Type: MCQ

Q1. HOOC CH_2 CH (COOH) CH_2 OH polymer can form (0.5)

1. Linear polymer
2. ** Branched polymer
3. Addition polymer
4. No Polymerization

Q2. Intrinsic viscosity of polyisobutene is 180 cm^3 /g and the Mark-Houwink constants K is 3.60 $\times 10^{-2}$, α is 0.64. The Molecular weight is (0.5)

1. 7.95 $\times 10^5$ g/mol
2. ** 5.9$\times 10^5$ g/mol
3. 6.9$\times 10^5$ g/mol
4. 4.9$\times 10^5$ g/mol

$$\eta_i = KM^a$$
$$\log \eta_i = \log K + a \log M$$
$$\log 180 = \log(3.6 + 10^{-2}) + 0.64 \log M$$
$$2.255 = -1.44 + 0.64 \log M$$
$$0.64 \log M = 3.695$$
$$\log M = \frac{3.695}{0.64} = 5.773$$
$$M = \text{antilog}(5.773)$$
$$\bar{M}_{vis} = 5.9 \times 10^5 \text{ gm/mol}$$

Q3. Which of the following best describes the glass transition temperature (Tg)?(0.5)

1. The temperature at which a crystalline polymer melts.
2. ** The temperature at which a polymer undergoes a significant change in its mechanical properties, transitioning from a glassy to a rubbery state.
3. The temperature at which a polymer completely decomposes.
4. The temperature at which a polymer becomes completely liquid.

Q4. Which of the following polymers contain only −C−C− linkages ? (0.5)

1. condensation polymers
2. copolymers
3. ** addition polymers
4. none of the mentioned

Q5. Polymer having high bonding strength to a variety of substrates including metals, ceramics, glass, and plastics. (0.5)

1. polyester

2. polyamide.
3. ** polyepoxies.
4. polyaniline.

Q6. Reaction of adipic acid and hexamethylenediamine produces (0.5)

1. Nylon 6
2. dacron
3. polycarbonate
4. ** Nylon 66

Q7. Pick out the **WRONG** statement regarding the solubility characteristics of high polymers.

1. Greater the degree of cross-linking in the polymer, lesser is its solubility
2. Polymers having more aliphatic character are more soluble in aliphatic solvents, while those polymers having more aromatic character are more soluble in aromatic solvents
3. Swelling tendency or solubility of polymers in a particular solvent decreases with increase in molecular weight of the solvent
4. ** High molecular weight polymers on dissolving gives solution of very low viscosity

Q8. Choose the INCORRECT statement regarding conducting polymers (0.5)

1. Polymers having conjugated double bonds in the backbone possess their conductivity due to π electrons.
2. They have high electron affinities
3. The electrical conductivity does not take place without thermal or photolytic activation of the electrons
4. **They have high ionization potential

Q9 Sodium naphthalide is involved in __ of conducting polymers (0.5)

1. p-doping and oxidation
2. n-doping and oxidation
3. ** n-doping and reduction
4. p-doping and reduction

Q10. During the working of Photo-responsive polymer (0.5)

1. Polymer expands and contract.
2. Polymer expands at lower temperatures and contracts at higher temperatures.
3. ** Switching between the cis and trans configuration occurs
4. Polymer swells and shrinks upon application of electrical energy

Type: DES

<table>
<tr><th>Q No</th><th>Scheme</th></tr>
<tr><td>Q11.</td><td>
a) Describe how the following properties of polymers are related to their structure

i) Elasticity (1M)
ii) Crystallinity (1M)

b) A polymer sample contains the following composition:

<table>
<tr><td>D.P.</td><td>300</td><td>500</td><td>700</td></tr>
<tr><td>Composition</td><td>0.30</td><td>0.5</td><td>0.2</td></tr>
</table>

If the number-average molecular mass (Mn) is 15,360 g/mol, calculate the weight-average molecular weight (Mw).

