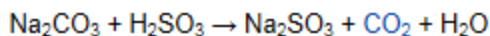


Fair Field Methodist School

Pure Chemistry Prelim Exam Paper 1-2011

Q1:

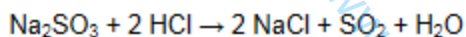
Sodium sulfite can be prepared in lab by reacting sodium carbonate with sulfurous acid:



The second way of prepare it in lab is reacting sodium hydroxide solution with sulfur dioxide gas:



By adding few drops of concentrated hydrochloric acid it can be tested that sodium sulfite is formed or not. if the solution of Na_2SO_3 gives bubbles of sulfur dioxide gas with HCl, that means the solution of sodium hydroxide is turned to sodium sulfite:



Na_2SO_3 soluble in water.

→ Option C is correct—Ans

1) Conc H_2SO_4 is a strong drying agent, $\text{Ca}(\text{OH})_2$ for removal of CO_2 , NH_3 (aq) for removal of acidic gas or vapor.

Q2: Condenser to prevent escapement of vapor

When the mixture was heated, evaporation will occur since both solution had low BP. The condenser was put in place to condense any vapor from Y & Z and return it to the flask for reaction. To minimize the problem, the flask should be heated in water bath to limit the heating temperature, to improve the mixing of solution, glass beads should be added.

→ Option D is correct--Ans

Q3: The brown powder could be a mixture of element or compounds (black residue + water soluble red crystal.) Since the separation process do not involve chemical reaction, the process was use to separate mixture of compound or element by their water solubility.

→ Option C is correct—Ans

Q4: In reducing order of MP $H_2S > C_4H_6 > C_3H_8 > CO$

-85 -135 -188 -205(Most volatile)

Solidify first

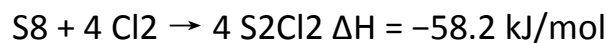
→ Option C is correct--Ans

Q5: N_2 is very stable due to its triple covalent bond, it is neutral gas, since it is in mixture of air, it can be obtained by fractional distillation, Low intermolecular bonding between N_2 molecules is a characteristics of covalent compound which cause it low BP (option C is also true but the intend of this question is comparing the BP of ionic and covalent bonded compounds)

→ Option D is correct—Ans

Q6: S belong to group 6 which started from $S=S$ similar to $O=O$, the reaction with Cl_2 to form $Cl-S-S-Cl$ (Noted S in this compound has 2 lone pairs and 2 shared of electrons) pairs

It is synthesized by partial chlorination of elemental sulfur. The reaction takes place at usable rates at room temperature. In the laboratory, chlorine gas is led into a flask containing elemental sulfur. As disulfur dichloride is formed, the contents become a golden yellow liquid:

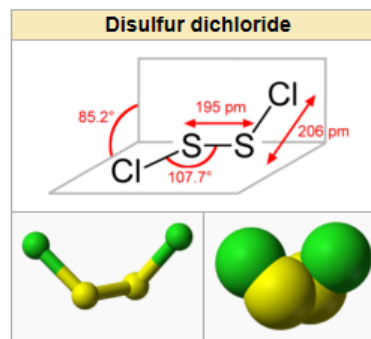
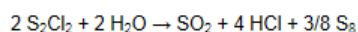


Disulfur dichloride is the **chemical compound** with the **formula** S_2Cl_2 ^{[2][3][4][5]}. Some alternative names for this compound are *sulfur monochloride* (the name implied by its **empirical formula**, SCl), *disulphur dichloride* (British English Spelling) and *sulphur monochloride* (British English Spelling). S_2Cl_2 has the structure implied by the formula $Cl-S-S-Cl$, wherein the angle between the Cl^a-S-S and $S-S-Cl^b$ planes is 90° . This structure is referred to as *gauche*, and is akin to that for H_2O_2 . A different **isomer** of S_2Cl_2 is $S=SCl_2$; this isomer forms transiently when S_2Cl_2 is exposed to UV-radiation (see **thiosulfoxides**).

Synthesis and basic properties

[edit]

Pure disulfur dichloride is a yellow liquid that smokes in air due to reaction with water:



→ Option A was correct—Ans

Q7:

- A) weak acid low conductivity
- B) I2 nonconductor
- C) Molten salt high conductivity
- D) solid salt non conductor

→ Option C is correct—Ans

Q8:

- A) Mixture, compound, compound
- B) Element, mixture, compound
- C) Compound, element, element
- D) Element, compound, compound

→ Option B is correct—Ans

Q9:

$\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$ HCO_3^- is the conjugate base

→ Option C is correct—Ans

Q10: PbSO_4 insoluble, use ppt method

A) Non-reactive, PbSO_4 will halt further reaction by coating

A) Non-reactive, PbSO_4 will halt further reaction by coating

A) 2 solutions mixed to obtain ppt

A) Non-reactive, PbSO_4 will halt further reaction by coating

→ Option C is correct—Ans

Q11: BaSO_4 insoluble will ppt out of the mixture

$\text{H}_2\text{SO}_4 (\text{aq}) + \text{Ba}(\text{OH})_2 (\text{aq}) \rightarrow \text{BaSO}_4 (\text{PPT}) + 2\text{H}_2\text{O}$ neutralization so all ions in the solution will be reduced until reaction complete.

→ Option B is correct—Ans (The min level of ions should be near zero at the neutral condition)

Q12:

J = HNO_3

$\text{ZnCO}_3 + 2\text{HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$

NO_3^- ions + NaOH + Al → NH_3 gas produced turn litmus paper red to blue

→ Option D is correct—Ans

Q13:

$\text{NH}_3 + \text{HCl (g)} \rightarrow \text{NH}_4\text{Cl}$ formation, very volatile will sublime

$\text{HCl} + \text{O}_2$ no reaction, $\text{HCl} + \text{H}_2$ no reaction, $\text{HCl} + \text{N}_2$ no reaction.

