

ENGINEERING CHEMISTRY QUESTION BANK

.Electrochemical Energy System

1. What is Galvanic cell? Explain its construction and applications.
2. What is Single electrode potential? Derive Nernst equation for the determination of single electrode potential with thermodynamic parameters.
3. What are concentration cells? Discuss its construction.
4. What are the reference electrodes? Give the construction of calomel electrode. Explain how this electrode is used to determine the potential of an unknown electrode.
5. Write a note on ion selective electrodes
6. Write a note on standard hydrogen electrode.
7. Describe principle and construction of glass electrode. What are its limitations?
9. Define EMF of a cell?
10. How do you determine pH of the solution by using glass electrode?
11. An electro chemical cell consists of iron electrode dipped in 0.1M FeSO₄ and silver electrode dipped in 0.05M AgNO₃. Write the cell representation, cell reactions and calculate e.m.f of the cell at 298K. Given that the standard reduction potentials of iron and silver electrodes are -0.44V and +0.80V respectively.
12. What is single electrode potential? Explain the origin of single electrode potential.
13. What are ion-selective electrodes? Explain the measurement of pH of a solution using a glass electrode.
14. Calculate the standard electrode potential of Cu²⁺/Cu if its electrode potential at 25 °C is 0.312V when [Cu²⁺] is 0.02M.

15. Define standard electrode potential. Explain with diagram measurement of single electrode potential of Zn-electrode.
16. Explain the principle of a membrane electrode. Mention the different types of membrane available.
17. Define reference electrode. State its types. Write limitation of primary reference electrode and advantages of secondary reference electrode.
18. Explain the determination of electrode potential of Cu- electrode dipped in 0.5M CuSO₄ using standard hydrogen electrode. What would be the measured emf? ($E^0_{\text{Cu}/\text{Cu}^{+2}} = +0.34\text{V}$)
19. An electrochemical cell is obtained by coupling two dissimilar electrodes, one of which has higher reduction potential than the other. If the standard reduction potentials of Cu and Ag are 0.34V and 0.80V respectively, and the ionic concentrations at the interface of Cu and Ag are 0.02M and 1M resp., Write the electrode reaction and calculate the emf of the cell at 298K.

Battery Technology and Fuel Cells

1. What is a battery? Explain the following battery characteristics (i) Voltage(ii)Capacity(iii) Cycle life (iv) shelf life (v) Energy efficiency (vi) Power density
2. What are the different kinds of batteries? Explain briefly. OR Write a note on classification of battery.
3. Write a note on 1) Li-MnO₂. 2) Zn-Air battery 3) Zn- MnO₂ battery. 4) Ni-Cd battery
4. Describe the construction of a Ni-MH battery. Give the relevant reactions that occur during discharging and charging. Mention its applications.
5. Discuss the construction and working of H₂-O₂ fuel cell. Why is the water formed in the H₂-O₂ fuel cell removed continuously? Mention its applications.
6. What are fuel cells? In what way fuel cells are differ from conventional batteries.

7. What are reserve batteries? Describe the construction of lead acid storage battery with charging and discharging reactions.
8. Give the advantages of fuel cells. Explain the construction and working of $\text{CH}_3\text{OH}-\text{O}_2$ fuel cell with electrode reactions. Mention its applications.

Chemical Energy Sources and Solar Energy

1. What are fuels and what are their desirable characteristics.
2. How are fuels classified?
3. Explain the following terms i) Cracking ii) Reforming iii) Knocking
4. What is an octane number and how the octane number of petrol can be improved.
5. How is synthetic petrol made by Fischer-Tropsch method and Bergius process?
6. Write a note on i) Anti- knocking agents (ii) Cetane number (iii) Octane number
7. Explain the importance of Photovoltaic cells
8. Explain the physical and chemical properties of silicon relevant to Photovoltaic cells
9. Write a note on production of solar grade silicon and doping of silicon.
10. Define gross and net calorific value. Explain Bomb calorimetric method of determining calorific value of a solid fuel.
11. Calculate Gross calorific value and Net calorific value of a coal sample from the following data: Mass of coal sample taken = 8.5×10^{-4} Kg; Mass of water taken in the calorimeter = 3.5Kg; Water equivalent of calorimeter = 0.5Kg; Initial temperature of water in calorimeter = 25°C ; Final temperature of water in calorimeter = 27.5°C ; Percentage of Hydrogen in the coal sample = 2.5; Latent Heat of Steam = 2455KJ/Kg. Specific heat of Water = 4.187 KJ/Kg/K.
12. What is cracking of petroleum? Explain fluidized catalytic cracking.
13. What is a photovoltaic cell? Explain the working of a photovoltaic cell.

