Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST –1

Sem & AY: Odd Sem. 2019-20 | Date: 27.09.2019

Course Code: CHE101 | Time: 9:30AM to 10:30AM

Course Name: Engineering Chemistry | Max Marks: 30

Program & Sem: B Tech.(Chemistry Cycle) & I | Weightage: 15%

Instructions:

(i) *Read the question properly and answer accordingly.*

(ii) *Question paper consists of 3 parts.*

(iii) Scientific and Non-programmable calculators are permitted.

Part A (Memory Recall Questions)

1. Choose the correct answer. Each Question carries one mark. (5Qx1M=5M)
(CO.NO.1) [Knowledge]

i. The bond formed between two non metals is

a. Covalent bond b. Ionic bond c. Metallic bond d. Coordinate bond

ii. The force present in all polar molecules is

a. dispersion force b. Dipole-dipole force c. vander waal force

d. hydrogen bonding

iii. Atomic number of an element refers to

a. number of protons b. number of neutrons

c. number of valency electrons d. number of electrons

iv. Color code used to represent Oxygen in ball and stick molecular model?

a. Black b. White c. Red d. Blue

v. The tool developed by the cheminformatics company is

a. ChemDraw b. ChemWindow c. ChemSketch d. ChemMine tool

b. State True or False for the following statements (5Qx1M=5M)

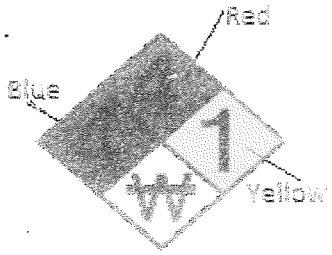
a. Hydrogen bonding is present in HF, but not in NH_3
b. Space-filling molecular model gives the best sense of the relative sizes of the atoms and how they merge together in bonding.
c. The octet rule refers to the tendency of atoms to prefer to have Nine electrons in the *valence shell.*
d. In electrostatic potential maps, electron rich region is represented by red colour and electron deficient region is given blue color.
e. Electrons are considered as particles in quantum mechanical model.

Part B (Thought Provoking Questions)

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

CO-1 and 2 [Comprehension]

c. The following MSDS label was found for a chemical. Discuss what the colours and numbers represents for safety measures.



d. In a polymer industry, when two polymers were being processed one of the polymers was found to become soft on heating and hard on cooling, and other polymers become permanently hard and rigid on continuous heating. What is the reason? What are these polymers referred to as? Give an example for each.

Part C (Problem solving Questions)

Answer the Question. The Question carries ten marks. (1Qx10M=10M)

(C.O.NO.-2) [Application]

5. A sample of Polymethyl methacrylate polymer was found to have, 30% monomers with molecular mass 28, 30% with molecular mass 42 and rest with molecular mass 50.

a. Calculate the number average molecular weight, weight average molecular weight and polydispersivity index of the polymer.

b. A polymer is found to have molecular weight 88200. If the molecular weight of a monomer is 42, Find out the degree of polymerization.

SCHOOL OF ENGINEERING

Semester: I

Course Code: CHE101

Course Name: Engineering Chemistry

Date: Engineering Chemistry

Time: 9:30am -10:30am

Max Marks: 30

Weightage: 15%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	1	Module 1	1x5									5
2	1	Module 1	1x5									5
3	1,2	Module 1 & 2				5						5
4	1,2	Module 1 & 2				5						5
5	2	Module 2							10			10
	Total Marks		10			10			10			30

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I here certify that All the questions are set as per the above lines Dr Shashikala A R]

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

Semester: I

Course Code: CHE101

Course Name: Engineering Chemistry

Date: Engineering Chemistry

Time: 9:30am -10.30am

Max. Marks: 30

Weightage: 15%

Part A (Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	i. a ii. b iii. a iv. c v. a	one mark for each correct answer	10mins
2	a. False b. True c. False d. True e. False	one mark for each correct answer	10mins