→ Option A is correct—Ans

Q14:

Only group 1 & some of group 2 metal (Calcium is marginally soluble) will form hydroxide that are soluble in water → Ionic compound → stable oxide that are solid at rtp → white color salt

→ Option C is correct—Ans

Q15: Transition element behavior-Zn with its fully filled D-10 orbital does not exhibit variable valencies behavior.

→ Option D is correct—Ans

Q16: Tl (atomic number 81) group 3 metal

Tl Cl₃

10g 5.2g

$10/\text{mr} : 5.2/35.5 \text{ mol} = 1:3 \rightarrow \text{mr} = 30/(5.2/35.5) = 204.8 \text{ g/mol}$

→ Option D is correct—Ans

Q17:



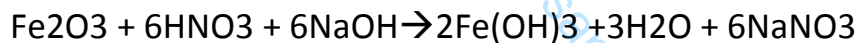
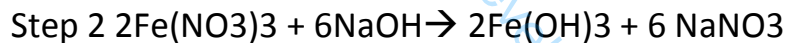
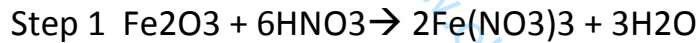
$$125 \text{ g} \quad \quad \quad x$$

$$125 / (65 + 12 + 16 \times 3) = x / (65 + 16) \rightarrow x = 81 \times 125 / 125 = 81 \text{ g}$$

$$\text{Yield} = 75 / 81 \times 100\%$$

→ Option D is correct—Ans

Q18:



1 mol

2 mol

$x/160$

$53.5/107$

$$x = (53.5/107) \times 160/2 = 40 \text{ g}$$

→ Option B is correct—Ans

Q19: 1 mol of N₂

1 mole = 6×10^{23} molecule of N₂ (Not atoms)

1 mole of NH₃ = 17 g = 24 dm³ at rtp = same volume of 1 mol N₂

1 mole of N₂ = $14 \times 2 = 28 \text{ g}$

→ Option B (Only II) is correct—Ans

Q20:

Increasing order of reactivity

R → P → (C) → Q → S

R; non-reactive with water and Acid

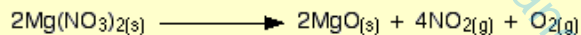
S; Most reactive metal's nitrate decompose to form O₂ and a salt only

→ Option B is correct--Ans

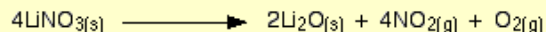
Heating the nitrates

Most nitrates tend to decompose on heating to give the metal oxide, brown fumes of nitrogen dioxide, and oxygen.

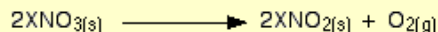
For example, a typical **Group 2 nitrate** like magnesium nitrate decomposes like this:



In **Group 1**, lithium nitrate behaves in the same way - producing lithium oxide, nitrogen dioxide and oxygen.



The rest of the Group, however, don't decompose so completely (at least not at Bunsen temperatures) - producing the metal nitrite and oxygen, but no nitrogen dioxide.



All the nitrates from sodium to caesium decomposes in this same way, the only difference being how hot they have to be to undergo the reaction. As you go down the Group, the decomposition gets more difficult, and you have to use higher temperatures.

Note: The more modern name for sodium nitrite is sodium nitrate(III). On this basis, sodium nitrate should properly be called sodium nitrate(V). Most people still call nitrates and nitrites by the older names.

The effect of heat on the Group 2 carbonates

All the carbonates in this Group undergo thermal decomposition to give the metal oxide and carbon dioxide gas. Thermal decomposition is the term given to splitting up a compound by heating it.

All of these carbonates are white solids, and the oxides that are produced are also white solids.

As you go down the Group, the carbonates have to be heated more strongly before they will decompose.

The carbonates become more stable to heat as you go down the Group.

The effect of heat on the Group 2 nitrates

All the nitrates in this Group undergo thermal decomposition to give the metal oxide, nitrogen dioxide and oxygen.

The nitrates are white solids, and the oxides produced are also white solids. Brown nitrogen dioxide gas is given off together with oxygen. Magnesium and calcium nitrates normally have water of crystallisation, and the solid may dissolve in its own water of crystallisation to make a colourless solution before it starts to decompose.

Again, if "X" represents any one of the elements:

As you go down the Group, the nitrates also have to be heated more strongly before they will decompose.

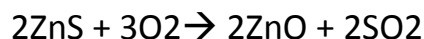
The nitrates also become more stable to heat as you go down the Group.

Q21:

Alloy physical properties change due to disruption of regular lattice structure due to different size of the atom (or +ion) of the different element.

→ Option A is the best answer (Option B density is indirect effect of the atoms size and mr)—Ans

Q22:



ZnO Yellow when hot, white when cold

SO₂ turn purple KMnO₄ to colorless

→ Option A is correct

Properties

Zinc oxide forms colorless hexagonal crystals or a white dusty powder. When heated, its color turns into lemon yellow changing into white again when cooled down. Zinc oxide has a density of 5.61 g/cm³. It evaporates at 1300°C and above and sublimates as it reaches a temperature of 1800°C. Hence, there is no (liquid) melt but a direct transition from the solid into the gaseous state of aggregation [1].

Occurrence and Production

Zinc oxide (ZnO) occurs in nature as a coarse-grained mineral (zincite). Technically, it is obtained by oxidation of zinc or zinc vapor with atmospheric oxygen (zinc white) or by calcination of different components such as zinc hydroxide, zinc carbonate or zinc nitrate. Technical zinc oxides often contain lead. Such plumbiferous compounds must be marked with the corresponding hazard symbol (X_n) [1].

