



J.S.S. ACADEMY OF TECHNICAL EDUCATION, BENGALURU.
DEPARTMENT OF CHEMISTRY

Question Bank

Module -1

Electrochemistry

1. What are electrochemical cells? Give their classification. Distinguish primary cells from secondary cells with examples.
2. Why the anode of galvanic cell is negative & cathode positive? Write the different electrode reactions that occur at the electrodes
3. Define standard electrode potential. Derive Nernst equation for electrode potential.
4. What are electrolyte concentration cells? Explain with example. Derive an expression for the emf of a concentration cell.
5. What are reference electrodes? Mention the limitations of primary reference electrode and advantages of secondary reference electrodes.
6. Explain the construction, working principle and applications of (i) Calomel electrode (ii) Silver-silver chloride electrode
7. Explain how calomel electrode is used as a reference electrode to determine the potential of an unknown electrode
8. Explain the principle of a membrane electrode. Mention the different types of membranes available. Mention the applications of ion-selective electrodes.
9. What are ion selective electrodes? Explain the construction, working principle & applications of glass electrode. Mention the advantages & disadvantages of glass electrode.
10. Explain how pH of the given solution is measured using glass electrode.

Quiz questions

- The chemical change that occurs when electric current is passed through an electrolyte
 - Conduction
 - Dissociation
 - Ionization
 - electrolysis
- An electrochemical cell converts
 - Electrical energy into chemical energy
 - Chemical energy into electrical energy
 - Both a & b
 - Chemical energy into heat energy
- Daniell cell is a combination of standard electrodes of
 - Cu & Ag
 - Zn & Cd
 - Zn & Cu
 - Cu&Cd
- The reference electrode used in the measurement of standard reduction potential is
 - Saturated calomel electrode
 - hydrogen electrode
 - Ag-AgCl electrode
 - SHE
- Calomel is the commercial name of
 - mercuric Chloride
 - mercurous chloride
 - mercuric Sulphate
 - mercurous sulphate
- Calomel electrode is reversible with respect to
 - Mercury ion
 - chloride ion
 - both ions
 - none of these
- A metal rod is dipped in a solution of its ions. Its electrode potential is independent of
 - temperature of the solution
 - concentration of the solution
 - area of the metal exposed
 - nature of the metal
- A Galvanic cell converts
 - electrical energy into chemical energy
 - chemical energy into electrical energy
 - electrical energy into heat energy
 - chemical energy into heat energy
- The potential of the standard hydrogen electrode is taken as
 - 1 volt
 - 0 volt
 - 10 volt
 - none of these
- In a concentration cell, the electrode kept in contact with a solution of lower concentration acts as
 - Anode
 - Cathode
 - both anode & cathode
 - none
- In a concentration cell consisting of copper rods dipped in solutions of Cu^{2+} solutions, the
 - concentration of Cu^{2+} ions at cathode is greater than that at anode
 - concentration of Cu^{2+} ions at anode is greater than that at cathode.
 - concentration of Cu^{2+} ions at cathode and anode are the same
 - none of these
- In a concentration cell, the electrode in contact with a solution of higher concentration acts as
 - anode
 - cathode
 - both anode & cathode
 - none

12. Electrode potential depends on
 a) temperature b) pressure c) activity of ionic species d) all of the above
13. Calomel electrode contains
 a) saturated HgCl_2 b) saturated NH_4Cl c) saturated NaCl d) Saturated Hg_2Cl_2
14. In a concentration cell, if the concentrations of the electrolytes at anode and cathode are equal, then the potential of the cell is
 a) 0 V b) 10 V c) 1 V d) none of the above
15. Example of an ion selective electrode is
 a) Calomel electrode b) Platinum electrode c) Glass electrode d) Ag-AgCl electrode.
16. In a galvanic cell, oxidation takes place at
 a) Cathode b) Anode c) Electrolyte d) salt bridge
17. The role of salt bridge is
 a) maintains electrical neutrality of the electrolyte b) nullifies liquid junction potential
 c) completes the circuit d) all of these
18. The standard reduction potential of Zn and Fe are -0.76 V & -0.44V respectively. The emf of cell formed by combining the above two electrodes will have
 a) +0.32 V b) -0.32 V c) -1.2 V d) -1.2V
19. Electrode potential of a metal electrode in a dilute solution is
 a) same as that in a concentrated solution b) lower than that in concentrated solution
 c) higher than that in a concentrated solution d) Intermediate
20. When the concentration of Cl^- ion in Ag-AgCl electrode increases, the reduction potential of the electrode
 a) increases b) decreases c) Does not alter d) none of these
21. For a galvanic cell with spontaneous reaction, E_{cell} is assigned
 a) Positive b) negative c) zero d) none of these
22. The potential of calomel electrode decreases with
 a) increase in Cl^- concentration b) decrease in Cl^- concentration
 c) both a & b d) does not alter with Cl^- ions
23. Which of the following is an ion selective electrode?
 a) calomel electrode b) Ag-AgCl c) SHE d) glass Electrode
24. If a salt bridge is removed between two half cells the voltage
 a) Drops to zero b) Does not change
 c) Increases gradually d) increases rapidly
25. Internal reference electrode present in a glass electrode is

