DAYANANDA SAGAR COLLEGE OF ENGINEERING

Accredited by National Assessment & Accreditation Council (NAAC) with 'A' Grade

(An Autonomous Institute Affiliated to VTU, Belagavi)

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Department of Chemistry

Question Bank

UNIT 1:

1. Define chemical fuels. Give the classification based on occurrence and physical state with examples.
2. Define calorific, gross and net calorific values.
3. Illustrate with a neat diagram the determination of calorific value of a fuel by bomb calorimeter method.
4. Solve for the net and gross calorific values of a sample of coke from the following data: mass of coke = 0.795 x 10^{-3} kg; mass of water = 2.5 kg; water equivalent of calorimeter = 1.3 kg; specific heat of water = 4.187 kJ/kg/K; rise in temperature = 1.8 K; % of hydrogen in coke = 2.5; latent heat of steam = 587 cal/g.
5. Solve for gross and net calorific values: On burning 1.15 g of a fuel in a bomb calorimeter, the temperature of 3.5 kg of water increased from 26.5 °C to 28.5 °C. Water equivalent of calorimeter is 325 g, specific heat of water is 4.187 J/g/K, latent heat of steam is 2458 J/g and the fuel contains 4 % hydrogen.
6. Solve for the gross and net calorific values of a sample of coal from the following data: mass of coal = 0.98 g; mass of water = 2600 g; water equivalent of calorimeter = 368 g; specific heat of water = 4.187 J/g/K; rise in temperature = 2.8 K; % of hydrogen in coal = 5.8; latent heat of steam = 2454 J/g.
7. On burning 0.96 x 10^{-3} kg of a fuel in a bomb calorimeter, the temperature of 2.75 kg of water was increased by 2.7 °C. Water equivalent of calorimeter, specific heat of water and and latent heat of steam are 0.385 kg, 4.187 kJ/kg/K and 2455 kJ/kg respectively. If the fuel contains 5% hydrogen, solve for its gross and net calorific values.
8. Examine the role of fluidized bed catalyst in cracking process with a diagram.
9. Describe the synthesis of petrol by Fischer-Tropsch process.
10. Recommend with an example any four reforming reactions.
11. Illustrate the following: (a) octane number (b) cetane number.
12. Analyse the mechanism of knocking of gasoline in internal combustion engine.
13. Define anti-knocking agents and elaborate their role in minimising knocking.
14. Define unleaded petrol and appraise how anti-knocking properties are achieved in unleaded petrol.
15. Justify the use of anti-knocking agent in gasoline.

16. Define: (a) petroleum cracking (b) reformation of gasoline (c) knocking of petrol
17. Define power alcohol. Explain its production and give its advantages and disadvantages.
18. Define bio-diesel. Explain the production of bio-diesel by trans-esterification of triglycerides. Mention its advantages.
19. Define photovoltaic cell. Describe the construction and working of a photovoltaic cell.
20. Record the advantages and disadvantages of a photo-voltaic cell.
21. Outline the Union Carbide process of production of solar grade silicon.
22. Elaborate the n- and p-type doping of silicon by diffusion technique.
23. Explain the purification of silicon by zone refining technique.

UNIT 2:

1. Generate Nernst equation for electrode potential.
2. Solve for the electrode potential of copper when it is in contact with 0.5 M $CuSO_4$ solution at 298 K, given E^o value of copper as 0.34 V.
3. Solve for the standard electrode potential of Zn^{2+}/Zn if the electrode potential at 25^{o}C is -0.764 V, when $[Zn^{2+}] = 0.73$ M.
4. Solve for the emf of a cell constructed by coupling a zinc electrode dipped in 0.5 M $ZnSO_4$ and a nickel electrode dipped in 0.05M $NiSO_4$. Write the cell representation and cell reaction, given the standard reduction potential of Zn and Ni as -0.76 V and -0.25 V respectively.
5. Solve for the emf of the following cell at 298 K; Ni/ Ni^{2+} (0.01M) // Cu^{2+} (0.5M) / Cu. The standard reduction potentials of Ni and Cu are -0.25 V and 0.34V respectively. Write the electrode reaction.
6. Classify the six different types of electrodes with examples for each.
7. Define reference electrodes and mention their applications. Explain the construction and working of Ag/AgCl electrode.
8. Describe the construction of calomel electrode with a neat diagram giving the electrode reaction.
9. Summarise the demerits of standard hydrogen electrode.
10. Determine the standard electrode potential of copper using a reference calomel electrode.
11. Describe the construction and working of glass electrode with a neat diagram.
12. Describe the determination of pH of a solution using glass electrode.
13. Define: (a) ion selective electrode (b) concentration cell
14. Illustrate the expression for the emf of concentration cell.
15. A concentration cell is constructed by immersing two iron electrodes in 0.01M and 0.1M $FeSO_4$ solutions. Represent the cell and solve for the emf of the cell at 298 K.
16. The emf of the cell Ag / $AgNO_3$(0.0093 M) // $AgNO_3$(X) / Ag is 0.086 V at 25 °C. Solve for the value of X.
17. Solve for the emf of the following concentration cell: Zn / Zn^{2+}(0.025 M) // Zn^{2+}(0.15 M) /Zn at 298 K.
18. Emf of the cell Ag / $AgNO_3(C_1)$ // $AgNO_3(C_2 = 0.2$ M) / Ag is 0.8 V. Solve for C_1.