┘

Q23: OS of Cu $2+ \rightarrow 1+ \rightarrow 2+$

- A) False: $2+ \rightarrow 1+$ by receiving e^-
- B) True: since Cu was reduce from $2+$ to $1+$
- C) False: reduction then Oxidation
- D) False Cu is $1+$ in Cu_2O

→ Option B is correct—Ans

Q24: Reversible reaction, yield in % is determined by the equilibrium point, rate of reaction is increase by pressure or concentration or temperature of reactants.

Le Chatelier principle on pressure effect and heat

3 mol total → 2 mol total (exothermic)

- A) True: increase pressure shift reaction to the right
- B) True: High pressure high SOR
- C) False: Low temp low SOR
- D) True : Low temp for exothermic reaction shift reaction to the right increasing the yield

→ Option C is incorrect--Ans

Q25:

- A) True as net reaction is transfer of nickel from anode to cathode
- B) True as there is no replenishment of Ni ion
- C) True assume true nickel is used in anode
- D) False : No change in inert electrode

→ Option D is incorrect—Ans

Q26:

$\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ at Anode

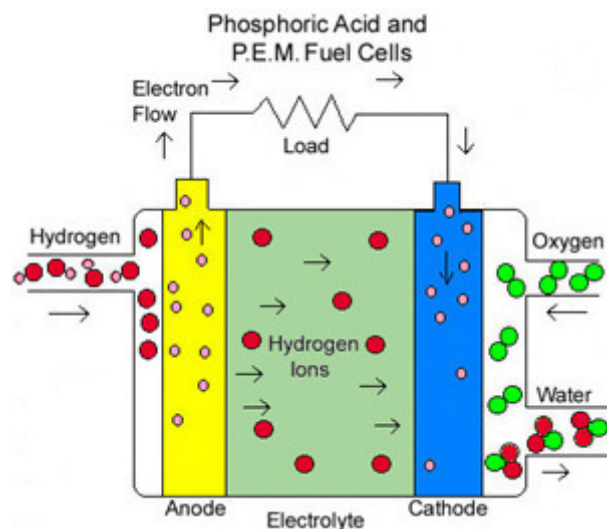
$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2 (\text{g})$ at Cathode

- A) False, Cu unchanged
- B) False, reverse
- C) False: H₂ gas at Cu electrode
- D) True

→ Option D is correct—Ans

Q27:

$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ redox in fuel cell



A) True, electrons transfer was controlled to generate electricity

B) False, H₂O is waste product

C) False, no burning thus minimum heat was generated

D) False, no hydrocarbon was involved.

→ Option A is correct—Ans

Q28:

$\text{Mg} + \text{Pb}^{2+} \rightarrow \text{Mg}^{2+} + \text{Pb}$ exothermic redox

→ Option D is correct—Ans Lower overall energy level

Q29:

I) Liquid to gas=evaporation endothermic

II) Combustion=exothermic

III) gas to liquid water=condensation exothermic

→ Option C is correct –Ans

Q30:

Zn is limiting thus overall H₂ should be the same

A) False, reduce conc of HCl reduce rate but should not change the final level of H₂

B) True

C) False, the SOR would increase by reducing size of Zn particles

D) False, lower temp will reduce SOR but not final level of H₂ gas

→ Option B is correct--Ans

Q31: 5g in 10 min with excess acid

A) True, add water reduce conc of acid

B) False, SOR unchanged

C) False, SOR not affected by pressure for solid/liquid reactant

D) False, SOR will be faster instead of longer time

→ Option A is correct—Ans

Q32:

Higher bond energy=Higher thermal/chemical stability

A) False, the most stable

B) False H₂ more stable

C) False, F₂ bond was weakest

D) $\text{H}_2 + \text{F}_2 \rightarrow 2\text{HF}$ for 2 mole of HF energy = $2 \times -556 + 158 + 436 = -518$ kJ

For each mole of HF, energy changed = -259 kJ exothermic

→ Option D is correct--Ans

Q33:

Catalytic converter $2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2$

→ Option A is correct—Ans

Q34:

$\text{C}_4\text{H}_6 + 2\text{H}_2 \rightarrow \text{C}_4\text{H}_{10}$ full saturated hydrocarbon

Butane

→ Option C is correct—Ans

Q35:

Converting heavy Alkane to Alkene by catalytic cracking

→ Option B is correct--Ans

Q36:

Carboxylic acid (COOH) vs Ester (COO) different in chemical reaction but same in { C₄H₈O₂ } same empirical formula C₂H₄O

→ Option C is correct—Ans

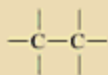
Q37 Structural Isomer should have same molecular formula but different structure (Geometrical Isomer not covered in O level)

→ Option C is correct

Note A is completely different compound, B is the same compound same structure, D is also the same compound same structure (Cis-Trans isomerism is not covered in O Level).

Solution

Carbon atoms form four bonds, but H and Cl can form only one each. Thus H and Cl can never connect two other atoms; they can only stick to the "backbone." Therefore, first draw the two-carbon backbone using a single bond, and then add enough bonds so that each carbon has four.

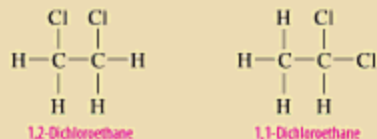


Count the open bonds. They total six—just right for the attachment of four H atoms and two Cl atoms. (If there were too many open bonds, an alkene, alkyne, or ring structure would be tried.)

Ignore the H atoms for the time being and see how many different ways you can put on the two Cl atoms. You will find two different ways. (Note: You must remember the tetrahedral geometry of the four bonds to C. There is no difference in the bonds you are drawing "out," "up," or "down." Each bond is really at 109.5° from another, not 90° or 180° .)



Add the four hydrogens to each structural formula, and the question is answered (● Fig. 14.11). Note how the names of the two isomers denote their structures.