Part B (Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
3	Blue-health-4-very short exposure cause death or serious injury.- severe health risk Red-Flammability-4-will vaporize and burn readily at normal temperature. Yellow-Stability-1-normally stable cab become unstable at higher temperatures. White- W - avoid water	1.5 1.5 1 1	10mins
4.	Thermoplastics become soft on heating and Thermosetting polymers become permanently hard and rigid on heating	naming thermoplastics and thermosetting polymers-2 marks	10mins

	In thermoplastics, polymers chains are held together with weak vander waal forces, but in thermosetting polymers, polymer chains are held with covalent bonds which is difficult to break. Examples: thermoplastics-PE, PVC Thermosetting-Bakelite, UFresin	reason 2 marks one example for each 0.5 x2=1	

Part C (Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5a.	$\overline{M_n} = \frac{N1M1 + N2M2 + N3M3}{N1 + N2 + N3}$ $\overline{Mw} = \frac{N1M1^2 + N2M2^2 + N3M3^2 + \cdots NiMi^2}{N1M1 + N2M2 + N3M3 + \cdots NiMi}$ PDI=Mw/Mn average Mn=41g/mol average Mw=43.03g/mol PDI=1.04965	Formula -3 marks Calculation of Mn (substitution and simplification)=2 Calculation of Mw (substitution and simplification)=2 Calculation of PDI-1 mark	25 mins
5b.	DP=Molecular weight of a polymer / molecular weight of a monomer DP=88200/42 =2100	formula 0.5 mark substitution 1mark and calculation 0.5 marks	5 mins

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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem. 2019-20
Course Code: CHE 101
Course Name: ENGINEERING CHEMISTRY
Program & Sem: B.Tech (Chemistry Cycle) & I

Date: 16.11.2019
Time: 9:30 AM to10:30 AM
Max Marks: 30
Weightage: 15%

Instructions:

I. Read the question properly and answer accordingly.
II. Question paper consists of 3 parts.
III. Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each sub Question carries one mark. (10Qx1M=10M)

1. Choose the correct answer. (C.O.NO.2&3) [Knowledge]

(i) Which of the following is a fully fluorinated polymer?
a) Neoprene c) Thiokol
b) Teflon d) PVC

(ii) Stereoregular polymers are
a) Isotactic, syndiotactic, atactic c) Natural and synthetic
b) Addition and condensation d) Elastomers, plastics and fibres

(iii) Which one is the example of conducting polymer?
a) Thiophene c) Polythene
b) Neoprene d) Thiokol

(iv) _____ is primary battery from the following.
a) Dry cell c) Ni-MH_2 battery
b) Ni-Cd battery d) Li-ion battery

(v) An example of primary fuel is----------.
a) Wood c) LPG
b) CNG d) Petrol

2. State **True** or **False** for the following: (C.O.NO.2&3) [Knowledge]

   (i) Liquid crystals are anisotropic.

   (ii) The addition of plasticizers in the virgin plastic is to improve flexibility and toughness.

   (iii) Tg value can decide whether a polymer at the use temperature will behave like rubber or plastic.

   (iv) Conducting polymers should have conjugation in their structure.

   (v) In Li-MnO_2 battery, electrolyte must be dissolved in aqueous solutions.

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

3. Explain construction, working and applications of Leclanche cell.
   (C.O.NO.3) [Comprehension]
4. How are the properties of virgin plastic modified. Explain it with suitable examples.
   (C.O.NO.2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carries ten marks. (1Qx10M=10M)

5. On burning 1.83 g of a solid fuel in a bomb calorimeter, the temperature of 3500 g of water increased from 35.5^0C to 39.2^0C. Water equivalent to the calorimeter is 395 g and latent heat of steam is 587cal/g. Calculate the gross and net calorific values of the fuel if % of hydrogen in fuel is 0.7. Specific heat of water is 1cal/g^{0}C.
   (C.O.NO.3) [Application]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 1st

