केन्द्रीय माध्यमिक शिक्षा बोर्ड, दिल्ली
सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा बारहवीं)
परीक्षार्थी प्रवेश-पत्र के अनुसार भरें

विषय Subject : CHEMISTRY (043)

परीक्षा का दिन एवं तिथि
Day & Date of the Examination : MONDAY, 7/3/2011

उत्तर देने का माध्यम
Medium of answering the paper : ENGLISH

Write Code No. as written on the top of the Question paper : 56/1

No. of supplementary answer-book(s) used : NIL

If physically challenged, tick the category

B D H S C

Yes / No NO

Each letter be written in one box and one box be left blank between each part of the name. In case Candidate's Name exceeds 24 letters, write first 24 letters.

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केन्द्रीय माध्यमिक शिक्षा बोर्ड, दिल्ली

Central Board of Secondary Education, Delhi

सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा बारहवी)

SENIOR SCHOOL CERTIFICATE EXAMINATION (CLASS XII)

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Ans: 1 For a chemical reaction,

$$A + B \longrightarrow C + D$$

$$Rate = K\,[A]^x[B]^y$$

where x is the order of the reaction w.r.t. A
y is the order of the reaction w.r.t. B
$x+y$ is the overall order of reaction.

Order of reaction is defined as sum of powers to which the concentrations of the reactant are raised in the rate law. It can be positive, negative or fractional

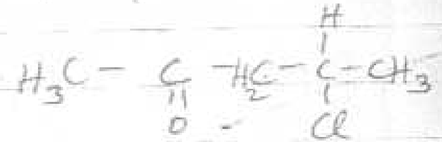
Ans: 2 The catalysis which depends on the size of the reactant, the size of the product and the pore size of the catalyst is called shape selective catalysis. Zeolites are examples of shape selective catalysts

Ans: 3 Naturally occuring chemicals in the earth's ~~cover~~ crust from which extraction of those chemicals is feasible are called minerals. The Ores are the minerals ~~from which~~ which contain considerable amount of metals such that extraction of metals from these minerals is economically viable and chemically feasiable.

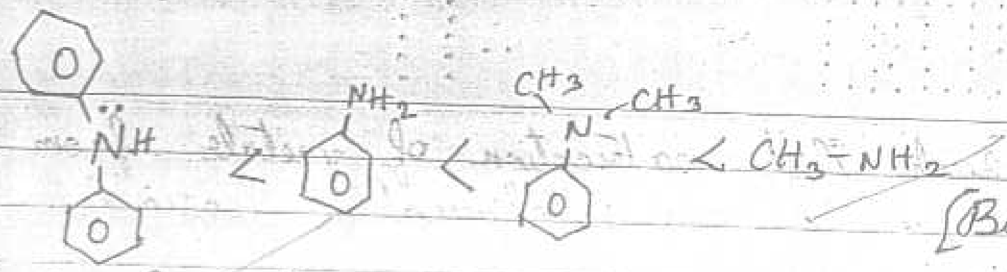
Ans: 4 In the lanthanoid series (4f series), the decrease of atomic sizes to a large extent as we move across the series is called lanthanoid contraction. It happens because of increasing nuclear charge and the filling of 4f electrons which are poor shielders of the nuclear charge causing the valence electrons to be pulled ~~into~~ closer.

Ans: 5 $CH_2 = CH - CH_2 - Br$

3-bromo-prop-1-ene.

Ans: 6 

Ans: 7 $C_2H_5OH \xrightarrow[443K,\ -H_2O]{conc.\ H_2SO_4} CH_2 = CH_2$ [Dehydration at higher Temperature]

Ans: 8 

[Basic character in vapour phase]

[$(C_6H_5)_2NH$] [$C_6H_5NH_2$] [$C_6H_5N(CH_3)_2$]

Ans: 9 Given:

Let the mass density be ρ

Let the dimensions of the unit cell be a.