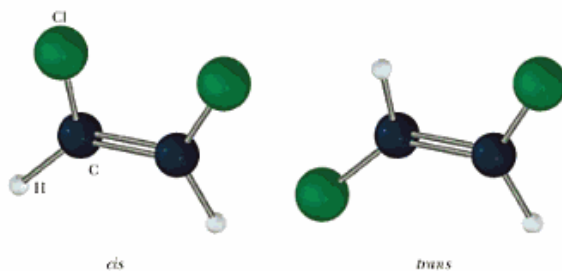


Figure 10.27 *Cis* and *trans* isomers of $\text{HC1C}=\text{CHCl}$.

Isomers

Chemists have a lot of additional experimental evidence to show that the π bond must be broken to allow rotation about a double bond. If two of the hydrogen atoms in ethylene are replaced with chlorine atoms, three new compounds with the formula $\text{C}_2\text{H}_2\text{Cl}_2$ can form. Two of these compounds have $\text{HC1C}=\text{CHCl}$ structures (1,2-dichloroethene). Each compound has different physical and chemical properties. For example, one compound boils at 47.5°C , whereas the other boils at 60.3°C . Structurally, the two forms differ in the orientation of the chlorine and hydrogen atoms in these planar molecules (Figure 10.27).

The two forms, called **isomers**, are compounds with the same molecular formula but different structures. In the form labeled *cis*, the chlorine atoms are both on the same side of the planar molecule; in the *trans* form, they are on opposite sides. The *cis* and *trans* isomers of the molecules shown in Figure 10.27 do not easily interconvert. The interconversion of the isomers requires the rotation of one $\text{H}-\text{C}-\text{Cl}$ group about the $\text{C}-\text{C}$ bond. Such a rotation must pass through 90° degrees where the overlap of the two p orbitals that

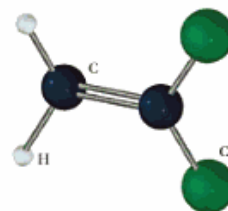


Figure 10.28 Third isomer of $\text{C}_2\text{H}_2\text{Cl}_2$. The third isomer of $\text{C}_2\text{H}_2\text{Cl}_2$, $\text{H}_1\text{C}=\text{CCl}_2$, has two hydrogen atoms bonded to one carbon atom and two chlorine atoms bonded to the other.

Q38:

Polyunsaturates bond is $\text{C}=\text{C}$ which are reactive to react with Br_2 to discolorise

→ Option D is correct --Ans

Q39: Hydrocarbon with $\text{C}=\text{C}$ bonds → Unsaturated hydrocarbon

→ Option D is correct—Ans

Note: Ester has COO functional group, polymer had many molecule joined together.

Q40: Special kind of stepwise polymerization (HCl) eliminated

HCl was eliminated from the joined monomers

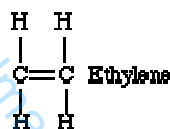
→ Option B is correct—Ans

Types of Polymerization Reactions

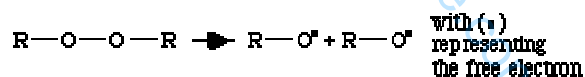
The chemical reaction in which high molecular mass molecules are formed from monomers is known as polymerization. There are two basic types of polymerization, chain-reaction (or addition) and step-reaction (or condensation) **polymerization**.

(1) Chain-Reaction Polymerization

One of the most common types of polymer reactions is chain-reaction (addition) polymerization. This type of polymerization is a three step process involving two chemical entities. The first, known simply as a monomer, can be regarded as one link in a polymer chain. It initially exists as simple units. In nearly all cases, the monomers have at least one carbon-carbon double bond. Ethylene is one example of a monomer used to make a common polymer.



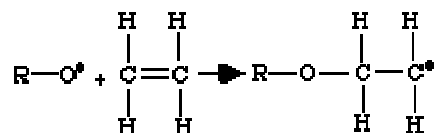
The other chemical reactant is a catalyst. In chain-reaction polymerization, the catalyst can be a free-radical peroxide added in relatively low concentrations. A free-radical is a chemical component that contains a free electron that forms a covalent bond with an electron on another molecule. The formation of a free radical from an organic peroxide is shown below:



In this chemical reaction, two free radicals have been formed from the one molecule of R_2O_2 . Now that all the chemical components have been identified, we can begin to look at the polymerization process.

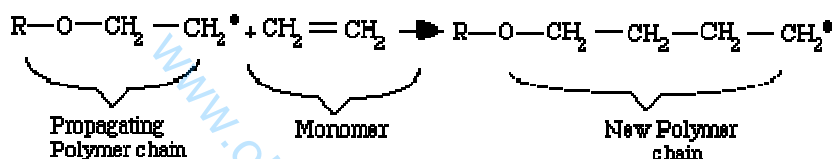
Step 1: Initiation

The first step in the chain-reaction polymerization process, initiation, occurs when the free-radical catalyst reacts with a double bonded carbon monomer, beginning the polymer chain. The double carbon bond breaks apart, the monomer bonds to the free radical, and the free electron is transferred to the outside carbon atom in this reaction.



Step 2: Propagation

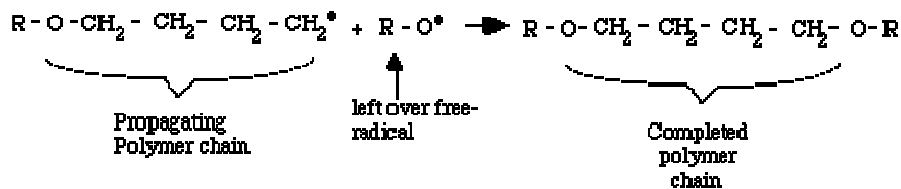
The next step in the process, propagation, is a repetitive operation in which the physical chain of the polymer is formed. The double bond of successive monomers is opened up when the monomer is reacted to the reactive polymer chain. The free electron is successively passed down the line of the chain to the outside carbon atom.