Course Code: CHE101

Course Name:Engineering Chemistry

Date: 16.10.2019

Time: 9:30-10:30 AM

Max Marks: 30

Weightage: 15%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	2 & 3	2 and 3	5									5
2	2 & 3	2 and 3	5									5
3	3	3				5						5
4	2	2				5						5
5	3	3							10			10
6												
7												
	Total Marks		10			10			10			30

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: 1st

Course Code: CHE101

Course Name:Engineering Chemistry

Date: 16.10.2019

Time: 9:30-10:30 AM

Max Marks: 30

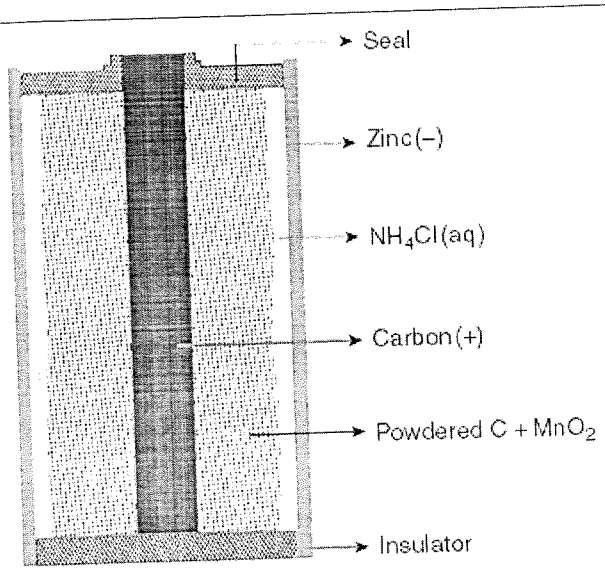
Weightage: 15%

Part A (10Q x 1M = 10 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1. (i)	b) Teflon	1 M	5 min
(ii)	a) Isotactic, syndiotactic, atactic	1 M	
(iii)	a) Thiophene	1 M	
(iv)	a) Dry cell	1 M	
(v)	a) Wood	1 M	
2. (i)	True	1 M	5 min
(ii)	True	1 M	
(iii)	True	1 M	
(iv)	True	1 M	
(v)	False	1 M	

Part B (2Q x 5M = 10 Marks)

Q No		Scheme of Marking	Max. Time required for each Question
3.	***Dry Cell:*** This cell, also known as Leclanche cell (Zinc-Carbon dry cell)	Diagram- 2M Reactions-3M	6 min.



The cell reactions are:

At the anode: $Zn \rightarrow Zn^{2+} + 2e^-$

At the cathode: $MnO_2 + H_2O + 2e^- \rightarrow Mn_2O_3 + 2OH^-$

The overall cell reaction: $Zn + 2MnO_2 + H_2O \rightarrow Zn^{2+} + Mn_2O_3 + OH^-$

6 min.

4.

- The polymer is combined with a range of additives to modify the properties to the specific application.
- The process of mechanical mixing of the virgin plastic with various additives (without chemical reaction) is known as *compounding of plastics*.

Definition- 2M
Additives with example- 3M

6 min.

1. **Fillers** – To impart special properties such as heat resistance, strength fillers are added into the polymer matrix etc.
   Eg: Mica, Clay, Titanium dioxide, wood flour or saw dust
2. **Plasticizers** – These are added to improve flexibility and toughness.
   Eg: Pthalates and Adipates
3. **Accelerators** – These are added to fasten the vulcanization process.
   Eg: Thiourea, Carbamate, Mercaptobezothiazole.
4. **Stabilizers** – These are added to improve the resistance to heat, UV light, general weathering and oxidation.
   Eg: Tin, Lead
5. **Coloring agents** - Coloring agents are used in plastics to give various colors.
   Eg: Dyes and pigments

Part C (1Q x10 M =10 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5.	$GCV = \frac{(W+w)(T_2 - T_1)}{x}.S$ GCV = (3500+395) (39.2-35.5) 1/1.83 = 7875.1 cal/g NCV = HCV – (0.09X% of H2 X Latent of steam) = 7875.1 – (.09 X 0.7 X 587) = 7838.1 cal/g	Formulas- 2 marks each Substitution- 2 marks each Calculation and correct answer- 3 marks each	15 min.