We know that,

$$\rho = \frac{\text{Mass}}{\text{Volume}} \quad \text{— (1)}$$

Let the mass of one atom be m

and No. of atoms in the unit cell be Z

Total mass of unit cell = Zm

$= Z \times \frac{M}{N_a}$

where M - Molar Mass

N_A - Avagadro's constant

From ①,

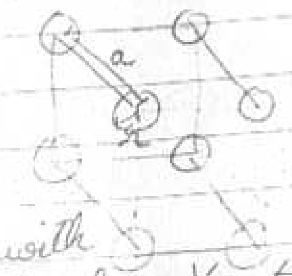
$$\rho = \frac{Z \times M}{N_a \times V}$$

$$\rho = \frac{Z \times M}{N_a \times a^3}$$

$$\Rightarrow \boxed{M = \frac{\rho a^3 N_A}{Z}}$$

This formula can be used to determine M if we know the no of metal atoms in one unit cell.

Ans: 10. Let the SCC be of edge length a,
Radius of the atom be r



Effective no. of atoms in one unit cell = 1 $[\frac{1}{8} \times 8 = 1$
There are 8 atoms with contribution of each being 1/8 to one cell$]$

Volume of all atoms = $\left(\frac{4}{3}\pi r^3\right) \times$ No. of atoms $= \frac{4}{3}\pi r^3$

Now, $a = 2r$.

Packing effeciency = $\frac{\text{Total volume occupied}}{\text{Total volume present}} \times 100$

$= \frac{4/3\ \pi r^3}{a^3} \times 100$

$= \frac{4\pi r^3}{3 \times 8 r^3} \times 100$

$= \frac{50\pi}{3}$

$= \frac{50 \times 3.14}{3}$

$= \frac{157.0}{3}$

$= 52.4\%$

Ans: 52.4% is the packing effeciency for SCC.

Ans: 11(i) The partial vapour pressure extered by a volatile component in a solution is directly propotional to the mole fraction of the component in the solution at a given temperature. Mathematically, If A, ~~B are~~ is ~~two~~ a volatile components in a solution then,

$$P_A \propto x_A$$
$$P_A = P_A^o x_A$$

where P_A - Partial pressure of A
x_A - Mole fraction of A in solution
P_A^o - Vapour pressure of pure A at that temperature

Ans: (iii) Henry's law states that the mole fraction of gas dissolved in a solvent is directly propotional to the partial pressure of the gas over the solvent. Mathematically,

$$p \propto x$$
$$p = K_H x$$

where K_H - Henry's constant (varies with gas and temperature).
p - Partial pressure of gas
x - Mole fraction of gas in solvent.

Ans. 12 Rate law of a reaction gives us the relationship for the rate of reaction and products. It states the the rate of reaction is directly proportional to concentration of reaction to the power their respective orders of reaction. The constant of proportionality (K) is the rate constant. It is the rate of reaction when ~~the~~ concentration of reactant is ~~one~~ 1M.

For a reaction,

$$A + B \longrightarrow C + D$$

$$R = \underbrace{K}_{\text{Rate constant}}[A]^x[B]^y \quad \text{— Rate law}$$

$x + y$ - Order of reaction

(i) Order of reaction = 0

(ii) Order of reaction = 2

13 Rate constant of decomposition of HCOOH = $2.4 \times 10^{-3}/s$
[First order reaction]

To find: Time taken for [HCOOH] = $\frac{1}{4}$ [HCOOH] initial
[$(3/4)^{th}$ has decomposed].

By integrated rate law,

$$Kt = \ln\left(\frac{A_0}{A}\right)$$ A_0 = Initial concentration of HCOOH

$$t = \frac{2.303 \log\left(\frac{A_0}{\frac{1}{4}A_0}\right)}{2.4 \times 10^{-3}}$$

$$t = \frac{2.303 \times 0.6021}{2.4} \times 10^{2}$$

$$\log t = 0.3623 + 0.7797 - 0.3802 + 2$$

$$\log t = 2.762$$

$$t = \text{Anti}(2.762)$$

$$t = 10^2 \times \text{Anti}(0.762)$$

$$t = 10^2 \times 5.781\ s$$

Ans: Time taken = 5.781×10^2 s

Ans: 14(i) Vapour phase refining ~~is based on~~ of Titanium is based on the fact that it reacts with I_2 on heating ~~which~~ is to form iodide which is volatile and can be collected. Then this iodide, being unstable at high temperatures, decomposes to give back pure titanium.