- a) calomel electrode b) Ag-AgCl electrode c) SHE d) none of these

26. Daniell Cell is represented as

- a) $\text{Zn}/\text{Zn}^{2+}(\text{aq}) \parallel \text{Cu}^{2+}(\text{aq}) \mid \text{Cu}$ b) $\text{Cu} \mid \text{Cu}^{2+}(\text{aq}) \parallel \text{Zn}^{2+}(\text{aq}) \mid \text{Zn}$
c) $\text{Zn}^{2+}(\text{aq}) \mid \text{Zn} \parallel \text{Cu} \mid \text{Cu}^{2+}(\text{aq})$ d) $\text{Zn}^{2+}(\text{aq}) \mid \text{Zn} \parallel \text{Cu}^{2+}(\text{aq}) \mid \text{Cu}$

27. Glass electrode is an example for

- a) metal ion-metal electrode b) gas electrode
c) metal insoluble salt electrode d) ion selective electrode

28. Electrode potential of a metal is calculated using

- a) Nernst equation b) Henderson's equation
c) Hammett equation d) none of these

29. In a galvanic cell, the reaction taking place at cathode is

- a) reduction b) oxidation c) both a & b d) none of these

30. The standard reduction potential of metal electrodes A, B, C & D are +0.41 V, +0.34 V, -0.74 V and -0.40 V respectively/ which of the following is the best reducing agent

- a) A b) B c) C d) D

Hint: Decreasing order of $C > D > B > A$, metal with least SRP is the better reducing agent.

31. The emf of $\text{Ag} \mid \text{AgNO}_3(0.01\text{M}) \parallel \text{AgNO}_3(0.1\text{M}) \mid \text{Ag}$ is

- a) 1 V b) 0 V c) 0.0591 V d) 10 V

Battery technology and fuel cells.

1. What are batteries? Give their classification with suitable examples.
2. Give an account of the criteria used to determine the cell performance. What are the factors that affect the voltage of a battery? Explain the techniques in increasing the voltage of a battery.
3. What are the requirements of a cell to become the commercial cell?
4. What are primary cells? Give the construction, working, applications, advantages and disadvantages of (i) Zn-MnO₂ cell, (ii) Zn-Air cell and (iii) Li-MnO₂ cell.
5. What are secondary cells? Why they are considered as storage cells? Explain the construction, working, applications, advantages and disadvantages of (i) Nickel - Metal hydride battery and (ii) Li-ion battery. Give the reactions involved during discharge and recharge modes.
6. What are the special properties of Lithium that make it advantageous to use as an electrode material?

7. What are fuel cells? How do they differ from batteries? Mention the advantages of fuel cells.
8. Explain the construction, working and applications of methanol-oxygen fuel cell.

Quiz questions

1. Which of the following is not rechargeable battery
a) Zn-air b) Ni-MH c) Li-ion battery d) None of these
2. In Methanol-O₂ fuel cell, which of the following electrolyte is preferred?
a) KOH b) H₂SO₄ c) NH₄OH d) CH₃COOH
3. Which of the following is a reserve battery?
a) Zn-O₂ b) Ni-MH c) Zn-Ag₂O d) Li-MnO₂
4. In which battery, a key component is separated from rest of the battery prior to activation?
a) primary battery b) secondary battery c) reserve battery d) none of these
5. Which of the following is a rechargeable battery?
a) Zn-O₂ Cell b) Li-MnO₂ c) Ni-MH cell d) none of these
6. The reaction that takes place at anode of a battery is
a) reduction b) oxidation c) neutralization d) addition
7. Fuel cells are more superior than conventional batteries because
a) they are light in weight b) they are ecofriendly
c) they produce DC at low cost d) They are easily fabricated at low cost
8. The electrolyte used in Zn-air cell is
a) aq H₂SO₄ b) aq. KOH c) Conc. KCl d) none of these
9. In which of the following, the cell reaction is irreversible
a) Zn-O₂ cell b) Ni-MH c) Li-ion battery d) None of these
10. Which of the following is used in cell phone
a) Zn-MnO₂ b) Pb – Acid c) Zn-Air d) Ni-MH
11. To derive Maximum voltage from a battery
a) the difference in the electrode potential must be high b) internal resistance must be low
c) the over potential at the electrodes must be low d) all of these
12. Li-MnO₂ has higher emf than Zn-MnO₂ because
a) Li is more electropositive than Zn b) SRP of Li is less than Zn
c) Li undergoes oxidation easily d) all of these

13. In fuel cells, alkalis are preferred over acids as electrolyte because
- a) acids are more corrosive
 - b) Reduction O_2 is reversible in alkaline medium
 - c) both a) & b)
 - d) none
14. The basic components of fuel cells are
- a) fuel & oxidant
 - b) Electrolyte & electro catalyst
 - c) Electrodes
 - d) all of these
15. Emf of a battery depends on
- a) difference in the SRP's of electrodes
 - b) temperature
 - a) reaction quotient
 - d) all of these
16. Which of the following metal is more advantageous when used as anode of a battery
- a) Zn
 - b) Li
 - c) Cd
 - d) MH
17. Fuel cells convert
- a) chemical energy to electrical energy
 - b) heat energy to electrical energy
 - c) mechanical energy to electrical energy
 - d) none of these
18. The number of charging & discharging cycles before the failure of a battery occurs is called
- a) shelf life
 - b) cycle life
 - c) Energy efficiency
 - d) none of these
19. Li - MnO_2 battery is a
- a) Primary cell
 - b) secondary cell
 - c) reserve battery
 - d) None of these
20. The advantage(s) of fuel cell over conventional secondary batteries
- a) High power efficiency
 - b) ecofriendly
 - c) No recharging
 - d) All of the above
21. Which of the following battery is used in LCD TV?
- a) Ni-MH battery
 - b) Zn-air cell
 - c) Li-ion battery
 - d) Li- MnO_2 cell