14. Calculate the Gross calorific value of a sample of coke from the following data: Mass of coke = 0.8 kg; Water equivalent of calorimeter = 2.5 kg; Mass of water: 1.3 kg;

Specific heat of water $4.187 \text{ KJkg}^{-1} \text{ K}^{-1}$; Rise in temperature = 1.8 K .

15. What is knocking of IC engine? Explain with reaction mechanism and mention ill effects and prevention of knocking of IC engine.

16. What is reformation of petroleum? Mention four important reactions involved.

Corrosion Science

1. What is metallic corrosion? Discuss the corrosion of iron based on electrochemical theory

2. Explain: (i) ship sailing in water corrodes below water line (ii) copper bolt should not be used in contact with steel.

3. What is anodizing? Explain anodizing of aluminum.

4 Write a note on corrosion inhibitors.

5. What are the different types of corrosion? Explain the following. 1) Stress corrosion 2) Differential metal Corrosion 3) Water line corrosion 4) Differential aeration corrosion.

6. Explain the factors influencing the rate of corrosion. i) Nature of Metal ii) Temperature iii) The ratio of anodic to cathodic area iv) Nature of corrosion product v) Over hydrogen voltage.

7. Give a brief note on anodic and cathodic protection?

8. Explain why pinholes on tin coated iron are more prone to corrosion than pin holes on zinc coated iron.

9. Explain phosphating technique to control corrosion.

10. Describe the following processes: - (i) Sacrificial anode method (ii) Impressed current method.

11. Write a note on galvanization and tinning.

Metal Finishing

1. What is metal finishing? Explain the technological importance of metal finishing.
2. Explain the following terms (i) Polarization (ii) decomposition potential and (iii) over-voltage.
3. Give any three objectives of electroplating and explain the electroplating of chromium. Why chromium anode is not used in electroplating of chromium?
4. Distinguish between electroplating and electroless plating.
5. Explain the effect of the following factors on the nature of electro deposit. i) Current density ii) pH iii) Throwing power iv) Temperature v) Metal ion concentration vi) Agitation
6. Discuss the electroless plating technique of copper in the manufacture of printed circuit boards.
8. What is electroless plating and discuss its advantages.

Nano technology

1. How Nanomaterials are classified? Explain with examples.
2. Describe the sol-gel method of synthesis.
3. Name two applications of nanoclusters.
4. Discuss the general properties of nanomaterials.
5. Explain the precipitation method of synthesis of
6. How are nanomaterials prepared by gas condensation method? Explain the principle, process and advantages of this method.
7. Discuss the chemical vapour condensation method of nanomaterial synthesis

8. Write a note on the synthesis of nanomaterials by hydrothermal process.
9. How do the nanomaterials are made by thermolysis process?
10. What are nano scale materials? Give examples
11. Write a short note on
 - a) Nanocrystals b) Nanoclusters c) Fullerenes d) Carbon nano tubes e) Nano wires f) Nanorods g) Nanocomposites
12. Briefly discuss the applications of nanomaterials

Water Technology

1. What is potable water? Describe purification of water by reverse osmosis process.
2. Explain how the following constituents are determined. a) Chlorides b) Fluorides c) Nitrates.
3. In COD experiment, 30cm^3 of an effluent sample required 9.9cm^3 of 0.001M $\text{K}_2\text{Cr}_2\text{O}_7$ for oxidation Calculate the COD of the sample.
4. Write a note on Sewage treatment.
5. How is alkalinity in water caused? Explain the method of determination of alkalinity by indicators method.
6. Describe the primary and secondary methods of sewage treatment.
7. 100ml of a water sample required 20ml of $\text{N}/50$ H_2SO_4 for neutralisation to phenolphthalein endpoint. After this methyl orange indicator was added to this and further acid required was again 20ml . Calculate the alkalinity of water as CaCO_3 in ppm.
8. Define COD and BOD. Calculate the BOD value of a sewage sample containing $9.2\text{mg}/\text{dm}^3$ of organic matter with the formula $\text{C}_6\text{H}_{12}\text{O}_6$.