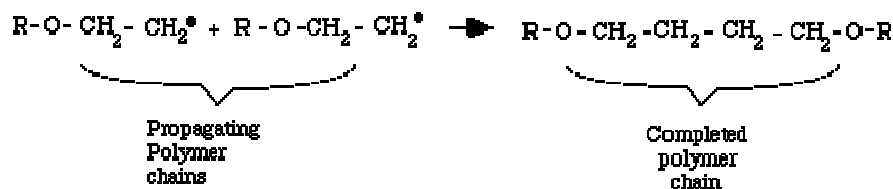


This reaction is able to occur continuously because the energy in the chemical system is lowered as the chain grows. Thermodynamically speaking, the sum of the energies of the polymer is less than the sum of the energies of the individual monomers. Simply put, the single bonds in the polymeric chain are more stable than the double bonds of the monomer.

Step 3: Termination

Termination occurs when another free radical (R-O[•]), left over from the original splitting of the organic peroxide, meets the end of the growing chain. This free-radical terminates the chain by linking with the last CH₂[•] component of the polymer chain. This reaction produces a complete polymer chain. Termination can also occur when two unfinished chains bond together. Both termination types are diagrammed below. Other types of termination are also possible.

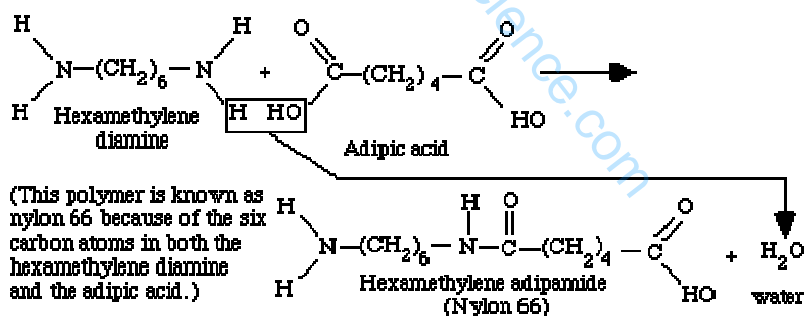




This exothermic reaction occurs extremely fast, forming individual chains of polyethylene often in less than 0.1 second. The polymers created have relatively high molecular weights. It is not unusual for branches or cross-links with other chains to occur along the main chain.

(2) Step-Reaction Polymerization

Step-reaction (condensation) polymerization is another common type of polymerization. This polymerization method typically produces polymers of lower molecular weight than chain reactions and requires higher temperatures to occur. Unlike addition polymerization, step-wise reactions involve two different types of di-functional monomers or end groups that react with one another, forming a chain. Condensation polymerization also produces a small molecular by-product (water, HCl, etc.). Below is an example of the formation of Nylon 66, a common polymeric clothing material, involving one each of two monomers, hexamethylene diamine and adipic acid, reacting to form a dimer of Nylon 66.



At this point, the polymer could grow in either direction by bonding to another molecule of hexamethylene diamine or adipic acid, or to another dimer. As the chain grows, the short chain molecules are called oligomers. This reaction process can, theoretically, continue until no further monomers and reactive end groups are available. The process, however, is relatively slow and can take up to several hours or days. Typically this process breeds linear chains that are strung out without any cross-linking or branching, unless a tri-functional monomer is added.

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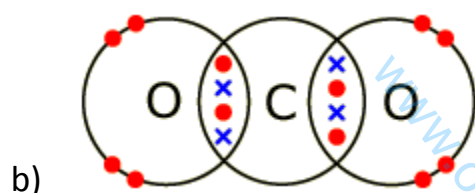
Pure Chemistry Prelim Exam Paper 3-2011

A1:

a)

Nitrogen had highest 79% by volume in clean air

Helium with lowest BP of -269 will distill over first.



c) **Uses:** Argon is used in electric lights and in fluorescent tubes, photo tubes, glow tubes, and in lasers. Argon is used as an inert gas for welding and cutting, blanketing reactive elements, and as a protective (nonreactive) atmosphere for growing crystals of silicon and germanium.

Sources: Argon gas is prepared by fractionating liquid air. The Earth's atmosphere contains 0.94% argon. Mars' atmosphere contains 1.6% Argon-40 and 5 ppm Argon-36.

More usage as follows:

Uses of Argon

- Argon gas is used in graphite electric burners to prevent the graphite from burning. The graphite would burn in normal air with oxygen present.
- Crystals of silicon and germanium are grown in the presence of argon.
- Argon is used to kill pigs humanely if there is an outbreak of some disease on the farm.
- Occasionally, argon is used to put out fires when it is vital that equipment is not damaged.
- Argon, in liquid form, is used by scientists to look for dark matter.
- Argon can be used to preserve paint, varnish and similar things for storage after opening.
- The American National Archives use argon to store important national documents (like the Declaration of Independence). This prevents the documents being destroyed by the air.
- In the science laboratory, argon is often used as a carrier gas in gas chromatography.

- While there are some risks, liquefied argon can be used to kill cancer cells in a procedure called 'argon enhanced coagulation'.
- Blue argon lasers are used in surgery to weld arteries and correct eye problems.
- Speaking of blue, blue laser lights are made with argon.
- Lights are filled with argon to prevent the filament from reacting with air.
- Scuba divers use argon to inflate a dry suit.

A2:

a) Ionic compound $Pb(II)Br_2$ dissociate into ions which are conductive whereas HBr remains as molecule thus are non-conductor.

b) In aqueous, HBr dissociate into H^+ & Br^- ions similar to HCl thus become conductive.

A3:

a) Sulfur is present in the ore.

b) $2ZnO (s) + 2CO (g) \rightarrow 2Zn (s) + CO_2 (g)$ reduction by Carbon

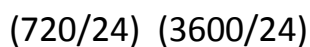
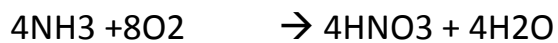
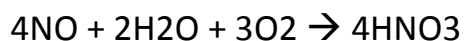
c) Zn block more reactive than Fe thus serves as anode sacrificial metal to protect corrosion of Fe.