Module -2

Corrosion

1. What is corrosion of metals? Explain the electrochemical theory of corrosion taking Fe as an example.
2. Discuss the how the following secondary factors affect rate of corrosion?
a) pH (b) Temperature (c) Conductance of the medium
3. Explain the following primary factors that affect the rate of corrosion
(a) Nature of metal (b) Nature of metal oxide (c) Relative areas of anode and cathode
4. Explain the following types of corrosion (i) pitting corrosion (ii) Water line corrosion
5. Give reason: (i) Pinholes on tin coated iron are more prone to corrosion than pin holes on zinc coated iron (ii) Nail inside the wall is black when it is pluck (iii) Deposition of oil or dust on metal surfaces for a long period is undesirable (iv) Nature of the environment affects corrosion
6. Explain what type of corrosion occurs when (i) Steel pipe is connected to copper plumbing (ii) presence of small dust particles on iron surface for a long time
7. Explain the type of corrosion occurring when (i) Screw and washer are made of different metals (ii) presence of NaOH in mild steel boilers under stress (iii) Small particles of dust on iron for a long time (iv) Bolt and nut made from different metals in contact with each other
8. What are the types of protective coatings? How do protective coatings help in controlling corrosion? Explain (a) Anodizing of Aluminum (b) Phosphating of Fe (c) Galvanizing and (d) Tinning
9. What is cathodic protection? With suitable examples, explain by control of corrosion by (a) sacrificial anode method (b) impressed current techniques
10. What is stress corrosion? Explain with suitable example
11. Explain the type of corrosion occurring when (i) Screw and washer are made of different metals (ii) presence of NaOH in mild steel boilers under stress (iii) small particles of dust on iron for a long time (iv) Bolt and nut made from different metals in contact with each other.

Metal finishing

1. Define metal finishing. Give its technological importance.
2. Explain the following factors in relevance to electroplating (i) Polarization (ii) Over-voltage (iii) Decomposition potential and its determination and mention their significance.

3. Discuss the role of following factors on the nature of electro deposit: a) Current density, b) pH, c) Metal ion concentration d) Organic additives e) Temperature
4. What is throwing power of the plating bath? Describe the experimental determination of throwing power of plating bath by using Haring-Blum cell.
5. Justify the following statements: a) Prior to electroplating, the metal to be plated needs cleaning. b) Chromium anodes are not used in electroplating of chromium plating.
6. Explain the electro plating of Chromium and mention its objectives and applications and explain why chromium plating has nickel undercoat.
7. Discuss the Electroless plating of Ni using Watt's bath.
8. What is meant by electroless plating? What are the advantages of electroless plating?
9. Distinguish between electroplating and Electroless plating.
10. Discuss the electroless plating of copper and explain in detail the electroless of copper relevant to PCB's.

Quiz questions

1. Corrosion of metals involves
 - (a) Physical reactions (b) Chemical reactions (c) Both (d) None
2. The following factors play vital role in corrosion process
 - (a) Temperature (b) pH (c) Conductance of the medium (d) All
3. Following equation is related to corrosion rate
 - (a) Nernst equation (b) Faraday's equation (c) Either (d) Neither
4. Passivity is due to
 - (a) Higher EMF (b) Lower EMF (c) Oxide film (d) All
5. Passivity is not reason for inertness of the following
 - (a) Au (b) Al (c) Ti (d) Ni
6. Difficult to monitor and very dangerous form of corrosion
 - (a) Galvanic (b) Pitting (c) Crevice (d) Stress
7. Main form of ceramic degradation
 - (a) Corrosion (b) Weathering (c) Dissolution (d) Swelling
8. The following influences deterioration of polymers
 - (a) Weather (b) Radiation (c) Temperature (d) All
9. Following is not the main form of polymer deterioration
 - (a) Corrosion (b) Swelling and Dissolution (c) Weathering (d) Scission
10. When Pt and Co are electrically connected, which one gets corroded
 - (a) Pt (b) Co (c) None (d) Can't decide

11. Which of the following can be used for cathodic protection?
 (a) Al (b) Cd (c) Cu (d) Au
12. Volatile oxidation corrosion product of a metal is,
 (a) Fe_2O_3 (b) MoO_3 (c) Fe_3O_4 (d) FeO
13. Lower is PH, corrosion is,
 (a) Greater (b) Lower (c) Constant (d) None of above
14. Electrochemical corrosion takes place on,
 (a) Anodic area (b) Cathodic area (c) Near cathode (d) Near anode
15. Chemical formula of Rust is,
 (a) Fe_2O_3 (b) $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (c) Fe_3O_4 (d) FeO
16. Smaller the anodic area, corrosion is,
 (a) Greater (b) Lower (c) Constant (d) Doesn't affected
17. Process of corrosion enhanced by,
 (a) Air & Moisture (b) Electrolytes in water (c) Metallic impurities
 (d) Gases like CO_2 & SO_2 (e) All
18. Ratio of volumes of metal oxides to metal is known as,
 (a) Specific mass ratio (b) Volume ratio (c) Specific ratio (d) Specific volume ratio
19. More active metal used in sacrificial anodic protection method is known as,
 (a) Sacrificial anode (b) Sacrificial cathode (c) Active anode (d) Active cathode
20. Identify the metal which is not employed as Sacrificial anode,
 (a) Mg (b) Zn (c) Al (d) Na
21. _____ is used for producing a coating of low melting metal such as Zn, Sn, Pb, Al on Fe, steel and Cu.
 (a) Hot dipping (b) Anodic coating (c) Cathodic coating (d) Galvanizing
22. _____ is the process of coating Fe or steel with a zinc coating.
 (a) Tinning (b) Hot dipping (c) Galvanizing (d) None of above
23. _____ is the process of coating of tin over Fe or steel.
 (a) Tinning (b) Galvanizing (c) Metal cladding (d) Sherardizing
24. _____ coating is non toxic in nature.
 (a) Sn (b) Zn (c) Fe (d) Cu
25. Coating applied must be chemically _____ to the environment.
 (a) Inert (b) Reactive (c) Soluble (d) Non reactive