$$\underset{\text{(impure)}}{Ti} + 2I_2 \xrightarrow{\Delta} TiI_4$$

$$TiI_4 \xrightarrow[1800\,K]{\text{electric filament}} \underset{\text{(pure)}}{Ti} + 2I_2$$

Ans: 14(ii) Froth floatation of sulphide ores is because of their differences of wettability in water and frothing agents like pine oil, xanthates etc. They are generally more solvated in pine oil and hence rise to the froth with them, leaving water wettable impurities in the solution itself.

Ans: 15(i) Electronic configuration (Valence shell) $Cr^{2+} - 3d^4$

$Cr^{3+} - 3d^3$

Mn^{3+} - $3d^4$

Mn^{2+} - $3d^5$

Cr^{2+} is a good reducing agent as it converts to a d^3 configuration in Cr^{3+} which ~~leads~~ to half filled t_{2g} orbital. ~~in the CFT~~.

While Mn^{3+} converts to a very stable half filled d-subshell (d^5) when it gets reduced to Mn^{2+} i.e. it is an oxidising agent.

Ans: 15(ii) The metals in the early transition series have very few electrons to donate or share, hence lower no. of oxidation states or positive while elements in the latter parts of the series, even though are electron rich; do not have enough empty d-orbitals ~~empty~~ to accomodate shared electrons. Hence in the middle of the series, like Mn, there are enough no. of electrons as well as empty d-orbitals to facilitate a large no. of oxidation states as no. of electrons can be donated ~~and~~ as well as shared.

Ans: 16(i) $8MnO_{4\,(aq)}^{-} + 3S_2O_{3\,(aq)}^{2-} + H_2O_{(l)} \longrightarrow 6SO_{4\,(aq)}^{2-} + 8MnO_{2\,(s)} + 2OH^{-}_{(aq)}$

(ii) $Cr_2O_{7\,(aq)}^{2-} + 6Fe^{2+}_{(aq)} + 14H^{+}_{(aq)} \longrightarrow 2Cr^{3+}_{(aq)} + 6Fe^{3+}_{(aq)} + 7H_2O_{(l)}$

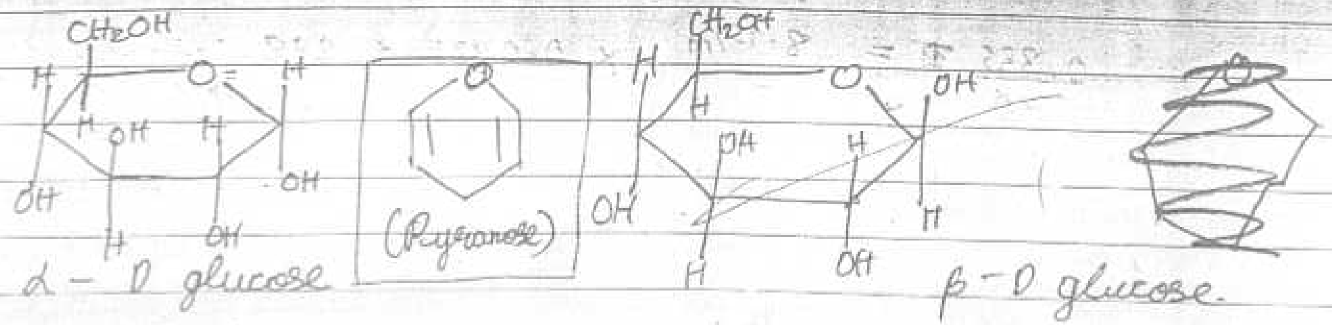
Ans: 17(i) The amidic linkage between the ~~acidic~~ carboxylic group and amino group of two amino acids is called a peptide linkage.

