

Mid-Term Examination, February 2021

First Semester [B.Tech.]

Applied Chemistry

Time: 1 hour

M.M. 30

Note: Attempt any two questions out of three.

Q1. Attempt **any five** parts:

- A good fuel should have high calorific value, moderate ignition temperature and low moisture content. Why?
- The ultimate analysis of a coal sample gave the following results: C=84%, H=5.5%, O=8.4% and S= 1.5%. Calculate the gross and net calorific value of this coal sample.
- Octane number of cracked gasoline is higher than that of straight run gasoline. Explain why?
- Name any two catalysts that can be used to bring about the catalytic cracking of heavy oils. What are some of the advantages offered by catalytic cracking over thermal cracking?
- A sample of coal was analysed as follows: 5 g of the sample dried at 110 °C to a constant weight left a moisture free residue of 4.80g. On further heating out of contact with air to about 900 °C, in a crucible with a vented lid to drive off all the volatile matter, a residue of 3.38g of coke was obtained. On heating the crucible strongly in air with an open lid, a residue of 0.075g was obtained. What is the proximate analysis of this coal sample?
- 0.5g of a sample of coal was used in a bomb calorimeter. The ash formed was extracted with acid and the acid extract was heated with barium chloride solution. The precipitate formed was filtered, washed and dried. Weight of this precipitate was 0.05g. Calculate the percentage of sulphur in this sample.

(3X 5=15)

Q2. Attempt **any three** parts:

- What is the value of P, C and F for these systems:
 - Pure crystals of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
 - NH_4Cl being heated alone in a closed vessel
 - Pb-Ag system at the Eutectic point
- Draw a labelled phase diagram for the Water system and explain why the fusion curve of ice has a negative slope.
- With the help of suitable plots explain briefly how the activity of an enzyme varies with the changes in temperature, pH and substrate concentration.
- In acid catalyzed reactions, one of the mechanisms involves transfer of a proton from the intermediate to a water molecule. Use the kinetics of this mechanism to derive the two cases of general acid catalysis and specific acid catalysis.

(5 X3= 15)

Q3. Attempt **any three** parts:

- (a) A sample of coal was tested for its calorific value using Bomb's calorimeter. Following data was obtained:

Weight of coal burnt = 0.920g

Weight of water taken = 550g

Water equivalent of bomb, calorimeter = 2200g

Rise in the temperature = 2.32°C

Fuse wire correction = 10 cal

Acid correction = 50 cal

Cooling correction = 0.007°C

Calculate the GCV and NCV of this sample, assuming that the sample contains 6% hydrogen. Latent heat of condensation of steam is 580 cal/g.

- (b) Using a neat and labelled diagram explain the recovery of various by-products from the coke oven gas produced in the Otto-Hoffmann's Oven.
- (c) A gas has the following composition by volume: $\text{H}_2 = 30\%$, $\text{CH}_4 = 10\%$, $\text{CO} = 15\%$, $\text{CO}_2 = 6\%$, $\text{O}_2 = 5\%$ and $\text{N}_2 = 34\%$. Find the volume of air actually supplied per m^3 of this gas.
- (d) With the help of balanced chemical reaction, describe the reaction between potassium permanganate and oxalic acid in acidic medium. What is the role of Mn^{2+} ions in this reaction. Why is it important to maintain acidity of the medium for this reaction?

(5X 3=15)