26. Acidic media are more corrosive than _____ and neutral media.
 (a) Less acidic (b) Alkaline (c) Inert (d) Non reactive
27. Increase in over voltage of corroding metal / alloy reduces the _____.
 (a) Reactivity (b) Inertness (c) Corrosion (d) Reduction
28. Evolution of hydrogen type corrosion occurs in _____ environment.
 (a) Acidic (b) Neutral (c) Basic (d) Alkaline
29. Corrosion is a process reverse of _____ of metal.
 (a) Destruction (b) Extraction (c) Rusting (d) Galvanizing
30. Parts above and closely adjacent to waterline are _____.
 (a) Protected (b) Anodic (c) Cathodic (d) Inert to environment
31. In galvanic series, a metal high in series is more _____.
 (a) Anodic (b) Cathodic (c) Corroded (d) None of the above
32. Caustic embrittlement, a type of stress corrosion contains deposition of corrosion products,
 (a) Na_2FeO_2 (b) NaFeO_2 (c) K_2FeO_2 (d) Fe_3O_4
33. In waterline corrosion highly oxygenated parts acts as,
 (a) Corroded (b) Anodic (c) Cathodic (d) None of above
34. In differential aeration corrosion, poor oxygenated parts are,
 (a) Cathodic (b) Anodic (c) Corroded (d) None of above.
35. Pitting corrosion is a _____ accelerated attack.
 (a) Non-localized (b) Localized (c) Diverse (d) None of above
36. In the corrosion process by evolution of hydrogen
 (a) The cathodes have larger area than anodes (b) The anodes have larger area than cathodes
 (c) The areas of anodes and cathodes are same (d) none of the above
37. Pore-free coating is needed when
 (a) Coating and the protected metal have the same potential (b) With respect to protected metal coating is base
 (c) With respect to protected metal coating is noble
 (d) None of the above is correct
38. The buried pipeline is protected from corrosion by connecting to Mg block it is called
 (a) Impressed current protection (b) Sacrificial anodic protection (c) Polarization
 (d) None
39. Electroplating is used to
 (a) To produce cheaper article (b) To apply coating of cheap metal to protect expensive metal
 (c) Apply a coating of metal that is too reactive for commercial applications
 (d) Apply thin layer of one metal over the other

- 40) In the electroplating process the over voltage potential depends on
 a) Electrolyte b) Temperature c) Current density d) All
- 41) In chromium plating the anode is
 a) Soluble Chromium anodes b) Insoluble anodes c) Inert anodes d) both b & c
- 42) Autocatalytic reaction method of plating is also known as
 a) Electroplating b) Electroforming c) Electroless plating d) electro refining
- 43) For a electrolytic mixture containing Zn^{2+} , Cu^{2+} , Ag^+ the ion which is going to be discharge first is
 a) Zn^{2+} b) Cu^{2+} c) Ag^+ d) None
- 44) Conductors and insulators can be plated by
 a) Electroplating b) Electroless plating c) Electro polishing d) None
- 45) The phenomenon in which the back EMF produced due to the products of Electrolysis is
 a) Electroplating b) Electro less plating c) Polarization d) None
- 46) When the metal structure to plated is irregular the process employed is
 a) Electroplating b) Electro polishing c) Electro less plating d) None
- 47) Addition of Complexing agent to the plating bath is to
 a) Increase the rate of electro deposition b) increase the metal ion concentration
 c) Decrease the metal ion concentration d) None
- 48) Over voltage depends on
 a) current density b) Temperature c) Nature of the substance deposited d) All
- 49) For good deposition throwing power of a plating bath has to be
 a) Low b) High c) Zero d) No effect
- 50) For a good deposition, metal ion concentration should be
 a) low b) high c) zero d) none
- 51) Organic additives are added to bath solution to get
 a) bright deposit b) level deposit c) fine deposit d) all
- 52) In Electroless plating process,
 a) levelers are not required b) current density is not required c) reducing agent is required
 d) all
- 53) In Electroless plating process of copper, plating bath contains
 a) $CuSO_4$ b) EDTA c) HCHO d) All
- 54) The solution used to maintain the pH Nickel plating in Watt's bath is
 a) Boric acid b) $NiCl_2$ c) $NiSO_4$ d) Nickel sulphamate

