**PILLAI COLLEGE OF ENGINEERING, NEW PANVEL**
**(Autonomous) (Accredited 'A+' by NAAC)**
**END SEMESTER EXAMINATION**
**SECOND HALF 2021 ( Supplementary)**

**BRANCH: FE (MECH/AUTO)**

**Subject: Engineering Chemistry – I Solution** **Time: 02.00 Hours**
**Max. Marks: 45** **Date: 01-06-2022**

**Q.1. Attempt all**

**a)** Weight of coal = 3 gm

% moisture = $\frac{loss\ in\ weight\ due\ to\ moisture}{Weight\ of\ coal}\ X\ 100$

2.5 = $\frac{3-x}{3}\ X\ 100$

X = 2.925

% volatile matter = $\frac{loss\ in\ weight\ due\ to\ v.m}{Weight\ of\ coal}\ X\ 100$ = $\frac{2.925-2.63}{3}\ X\ 100$

**= 9.83 %**

**b)**

| **Temporary Hardness** | **Permanent Hardness** |
|---|---|
| $Ca(HCO_3)_2$, $MgCO_3$ | $Mg(NO_3)_2$, $Al_2(SO_4)_3$ |

**c)** Galvanizing is preferred to tinning because the coating will protect the base metal even if it is non uniform. If there is a crack in the coating of Zinc, the base metal will be acting as the cathode and the coating metal will act as the anode.

**d)**
1. It reduces friction, wear and tear because direct contact between the rubbing surfaces is avoided.
2. It reduces the frictional heat, or it act as a coolant.
3. It increases the efficiency of machine by minimizing the loss of mechanical, electrical or chemical energy.
4. It acts as a sealant preventing the entry of dust, dirt and moisture.
5. It reduces the maintenance cost and running cost of machines.
6. It makes the relative motion of sliding parts noise free.

Any one example of lubricant as seal.

**e)** Sulphur system – One component
Bi- Cd System – Two component
Homogenous solution of glucose - Two component

**Q.2.**

**a)** Water which contains large amount of salt content is called brackish water.
Electro dialysis is a method in which positive and negative ions are pulled out from salt water through an ion selective membrane under the influence of an electric field.
Saline water is introduced at a pressure of 5 – 6 kg/$m^2$ is passed through paired set of ion selective membranes (called as cells). When an electric current is passed in a direction perpendicular to the direction of flow of saline water, $Na^+$ ions moves towards the cathode and $Cl^-$ ions move towards the

anode through the membrane. The concentration of brine decreases in the middle compartment. Pure water is removed from the central compartment from time to time, while the concentrated brine in the side compartment is replace by fresh brine or sea water..

**Advantages**

1. It is a compact unit.
2. Installation and operational cost is less.
3. If electricity is available, it is best suited.

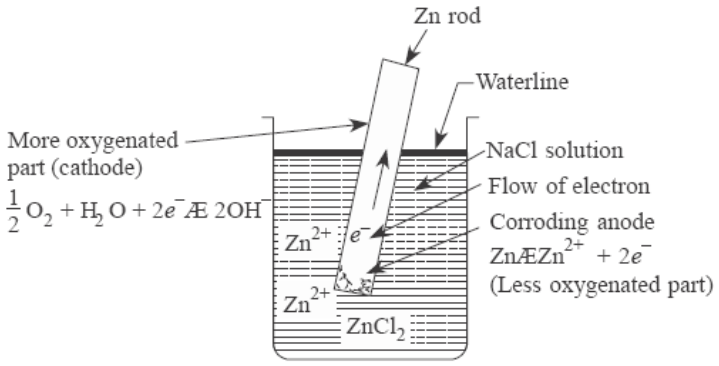
**b)** If a metal rod is dipped in an electrolyte, the portion dipped in water is poor in oxygen concentration and works as anode which gets corroded and the portion above water acts as cathode which is protected. The system will act as a concentration cell and the chemical reactions for zinc dipped in water are given as:

$$Zn \longrightarrow Zn^{++} + 2e^-$$

$$H_2O + \frac{1}{2}O_2 + 2e^- \longrightarrow 2OH^-$$

$$Zn + H_2O + \frac{1}{2}O_2 \longrightarrow Zn(OH)_2$$

$Zn(OH)_2$ appears as corrosion products.




c)

| Element | % | Weight /unit weight of fuel |
|---|---|---|
| **C** | **76** | **0.76** |
| **H** | **8** | **0.08** |
| **S** | **3** | **0.03** |
| **O** | **8** | **0.08** |

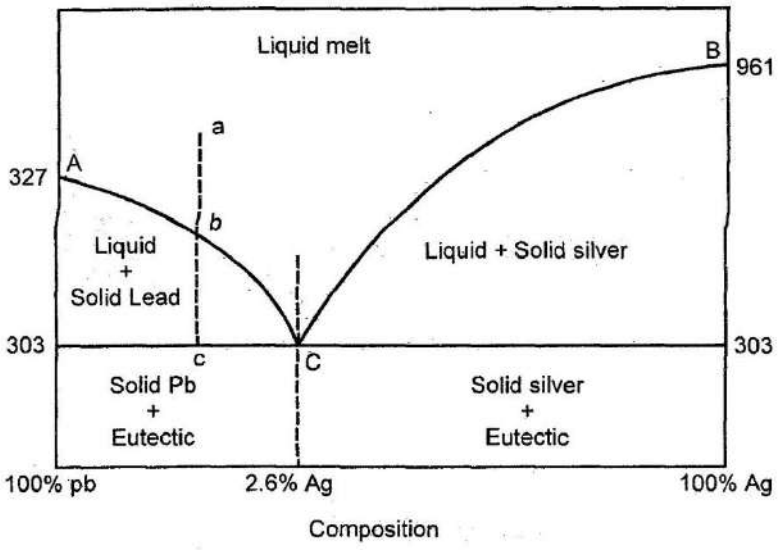
Weight of Oxygen = $\frac{32}{12}$ C + 8H +S –O