Eg. $CH_3-\underset{NH_2}{\underset{|}{CH}}-COOH + \underset{NH_2}{CH_2}-COOH \xrightarrow[-H_2O]{} CH_3-\underset{NH_2}{\underset{|}{CH}}-\boxed{\underset{O}{\underset{\|}{C}}-NH}-CH_2-COOH$

(Alanine) (Glycine) Peptide linkage

Ala-gly.

Ans: 17(ii) The six ring, ~~cyclic~~ heterocyclic hemiacetal cyclic structure ~~structure~~ of glucose with oxygen in the ring to explain the presence of α, β forms of glucose as well as inavailability of a -CHO group in pentacetate glucose is the pyranose structure of glucose.



Ans: 18 — DNA has a double stranded helical structure where two complementary strands are held together by hydrogen bonds.
- RNA is a single strand which is coiled over itself by folding back over half its strand.
Of the four bases, cytosine, adenine & guanine are the bases common to both RNA and DNA.

19 Mass of gene fragment dissolved $= 8.95 \times 10^{-3}$ g.
Volume of water $= 35 \times 10^{-3}$ l.
Osmotic pressure $= 0.335$ torr $= 0.335/760$ atm.
Temperature $= 298$K.
$\pi = CRT$

$$\frac{0.335}{760} = \frac{8.95/m}{35} \times 0.0821 \times 298$$

[m – Molar mass]

$$m = \frac{760 \times 8.95 \times 0.0821 \times 298}{35 \times 0.335}$$

$$m = \frac{7.6 \times 8.95 \times 8.21 \times 2.98 \times 10^2}{3.5 \times 3.35}$$

$$\log m = 0.8808 + 0.9518 + 0.9138 + 0.4742 + 2 - 0.5441 - 0.5250$$

$$\log m = 4.1515$$

$$m = 10^4 \times \text{Anti}(0.152)$$

$$m = 10^4 \times 1.416\ g$$

Ans: The molar mas of the gene is 14.16 kg.

Ans 20 Whith water as dispersion medium colloids can be classified on two basis

(a). Nature of interaction of dispersed phase and water.

(i) ~~Hydrophilic~~ Lyophillic colloids – The dispersed phase is solvated, hence the colloid is highly stable and can be prepared by mixing phase and water directly.

Eg. Starch, gum sols.

(ii) ~~Hydroph~~ Lyophobic colloids - Water and dispersed phase repel each other, hence are very unstable and coagulate easily. They are irreversible sols.

Eg. Metals and metal sulphide sols.

(b) On the basis of size of dispersed phase

(i) Multimolecular colloids - A no. of smaller non-colloidal size molecules aggregate to form a colloidal size molecules at all concentrations.

Eg. Au and sulphur sol.

(ii) Macromolecular colloids - Individual particles themselves are collodial size. These are very stable colloids almost like solutions.

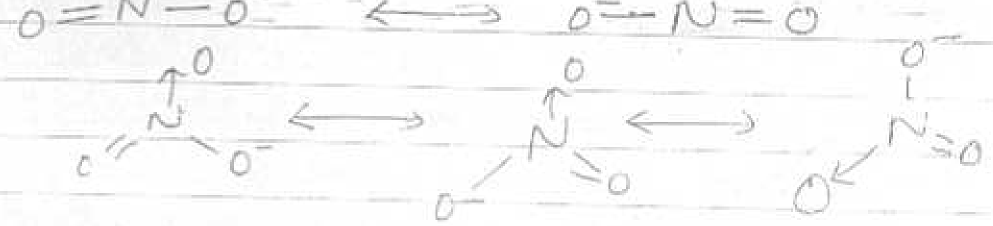
Eg. Protein sol

(iii) Associated colloids - After a particular concentration (critical micelle concentration) and temperature [Kraft temperature], small particles in solutions aggregate to form colloidal size ~~particles~~ micelles to form colloids

Eg. Soaps and detergents

Ans: 2(i) As we move down the 16 group, the M – H [M - O, S, Se, Te, P] bond dissociation energy continuously decreases, hence losing H as H^+ becomes more and more easy. So, H_2S is more acidic than H_2O.