Module-3

Fuels and Solar Energy

1. What is meant by HCV & NCV ? How can the calorific value of a liquid fuel is determined by using Bomb calorimeter.
2. What is reforming of petrol? How does reforming increase octane number? Give the reactions involved in reforming.
3. What is meant by knocking in IC engine? What are its ill effects? Explain the mechanism of knocking. How it can be prevented?
4. What is meant by cracking of petroleum? How is gasoline obtained by fluidized bed catalytic cracking process? Give its advantages.
5. Write a short note on i) Biodiesel ii) Power alcohol iii) Unleaded petrol
iv) Antiknocking agent v) Octane number v) Cetane number
6. Describe the synthesis of petrol by Fischer Tropsch process.
7. Explain the principle, construction and working of solar cell.
8. What are the advantages and disadvantages of PV cells.
9. Explain the diffusion technique for p- & n- doping of silicon.
10. Describe the method of production of solar grade silicon by union carbide process.
11. Discuss the purification of Si by zone refining.
12. Write a short note on solar panels, modules and arrays.
13. Calculate GCV & NCV using the following data, Mass of coke = 0.8 Kg, Mass of water = 25 Kg, water equivalent of calorimeter = 0.5 kg, specific heat of water = 4.187 KJ/K/Kg. Increase in temperature = 2.8K, latent heat = 2457 KJ/Kg.
14. Calculate GCV & NCV of a sample of coke from the following data. Mass of coke = 0.795×10^3 Kg, Mass of water = 2.5 Kg, water equivalent of calorimeter = 1.3kg, specific heat of water = 4.187 KJ/K/Kg. Increase in temperature = 1.8K, latent heat of steam = 587 Cal/g.
15. Explain knocking in CI engine.

Quiz questions

1. Cetane number of fuel is improved by adding
a) Tetraethyl lead b) Methyl tertiary butyl ether c) Ethyl nitrite d) Methanol
2. For improving anti – knock property of petrol it is mixed with
a) Lead bromide b) Lead tetraethyl c) Allyl bromide d) tetraethyl lead + ethyl bromide
3. If the percentage of hydrogen in fuel is high, its calorific value is
a) high b) low c) constant d) cannot be predicted
4. Which of the following posses zero octane number?
a) Isooctane b) α - Methyl naphthalene c) n-heptane d) cyclohexane
5. A good fuel should have

- a) high moisture content b) low calorific value c) moderate ignition temperature
d) high ash content
6. Photovoltaic cell is a
a) Storage cell b) Rechargeable cell
c) Energy conversion device d) fuel cell
7. Which of the following is not a secondary fuel?
a) Coal gas b) Water gas c) Producer gas d) Natural gas
8. The knocking tendency of hydrocarbons decreases in the following order
a) Straight chain > cycloalkanes > aromatic > branched chain
b) Straight chain > branched chain > cycloalkanes > aromatics
c) Straight chain > cycloalkanes > aromatic > branched chain
d) Aromatics > Straight chain > cycloalkanes > aromatic
9. The catalyst employed in fluidized catalytic cracking is
a) $\text{Al}_2\text{O}_3 + \text{SiO}_2$ b) $\text{Fe}_2\text{O}_3 + \text{SiO}_2$ c) $\text{ZrO}_2 + \text{SiO}_2$ d) $\text{TiO}_2 + \text{SiO}_2$
10. In photovoltaic cells solar energy is utilized to transform
a) Solar energy into light and heat energy b) Solar energy into electrical energy
c) Solar energy into electrical and chemical energy d) All of these
11. The tendency of knocking is high in
a) Aromatics b) Olefins c) Straight chain hydrocarbons d) Cycloparaffins
12. A device in which electricity is produced using solar energy is called
a) Fuel cell b) Voltaic cell c) Photovoltaic cell d) Concentration cell
13. Knocking is due to
a) Slow combustion b) Instantaneous explosive combustion
c) Incomplete combustion d) All of these
14. Which of the following is used to determine the calorific value of gaseous fuels?
a) Photovoltaic cells b) Bomb calorimeter
c) Boy's calorimeter d) Muffle furnace
15. Which of the following can be used as alternative fuel for gasoline
a) Solar energy b) Petrohol c) Gasohol d) All
16. Unleaded petrol mainly contains
a) MTBE b) Ethyl bromide c) Cetane d) n-Decane
17. The Biodiesel is
a) Renewable b) Obtained by trans esterification c) Eco-friendly d) All
18. Quality of gasoline is expressed in terms of its
a) Octane no. b) cetane no. c) compression ratio d) compression no.

19. In fluidized bed catalytic cracking process, the cracking of heavy oil takes place at
 a) 200-300°C b) 500-600°C c) 1000-1200°C d) 1500°C
20. Methyl tertiary butyl ether is added to petrol which acts as
 a) Inhibitor b) Accelerator c) antiknocking agent d) catalyst
21. Catalysts used in Fluidized catalytic converter is
 a) Pt, Pd and Rh b) Ni, Co and Cr c) SiO₂ and Al₂O₃ d) Co+Th+MgO+ keiselguhr
22. If its GCV and NCV are equal, the fuel has
 a) No hydrogen content b) Low hydrogen content c)
 High hydrogen content d) High carbon content
23. The knocking characteristic of petrol is expressed in terms of
 a) cetane no. b) octane no. c) calorific value d) power number.
24. Photovoltaic cell is
 a) energy conversion device b) storage device
 c) rechargeable cell d) fuel cell
25. Zone refining technique for purification of solar grade silicon is based on
 a) Henry's law b) Newton's law c) partition law d) phase rule
26. Which of the following is not a secondary fuel?
 a) coal gas b) water gas c) producer gas d) natural gas.
27. The process of breaking down hydrocarbons of higher molecular weight into lighter hydrocarbons is known as
 a) refining b) reforming c) isomerization d) cracking
28. The octane no. of a fuel is a measure of
 a) its ability to resist anti knocking b) inability to offer resistance for knocking
 c) its ability to resist knocking d) none of these
29. Addition of TEL to gasoline is
 a) decreases octane no. b) increases octane no.
 c) decreases cetane no. d) increases cetane no.
30. Photovoltaic cell consists of
 a) p-n junction b) n-type junction c) p-type junction d) none of these.
31. Ignition point of fuel depends on
 a) hydrogen content b) oxygen content c) sulfur content d) nitrogen content
32. Reforming is a process of
 a) structural rearrangement of hydrocarbon
 b) breaking of heavier hydrocarbon to lower hydrocarbon
 c) structural rearrangement without altering the no. of carbon atoms