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20 | **Date**: 28 December 2019

Course Code: CHE 101 | **Time**: 1:00 PM to 4:00 PM

Course Name: ENGINEERING CHEMISTRY | **Max Marks**: 100

Program & Sem: B.Tech (Chemistry Cycle) & I | **Weightage**: 50%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Non-programmable calculators are permitted

Part A [Memory Recall Questions]

Answer all the Questions. [Knowledge]

1. Fill in the blanks. Answer all questions [10QX1M=10M]

(a) _____is an example for reserve batteries. (C.O.No.1)

(b) A _____is a combined material formed by the assembly of two or more components, such as fillers or reinforcing agents and a compatible matrix binder. (C.O.No.2)

(c) Reactions in which chemical changes occur on the passage of an electrical current is called _____process (C.O.No.3)

(d) _____liquid crystals depend on both temperature and concentration of the solvent (C.O.No.2)

(e) The polymer which becomes soft on heating and hard on cooling is_____ (C.O.No.2)

(f) ___state of matter will have weak intermolecular forces at room temperature. (C.O.No.1)

(g) When two atoms approach each other, the electrons of one atom are attracted to the nucleus of the other according to_____ (C.O.No.1)

(h) The bond between two Nitrogen atoms is a_____ (C.O.No.1)

(i) _____enables to visualize the charge distributions of molecules and charge related properties of molecules (C.O.No.1)

(j) _____ is one of the types of reaction that takes place during catalytic reforming (C.O.No.3)

2. Answer all questions.

[10QX2M=20M]

(a) Define priming and suggest one preventive measure (C.O.No.4)

(b) Mention any two factors that affect the rate of corrosion (C.O.No.4)

(c) Define Osmosis and reverse osmosis (C.O.No.4)

(d) Give the type of hardness caused by the presence of $CaSO_4$, $CaCl_2$, $Mg(HCO_3)_2$ and NaCl in water (C.O.No.4)

(e) Define electroless plating (C.O.NO.4)

(f) Define desalination. (C.O.NO.4)

(g) Monomers A and B undergo condensation to give Nylon-6,6 Mention the names of A and B (C.O.No.2)

(h) when Zn and Cu are in contact with each other in sulphuric acid medium, which metal corrodes and why? (C.O.No.4)

(i) On what, the levels of Dissolved oxygen (DO) depend. Suggest the name of method that is commonly used to determine DO. (C.O.No.4)

(j) Give one example each for waterline and pitting corrosion (C.O.No.4)

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 8 marks. (5Qx8M=40M)

3. Identify and discuss about, the intermolecular forces present in (a) H_2 molecule (b) H_2O (c) Acetone (d) NaCl dissolved in water.

(C.O.No.1) [Comprehension]

4. Monomers A and B undergo condensation to give a linear chain polymer (C) which on heating in presence of a base D forms Bakelite. Mention the names of A, B, C, D. Write the step wise reaction involved in the formation of Bakelite.

(C.O.No.2) [Comprehension]

5. The nickel –metal hydride battery uses hydrogen, adsorbed in a metal alloy. This metal alloy is capable of undergoing a reversible hydrogen adsorbing-desorbing reaction as the battery is charged and discharged. Explain its construction and cell reactions

(C.O.No.3) [Comprehension]

6. (a) What is electroplating? (b)Mention its purpose. (c) Describe the electroplating of Chromium (C.O.No.4) [Comprehension]

7. (a) Which are the various reasons that cause boiler corrosion? (b) Explain with reactions and respective measures to avoid/prevent the boiler corrosion.