9. How do you purify water using Flash evaporation, Electro dialysis and Reverse osmosis.
10. Explain gravimetric method of determination of sulphate content in water.

High Polymers

1. What are polymers and what is their importance in today's world.
2. What is the difference between addition and condensation polymerization?
3. Explain the free radical mechanism of addition polymerization, taking ethylene as an example.
4. Explain the technique of suspension polymerization and how it is better than bulk polymerization.
5. What is glass transition temperature? What are the factors affecting T_g ? Mention its significance.
6. Discuss briefly preparation and applications of the following polymers:
(1) Teflon (2) Polymethacrylate (3) Polyurethane (4) Phenol-Formaldehyde
(5) Low density Polyethylene (6) Poly carbonate (7) Bakelite
7. What are the advantages of synthetic rubber over natural rubber? Explain the synthesis and applications of (i) Butyl rubber (ii) Neoprene
8. What are conducting polymers? Explain the mechanism of conduction in polyacetylene.
9. Give the preparation and uses of conducting polyaniline.
10. What are the factors affecting the structure of polymer?
11. What are adhesives? Explain the manufacture of epoxy resin.
12. What are elastomers? Mention the advantages of synthetic rubber over natural rubber.
13. Distinguish between Addition & condensation polymers.
14. What are resins & plastics? Explain compounding of resins.
15. Differentiate between thermoplastics & thermosetting. Give one example of each.

16. Write a short note on adhesives.

Multiple Choice Questions

High Polymers

1. A polymer with higher Tg value is.

- a) PVC b) Polyethylene c) Polypropylene d) Polystyrene

2. Phenol-formaldehyde resin is commercially known as:

- a) PVC b) elastomer c) Bakelite d) Nylon

3. A plastic which can be softened on heating and hardened on cooling is called:

- a) Thermo elastic b) Thermoplastic c) Thermosetting d) Thermitite

4. Most commonly used vulcanizing agent is:

- a) Graphite b) Carbon black c) Sulphur d) Dry ice

5. Which one is a co-polymer?

- a) Nylon-66 b) Bakelite c) Terylene d) Teflon

6. Tetra fluoro ethylene is the monomer of:

- a) Nylon-6, 6 b) Teflon c) Polyethylene d) PVC

7. The process of vulcanization makes rubber:

- a) soluble in water b) hard c) soft d) More elastic

8. A linear polymer used mostly forming textile fibers is:

- a) PVC b) Nylon c) Bakelite d) Neoprene

9. A common catalyst used in addition polymerization is:

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- a) Nickel b) Thermoplastic c) Ziegler-Natta catalyst d) Platinum

10. Amorphous polymers do not possess any clear:

- a) Glass transition temp. b) Melting point c) Both of these d) none of these

1(d) 2(c) 3(b) 4(c) 5(a) 6(b) 7(b) 8(b) 9(c) 10(b)

Electrode potential and cells

1. The potential of standard hydrogen electrode is taken as,

- a) 1 volt b) 0 volt c) 10volt d) None of these

2. A galvanic cell converts

- a) Electric energy into chemical energy b) Chemical energy into electrical energy
c) Electrical energy into heat energy d) chemical energy into heat energy

3. Which one of the following doesn't conduct electricity?

- a) Fuses NaCl b) Solid NaCl c) NaCl solution d) Both cations and anions

4. Calomel electrode is constructed using a solution:

- a) Sat. KCl b) Sat. CaCl₂ c) NH₄Cl d) Sat. NaCl

5. In the electrochemical series, elements are arranged in the:

- a) Decreasing order of standard reduction potential b) Increasing order of standard reduction potential

- c) Increasing order of oxidation potential weight d) Increasing order of equivalent weight
6. The electrode potential is the tendency of metal:
- a) To gain electrons b) to loose electrons c) either to lose or gain electrons
d) None of the above
7. The potential of two metal electrodes used in a cell are 0.35V and 0.85V. The emf of the cell formed by combining them is:
- a) 1.20V b) 0.5V c) -0.50V d) None of these
8. The electrode with lowest hydrogen over voltage is:
- a) Zinc b) Nickel c) Mercury d) Platinum
9. The potential of hydrogen electrode in contact with a solution of pH=10 is:
- a) 0.592V b) zero volt c) -0.0592V d) -0.0592V
10. Standard reduction potential of zinc and silver electrodes are -0.76V & +0.80V respectively. If a cell is constructed by coupling the two electrodes, then
- a) silver acts as anode b) zinc acts as anode c) silver loses electrons d) zinc gains electrons