- d) none of these.
33. Reaction involved in reforming
 a) isomerization b) dehydrocyclization c) hydrocracking d) All of these.
34. ----- junction is used in the conversion of solar energy into electrical energy
 a) p-n-p b) n-p-nc) p-n d) none of these
35. Petrol obtained from petroleum oil is subjected to reforming because
 a) to remove impurities in water b) for structural modification
 c) for degradation of high mol. Wt. hydrocarbons d) to reduce weight.
36. Catalyst used in the synthetic petrol by Fischer-Tropsch process
 a) Co+Th+MgO+ keiselguhr b) Fe+Th+MgO+ keiselguhr c) Pt-Rh-pd d) none of these
37. The tendency of knocking is more in ----- hydrocarbons
 a) aromatic b) straight chain c) olefins d) cyclic
38. Gasohol is a blend of gasoline with
 a) methanol b) ethanol c) propanol d) butanol
39. Knocking sound is produced in the internal combustion engine when the fuel
 a) burns slowly b) burns fast c) contains rain water d) none of these
- Which of the following hydrocarbons have highest octane no
 a)alkene b)cycloalkanes c)aromatic compounds d)alkanes
- Bio gas is
 a) CH₄+CO₂ b)CH₄+CO c)CH₄+C₂H₆ d) none of these
40. For good performance, the hydrocarbon molecules in a diesel fuel should be
 a) straight chained b) branched chain c) side chained d) aromatic
41. Catalytic cracking of heavy oil is carried out to get better quality
 a) kerosene b) diesel c) gasoline d) lubricating oil
42. Suitability of diesel fuel is determined by
 a) octane no. b) propane no. c) cetane no. d) butane no.

Module-4

Polymers

1. What are polymers? Explain the types of polymerization with suitable examples.
2. Explain Free radical mechanism of addition polymerization taking vinyl chloride as example.
3. Define Glass transition temperature(Tg). Explain any three factors influencing Tg. Mention the significance.
4. Derive an expression to determine number and weight average molecular weight of a polymer.
5. In a polymer sample, there are 100 molecules of molecular weight 10000, 200 molecules of molecular weight 12000 and 10 molecules of molecular weight 14000. Calculate number average and weight average molecular weight of sample.
6. Discuss the following structure property relationships i) crystallinity ii) tensile strength
iii) Elasticity iv) chemical resistance
7. Explain the synthesis, properties and applications of the following polymers. i) plexi glass
ii) polyurethane iii) polycarbonate iv) Silicone rubber
8. Explain the preparation of epoxy resin. Mention two applications.
9. Write a note on polymer composites.
10. Discuss the synthesis of Kevlar and mention any two properties and uses
11. Describe the mechanism of conduction in polyaniline.
12. What are conducting polymers? Write the structure of conducting polyaniline. Mention any four applications.

Quiz questions

1. A polymer formed by direct addition of repeated monomers without elimination of by product is called
a) Elastomer b) conducting polymer c) condensation polymer d) addition polymer
2. A requirement for a monomer to undergo addition polymerization is
a) Presence of unsaturated bonding sites b) presence of functional groups
b) presence of -COOH group d) all of these
3. An example of condensation polymer is
a) PVC b) plexi glass c) polyethylene d) polycarbonate
4. Glass transition temperature of a polymer depends on
a) Flexibility of a polymer b) magnitude of attractive forces
b) Molecular mass of a polymer d) all the above
5. Glass transition temperature is highest in
a) Polyethylene b) polypropylene c) PVC d) polystyrene
6. If all the polymeric chains are arranged in orderly manner with symmetrical orientation, with higher force of attraction between the chains, then it is
a) conducting polymer b) Crystalline polymer c) adhesive d) elastomer
7. Poly methyl metha acrylate is known as
a) Natural rubber b) plexi glass c) copolymer d) Teflon
8. Polyurethane could be used as

- a) Elastomer b) coating material c) cushioning material d) all of these
9. Epoxy resin is
 a) Conducting polymer b) natural rubber c) all purpose adhesive d) none
10. Epoxy resin is synthesized using
 a) Aniline b) methyl metha acrylate c) Bisphenol-A and epichlorohydrin d) diisocyanate
11. silicone rubber is
 a) an elastomer b) used to manufacture artificial heart valves
 c) Retains elasticity over a wide range of temp. d) all are true
12. Polymer prepared by the addition reaction of alkyl di-isocyanate with diol or triol is known as
 a) nylon b) plexi glass C) polyurethane d) polycarbonate
13. The continuous phase of a Polymer composites constitute
 a) Fiber phase b) Matrix phase c) both d) none
14. Kevlar is an example of
 a) adhesive b) elastomer c) polymer composite d) fiber
15. polymer composites are used to manufacture
 a) sports equipments b) automobile parts c) aircraft parts d) all of these
16. All organic polymers in their pure state
 a) Insulators b) conductors c) semiconductors d) none
17. Requirement of a polymer to be converted as conducting polymer
 a) Linear structure b) conjugated polymer backbone c) delocalized pi electron system
 d) all of these
18. Polyaniline could be converted in to conducting polymer by
 a) oxidation b) reduction c) protonic acid doping d) compounding
19. Polyaniline is used in the manufacture of
 a) PCB's b) electronic sensors c) rechargeable batteries d) all the above
20. A polymer with non polar nature dissolves or swells in a
 a) polar solvent b) non polar solvent c) alcohols d) do not dissolve
21. In general tensile strength of a polymer
 a) Decreases with increase in molecular
 b) Increases with increase in molecular mass up to 20000
 c) Do not change with molecular mass d) changes irregularly