19. Classify the three different types of batteries with description.
20. Analyse the following characteristics of a battery: (a) cell potential (b) capacity (c) energy density.
21. Analyse the following characteristics of a battery: (a) current (b) energy density (c) energy efficiency (d) cycle life and (e) shelf life.
22. Describe the construction, working and applications of: (a) Zn-air battery (b) Ni – metal hydride battery.
23. Analyse the criteria for selection of lithium as anode.
24. Appraise the construction, working and applications of Li ion battery.
25. Define fuels cells. Clarify the differences between a battery and a fuel cell.
26. Classify fuel cells based on the nature of the electrolyte.
27. Formulate the construction and working of hydrogen-oxygen fuel cell.

UNIT 3:

1. Describe the electrochemical theory of corrosion with iron as an example.
2. Clarify the importance of galvanic series.
3. Elaborate the effect of following factors on rate of corrosion. (a) ratio of anodic to cathodic areas (b) nature of corrosion product (c) nature of metal.
4. Explain the effect of the following factors on the rate of corrosion: (a) pH (b) conductivity (c) temperature
5. Illustrate the following types of corrosion with an example: (a) differential metal corrosion (b) differential aeration corrosion (c) stress corrosion
6. Analyse caustic embrittlement in boilers.
7. Elaborate the procedure for the estimation of corrosion rate.
8. Define inorganic coatings. Explain anodising of aluminium.
9. Explain the phosphate coating method of corrosion control.
10. Define metallic coatings. Describe the following processes: (a) galvanisation (b) tinning.
11. Define cathodic protection. Describe the following methods: (a) sacrificial anode (b) impressed current.
12. Define metal finishing and outline the technological importance of metal finishing.
13. Illustrate the significance of polarization, decomposition potential and overvoltage in electroplating.
14. Describe the effect of the following factors on the nature of the electrodeposit: (a) current density (b) metal ion concentration (c) pH (d) temperature (e) addition agents (f) throwing power of the plating bath
15. Define electroplating. Explain the electroplating of chromium.
16. Appraise the differences between electro plating and electroless plating.
17. Justify the application of electroless plating of copper in the manufacture of PCB.

UNIT 4:

1. Define : (a) monomer (b) polymer (c) polymerisation (d) degree of polymerisation

2. Describe addition and condensation polymerisation reactions with suitable examples.
3. Describe the free radical mechanism of addition polymerisation of ethylene.
4. Distinguish between number average and weight average molecular weights of a polymer.
5. Solve for M_n and M_w of a polymer which consists of 35% molecules having molecular mass 25000, 35% molecules having molecular mass 20000 and the remaining molecules having molecular mass 10000.
6. Solve for number average and weight average molecular weights of a polymer consisting of 150 molecules with molecular mass 1000, 200 molecules with molecular mass 10000 and 350 molecules with molecular mass 100000.
7. A polymer sample contains 2, 3 and 4 molecules having molecular weights 2×10^3, 3×10^3 and 4×10^3 respectively. Solve for the number average and weight average molecular weights of the polymer.
8. Solve for the number average and weight average molecular weights of two polymers of molecular weights 10000 and 100000 when they are mixed: (a) in equal parts by weight, (b) in equal number of molecules.
9. A polymer sample consists of 10% by weight of macromolecules of mol. wt. 10000 and 90% by weight of macromolecules of mol. wt. 100000. Solve for its number average and weight average molecular weights.
10. A polymer sample has population as follows: 5 molecules of molecular mass each = 25000; 10 molecules of molecular mass each = 5000; 20 molecules of molecular mass each = 10000; 25 molecules of molecular mass each = 15000. Solve for its number average and weight average molecular weights.
11. Illustrate the significance of glass transition temperature.
12. Clarify the role of the following on Tg: (a) molecular mass (b) branching & cross linking (c) stereoregularity
13. Illustrate the influence of the following on Tg; (a) flexibility (b) intermolecular forces
14. Define: (a) glass transition temperature (Tg) (b) elastomer (c) polymer composite (d) conducting polymer (e) adhesive
15. Explain the synthesis, properties and applications of PMMA (Plexi glass).
16. Illustrate the synthesis, properties and applications of the following polymers: (a) teflon (b) polyurethane.
17. Construct the synthesis of silicone rubber starting from dichlorosilane and mention its properties and applications.
18. Illustrate the synthesis and properties of epoxy resin along with its applications.
19. Construct the poly condensation reaction of synthesis of Kevlar and mention its uses.
20. Outline the mechanism of conduction in doped polyaniline.