1(b) 2(b) 3(b) 4(a) 5(b) 6(c) 7(b) 8(d) 9(c) 10(b)

Corrosion Science

1. Corrosion process is an example of,
- a) Oxidation b) Reduction c) Electrolysis d) Both a and b
2. The rusting of iron is catalyzed by which one of the following:

a) Fe

b) O₂

c) Zn

d) H⁺

3. For corrosion of iron to take place:

a) Presence of moisture is sufficient
oxygen is essential

b) presence of both moisture and

c) Hydrogen is required

d) strong acid is necessary

4. In waterline corrosion, the maximum amount of corrosion takes place:

a) along a line at the level just above the level of the water meniscus

b) along a line just below the level of the water meniscus

c) along a line just below the level of the water meniscus

d) at the bottom of the vessel

5. If a piece of iron combined with copper metal is exposed to corrosive atmosphere, which will work as anode?

a) Fe

b) Cu

c) Both Fe & Cu

d) None

6. In a bimetallic couple of iron and zinc, which metal is protected from corrosion?

a) Fe

b) Zn

c) Both Fe & Zn

d) None

7. When a buried pipeline is protected from corrosion by connecting to Mg block, it is called:

a) Impressed voltage protection

b) Sacrificial cathodic protection

c) Sacrificial anodic protection

d) any of these

8. Galvanising is the process of coating iron with

a) Tin

b) Zinc

c) Copper

d) Nickel

9. The process of cementation with zinc powder is known as:

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- a) Galvanizing b) Zincing c) Sherardizing d) Tinning

10. During oxygen concentration type corrosion, the corrosion:

- a) occurs at more-oxygenated part b) occurs at less-oxygenated part
c) is uniform throughout d) occurs at the cathodic part

1(a) 2(d) 3(b) 4(c) 5(a) 6(a) 7(c) 8(b) 9(c) 10(b)

Battery Technology and Fuel Cells

1. Molten carbonate fuel cell operates at about:

- a) 500 °C **b) 650 °C** c) 50 °C d) 100 °C

2. Which one of the following is a Modern battery?

- a) Ni-MH battery** b) Zn-MnO₂ battery c) Lead-acid battery
d) Ni-Cd battery

3. The potential of lead storage battery _____ with decrease in concentration of H₂SO₄.

- a) Increase **b) Decrease** c) Remains same d) Either
increase or decrease

4. Which is used as anode in Zn-MnO₂ cell?

- a) Zn-Container** b) graphite rode c) Mn d) Carbon

5. Which electrolyte is used in Ni-MH batteries?

- a) aq.KOH** b) H₂SO₄ c) NaOH d) KCl

6. Dry cell does not have indefinite life, because acidic _____ corrodes the container.

- a) KCl **b) NH₄Cl ; Zn** c) HCl d) None

7. During discharging operation of lead-acid battery, the concentration of H₂SO₄ _____
- a) Increase **b) Decrease** c) Remains equal d) either increase of decrease
8. An intermediate temperature fuel cell operates at:-
- a) 25-100 °C **b) 100-500 °C** c) 500-1000 °C d) > 1000 °C
9. The electrolyte used in methanol-oxygen fuel cell is,
- a) CH₃OH **b) H₂SO₄** c) KOH d) None
10. Which of the following fuel cell operates at very high temperature ie, >1000 °C
- a) Alkaline fuel cell b) Phosphoric acid fuel cell
- c) Solid oxide fuel cell** d) Molten carbonate fuel cell

Chemical Energy Sources and Solar Energy

1. A good fuel should possess:
- a) high ignition temperature b) moderate ignition temperature
- c) high calorific value **d) both (b) and (c)**
2. Isooctane (2,2,4-trimethyl pentane) has an octane rating of:
- a) 100** b) zero c) 50 d) above 100
3. p-n junction in a PV cell is made up of
- a) Silicon** b) Argon c) Tungsten d) Iron
4. For good performance, the hydrocarbon molecules in a diesel fuel should be:
- a) Branched-chained b) side-chained **c) straight-chained** d) aromatic