= $\frac{32}{12}$ 0.76 + 8 x 0.08 + 0.03 –0.08 = **2.6192 kg**

Weight of air = $\frac{100}{23}$ $X$ 2.6192 = **11.39 kg**

Weight of air for 5 kg = 11.39 x 5 = **56.95 kg**

Volume of air = 56.95 x 22.4 / 28.94 = **44.08 $m^3$**

| Q.3. | |
|---|---|
| a) | Knocking is defined as the sharp metallic noise produced in an internal combustion engine and results in loss of energy. Knocking is also defined as a sharp metallic noise produced in an internal combustion engine and results in a loss of energy.<br>In an I.C.Engine (spark ignition) a mixture of fuel and air is compressed and ignited by an electric spark and the essential chemical reaction is oxidation of hydrocarbon molecules. After the initiation of the combustion reaction by the spark, the flame should spread rapidly and smoothly through the gas mixture and the expanding gas drives the piston down the cylinder. In some cases the rate of oxidation becomes so great so that the mixture gets ignited spontaneously producing a sound called knocking. The rate of oxidation depends on the number of carbon atoms in the molecule, on the structure of hydrocarbon and on the temperature. The temperature in turn depends on the compression ratio i.e., the ratio of the gaseous volume at the end of the suction stroke to that at the end of the compression stroke. Theoretically the power output and the efficiency should increase continuously with increase in C.R. The compression ratio corresponding to the maximum output is called the Highest Useful Compression Ratio. When the C.R is increased beyond this value the fuel gets ignited even before the regular spark. This pre ignition of the fuel ahead of the flame is called Knocking.<br>The knocking tendency depends on the fuel constituents. The tendency to knock increases in the order: naphthalene < iso octane < n- octane. |
| b) | The maximum number of degrees of freedom in a two component system is 3, that is when there is only one phase. F = C − P + 2 = 3. The system will have 3 variables namely temperature, pressure and concentration. So the phase diagram will be three dimensional. It is possible to split the 3D diagram into three 2D diagrams by keeping one variable as a constant. Any such restriction in the phase rule equation regarding the constancy of one of the variables reduces the phase rule equation to the following form.<br>$F = C - P + 1$<br>This is called ***reduced (condensed) phase rule***.<br>  <br><br>**Eutectic point)**: - The two curves BC and AC meet at C, where three phases (solid Ag, solid Pb and their solution) co-exists and according to reduced phase rule the system will be invariant. The point C represents a fixed composition and is called eutectic composition. No mixture of Pb and Ag has a melting point lower than the eutectic temperature. Further cooling results in the simultaneous crystallization of mixture of Ag and Pb.<br>F =0 |

| | |
|---|---|
| | |
| **c)** | **Anodic protection** (**AP**) is a technique to control the corrosion of a metal surface by making it the anode of an electrochemical cell and controlling the electrode potential in a zone where the metal is passive.<br>AP is used to protect metals that exhibit passivation in environments whereby the current density in the freely corroding state is significantly higher than the current density in the passive state over a wide range of potentials.<br>To protect the structure anodically, a device called potentiostat is used. A potentiostat is a device which maintains a metal at a constant potential with respect to reference electode. A potentiostat has three terminals connected to i. the structure to be protected, ii. reference electrode (calomel electrode) and iii. auxiliary electrode (Pt clad electrode).<br>Potentiostat maintains a constant potential between object and reference electrode. The potential required for protection is determined by electrochemical methods.<br>Advantages :<br>Operating cost is low and complicated metal structure can be protected.<br>Diagram |
| **Q.4** | **Attempt all** |
| **a)** | Alloy can be defined as the solid mixture of two or more elements, one of which is essentially be metal.<br>1. *Enhance the hardness of a metal*: An alloy is harder than its components. Pure metals are generally soft. The hardness of a metal can be enhanced by alloying it with another metal or nonmetal.<br>2. *Lower the melting point*: Pure metals have a high melting point. The melting point lowers when pure metals are alloyed with other metals or nonmetals. This makes the metals easily fusible. This property is utilized to make useful alloys called solders.<br>3. *Enhance tensile strength*: Alloy formation increases the tensile strength of the parent metal. |
| **b)** | Formed by:<br>Decomposition of bicarbonates<br>Deposition of CaSO4<br>Hydrolysis of Mg salts<br>Presence of Silica<br>Disadvantages:<br>Wastage of fuel<br>Low boiler safety<br>Decrease in efficiency<br>Danger of Explosion |
| **c)** | To understand the amount of adulteration in the given lubricant.<br>Saponification value = $\frac{Volume\ of\ KOH\ used\ \ x\ Normality\ of\ KOH\ x\ 56}{weight\ of\ oil}$<br>148 = (45 – x) x 0.4 x 56 / 1<br>X = 38.39 |