(C.O.No.4) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 10 marks. **(3Qx10M=30M)**

8. Calculate the Total hardness, Temporary Hardness and Permanent Hardness of a water sample containing: $Ca(HCO_3)_2$ = 60 ppm, $Mg(HCO_3)_2$ = 120 ppm, $CaSO_4$= 150 ppm, $MgSO_4$ = 55 ppm, $MgCl_2$ = 35 ppm. Express the hardness in degree Clarke and degree french. Atomic Weights: Ca:40, Mg: 24, H: 1, C: 12, O:16, S: 32, Cl: 35.5, N: 14)

(C.O.No.4) [Application]

9. (a) On burning 0.83 kg of a solid fuel in a bomb calorimeter, the temperature of 3500 kg of water increased from 25.5 ℃ to 29.2 ℃. Water equipment of calorimeter is 385 kg and latent heat of steam is 2457 KJ/kg. Specific heat of water is 4.187KJ/Kg/^oC. Calculate the gross and net calorific value of fuel, if % of hydrogen in fuel is 0.7%.

[8 M]

(b) Justify why Gross calorific value is greater than the Net calorific value. [2 M]

(C.O.No.3) [Application]

10. Analysis of a sample of polypropylene shows that there are five different chains of different molecular weights, calculate the Number-average molecular weight, Weight-average molecular weight, Polydispersity Index and the degree of polymerization (weight average molecular weight). The molecular weight of propylene is 42.

Molecular Weight (g/mol)	No. of Molecules
120	150
200	200
240	250
260	250
320	300

[4+4+1+1=10M]

(C.O.No.2) [Application]

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF Engineering

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	CO1-20 CO2-30 CO3-30 CO4-20	Module 1 Module 2 Module 3 Module 4	2 3 3 2			10
2	CO1-20 CO2-30 CO3-30 CO4-20	Module 1 Module 2 Module 3 Module 4	2 3 3 2			20
3	CO1	Module 1		8		8
4	CO2	Module 2		8		8
5	CO3	Module 3		8		8
6	CO4	Module 4		8		8
7	CO4	Module 4		8		8
8	CO4	Module 4			10	10
9	CO3	Module 3			10	10
10	CO2	Module 2			10	10
	Total Marks		30	40	30	100

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SOLUTION

Semester : Odd Semester: 2019 - 20
Course Code: CHE 101
Course Name: Engineering Chemistry
Program & Sem: B.Tech 1st Sem

Date: 28.12.2019
Time: 3 HRS
Max Marks: 100
Weightage: 50%

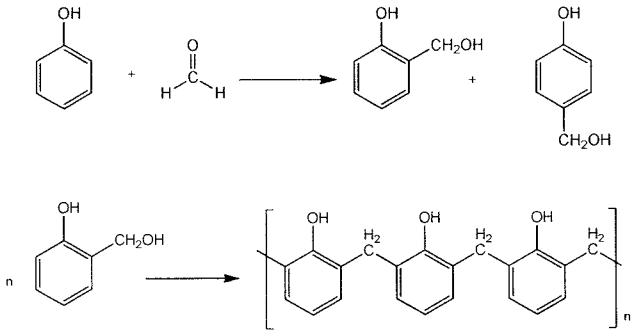
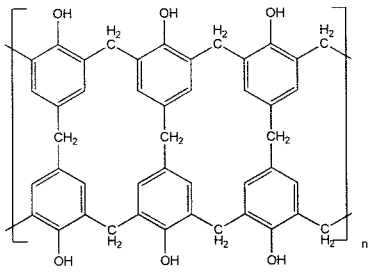
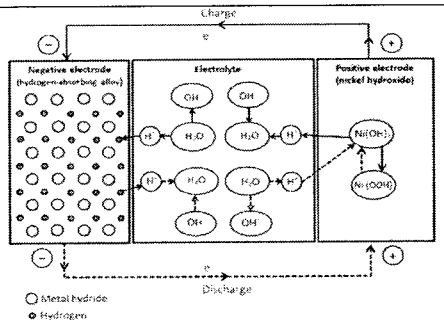
Part A

