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B.Tech 2nd Semester Examination

Chemistry

AS-1004

Time : 3 Hours   Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/ continuation sheet will be issued.

Note :   Section E is compulsory. Attempt any one question each from sections A, B, C & D.

SECTION - A

1. (a)   Derive the Gibbs-Helmhoitz equation and discuss its applications.

    (b)   Comment on the statement 'The entropy of the universe is always increasing'.

    (c)   The latent heat of vaporization of water is 540 cal/g at about 100°C. Calculate the pressure at which water must be heated to produce super heated steam at 150°C.   **(7+6+7)**

2. (a)   What is Gibbs phase rule? Discuss the merits of Gibbs phase rule.

    (b)   i.   State the significance of triple point.

          ii. With the help of phase rule diagram, show how is it possible to have super cooled water. Does it represent a stable phase?

    (c)   With the help of a neat phase diagram describe lead-silver system.   **(6+6+8)**

SECTION - B

3. (a) What do you mean by hardness of water? Discuss the ion-exchange process used for the softening of hard water.

   (b) Explain the terms BOD and COD. Indicate their significance in sewage treatment.

   (c) What is the chemistry involved in smog formation? How is ozone formed and depleted in nature? What are the consequences of depletion of ozone layer in the atmosphere? **(4+6+10)**

4. (a) Discuss the mechanism of electrochemical corrosion. Is stress corrosion a type of electrochemical corrosion? Discuss in brief caustic embrittlement.

   (b) What is the effect of temperature, moisture and pH on the rate of corrosion?

   (c) What are corrosion inhibitors? Distinguish between cathodic and anodic inhibitors. **(10+5+5)**

SECTION - C

5. (a) A sample of coal contains C=93%, H=6% and Ash=1%. The following data were obtained when the above coal was tested in bomb calorimeter:

   (i) Wt. of coal burnt = 0.92g
   (ii) Wt. of water taken = 2200g
   (iii) Water equivalent of bomb calorimeter = 550g
   (iv) Rise in temperature = 2.42°0
   (v) Fuse wire correction = 10.0 cal
   (vi) Acid correction = 50.0 cal

   Calculate gross and net calorific values of the coal, assuming the latent heat of condensation of steam as 580 cal/g.

(b)   What is meant by cracking of petroleum oil? Differentiate between thermal and catalytic cracking. What are the advantages of catalytic cracking over thermal cracking?

(c)   What are the constituents of coal as determined by proximate analysis? How is this analysis method different from ultimate method?   **(10+5+5)**

6. (a)   What type of lubrication is applied to a machine working under extremely high loads? Explain its mechanism. Suggest the type of additives added to the lubricating oil in such conditions.

     (b)   Discuss the important functions of lubricants. Explain how graphite and molybdenum disulphide act as lubricants.

     (c)   Under what situations greases are used? What are the main functions of soap in greases?

     (d)   What is water gas? Give its composition. How is it prepared on large scale? What are its uses?   **(6+5+5+4)**

SECTION - D

7. (a)   With the help of band theory explain conductors, insulators and semiconductors.

     (b)   Calculate the angle at which (a) first order reflection and (b) second order reflection will occur in an X-ray spectrophotometer when X-rays of wavelength 1.54 A° are diffracted by the atoms of a crystal, given that the interplanar distance is 4.04 A°.

(c) Explain the theory involved in nuclear magnetic resonance spectroscopy.

(d) Define infrared spectroscopy. Describe the various molecular vibrations that can take place in a triatomic molecule when it is irradiated with IR radiations.   **(5+5+5+5)**

8. (a) Explain the action of catalyst in terms of activation energy.

(b) Explain why rough surface of a catalyst is more effective than smooth surface for its functioning.

(c) Define enzyme catalysis. Give the kinetics and mechanism of enzyme catalyzed reaction.   **(6+4+10)**

9. (a) What is condensed phase rule? When is it applied?

(b) Why is hardness of water expressed in terms of $CaCO_3$ equivalent?

(c) Define octane number for gasoline.

(d) What is acid rain?

(e) Why radioactive waste is disposed off in salt mines?

(f) Why does corrosion occur in steel pipes connected to copper plumbing?

(g) What is relation between the edge length (a) and ionic radii (r_+, r.) in afcc unit cell?

(h) Why are antioxidants added to hydrocarbon oils?

(i) State the effect of increased temperature on entropy of a substance.

(j) Explain why methane does not absorb IR energy.   **(2×10=20)**