1. **Define corrosion. What are the consequences of corrosion**

   Corrosion is defined as "the gradual destruction or degradation of metals/alloys due to chemical or electrochemical reaction with its environment".

   The consequences of corrosion.

   - Due to formation of corrosion product over the machinery, the efficiency of the machine gets lost.
   - The products get contaminated due to corrosion.
   - The corroded equipment must be replaced frequently.
   - It is necessary for over design to compensate for the corrosion.
   - Corrosion releases toxic products, health hazard, etc.
   - Plant gets failure due to corrosion.

2. **List out the differences between dry corrosion and wet corrosion**

S.No	Dry or chemical corrosion	Wet or Electrochemical corrosion
1.	It occurs in dry state.	It occurs in presence of moisture or electrolyte.
2.	It follows adsorption mechanism.	It follows the mechanism of electrochemical reaction.
3.	Corrosion products accumulate on the same spot where corrosion occurs.	Corrosion occurs at anode while products gather at cathode.

3. **What is pilling beds worth rule?**

   a. According to pilling-Bedworth rule, if the volume of the oxide layer formed is less than the volume of the metal, the oxide layer is porous and non-protective.

   b. On the other hand, if the volume of the oxide layer formed is greater than the volume of the metal, the oxide layer is non-porous and protective.

4. **Define inhibitors. Mention their types.**

A corrosion inhibitor is a substance, which reduces the corrosion of metal, when it is added to the corrosive environment.

Example:

Anodic inhibitors : Chromates, Nitrates, Phosphates of transition elements.

Cathodic inhibitors : Antimony or Arsenic oxides, Na_2SO_3, N2H4

Vapour phase inhibitors (VPI): Dicyclo hexyl ammonium Nitrate

5. What are vapour phase corrosion inhibitors? Give an example

Vapour phase inhibitors (VPI) are organic inhibitors, which readily vapourise and form a protective layer on the metal surface. VPI are used in the protection of storage containers, packing materials, sophisticated equipments, etc.

Example: Dicyclo hexyl ammonium Nitrate, Benztriazole.

6.**Compare sacrificial anode method and impressed current method**.

S.No	Sacrificial anode method	Impressed current method
1	No external power supply is necessary.	External power supply must be present.
2	This method requires periodical replacement of sacrificial anode.	Here anodes are stable and do not disintegrate.
3	Investment is low.	Investment is more.
4.	Soil and microbiological corrosion, effects are not taken into account.	Soil and microbiological corrosion, effects are taken into account.
5	This method is most economical method especially when short-term protections required.	This method is well suited for large structures and long term operations.

7. **What is galvanic cell corrosion?**

When two different metals are in contact with each other in presence of an aqueous solution or moisture, galvanic corrosion occurs.

Here the more active metal acts as anode and the less active metal acts as cathode.

Example: In Zn-Fe couple, Zn acts as anode and undergoes corrosion. But in Fe-Cu couple, Fe acts as anode and undergoes corrosion.

8. **Bolt and nut made of the same metal is preferred in practice. Why?**

It is preferred in practice because galvanic corrosion is avoided due to homogeneous metals (no anodic and cathodic part)

9.What is differential aeration corrosion?

Differential aeration corrosion occurs when a metal is exposed to varying concentration of oxygen or air.

10. **What are fire retardant paints**?

Fire retardant paints are protective, decorative coating designed to reduce the spread of flames in the event of a fire. It is formulated with special additives that help slow the spread of flames in the event of a fire.

11. What is top-down approach? Give an example

Top down process involves the conversion of bulk materials into smaller particle of nano-scale structure.

1.Laser Ablation Method

2. Ball milling

12. What is Bottom up approach? Give an example

It involves building-up of materials from the bottom by atom by atom (≈ 0.1 nm□), molecule by molecule or cluster by cluster.

1.Chemical Vapour Deposition method

2. Sol-gel method

3.Solvo Thermal Analysis

13. What are nanoparticles? Give an example

Nanoparticles are the particles, the size of which ranges from 1-100 nm.,Gold Nano Particle,ZnO Nano Particle.