A4: Haber process

a) $N_2 + 3H_2 \rightarrow 2NH_3$ all gaseous reactants exothermic reaction

Le Chatelier's Principle, Low temperature and high pressure will help shift reaction to the right maximizing the yield % of NH_3 .

Ideal condition is 99.9% yield at 1000 atm 100 degree C.



limiting Excess $(720/24) \times (1 + 14 + 3 \times 16) = 1890$ g of HNO_3

A5:

F = BaSO_4 ppt

C = NaOH

A = Fe(II)SO_4

E = Fe(II)(OH)_2

B = $\text{Zn(NO}_3)_2$

D = Zn(OH)_2

G = ZnCO_3

H = ZnO

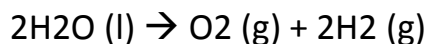
A6:

a) Anode: $4\text{OH}^- (\text{aq}) \rightarrow 2\text{H}_2\text{O} (\text{l}) + \text{O}_2 (\text{g}) + 4\text{e}^-$

Cathode: $4\text{H}^+ (\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2 (\text{g})$

b) dilute NaCl or Na₂SO₄ solution.

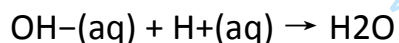
c) overall reaction eqn:



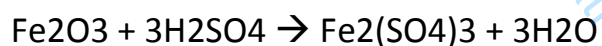
d) **Acid/base reaction** : Neutralization reaction

An acid–alkali reaction is a special case of an acid–base reaction, where the base used is also an alkali. When an acid reacts with an alkali it forms a metal salt and water. Acid–alkali reactions are also a type of neutralization reaction.

In general, acid–alkali reactions can be simplified to



by omitting spectator ions.



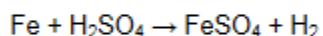
Mol of H₂SO₄ = 49 / (2 + 4 * 16 + 32) mol

Mol of Fe₂O₃ = 3 * 49 / 98 = 1.5 mol = 1.5 * (2 * 56 + 16 * 3) = 240 g of rust can be removed.

Production and reactions

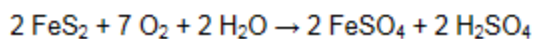
[\[edit\]](#)

In the finishing of [steel](#) prior to plating or coating, the steel sheet or rod is passed through [pickling baths](#) of sulfuric acid. This treatment produces large quantities of iron(II) sulfate as a by-product.^[2]



Another source of large amounts results from the production of [titanium dioxide](#) from [ilmenite](#) via the sulfate process.

Ferrous sulfate is also prepared commercially by oxidation of pyrite:



Rust is a general term for describing **iron oxides**. In colloquial usage, the term is applied to red oxides, formed by the reaction of **iron** and **oxygen** in the presence of water or air moisture. There are also other forms of rust, such as the result of the reaction of iron and **chloride** in an environment deprived of oxygen, such as **rebar** used in underwater **concrete pillars**, which generates **green rust**. Several forms of rust are distinguishable visually and by **spectroscopy**, and form under different circumstances.^[1] Rust consists of hydrated **iron(III) oxides** $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$ and **iron(III) oxide-hydroxide** ($\text{FeO}(\text{OH})$, $\text{Fe}(\text{OH})_3$). Given sufficient time, oxygen, and water, any iron mass will eventually convert entirely to rust and disintegrate. Surface rust provides no protection to the underlying iron, unlike the formation of **patina** on copper surfaces.

Rusting is the common term for **corrosion** of iron and its alloys, such as **steel**. Many other metals undergo equivalent corrosion, but the resulting oxides are not commonly called rust.

Note rust also contain $\text{Fe}(\text{OH})_3$ but for this question assume rust= Fe_2O_3 ONLY.

A7: Be careful about the kJ/mol definition

From the information given the reaction is exothermic thus the solution which act as the surrounding of the closed system will gain heat thus temperature will rise.

$2 \times (463 \times 2 + x) - 496 - 2 \times 463 \times 2 = -206$ **Note: assume the delta-H refer to -206 kJ/mol of O₂ release.**

X=145 kJ/mol of O-O bond energy.

Single Bonds					
Bond	Bond Energy (kJ/mole)	Bond	Bond Energy (kJ/mole)	Bond	Bond Energy (kJ/mole)
H-H	436.4	C-H	414	O-O	142
H-N	393	C-C	347	O-P	502
H-O	460	C-N	276	P-P	197
H-S	368	C-O	351	S-S	268
H-P	326	C-P	263	F-F	156.9
H-F	568.2	C-S	255	Cl-Cl	242.7
H-Cl	431.9	N-N	193	Br-Br	192.5
H-Br	366.1	N-O	176	I-I	151
H-I	298.3	N-P	209	O-O	142

A8:

a)

i) C₄H₆O₂- carboxylic acid/Alkene

ii) CH₂CHCOOCH₃ – ester/Alkene

b)

i) Bromination occur turn reddish brown Br₂ solution to colorless due to reactive C=C bonds in compound X.

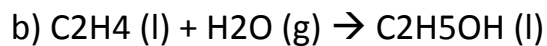
ii) CH₂BrCCH₃BrCOOH

iii) CH₂CCH₃COOH (aq)+ Mg (s) → {CH₂CCH₃COO}₂-Mg (aq)+ H₂(g)

iv) Carboxylic acid react with Alcohol with H₂SO₄ as catalyst form ester which is sweet smelling.