Ans 2(ii)



NO_2^-

NO_3^-

As the resonanting structures of NO_2^- shows the N – O bond has partial double bond character because of one single bond and double bond.

While in case of NO_3^-, two singles bonds and one double bond between N – O given the double bond character which will obviously be

less than the double character in NO_2^-.
Since NO_2^- has more double bond character, ~~they~~ it has a shorter bond length than NO_3^-

2(ii) Oxygen has the capability of forming multiple bonds with other elements in higher oxidation state. The π and σ bonds between O and element stabilise the oxidation state more than the single bond energy (σ) of fluorine.

Eg. MnF_4 is the maximum O.S. of Mn in an halide while Mn_2O_7 has Mn in +7 oxidation state.

s:22(i) The ligands which can bind from two centres, but only one at a time are called amident ligands

Eg.

$-\ddot{N}=O$, $\rightarrow O$

[Nitrito − N]
Binds by N

$O=N-\ddot{O}-$

[Nitrito − O]
Binds by oxygen

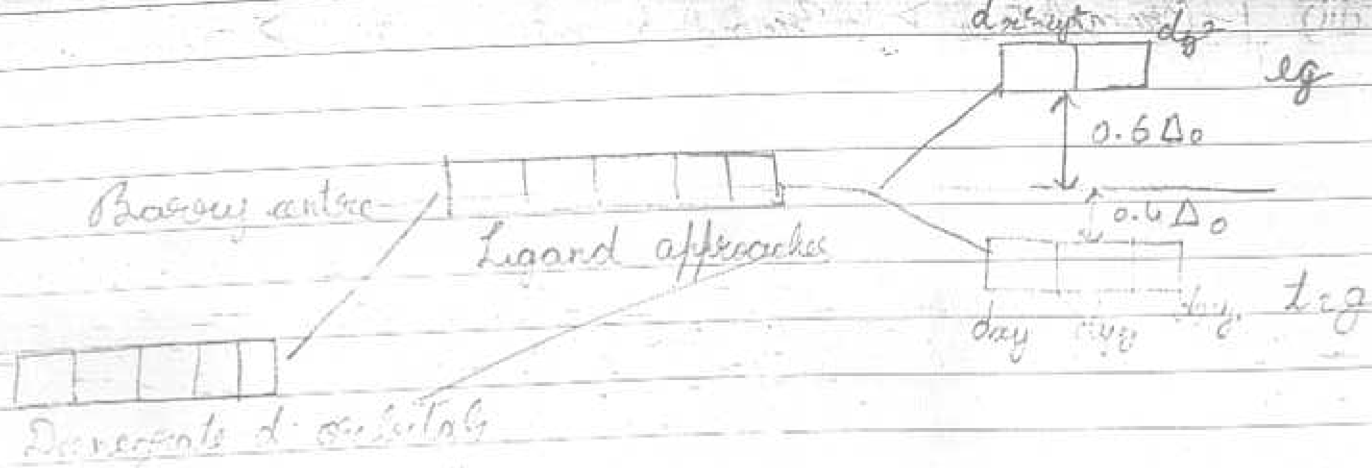
Ans: 22(ii) The no. of centres from which a ligand can bind with the central metal atom simultaneously is called the denticity of a ligand.

Denticity of $NH_2-(CH_2)_2-NH_2$ = 2
[Both N can bind together].

Denticity of $\ddot{N}H_3$ = 1

Ans: 23(iii) When a ligand approaches a metal atom along the axes, the $d_{x^2-y^2}$, d_{z^2} (eg) orbitals face severe repulsion and gain energy while the d_{xy}, d_{yz}, d_{zx} facing less repulsion lose energy. Thus the ~~d~~ orbitals of the metals split in the external octahedral field to give two sets of orbitals.