14. How do nanomaterials differ from bulk materials ?

- The size of nano particles are less than 100 nm in diameter but bulk materials are larger in micron size.
- Nano particles are collection of few molecules that is less than 100 nm but bulk materials contains thousands of molecules.
- Surface area of nano particles is more than the bulk materials.
- Hardness of the nano materials are 5 times more than the bulk materials
- Strength of nano materials is 3 - 10 times higher than the bulk materials
- Nano particles possesses size dependent properties, but bulk materials possess constant physical properties.
- Corrosion resistance and wear resistance is more than the bulk materials
- Nano particles, due to its size, possess unexpected optical (visible) properties.

15. What is Electroplating?

Electroplating is the process of depositing the coating metal on the base metal by passing electric current through an electrolytic solution containing the soluble salt of the coating metal.

Two Marks Questions

1. **What are types of nanomaterials?**

   Zero Dimensional nanomaterials: Nano Clusters, Quantum Dots

   One Dimensional nanomaterials- Nano rods, Nanowires and Nano tubes

2. **List out the properties of carbon nanotubes**

   - CNTs are very strong.
   - It can with stand extreme strain in tension and posses elastic flexibility
   - The atoms in a Nanotube are continuously vibrating back and forth
   - It is highly conducting and behaves like metallic or semiconducting materials
   - It has very high thermal conductivity and kinetic properties

3. **List out the uses of carbon nanotubes.**

   - It is used in battery technology and in industries as catalyst
   - It is also used as light weight shielding materials for protecting electronic equipments
   - CNTs are used effectively inside the body for drug delivery
   - It is used in composites
   - It also act as an efficient catalysts for some chemical reactions
   - It acts as a very good biosensor.
   - It is also used in water softening process as a filter

4. **Write the uses of sol gel method.**

- Sol-gel is a chemical solution process used to make ceramic and glass materials in the form of thin films, fibers or powders .
- Used in health care, cosmetics, food, and special chemicals

5. **Write a note on Biogas**

   - Biogas is a type of biofuel that is naturally produced from the decomposition of organic waste in the absence of oxygen
   - When organic matter, such as food scraps and animal waste, break down in an

anaerobic environment (an environment absent of oxygen) they release a blend of gases called biogas.

- it is a renewable energy source

6. What is Carbonization?

The process of preparing coke from coal is known as carbonization of coal. When bituminous coal is heated strongly in the absence of air, the dense strong, porous mass obtained is called metallurgical coke.

7. List out composition of CNG.

The average composition of CNG is as follows:

Constituents	Percentage %
Methane	88.5
Ethane	5.5
Propane	3.7
Butane	1.8
Pentane	0.5

8. List out composition of LPG.

The average composition of LPG is as follows:

Constituents	Percentage %
n-Butane	38.5
Iso Butane	36.7
Propane	24.7
Others	0.1

9. Write a note on Biodiesel.

A fuel derived from organic oils, such as vegetable oil, rather than petroleum. Biodiesel's use and production are increasing. It's typically used for aircraft, vehicles and as heating oil. It involves treatment of vegetable oil (sunflower oil, palm oil, soya bean oil, mustard oil, etc.) with excess of methanol in the presence of catalyst to give mono ethyl esters of long chain fatty acid(Bio diesel) and glycerin.

10. Define calorific value

The efficiency of a fuel is determined by its calorific value. The calorific value of a fuel is defined as "the total amount of heat liberated by the complete combustion of an unit mass of fuel".

11. Define Gross calorific value

Gross or higher calorific value is defined as the total amount of heat produced, when a unit mass of the fuel is completely burnt and the products of combustion are cooled to room temperature.

12. Define Gross calorific value

The net calorific value is defined as the net heat produced, when a unit mass of the fuel is completely burnt and the products of combustion are allowed to escape.

Net calorific value = Gross calorific value - Latent heat of condensation of water vapour produced