A9:

a) Cold air in and warm air out → carry the energy released from the bacteria reaction → exothermic reaction



mol of ethane = $1.920/24 \text{ mol} = \text{mol of ethanol}$

mass of theory ethanol = $1.92/24 * (12*2 + 16+6) = 3.68 \text{ g}$

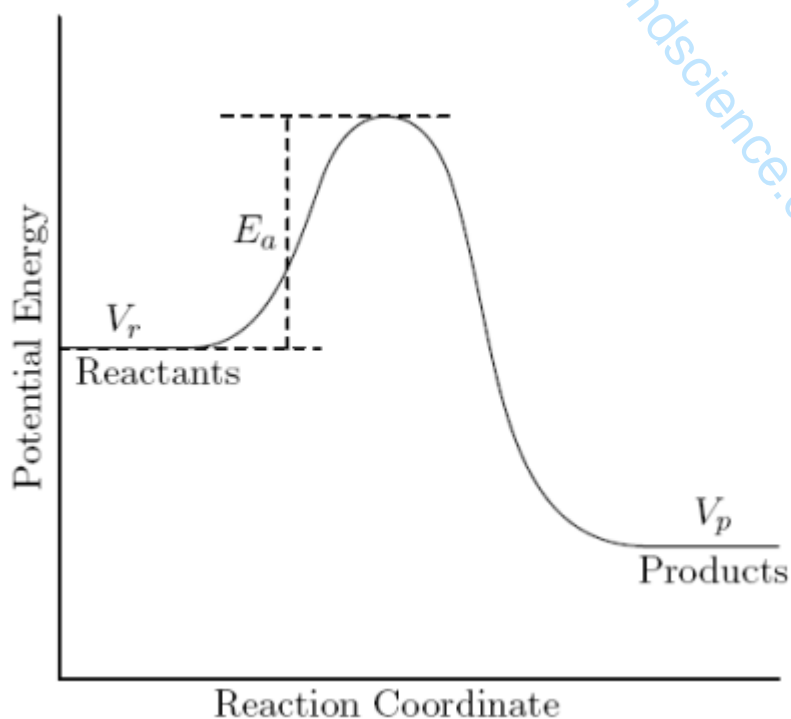
Yield = $\text{actual/theory} = 3.496/3.68 * 100\% = 95\%$

B10:



OS of Cr from 6+ to 3+ reduction occur.

The reaction is exothermic as its continue after the initial activation (there is activation energy needed) by heat.



b)

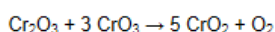
i) Cr₂O₃ reacts with Alkali and Acid to form salt and water.

ii) Cr₂O₃ is Hard solid at rtp insoluble in water. It is ionic compound with strong crystal lattice bonding structure.

Applications

[edit]

Because of its considerable stability, chromia is a commonly used pigment and was originally called *viridian*. It is used in paints, inks, and glasses. It is the colourant in "chrome green" and "institutional green." Chromium(III) oxide is the precursor to the magnetic pigment **chromium dioxide**, according to the following reaction:^[5]



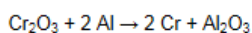
It is one of the materials that are used when polishing the edges of knives on a piece of leather (also called **stropping**). In this context it is often known as green compound.

Thermochemistry	
Std enthalpy of formation $\Delta_f H^\ominus_{298}$	-1128 kJ·mol ⁻¹
Standard molar entropy S^\ominus_{298}	81 J·mol ⁻¹ ·K ⁻¹
✓ (verify) (what is: ✓/X?)	
Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa)	
Infobox references	

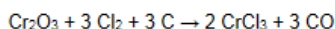
Reactions

[edit]

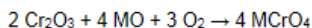
Chromium(III) oxide is **amphoteric**. Although insoluble in water, it dissolves in acid to produce hydrated chromium ions, [Cr(H₂O)₆]³⁺. It dissolves in concentrated alkali to yield chromite ions. When heated with finely divided aluminium or carbon, it is reduced to chromium metal and **aluminum oxide**:



Heating with chlorine and carbon yields **chromium(III) chloride**:



Chromates can be formed by the oxidation of chromium(III) oxide and another oxide in a basic environment:

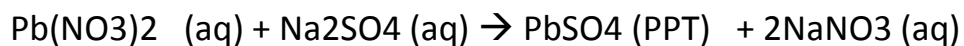


See also

[edit]

B11:

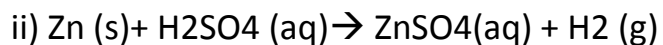
a) Pb(II)O (s) + HNO₃ (aq) → Pb(NO₃)₂ (aq) + H₂O (l) use excess PbO, filter out excess PbO.



Filter residue → rinse in distill water → drying

b)

i) CuSO₄ act as catalyst to speed up the redox in experiment Y.



Mol zn = $100/65 = 1.54$ excess Zn

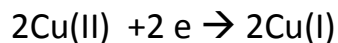
Mol H₂SO₄ = 0.1 mol

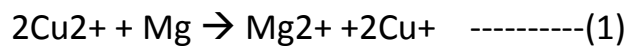
Mol of H₂ = mol of H₂SO₄ = 0.1 mol

Volume H₂ = $0.1 * 24 = 2.4$ dm³ of gas produced.

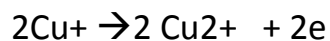
iii) Cu is less reactive than Zn, excessive Cu²⁺ ions in the solution will result in metal displacement reaction with Cu(s) deposited out of the solution affecting the reaction between Zn & acid.

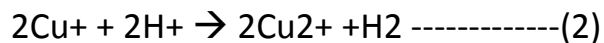
Reaction-1



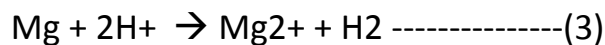


Reaction-2

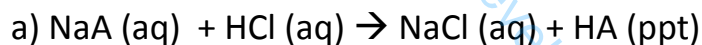




Overall reaction



B12:



The covalent bond strength between HA is strong thus the polarity of water cannot cause high % of dissociation thus it is a very weak acid.