Eg. The electronic configuration (valence shell) of ~~$[Fe(CN)_6]^{3-}$~~ Fe^{3+} in $[Fe(CN)_6]^{3-}$ is
$t_{2g}^{2,2,1}\ e_g^{0,0}$



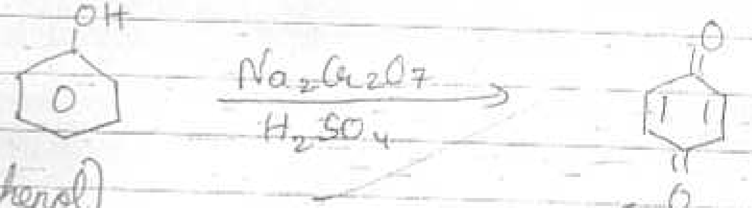
23. The reactivity towards ~~SN~~ S_N2 displacement depends on steric hindrance of the carbon on which the leaving group is present.
Generally $1^\circ > 2^\circ > 3^\circ$ [S_N2 reactivity]

(i) 1-Bromopentane > 2 Bromopentane > 2-Bromo-2methylbutane.

(ii) 1-Bromo-3methylbutane > 3-Bromo-2-methylbutane > 2-Bromo 2-methylbutane.

(iii) 1-Bromobutane > 1-Bromo-2-methylbutane > 1-bromo-2,2-dimethylpropane

24.
Ans: (i)



[Phenol] [Benzoquinone]

Ans: (ii)

$$H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$$

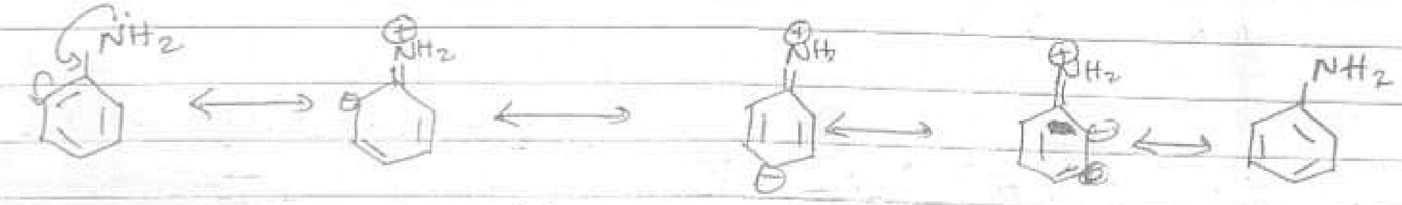
(acetone)

$$CH_3-MgBr + CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \longrightarrow CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{OMgBr}{|}}{C}}-CH_3$$

$$\xrightarrow{H_2O/H^+} CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$$

3:(iii) $H_3C-HC=CH_2 \xrightarrow[H_2O]{\text{dil } H_2SO_4} H_3C-\underset{\displaystyle OH}{\underset{|}{HC}}-CH_3$

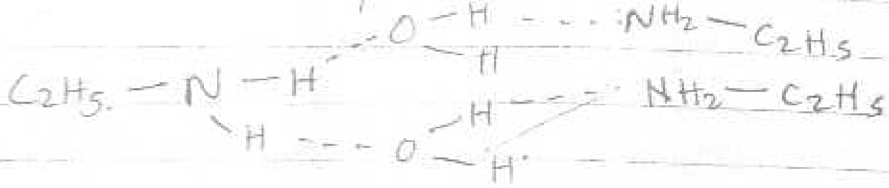
8: 25(i)



$CH_3 \gg \ddot{N}H_2$

As the resonanting structures show $-\ddot{N}H_2$ lone pairs are involved in resonance with the benzene ring, hence their availabity for donation i.e. basic character is less. While for methamine, CH_3 $+I$ effect enhances the donation of lone pair.
So CH_3-NH_2 is more basic than $Ph-NH_2$, hence has a lower p^{Kb} value as $p^{Kb} = -\log K_b$

(ii) Ethylamine can for H-bond with water molecules



Hence it is readily soluble in in water. In case of aniline, the bulkiness of the phenyl group doesn't allow appreciable H- bonding, hence it is insoluble in water.

Ans: 25 (iii) Boiling point of amine is decided by between amine molecules. In primary amines, there are two hydrogen on N, which can form H- bonds with other amine molecules. In case of 3°- amines, the nitrogen has no hydrogen. So H- bonding is no possible and they are held only by Dipole- Dipole attraction. Since H- bonds are stronger, 1° amines have greater boiling points that 3° amines.