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	(a) Zn-AgO Battery (b) Composite (c) Voltaic (d) Lyotropic (e) Strength per unit weight (f) Gases (g) Coulomb's law (h) Covalent bond (i) Electrostatic Potential maps (j) Hydrogenation	1 mark each for the each right option	I min each
2	(a) The passage of water particles mixed with steam from the boiler is called PRIMING. Can be avoided by Fitting mechanical steam purifiers Avoided rapid change in steaming rate Maintaining low water levels in the boilers Use softened and filtered water in the boiler (b) Lesser the pH higher is the corrosion rate and lesser the Hydrogen over potential lesser is the corrosion rate (c) When two solutions of unequal concentrations are separated by a semi-permeable membrane, the flow of the solvent takes place from dilute to concentrated side. This is called OSMOSIS. If a hydrostatic pressure is applied on the concentrated side then the flow is reversed. This is called REVERSE OSMOSIS. (d) $CaSO_4$: Permanent $CaCl_2$: Permanent $Mg(HCO_3)_2$: temporary and NaCl: no hardness (e) Electroless plating is a method of depositing a noble metal (from its salt solution) on a catalytically active surface of a less noble metal by employing a suitable reducing agent without using electrical energy. The electroless plating takes place only on the catalytically active surface .The reducing agent brings about the reduction of the metal ions to the metal which plated over a catalytic surface. Therefore, electroless plating is also termed as **autocatalytic plating.**	2 marks each for right answer	3 min each

	(f) Sugar cannot crystallize in hard water; presence of hardwater can increase the calcium content in cement thereby reducing soundness and imparting cracks (g) A: Hexamethylene diammine B: Adipic acid (h) Zn corrodes first as Zn has low reduction potential compared to Cu (i) Dissolved oxygen (DO) levels in environmental water depend on the physiochemical and biochemical activities in water body and it is an important useful in pollution and waste treatment process control. The iodometric method which is a titration-based method and depends on oxidizing property of DO (j) Waterline Corrosion: Ocean going ship - hulls of ships which float for long periods in the sea water. Pitting Corrosion: Cracks in metals which are not well aerated.		

Part B (5Q x 8M = 40 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
3	**(a) H_2 molecule will have a Dispersion Force** The one intermolecular force **present between all molecules and atoms** is the dispersion force (also called the London force). Dispersion forces are the **result of fluctuations in the electron distribution** within molecules or atoms. Since all atoms and molecules have electrons, they all exhibit dispersion forces. **(b) H_2O will have a Hydrogen bonding** **Polar molecules containing hydrogen atoms bonded directly to small electronegative atoms** most importantly fluorine, oxygen, or nitrogen—exhibit an intermolecular force called hydrogen bonding. HF, NH_3, and H_2O, for example, all exhibit hydrogen bonding. **(c) Acetone possess a Dipole–Dipole Force** The dipole–dipole force **exists between all molecules that are polar.** **Polar molecules have electron-rich regions** (which have a partial negative charge) and **electron-deficient regions** (which have a partial positive charge). **(d) NaCl has a Ion–Dipole Force** The ion–dipole force occurs when an ionic compound is mixed with a polar compound; it is especially important in aqueous solutions of ionic compounds.	Each 2 marks	10 min

