**­­­­­­­CY3151- ENGINEERING CHEMISTRY**

**PART – A**

**UNIT I – WATER AND ITS TREATMENT**

**1. Write any two disadvantages of hard water in boilers. [ April/May 2015]**

When hard water is used in the boilers for the production of steam, following disadvantages

occur.

(i) Scale and sludge formation (ii) Caustic embrittlement (iii) Boiler corrosion

(iv) Priming and foaming

**2. Why calgon conditioning is better than phosphate conditioning? [AU May 2016]**

In calgon conditioning, it forms soluble complex of scale but phosphate conditioning

converts scales to sludge which needs periodical disposal. So calgon conditioning is better .

**3. How is the exhausted zeolite regenerated? [AU June 2010]**

The exhausted zeolite is regenerated by treating with 10% solution of NaCl

CaZe + 2NaCl Na2Ze + CaCl2

MgZe + 2NaCl Na2Ze + MgCl2

**4. Define hardness of water. [AU June 2010, 2009]**

Hardness of water is the property or characteristics of water which prevents the lathering of

soap.

**5. List out the requirements of boiler feed water(AU May 2016)**

The boiler feed water should be free from permanent and temporary hardness which is

responsible for boiler troubles and corrosion. The water should be treated and deionised

water should be introduced into boiler.

**6. How does Eriochrome Black-T indicator function as an indicator in EDTA titration?**

**[AU June 2008]**

EBT reacts with hard water to form wine red colored unstable complex. When this hard

water reacts with EDTA, it forms stable complex and EBT is set free and gives steel blue

color.

**7. Define desalination. What is the principle behind desalination? [AU Jan 2009, June**

**2007, Dec 2006]**

The process of removing common salt from the water is known as desalination. If a

hydrostatic pressure in excess of osmotic pressure is applied on the higher concentrated

side, the solvent flows from higher concentration to lower concentration. This process is

called reverse osmosis.

**8. Every soft water is not a demineralised water whereas every demineralised water is a**

**soft water- Justify.[AU Jan 2013]**

Soft water produce by lime soda and zeolite process does not contain hardness producing

calcium and magnesium ions but it will contain other ions .other hand demineralized water does not contain both anions and cations.

**9. What is meant by calgon conditioning? [ Nov/Dec 2015, AU Jan 2013,2009.June 2005]**

Calgon is sodium hexa meta phosphate Na2[Na4(PO3)6]. This substance interacts with

calcium ions forming a highly soluble complex and thus prevents the precipitation of scale

forming salts.

2CaSO4 + Na2[Na4(PO3)6] Na2[Ca2(PO3)6] + 2Na2SO4

**10. Name the salts responsible for scale and sludge.**

Scale – Calcium bicarbonate, Calcium sulphate, Magnesium chloride.

Sludge- Magnesium chloride, Magnesium carbonate, Magnesium sulphate and calcium

Chloride

**UNIT– II – NANOCHEMISTRY**

**1. What are nonoparticles?**

Nanoparticles are the particles, the size of which ranges from 1-100 nm.

**2. What are nano-materials?**

Nanomaterials are the materials having components with size less than

100 nm at least

in one dimension.

**3. What is nano-chemistry? (A.U.T. (Coim) May 2011)**

Nano-chemistry is the branch of nano-science, which deals with the chemical applications

of nanomaterials. It also includes the study of synthesis and characterisation of

nanomaterials.

**4. Name some important physical methods of synthesizing nano-**

**materials.**

a. Laser ablation

b. Chemical Vapour Deposition (CVD)

c. Electro-deposition

**5. What is CVD?**

CVD is Chemical Vapour Deposition. It is a process of chemically

reacting a volatile compound of a material with other gases, to produce a

non-volatile solid that deposits automatically on a suitably placed

substrate.

**6.What is the basic principle involved in solvothermal synthesis of nano-**

**materials.**

Solvothermal synthesis involves the use of solvent under high temperature

(between 100 C to 1000 C) and moderate to high pressure (1 atm to

10,000 atm) that facilitate the interaction of precursors during

synthesis.

**7. Define nano-wires.**

Nano-wire is a material having an aspect ratio ie., lengthto width ratio

greater than 20. Nano-wires are also referred toas “quantum wires”.