26\. Ans: (i) Monomer - $CH_2=CH_2$ (ethene)

$$CH_2=CH_2 \xrightarrow[350-570\,K]{1000-2000\,atm} \left[CH_2-CH_2\right]_n$$

(Polyethene)

Q:(i) PVC

Monomer − $CH_2 = CH(Cl)$ (Vinyl chloride)

$$CH_2 = \overset{Cl}{\overset{|}{CH}} \xrightarrow{\text{Polymerisation}} \left[CH_2 - \overset{Cl}{\overset{|}{CH}} \right]_n$$

[Polyvinyl chloride]

Q:(ii) Teflon

Monomer − $F_2C = CF_2$ [Tetrafluoro ethene]

$$CF_2 = CF_2 \xrightarrow[\text{High pressure}]{\text{Persulphate}} \left[F_2C - CF_2 \right]_n$$

(Polytetrafluoro ethene)

Q:27 (i) Food preservatives ~~present~~ prevent the degradation of food because of microbes, ~~and~~ rendering ~~them~~ food fit for consumption for a longer time period.

Sodium benzoate

Q:27(ii) Synthetic detergents are cleasing agents composed of Sodium or potassium salts of long chain sulphonic acid (~~cationic~~ anionic detergents) or are quaternary ammonium chlorides, bromides or acetates (cationic detergents) or long chain esters (non-ionic detergents) manufactured artificially.

Eg. Sodium lauryl sulphate | Detergents are effecti in hard as well as in cold water

$CH_3-(CH_2)_{11}-SO_4^- Na^+$

Ans: 28(iii) Antacids are mild bases used to neutralise the excess acid in stomach which otherwise causes irration and pain. Antacids increase the p^H in the stomach leading to alkalyosis hence their continuous consumption is ill-advisable.

Eg. Metal ~~bas~~ hydroxides like a mixture of aluminium and magnesium hydroxides

~~Ans: 28(a) A secondar~~

Ans: 28(a) The lead storage battery is a secondary

battery which can be recharged by passing current through it in the opposite direction.
The anode is spongy lead in Pb grills while cathode is PbO_2 in lead grills and electrolyte is 38% H_2SO_4. The discharge reactions taking place are,

Anode: $Pb + SO_4^{2-} \longrightarrow PbSO_4 + 2e^-$

Cathode: $PbO_2 + SO_4^{2-} + 4H^+ + 2e^- \longrightarrow PbSO_4 + 2H_2O$

Overall reaction: $Pb + PbO_2 + 2H_2SO_4 \longrightarrow 2PbSO_4 + 2H_2O$

The $PbSO_4$ produced in both compartments stick to the lead grills. On ~~discharge~~ charging the reactions that occur,

[previously cathode] Anode: $PbSO_4 + 2H_2O \longrightarrow PbO_2 + SO_4^{2-} + 4H^+ + 2e^-$

[previously anode] Cathode: $PbSO_4 + 2e^- \longrightarrow Pb + SO_4^{2-}$

[During charging polarity is reversed, hence the reactions are as above]

Overall reaction: $2PbSO_4 + 2H_2O \longrightarrow Pb + PbO_2 + 2H_2SO_4$

(b) $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O \quad E^\circ = 1.33\,V$

Given:

$[K_2Cr_2O_7] = 0.1\,M$

$[Cr^{3+}] = 0.2\,M$

$[H^+] = 10^{-4}\,M$

By the Nernst equation,

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log Q$$

$$Q \text{ for reaction} = \frac{[Cr^{3+}]^2}{[H^+]^{14}[Cr_2O_7^{2-}]}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[Cr^{3+}]^2}{[H^+]^{14}[Cr_2O_7^{2-}]}$$

$$= 1.33 - \frac{0.0591}{6} \log \frac{4 \times 10^{-2}}{10^{-56} \times 10^{-1}}$$