Module-5

Water Technology

- 1) What do you mean by boiler feed water? Give its characteristics.
- 2) What are boiler troubles? Mention their disadvantages.
- 3) Explain the boiler troubles on scale and sludge formation in boilers.
- 4) Differentiate between sludge and scale.
- 5) What is composition of the scale? Why only some constituents form scale and not other impurities normally present in the water?
- 6) What are boiler troubles? Why are they caused? What are the methods of their elimination?
- 7) What are the disadvantages of scale formation?
- 8) Enumerate any four internal methods of treatment for boiler water.
- 9) Enumerate the remedial ways for the removal of scale.
- 10) Which components of boiler water form sludge?
- 11) Enumerate the remedial ways for the removal of sludge
- 12) What are the disadvantages of sludge formation?
- 13) Explain foaming in boilers, its problems and remedial measures.
- 14) Discuss the methods of preventing boiler troubles.
- 15) Write a note on corrosion of boilers.
- 16) What are the causes of corrosion of boilers?
- 17) Write notes on a) Priming and foaming b) boiler corrosion.
- 18) Explain priming in boilers, its problems and remedial measures.
- 19) Explain nature and ways of mitigating boiler corrosion caused by the following:
i) Dissolved CO_2 ii) Dissolved O_2 iii) Dissolved MgCl_2
- 20) Define DO. What is its significance? Discuss the method of determination of DO by Winkler's method.
- 21) Explain the principle and procedure for the determination of DO by Winkler method.
- 22) Define BOD and COD. Why COD is always greater than BOD?
- 23) Explain the terms i) BOD ii) COD
- 24) Outline the significance of BOD measurement
- 25) Explain the term COD of an industrial waste water.
- 26) Define BOD. Explain activated sludge treatment.
- 27) Define COD. What is its significance? Explain the method of determination of COD of a water sample.
- 28) Define COD. Explain the sewage treatment of activated sludge process.
- 29) Explain the determination of BOD by using Winkler's method
- 30) Define BOD. How does it differ from COD. Explain the method of determination of BOD of a water sample.
- 31) Explain the principle and procedure for the determination of BOD.
- 32) Explain the principle and procedure for the determination of COD.
- 33) Distinguish between BOD and COD.
- 34) Explain the desalination of water by reverse osmosis process.
- 35) What is desalination of water? What is potable water? Explain the desalination of water by electro dialysis.(ion selective)
- 36) Explain Winkler's method of determining dissolved oxygen. Give the reactions involved.

- 37) Discuss the primary, secondary and tertiary steps of sewage treatment.
- 38) Discuss purification of water (softening of water) by Ion-exchange method process.
- 39) Write a note on softening of water by ion exchange process.
- 40) What is softening of water? Distinguish between soft and demineralised water.
- 41) Discuss the steps involved in tertiary treatment method of waste water.
- 42) Discuss the secondary steps involved in the sewage treatment process.
- 43) Discuss the principles involved in the operation of activation sludge. What are the advantages and limitations of this process.
- 44) What are boiler troubles and what are their consequences? How can the boiler troubles be minimized?

Numerical problems:

- 1) 20ml of sample of COD analysis was reacted with 10ml of 0.25N $K_2Cr_2O_7$ and the unreacted dichromate required 6.5ml of 0.10N FAS. 10ml of same $K_2Cr_2O_7$ and 20ml of distilled water under the same conditions as the sample required 26.0ml of 0.10NFAS. What is the COD of the sample?
- 2) Calculate COD of effluent sample when $25cm^3$ effluent requires $8.9cm^3$ of 0.001M $K_2Cr_2O_7$ for complete oxidation.
- 3) In a COD test, 28.1ml and 14.0ml of 0.05N FAS solution were required for blank and sample titration, respectively. The volume of test sample used is 25ml. Calculate COD of the sample solution.
- 4) 25ml of an industrial effluent requires 12.5ml 0.5N $K_2Cr_2O_7$ for complete oxidation. Calculate COD of the sample. Assuming that the effluent contains only oxalic acid, calculate the amount of oxalic acid present in $1dm^3$ (given equivalent mass of oxalic acid is 45).
- 5) 25ml of waste water was mixed with 25ml of $K_2Cr_2O_7$, acidified and refluxed. The unreacted $K_2Cr_2O_7$ acidified required 8.2ml of FAS. In a blank titration, 25ml of $K_2Cr_2O_7$ acidified required 16.4ml of same 0.2N FAS. Calculate COD of waste water.