Human stomach produces HCl equivalent acid and thus ppt will occur in the stomach.

b)

i) $\text{C}_6\text{H}_8\text{O}_6$ oxidized to $\text{C}_6\text{H}_6\text{O}_6$ by losing Hydrogen atom (Noted that losing hydrogen is oxidation, thus it is a weak reducing Agent) by interacting with free radical in foods element.

ii) $\text{C}_6\text{H}_8\text{O}_6$ act as reducing agent which prevent food from oxidizing.

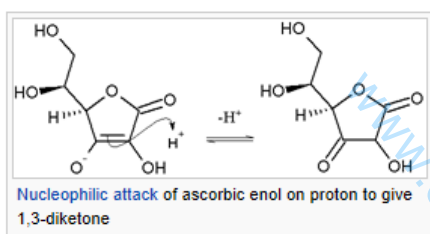
iii) $\text{C}_6\text{H}_8\text{O}_6 + \text{I}_2 + \dots \rightarrow \text{C}_6\text{H}_6\text{O}_6 + 2\text{I}^- + \dots$ do not ry balance the complete equation

Mol of I2 = $0.005 \times 28 \times 0.001 = 1.4 \times 10^{-4}$ mol

Mol of Ascorbic acid = 1.4×10^{-4} mol

Mass of ascorbic acid = $1.4 \times 10^{-4} \times (12 \times 6 + 8 + 6 \times 16) = 24.64$ mg

$24.64/50 \times 100\% = 49.28\%$ not enough for the recommended daily intake.



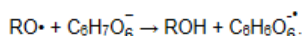
Antioxidant mechanism

[edit]

As a mild **reducing agent**, ascorbic acid degrades upon exposure to air, converting the oxygen to water. The redox reaction is accelerated by the presence of metal ions and light. It can be oxidized by one electron to a radical state or doubly oxidized to the stable form called dehydroascorbic acid.

Ascorbate usually acts as an antioxidant. It typically reacts with oxidants of the **reactive oxygen species**, such as the **hydroxyl radical** formed from **hydrogen peroxide**. Such

radicals are damaging to animals and plants at the molecular level due to their possible interaction with **nucleic acids**, proteins, and lipids. Sometimes these radicals initiate chain reactions. Ascorbate can terminate these chain radical reactions by **electron transfer**. Ascorbic acid is special because it can transfer a single electron, owing to the stability of its own **radical ion** called "semidehydroascorbate", **dehydroascorbate**. The net reaction is:

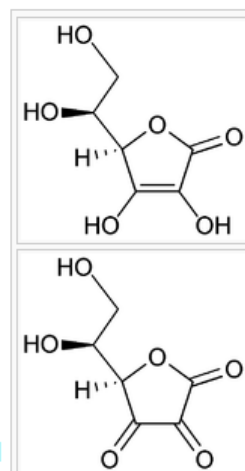


The oxidized forms of ascorbate are relatively unreactive, and do not cause cellular damage.

However, being a good electron donor, excess ascorbate in the presence of free metal ions can not only promote but also initiate free radical reactions, thus making it a potentially dangerous pro-oxidative compound in certain metabolic contexts.

Acidity

Ascorbic acid, a **reductone**, behaves as a **vinyllogous carboxylic acid** wherein the electrons in the double bond, hydroxyl group lone pair, and the carbonyl double bond form a **conjugated system**. Because the two major **resonance structures** stabilize the deprotonated **conjugate base** of ascorbic acid, the hydroxyl group in ascorbic acid is much more acidic than typical hydroxyl groups. In other words, ascorbic acid can be considered an **enol** in which the deprotonated form is a stabilized **enolate**.



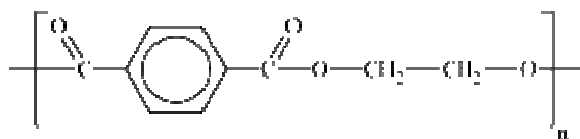
[edit]

OR

B12

a) The function group $-\text{COCl}$ and $-\text{OH}$ the likely polymerization process is elimination of H & Cl to form HCl fume by condensation polymerization (a kind of stepwise polymerization)

PET → - [CO- ||||| -COO-CH₂-CH₂-O]- a form of polyester.



PET is resistant to acid thus suitable to contain H₂CO₃ a form of weak acid. It is light and impact resistant.

b)

i) Conversion of alcohol to carboxylic acid → Oxidation reaction with formation of water.

ii)



iii)

-COO- Ester functional group

From the chemical name poly(methyl 2-methyl propenoate)

⇒ Methyl group form from (Methanol with -OH removed)

⇒ 2-methyl there is another CH₃ attached to C atom in the COO functional group

⇒ The Carboxylic acid is Propenoic with 1 double bond in the 3C atom, -H was removed when reacted with -OH to form H₂O

So the monomer structure should be :

CH₂=CCH₃COOCH₃ the polymer is formed by addition polymerization with opening of the C=C double bond.

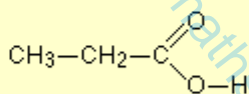
Esters

Esters are one of a number of compounds known collectively as **acid derivatives**. In these the acid group is modified in some way. In an ester, the hydrogen in the -COOH group is replaced by an alkyl group (or possibly some more complex hydrocarbon group).

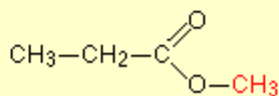
Example 1: Write the structural formula for **methyl propanoate**.

An ester name has two parts - the part that comes from the acid (propanoate) and the part that shows the alkyl group (methyl).

Start by thinking about propanoic acid - a 3 carbon acid with no carbon-carbon double bonds.



The hydrogen in the -COOH group is replaced by an alkyl group - in this case, a methyl group.



methyl propanoate

For addition polymerization, no elimination or addition of other elements thus total mass remains unchanged=500 g

End of paper