5. The cetane rating of hexadecane is :
- a) **100** b) zero c) 50 d) None of these
6. Which of the following is used as a jet engine fuel?
- a) LPG **b) Kerosene** c) Power alcohol d) Coal
7. Bergius process of synthetic petrol involves mainly:
- a) Passing water gas over heated powdered coke under pressure
- b) Catalytic hydrogenation of coal**
- c) Heating coal alone under pressure
- d) Cracking of heavy oil
8. A good fuel should possess:
- a) low calorific value b) high ignition temperature **c) high calorific value**
- d) high ash content
9. An example of primary fuel is
- a) Natural gas** b) Petrol c) Wood charcoal d) coke
10. The calorific value of a fuel is expressed as :
- a) Kcal cm b) Kcal cm⁻³ **c) Kcal m⁻³** d) cal
- m⁻³

Metal Finishing

1. How you will express current density?
- a) mA m² b) Acm² **c) mAcm⁻²** d) mA m⁻²
2. What is the optimum range of pH for good deposition?

a) 2-4

b) 2-8

c) **4-8**

d) 4-10

3. Which buffer is used in gold plating?

a) borate buffer

b) ammonical buffer

c) **citrate buffer**

d)

None of these

4. What is the optimum range of temperature to get a good deposit?

a) 20 – 40 °C

b) 20 – 45 °C

c) **35 – 60 °C**

d) 35 –

80 °C

5. % throwing power = $100(X-Y) / (X+Y-2)$, what is X ?

a) C_2/C_1 b) W_2/W_1 c) **C_1/C_2** W_1/W_2

d)

6. % throwing power = $100(X-Y) / (X+Y-2)$, what is Y ?

a) C_2/C_1 b) C_1/C_2 c) **W_2/W_1** W_1/W_2

d)

7. In pickling, which solution is used to remove any oxide scale on the surface?

a) HCl b) HNO₃ c) **10% H₂SO₄** d) 10% HCl

8. In electroplating of gold which type of Bath is used for decorative gold plating in jewellery?

a) Bath A & B

b) Bath C

c) **Bath A**

d) Bath

B

Water Technology

1. Permanent hardness of water is caused due to the presence of

A) CaCO₃

B) Ca(HCO₃)

C) **CaCl₂**

D) All

2. Winkler's method is used to determine

- A) COD B) BOD C) **DO** D) Both B & C

3. Which of the following alkalinity is not present in water

- A) CO_3^{2-} & HCO_3^- B) CO_3^{2-} & OH^- C) **OH^- only** D) HCO_3^- & OH^-

4. The method used for desalination of water is

- A) Lime soda process B) Reverse Osmosis C) **Ion-exchange process** D) Permutit process

5. The indicator used for the estimation of total hardness of a given water sample by EDTA method,

- A) Starch B) **EBT** C) Ferroin D) methyl orange

6. Temporary hardness of water is caused due to the presence of

- A) CaCO_3 B) CaCl_2 C) **$\text{Mg}(\text{HCO}_3)_2$** D) None of these

7. The method used for desalination of water is

- A) Zeolite process B) Lime-soda process C) **Ion-exchange process** D) Electrodialysis

8. The indicator used in the determination of chloride content of water sample by Mohr's method

- A) Phenolphthalein B) K_2CrO_4 C) **Starch** D) Ferroin

9. The indicator used in the determination of sulphate content in water is

- A) Ferroin B) EBT C) **Phenolphthalein** D) K_2CrO_4

10. The indicator used for the determination of dissolved oxygen content in water using Winkler's method is

- A) Phenolphthalein B) Ferroin C) **Starch** D) K_2CrO_4

11. In the process of determination of chloride content of water, the sample and K_2CrO_4 is titrated with

- A) Ag_2CrO_4 B) $AgCl$ C) **$AgNO_3$** D) $CaCO_3$

12. The total hardness of water is expressed in

- A) gm/cm^3 B) mg/dm^3 C) **ppm** D) None

13. Nitrate content in water is determined using

- A) Volumetric method B) gravimetric method C) **Colorimetric method** D) titrimetric method