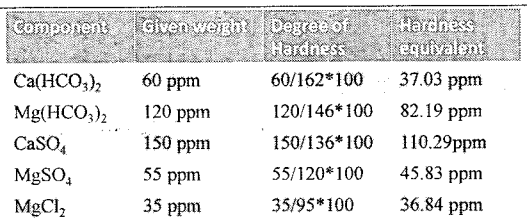
4	A: Phenol B: Formaldehyde C: Novolac D: Hexamethylene tetrammine  ▪ During moulding of NOVOLAC, Hexamethylenetetramine is added $[(CH_2)_6N_4]$. This converts the soluble and fusible Novolac to a hard infusible, insoluble, cross-linked polymer, **Bakelite**. 	1 mark each for mentioning the names 1 mark each for each step 1 and 2 of reaction 2 marks for step 3	10
5	 Electrode reactions that occurs during discharge are, At the anode: $MH_2 + 2OH^- \longrightarrow M + 2H_2O + 2e^-$ At the cathode: $2NiO(OH) + 2H_2O + 2\,e^- \longrightarrow 2Ni(OH)_2 + 2OH^-$ The overall reaction on discharge is, $MH_2 + 2NiO(OH) \longrightarrow M + 2Ni(OH)_2$ The process is reversed during charge. The open circuit potential of the cell ranges from 1.25-1.35V.	Construction: 3 marks Each reaction: 1 mark Applications 1 mark Emf 1 mark	10 min
6	• Electroplating is a process of depositing a superior metal over an inferior metal by means of electrolysis using suitable electrolyte in an aqueous solution. • **<u>Principle of Electroplating</u>:** The electroplating device essentially an electrolytic cell, in which two electrodes, anode and cathode are dipped in an electrolyte solution.	2 + 6	10 min

Components	*Hard Chromium*	*Decorative Chromium*
Anode	Lead with up to 7% Sn or Sb	Lead with up to 7% Sn or Sb
Cathode	Article to be plated	Article to be plated
Bath composition	H_2CrO_4 (250–300 g/l) and H_2SO_4 (2.5–3.0 g/l)	H_2CrO_4 (250–300 g/l) and H_2SO_4 (2.5–3.0 g/l)
Current density (mA/cm^2)	290–580	150–430
Temperature (°C)	45–60	45–60
Current efficiency (%)	17–20	10–15
Applications	Extensively used in industrial and engineering applications, such as hydraulic cylinder rods, rollers, piston rings, mold surfaces, thread guides, gun bores, etc.	Provides durable and good finish on automobiles, surgical instruments, etc.

7	➢ **Boiler Corrosion** It is the decay of boiler material by a chemical or electrochemical attack by its environment. Main reasons are ❖ Dissolved O_2 ❖ Dissolved CO_2 ❖ Acids from dissolved salts ➢ **Boiler Corrosion** ❖ Dissolved O_2 Water usually contains about 8mL of dissolved Oxygen per litre at room temperature. Dissolved Oxygen in water in presence of high temperature, attacks the boiler material. $2\,Fe + 2\,H_2O + O_2 \longrightarrow 2\,Fe(OH)_2$ $2\,Fe(OH)_2 + O_2 \longrightarrow 2\,Fe_2O_3 + 2\,H_2O$ Rust ➢ **Boiler Corrosion** ❖ Removal of dissolved O_2 By adding a calculated amount of Sodium Sulphite or hydrazine or Sodium Sulphide $2\,Na_2SO_3 + O_2 \longrightarrow 2\,Na_2SO_4$ $N_2H_4 + O_2 \longrightarrow N_2 + 2H_2O$ $Na_2S + 2O_2 \longrightarrow 2\,Na_2SO_4$	3 + 3 + 2 marks	10 min