$$= 1.33 - \frac{0.0591}{6} [\log (4 \times 10^{55})]$$

$$= 1.33 - \frac{0.0591}{6} [55 + 0.6021]$$

$$= 1.33 - \frac{0.0591 \times 55.6021}{6}$$

$$E_{cell} = 1.33 - \frac{0.591 \times 5.5602}{6}$$

Let $x = \frac{0.591 \times 5.5602}{6}$

$$x = \frac{5.91 \times 5.5602}{6} \times 10^{-1}$$

$$\log x = 0.7716 + 0.7451 - 1 - 0.7782$$

$$\log x = 1.5167 - 1.7782$$

$$\log x = -0.262$$

$$x = \text{Anti}(0.262) - 1$$

$$x = 1.828 - 1$$

$$x = 0.828$$

$$\log x = 0.738 - 1$$

$$x = (5.47)/10$$

$$x = 0.547.$$

$$\Rightarrow E_{cell} = 1.33 - 0.547$$

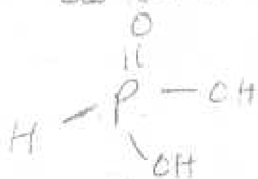
$$= 0.783\text{ V}$$

Ans: $E_{cell} = 0.783 V$

Ans: 29 (a) (i) $3Cl_2 (g) + 6NaOH_{(aq)} \longrightarrow 5NaCl_{(aq)} + NaClO_{3(aq)} + 3H_2O_{(l)}$
(hot / conc.)

(ii) $SO_{2(g)} + 2Fe^{3+}_{(aq)} + 2H_2O_{(l)} \longrightarrow SO_{4(aq)}^{2-} + 2Fe^{2+}_{(aq)} + 4H^+_{(aq)}$

Ans: 29 (b)
(i) Basicity of H_3PO_3 is 2.
Structure of H_3PO_3



As the structure depicts there are only two acidic hydrogen i.e. hydrogen attached to O. Since P is not as electronegative as O, the

H attached to it doesn't contribute to basicity of the acid as it can't be lost at H^+.

Ans. (ii) Fluorine is a second period element without any d-orbitals. ~~For~~ In an interhalogen compound, the central atom, more often that not, has an expanded octet which is possible Cl onwards as they have empty d-orbitals to accomodate the extra electrons. Fluorine lacks this ability, hence cannot be a central atom in interhalogen compounds.

Ans. (iii) Noble gases atoms are held together only by very weak vanderwaall forces which can be broken easily. Hence their boiling points very low. The reason for the weak forces can be attributed to their large size and complete octets (duets causing repulsion) which further weaken the already weak forces.

He has the lowest known boiling point at 4.2 K

Ans: 30 (a) (i) Cannizzaro's reaction is the disproportionation of aldehydes without α-hydrogen in the presence of a strong concentrated base. The products are an alcohol and a salt of a acid

$$HCHO \xrightarrow[\Delta]{conc.\ NaOH} CH_3-OH + HCOO^- Na^+$$

(ii) The reduction of aldehydes and ketones to alkanes using zinc amalgam in the presence of ~~conc HCl~~ concentrated hydrochloric acid is called Clemmensen reduction.

$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[conc.\ HCl]{Zn-Hg} CH_3-CH_2-CH_3$$

$$R-CHO \xrightarrow[conc.\ HCl]{Zn-Hg} R-CH_3$$

(i) To convert: $CH_3CHO \longrightarrow H_3C-HC=CH-CHO$

Aldol condensation

STEP I $CH_3CHO \xrightarrow{\text{dil NaOH}} H_3C-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CHO$

STEP II $H_3C-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CHO \xrightarrow[-H_2O]{\Delta} CH_3-CH=CH-CHO$

(ii) To convert: $H_3C-H_2C-H_2C-H_2C-OH \longrightarrow CH_3-CH_2-CH_2-COOH$

STEP I $CH_3-CH_2-CH_2-CH_2-OH \xrightarrow[\text{Vigourous Oxidation}]{KMnO_4/H^+} CH_3-CH_2-CH_2-COOH$

(iii) To convert:

STEP I