Quiz questions

- 1) Primary treatment of sewage is used to remove:
 - a) Suspended and floating solids
 - b) Soluble inorganic solids
 - c) Pathogenic bacteria
 - d) All of these
- 2) As the temperature increases, the amount of dissolved oxygen of water sample
 - a) Increases
 - b) Decreases
 - c) Has no effect
 - d) None of the above
- 3) Reverse osmosis is method of getting pure water from
 - a) Sewage water
 - b) Industrial waste water
 - c) Sea water/Brackish water
 - d) River water
- 4) The method adopted to convert saline water into potable water is
 - a) Demineralisation
 - b) Ion exchange process
 - c) Permutit process
 - d) Electrodialysis
- 5) General impurities present in water are

- a) Organic matters b) Pathogenic bacterias
c) calcium sulphate d) All of these
- 6) Potable water is totally devoid of
a) Pathogenic bacteria b) Calcium and magnesium salts
c) Chlorides d) Nitrates
- 7) In the determination of dissolved oxygen in water by Winkler's method, sodium Azide is added to
a) Liberates b) Oxidize KI c) Destroy nitrites d) React with starch
- 8) Secondary treatment of sewage is carried out to reduce
a) Organic load b) Inorganic load c) Destroy micro-organisms d) None of these
- 9) In reverse osmosis the flow of solvent takes place from
a) Dilute to concentrated side b) Concentrated to dilute side
c) solute to solvent side d) None of these
- 10) The method used for secondary treatment of sewage is
a) Activated sludge process b) Ion-exchange process
c) Reverse osmosis d) Electrodialysis
- 11) The method adopted to analyse DO/BOD in water is
a) Volhards b) Winkler's c) Argentometric d) Dumas
- 12) Secondary treatment of sewage is carried out to reduce
a) Organic load b) Inorganic load
c) Destroy micro-organisms d) None of these
- 13) BOD and Do can be determined by.....method.
a) Complexometric method b) Argentometric method
c) Winkler's method d) Gravimetric method
- 14)method used to convert sea water to potable water.
a) Electrodialysis b) Distillation c) Boiling d) Refluxing
- 15) Winkler's method is used to determinein water sample.
a) Dissolved Oxygen b) Chlorides c) Sulphates d) Hardness
- 16) The magnitude/Value of BOD isthan COD.
a) Equal b) Smaller c) Greater d) None of these.
- 17) Boiler corrosion occurs due to dissolvedgases.
a) CO_2 & O_2 b) CO_2 & H_2 c) N_2 d) All of the above
- 18) Priming in boilers occurs due to
a) High water level b) Low water level
c) Medium water level d) None of these
- 19) Formation of Scales is due to.....
a) $\text{Mg}(\text{OH})_2$ & CaSO_4 b) Nitrates c) Sulphides d) Borates
- 20) Formation of sludges is due to
a) CaCl_2 & MgCl_2 b) Hydrides c) Phosphates d) None of these
- 21) Secondary treatment of sewage uses process.
a) Aerobic Oxidation b) Anaerobic Oxidation c) Hydrogenation d) All of these
- 22) The conditioning of water in the boiler itself, by the addition of chemicals is called.....
a) External treatment b) Internal treatment c) Boiling d) None of these
- 23) The unit used to express COD and BOD.....
a) mg of O_2/dm^3 b) ppb c) Dynes d) Millipoise

Nanomaterials.

1. Give the classification of nanomaterials.
2. Explain Sol-gel synthesis, giving its advantages and disadvantages.
3. What are sols and gels?
4. Name two applications of Nanoclusters.
5. Discuss general properties of Nanomaterials.
6. How Nanomaterials are prepared in gas condensation method? Explain the principle, process and advantages of this method.
7. What do you mean by bottom approach of nanomaterials by sol-gel method.
8. Explain the precipitation method of synthesis of Nanomaterials.
9. With appropriate scheme discuss the synthesis of Nanomaterials by Sol-gel method.
10. Discuss the chemical vapour condensation method of Nanomaterials synthesis.
11. Write notes on gas condensation and chemical vapour condensation techniques of synthesis of nanomaterials.
12. What are nanoscale materials? Give examples.
13. Write a short note on
 - a) Nanocomposites
 - b) Dendrimers
 - c) Fullerenes
 - d) Carbon nanotubes
 - e) Nanowires
 - f) Nano rods
14. How nanomaterials are classified? Explain with examples.
15. Briefly discuss the applications of Nanomaterials.
16. Explain the physical and chemical properties, applications of Buckminster fullerene(C_{60}).
17. What are carbon nanotubes? Give their types, properties and uses.
18. What is nanowire? Give its applications.
19. What are nanorods? Give its applications.
20. What are dendrimers? Give their properties, applications.
21. What are nanocomposites? Give their properties, applications.
22. What do you mean by bottom approach of nanomaterial synthesis? Explain with suitable Example.

Quiz questions

1. The diameter of human hair ism
 - a) 75000nm
 - b) 10m
 - c) 100m
 - d) None of these
2. The diameter of bucky ball is aboutnm
 - a) 1nm
 - b) 100nm
 - c) 0.5 nm
 - d) None of these
3. A bucky ball is a molecule consisting ofatoms.
 - a) 70
 - b) 60
 - c) 5
 - d) 1000
4. The size of quantum dot isnm
 - a) 1nm
 - b) 1000nm
 - c) 5nm
 - d) 10nm

5. Nanotechnology, in other words atomic.....
 - a) Engineering b) Tailoring c) cleavage d) None of these.
6. The tensile strength of carbon nanotube istimes that of steel.
 - a) 1 b) 10 c)100 d)1000
7. In a bucky ball/CNT's, each carbon atom is bound to.....adjacent carbon atoms.
 - a) 3 b) 4 c) 5 d) 10
8. The concept of dendrimers was introduced by.....
 - a) Donald A Tomalia b) Niel Armstrong c) Gregor Jhon Mendeleev d)C N Rao
9. Nano in Greek means.....
 - a) Big b) Giant c) Dwarf d) Medium
10.is a multidisciplinary science and technology and encompasses physical, chemical, biological, engineering and electronic processes.
 - a) Nanotechnology b) Biotechnology c) Foodtechnology d) Seedtechnology
11. 1nm is equal to.....
 - a) 10^{-10} m b) 10^{-9} m c) 10^{-6} m d) 10^{-3} m