Orsat apparatus. Calculate % excess air used.

15. Calculate the heat of formation of gaseous ethyl alcohol at 298.15 K using the following data :

Standard heat of formation of $CO_2(g)$ = –393.51 kJ/mol

Standard heat of formation of $H_2O(l)$ = –285.83 kJ/mol

Heat of combustion of gaseous ethyl alcohol at 298.15 K = –1410.09 kJ/mol

(OR)

Calculate the standard heat of reaction of the following reaction :

$$CH_3OH(l) + 1/2\ O_2(g) \rightarrow HCHO(g) + H_2O(l)$$

Data :

ΔH_F° of CH_3OH = –239.2 kJ/mol; ΔH_F° of HCHO = –108.6 kJ/mol; ΔH_F° of H_2O = –285.83 kJ/mol.

PART—C

10×1=10

Instructions : (1) Answer the following question.

(2) The question carries **ten** marks.

(3) Answer should be comprehensive and the criterion for valuation is the content but not the length of the answer.

16. Calculate the density of air at 503 K (230 °C) and 1519·875 kpa.

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