**8. What are the characteristics of nano-wires.**

a. Nano-wires are two-dimensional material.

b. Conductivity of a nano-wire is less than that of the

corresponding bulk materials.

c. It exhibits distinct optical, chemical, thermal and electrical

properties due to this large surface area.

**9. Mention some important applications of nano-wires.**

a. Nanowires are used for enhancing mechanical properties of

composites.

b. It is also used to prepare active electronic components such as p n

junction and logic gates.

c. Semiconductor nanowire crossings are expected to play a important

role in future of digital computing.

**10. What is nano-Rod?**

Nanorod is two dimensional cylindrical solid material having an

aspect ratio i.e., length to width ratio less than 20.

**UNIT– III –PHASE RULE & COMPOSITES**

**1. State phase rule and explain the terms involved.**

If the equilibrium between any number of phases is not influenced by gravity, or electrical, or

magnetic forces but are influenced only by pressure, temperature and concentration, then the numberof degrees of freedom (F) of the system is related to number of components (C) and the number of phases (P) by the following phase rule relation F = C – P + 2

**2. What are degrees of freedom (F)?**

Degrees of freedom (F) is defined as, “the minimum number of independent variable factors such as temperature, pressure and concentration, which must be fixed in order to define the system completely”.

**3. Define phase (P) with suitable example.(Chen A.U. Dec 2009)**

Phase is defined as, “any homogeneous physically distinct and

mechanically separable portion of a system whichis separated from other parts of

the system by definiteboundaries”.Consider a water system consisting of three phases. Ice+s+

Water+l+ Vapour+gEach phase is physically distinct and homogeneous and there are definite

boundaries between phases. So this forms three phases.

**4. Mention the merits of phase rule.**

I. It is applicable to both physical and chemical equilibrium

II. It is a convenient method of classifying the equilibrium states in terms of phases,

components, and degree of freedom.

III. It helps in deciding whether the given numbers of substances remain in equilibrium or not.

**5. What are the limitations of phase rule?**

I. Phase rule can be applied only for the systems in equilibria.

II. Only three variables like P, T & C are considered, but not electrical, magnetic and

gravitational forces.

III. All the phases of the system must be present under the same conditions of T and P.

IV. Solid and liquid phases must not be in finely divided state, otherwise deviations occur.

**6. What is eutectic mixture? (OR) Eutectic is a mixture and not a compound explain.**

Eutectic mixture is an unique mixture of two solids which has the lowest melting point. Since it is completely immiscible in the solid state, it is a mixture not a compound

**7. What is an Eutectic point in a binary alloy system?**

It is the point at which two solids and one liquid phase are in equilibrium in a binary alloysystem.

Solid (A) ↔ Solid (B ) ↔ Liquid melt (A +B)

**8. How many phases and components are present in the following system?**

CaCO3(s) ↔ CaO(s) + CO2(g)

It consists of two solid phases and one gaseous phase. P = 2; C = 2

F = C – P + 2 = 2 – 3 + 2 = 1.

**9. Give the percentage composition of Bronze.**

Bronze is also a copper alloy containing copper and tin in the following composition:

Cu = 80 – 95 %, Sn = 20 – 5%

**10. State the number of degrees of freedom for the following system:**

Ans: PCl5(s) ↔ PCl3(g) + Cl2(g) at 50

oC F = C – P + 1; 2 – 2 + 2; F = 2

CaCO3(s) ↔ CaO(s) + CO2(g) C – P + 1; 2 – 3 + 2; F = 1

**UNIT IV - FUELS AND COMBUSTION**

**1. What are the drawbacks of sulphur in coal ? (AU 2015)**

Though it increases the calorific value the oxidation products of sulphur SO2, SO3

especially in the presence of moisture forms Sulphuric acid which corrodes the

equipment and pollute the environment.

**2. What is meant by knocking and cracking?(AU 2011)**

* Knocking is a kind of explosion due to rapid pressure rise occurring in an
* internalcombustion engine. Knocking can be reduced by adding Tetra ethyl
* lead.
* Cracking is defined as decomposition of higher molecular weight hydrocarbons to
* lowermolecular weight hydrocarbons having low boiling point.
* Eg: cracking of heavy oil.