UNIT 5:

1. Name the different types of impurities present in water.
2. Define boiler sludges and scales. Describe their formation.

3. Analyse the disadvantages of sludges and scales in boilers.
4. Define boiler corrosion. Elaborate on the mechanism of boiler corrosion due to dissolved oxygen, carbon dioxide and magnesium chloride.
5. Explain the determination of dissolved oxygen by Winkler's method.
6. Define biological oxygen demand. Describe its determination.
7. Define chemical oxygen demand. Describe its determination.
8. 20 ml of sewage sample was diluted to 600 ml and equal volumes were filled in two BOD bottles. DO in one bottle was determined immediately and 200 ml of this solution required 4.2 ml of N/40 $Na_2S_2O_3$ solution. The second sample was incubated for five days and in DO determination, 200 ml of the solution required 2.2 ml of N/40 $Na_2S_2O_3$ solution. Solve for BOD of the sample.
9. 20 ml of sewage sample is reacted with 25 ml of $K_2Cr_2O_7$ solution and the unreacted $K_2Cr_2O_7$ requires 9 ml of 0.25 N FAS solution. Under similar conditions, in blank titration 15 ml of FAS is used up. Solve for the COD of the sample.
10. 50 ml of an industrial effluent is allowed to react with 100 ml of $K_2Cr_2O_7$ solution. The unreacted $K_2Cr_2O_7$ consumed 25 ml of 0.05 N FAS solution. In blank titration, 35 ml of same FAS is consumed. Solve for the COD of the effluent.
11. In a COD experiment, 20 ml of waste water sample consumes 30 ml of 0.01 M $K_2Cr_2O_7$ for oxidation of impurities. Solve for the COD value of water sample. [MW of $K_2Cr_2O_7$ = 294]
12. Solve for the COD of the effluent sample when 25 ml of the effluent requires 10.5 ml of 0.005 M $K_2Cr_2O_7$ for complete oxidation.
13. 25 ml of waste water was mixed with 25 ml of $K_2Cr_2O_7$, acidified and boiled. The unreacted $K_2Cr_2O_7$ required 8.2 ml of 0.2 N FAS. In a blank titration, 25 ml of $K_2Cr_2O_7$ required 16.4 ml of the same FAS. Solve for the COD of waste water.
14. 25 ml of sewage water was boiled with 10 ml of $K_2Cr_2O_7$ in sulphuric acid medium. The unreacted $K_2Cr_2O_7$ required 6.1 ml of 0.1 N FAS. Under similar conditions, 10 ml of $K_2Cr_2O_7$ required 28.2 ml of FAS. Solve for the COD.
15. Appraise the activated sludge process of sewage treatment.
16. Explain tertiary treatment method of sewage water.
17. Describe the ion exchange method of softening of water.
18. Define desalination. Describe reverse osmosis and eletrodialysis methods.
19. Define nanomaterials. Explain their size dependent properties.
20. Describe the synthesis of nanomaterials by sol-gel method and mention its advantages.
21. Describe the synthesis of nanomaterials by the following methods with an example for each: (a) chemical vapour condensation (b) hydrothermal.
22. Elaborate on the following along with their applications: (a) fullerenes (b) nanowires (c) nanorods (d) nanocomposites.
23. Formulate the synthesis, properties and applications of carbon nanotube.
24. List the various applications of nanomaterials.