$Mn = \frac{0.3(x \times 300)+0.5(x \times 500) + 0.2(x \times 700)}{1}$

Mn = 90x+250x+140x

15360 = 480x

X = 15360/480 = 32 1 M

$Mw = \frac{0.3(32 \times 300)^2+0.5(32\times 500)^2 + 0.2(32 \times 700)^2}{0.3(32 \times 300)+0.5(32\times 500) + 0.2(32 \times 700)}$

$= \frac{27648000+128000000+100352000}{15360}$

Mw= 16,666.7 1 M
</td></tr>
<tr><td>Q12.</td><td>
i) Conducting membrane in Proton exchange membrane cell. - Dehydration of membrane reduces proton conductivity and excess water can lead to flooding of the electrolyte. Both the conditions leading to poor performance. ----------- (1.5 M)

ii)

- **Crucial Disposal Management**: Essential to minimize environmental harm.
  - **Recycling Infrastructure**: Development needed to prevent pollution.
  - **Material Reuse**: Advocacy for reusing battery materials to reduce impact. ---------(1.5M)
</td></tr>
<tr><td>Q13.</td><td>
Describe the construction and working of the Li-ion battery.

Construction -----------(1M)

Reaction Charging and Discharge --------(2M)

Discharging
</td></tr>
</table>

	Anode reaction: Li (C) $\longrightarrow$ Li^+ + e^- Cathode: Li^+ + e^- +CoO_2 $\longrightarrow$ $LiCoO_2$ Charging Anode: $LiCoO_2$ $\longrightarrow$ Li^+ + e^- + CoO_2 Cathode reaction: Li^+ + e^- $\longrightarrow$ Li (C)
Q14.	i) Explain any three factors from the following ----------(1.5M) • chain geometry • chain flexibility • molecular aggregates • hydrogen bond between polymer chains • presence of plasticizers and • presence of substrates in the polymer chains ii) Polythiophene as a smart polymer. (Electro-responsive polymer and working Electro-responsive or electroactive polymers (EAPs) represent a specialized category within smart polymers capable of dynamically adjusting their physicochemical characteristics upon exposure to electric signals. Polythiophene is a conducting polymer which change their electrical conductivity when subjected to an electric field. This can happen through doping (adding or removing electrons), which alters the polymer's electronic structure, making it more or less conductive ------------ (1.5M)
Q15.	With suitable examples explain doping in conducting polymers. (P-doping 1.5 M and n doping 1.5M) examples 0.5 each
Q16.	Differentiate between. (2 differences: 1M each) a) Energy density and Power density b) Lithium ion and Lithium sulfur batteries c) fuel cell and galvanic cell
Q17.	Give a reason for the following i) PLA's degradation rate depends heavily on environmental conditions. In natural environments like soil or water, degradation is slower because of lower temperatures, reduced microbial activity, and limited moisture. In industrial composting settings, which provide optimal conditions (higher temperatures, moisture, and controlled microbial activity), PLA can degrade more quickly, typically within a few months. -------- (1M) ii) Polystyrene has lesser slipping power than PVC (Benzene is a Bulky group than chlorine which hinders the movement of polymeric chains over one another) ---

	--------(1M)
Q18.	i) The cell potential of Nickel metal hydride battery is invariant whereas that of lead acid battery drops with usage. ---------1 M Reason – the concentration of electrolyte is invariant as there is production of same amount of OH- ions as it is consumed in the electrode reactions. Therefore potential is constant. In lead acid battery at both anode and cathode there is consumption of electrolyte which tend to decrease its concentration inturn decreasing the potential ii) Maintenance free lead acid batteries do not need top up ---------- 1 M Reason – In this the presence of catalyst converts the H2 and O2 produced during overcharging back into water or Replacement of Pb by Pb-Ca alloy prevents the electrolysis of water. Therefore there is no loss of water during overcharging. Therefore it doesn't need top up
Q19.	Calculate E.M.F. of the zinc – silver cell at 25 ˚C when $[Zn^{2+}]$ = 1.0 M and $[Ag^{+}]$ = 10 M Write the cell representation and cell reaction. [Given: E^0Zn^{2+}/Zn= - 0.76 V and E^0Ag^{+}/Ag is 0.80 V at 25˚C]. Cell representation Zn|Zn2+(1M)||Ag+(10M)|Ag ---------(0.5 M) Cell reaction: Zn + 2Ag+ → Zn2+ + 2Ag Eocell = Eocathode − Eo anode = 0.80 − (−0.76) = 1.56 V -------(0.5M) Ecell = E°cell − (0.0591/ 2) log [1]/[10]2 = 1.56 – (0.0591 /2) log [1] / [10]2 = 1.6191 V ------------(1M)