**3. Define explosive range of fuel. Give examples.(AU 2014)**

The range covered by the upper and lower limits of the fuel is known as explosive

rangeof the fuel.

Eg. H2 (6-71), CH4 (6-13) petrol vapour (2-4.5)

**4. What is Cottrell’s process in crude refining?(AU 2009)**

Removal of water from oil by using ring electrodes is called Cotterll’s process.when

the crude oil is allowed to flow between the two highly charged electrodes the

colloidal water combine to form large drops which is then separated from oil.

**5. What is meant by calorific value of a fuel? What are the types of calorific values?**

The amount of heat liberated by the complete combustion of a unit mass of a fuel

iscalled calorific value. Its unit is calorie or kilocalorie. The two types are Higher or

Gross calorific value and Lower or Net calorific value.

**6. Write Dulong’s formula for calculation of calorific Value.**

GCV= 1/100(8080C+34500(H-O/8)+2240S)k.cal/kg LCV=GCV-0.09H X 587 k.cal/kg.

**7. What is synthetic petrol?(AU 2011)**

The gasoline obtained from the fractional distillation of crude petroleum oil is called

straight run or synthetic petrol. Coal paste mixed with heavy oil and catalyst and heated

under pressure will give crude oil which then fractionate and give gasoline.

**8. Write the hydrocarbon order on the basis of knocking.**

Straight chain paraffins> Branched chain paraffins> Olefins

>Cycloparaffins> Aromatics

**9. What are octane and cetane number?(AU 2006)**

Octane number is defined as the percentage of iso-octane present in a mixture of

iso-octane and n-heptane.Cetane number is defined as the percentage of cetane present in a mixture of cetane and α- methyl naphthalene.

**10. What is anti-knocking agent?**

Knocking can be reduced by adding TEL tetra ethyl lead. This is known as

antiknock.To overcome the disadvantage of leaded petrol antiknock fluid mixture of

TEL 60%,Ethylene bromide 26%, ethylene chloride 9% and a red dye 2%, can be used.

**UNIT – V- ENERGY SOURCES AND STORAGE DEVICES**

**1) Define nuclear fission? (AU Dec 2007, May 2009, May 2015)**

Nuclear fission: It is the nuclear reaction in which heavy isotopes are split into lighter

nuclei on bombardment by neutrons. Fission reaction of U 235

is given below

**2) What is light water nuclear power plant?**

Light water nuclear power plant is one in which U

235 fuel rods are submerged in water. Here the water acts as coolant and moderator.

**3) Explain the process taking place in light water nuclear power plant?**

The fission reaction is controlled by inserting or removing the control rods of

automatically from the spaces between the fuel rods.

**4) What is a breeder reactor? (AU Jan 2009, Jan 2013)**

A breeder reactor is a nuclear reactor that converts non-fissonable like U 238 and Th 232 material into fissional materials like U 235 and Pu 239

**.5) What is a nuclear reactor?**

The equipment used to carry out fission reaction under controlled conditions is called a

nuclear reactor.

**6) What are the components of a nuclear reactor?**

Fuel rods, control rods, moderator, coolant, pressure vessel, protective shield, and

Turbine.

**7) What are functions of fuel rods and control rods?**

Fuel rods: U-235 is used in the reactor in the form of rods or strips. The fission of U-235

produces heat energy and neutrons that start the chain reaction.

Control rods: It controls the rate of fission reaction. These are made of boron or

cadmium that absorbs the excess neutrons.

**8) What are the functions of moderators?**

Moderator: It slows down the speed of the neutrons. The most commonly used

moderator is ordinary water, graphite etc.

**9) What are the functions of coolant and pressure vessel? (AU June 2011)**

Coolant: It cools the fuel core by removing the heat produced by the fission reaction.

Water used in the reactor serves both as moderator and coolant.

Pressure vessel: It encloses the core and also provides the entrance and exit passages for

coolant.

**10) Explain the role of protective shield and turbine?**

* Protective shield: It protects the operating personnel and environments from destruction
* in case of leakage of radiation.
* Turbine: The steam generated in the heat exchanger is used to operate a steam turbine,
* which drives a generator to produce electricity.