	➢ **Boiler Corrosion** ❖ Dissolved CO_2 Water with carbon dioxide forms carbonic acid which has a slow corrosive effect on the boiler material. CO_2 is also released into the boiler if the water for steam generation contains HCO_3^- $CO_2 + H_2O \longrightarrow H_2CO_3$ $Mg(HCO_3)_2 \xrightarrow{Heat} MgCO_3 + H_2O + CO_2$ ➢ **Boiler Corrosion** ❖ Removal of dissolved CO_2 By adding a calculated amount of ammonia $2NH_4OH + CO_2 \longrightarrow (NH_4)_2CO_3 + H_2O$ ➢ **Boiler Corrosion** ❖ Acids from dissolved salts Water containing dissolved magnesium salts liberate acids on hydrolysis The liberated acid reacts with iron producing HCl again and again $Fe + 2HCl \longrightarrow FeCl_2 + H_2$ $FeCl_2 + 2H_2O \longrightarrow Fe(OH)_2 + 2HCl$		

Part C (3Q x 10M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
8	 Total Hardness = Temporary hardness+ Permanent hardness Temp. Hardness= $Ca(HCO_3)_2 + Mg(HCO_3)_2$ = 37.03 + 82.19 =119.2 ppm Perm. Hardness = $CaSO_4 + MgSO_4 + MgCl_2$ = 110.29 + 45.83 + 36.84 = 192.96 ppm Total hardness =119.2 + 192.96 =312.16 ppm In degree clarke: 312.16 * 0.07 = 21.85 °Cl	Formula: 2 marks Temp Hardness 2 mark Perm. Hardness 2mark Total hardness in ppm 2 mark and total hardness in degree Clarke 1 marks total hardness in degree French 1 marks	20
9	Rise in temperature = 29.2–25.5 °C = 3.7 °C Now, the gross calorific value can be calculated as:	1+1+2+2 + 2	20

Component	Given weight	Degree of Hardness	Hardness equivalent
$Ca(HCO_3)_2$	60 ppm	60/162*100	37.03 ppm
$Mg(HCO_3)_2$	120 ppm	120/146*100	82.19 ppm
$CaSO_4$	150 ppm	150/136*100	110.29ppm
$MgSO_4$	55 ppm	55/120*100	45.83 ppm
$MgCl_2$	35 ppm	35/95*100	36.84 ppm

	Gross calorific value = $\frac{(W+w)(T_2-T_1)}{x}.S$ Substituting the values, we get $\frac{(3500+385)3.7X1}{0.83}$ = 17318.67 cal/g NCV = GCV – 0.09H X 587 = 17318.67 – 0.09 X 0.7 X 587 =17281.68 cal/g a. Gross calorific value is greater than the Net calorific value **(i) Gross [Higher] calorific value:** It is defined as "the total amount of heat produced (liberated) when unit mass OR volume of the fuel has been completely burnt and the product of combustion have been cooled to room temperature is called Gross [Higher] calorific value." **(ii) Net [Lower] calorific value:** It is defined as "the net heat produced when unit mass OR volume of the fuel is completely burnt and the products are permitted to escape is known as net calorific value." L.C.V = H.C.V – Latent heat of water vapor formed b. A good fuel should have a moderate ignition temperature The temperature of the fuel at which ignition starts and continues to burn without further addition of heat is called ignition temperature. It should be moderate for a good fuel. Very low ignition temperature leads to fire hazard and very high ignition temperature disfavors the starting of fire.	2+2	
10	$\overline{M_n} = \frac{N1M1 + N2M2 + N3M3 \ldots\ldots NiMi}{N1 + N2 + N3 \ldots\ldots Ni}$ $\overline{Mn} = \sum NiMi / \sum Ni$ $\overline{Mn} = 24261\ g/mol$ $\overline{Mw} = 25871$ g/mol Degree of polymerization (n) = Molecular weight of the polymer (M) / Molecular weight of monomer or repeating unit (W) $PDI = \frac{\overline{Mw}}{\overline{Mn}} = 1.066$	4+4+1+1	20

	$$DP(n) = 616$$ $$\overline{Mw} = \frac{N1M1^2 + N2M2^2 + N3M3^2 + \cdots NiMi^2}{N1M1 + N2M2 + N3M3 + \cdots NiMi}$$ $\overline{Mw}=\sum NiMi^2 / \sum NiMi$		