NgeeAnn Secondary School

Pure Chemistry Prelim Exam Paper 1-2011

Q1: Diffusion rate inversely proportional to square of mr

KE=1/2* mass*Velocit^2, for gas at rpt, the KE is the same thus:

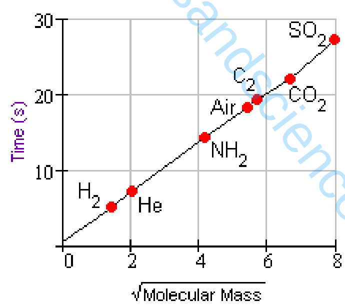
Velocity= sqrt((2*KE)/mr)=diffusion rate

➔Option **D** is correct—Ans

Graham's Law of Effusion

- The rate of effusion of a gas is inversely proportional to the square root of either the density or the molar mass of the gas.

$$\text{Rate}_{\text{effusion}} \propto \frac{1}{\sqrt{\text{density}}} \propto \frac{1}{\sqrt{\text{MM}}}$$

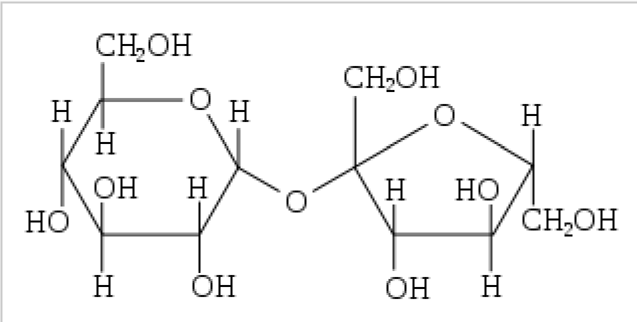


The time required for 25-mL samples of different gasses to diffuse through a pinhole into a vacuum.

1) Solubility & BP depends on the polarities of molecules and the solvent properties more than the value of mr. Number of atoms does not directly link to the value of mr.

Q2: dilute sugar molecules (C6H12O6) in water

Sugar molecules are separated far apart from each other, randomly mixed between water molecules, all moving at random



Sucrose: a disaccharide of glucose (left) and fructose (right), important molecules in the body.

➔Option **A** is correct

Q3:

To be liquid at room temperature 30 C, the temp range of MP to BP must include 30 C.

➔Option **B** is correct—Ans

1) Option C temp range include 30 C but the BP is too high thus not volatile.

Q4: Elements from Ionic compounds must be extracted either by reduction method or electrolysis

➔Option **C** is correct--Ans

1) Crystallization for obtaining solid dissolved compounds from a solution, Distillation for obtaining pure liquid distillate from a solution, Filtration for separating solid from a liquid.

Q5: Experimental setup

To obtain pure & dry sample, the final stage must not use water displacement method as water evaporate at normal temperature as well, so the setup should use gas syringe 1-3-2-4.

➔Option **D** is correct –Ans

Q6: Kr p=e=36

From periodic table,

Cl- e=17+1=18

Rb+ e=37-1=36

Na+ e=11-1=10

Xe e=p=54

➔Option **B** is correct --Ans

Q7: Ionic compound physical properties➔ High MP, conductive in aqueous or molten state

➔Option **D** is correct—Ans

1) Option C could be reactive metal such as sodium, potassium which conduct electrical at solid state and is reactive with water to form alkali.

Q8: Iron (III) nitrate➔ Fe(NO3)3 ➔ Option A is correct –Ans

Q9: covalent compound

From given diagram Y has 6 valance e- ➔ group 6

X has 7 valance e-➔ group 7

Check given option from PT,

Option **D** is correct –Ans

Q10: % composition

% O in H_2O= 16/(16+2)

Mass of O in 72g= 72*16/18=64g

➔Option **C** is correct –Ans

Q11: electrical conductor

Pure ethanoic acid is weak acid, so its conductivity is lower than metallic sodium

➔Option **C** is correct--Ans

Q12: Test for presence of reducing agent by $K_2Cr_2O_7$

Present of RA such as KI will change the color of K2CR2O7 from orange to green.

→Option **D** is correct.—Ans

Q13: Catalyst speed up reaction but not involve in final product.

$2H_2O_2$ (l)→ $2H_2O$ (l) + O_2 (g)

Final solution is water (colorless), CuO is black in color insoluble in water

→Option **A** is correct—Ans

Q14:

OS of sulfur: 0 → 4+ → 6+ → 6+

→Option **A** is correct—Ans

Q15: H_2 + Cl_2→ 2HCl exothermic

More energy released from bonds formation than energy absorbed to break bonds.

→Option **B** is correct --Ans

Q16: Optimum temperature for enzyme to function

At low temperature, enzymes are inactive, at too high temperature, the hydrogen bonds in the protein structure of enzyme are denatured thus not functioning, at optimum temperature, the high collision rate lead to high reaction rate.

➔Option B is correct—Ans

Q17: Acid.

HCl react with calcium carbonate to given colorless CaCl2 solution + CO2.

HCl react with Fe(OH)2 to given FeCl2 solution which is light bluein color.

HCl react with KOH to given colorless KCl solution.

HCl react with AgNO3 to give AgCl ppt + HNO3

Chromium(III)	Cr^{3+}	Blue-green
Chromate	CrO_4^{2-}	Colorless or Yellow(sometimes)
Dichromate	$Cr_2O_7^{2-}$	Orange
Manganese(II)	Mn^{2+}	Colourless
Manganate(VII) (*Permanganate*)	MnO_4^-	Deep violet
Manganate(VI)	MnO_4^{2-}	Dark green
Manganate(V)	MnO_4^{3-}	Deep blue
Iron(II)	Fe^{2+}	Light blue
Iron(III)	Fe^{3+}	Yellow/brown
Cobalt(II)	Co^{2+}	Pink
Cobalt-ammonium complex	$Co(NH_3)_6^{3+}$	Yellow/orange
Nickel(II)	Ni^{2+}	Light green
Nickel-ammonium complex	$Ni(NH_3)_6^{2+}$	Lavender/blue
Copper(II)	Cu^{2+}	Blue

Key is: Transition metal ions has color in aqueous solution !

➔Option **C** is correct—Ans

Q18: H2SO4

$Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$

$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

$Mg(NO_3)_2 + H_2SO_4 \rightarrow$ No reaction, mixture of aqueous solution

$MgO + H_2SO_4 \rightarrow MgSO_4 + H_2O$

➔Option **C** is correct—Ans

Q19: Transition metal characteristics: Multiple OS, colored compound

➔Option **C** is correct—Ans

1) Group 1,2,3 compound are single OS and white in color.

Q20: Amphoteric oxide Zn,Pb,Al

➔Option **D** is correct—Ans

1) all options are carbonate which decompose to metal oxide + CO_2.

Q21: Acidic air pollutant: SO_2, NO_2, CO_2

H_2, N_2 are neutral

NH_3 is alkaline

SO_3 is acidic

H2SO4 acid gas/aqueous

➔Option C is best answer—Ans

Q22: Halogen exist in diatomic molecules, form -1 anions, reactivity reduces down the group, compound with Ag sensitive to UV light.

A **silver halide** is one of the compounds formed between silver and one of the halogens — silver bromide (AgBr), chloride (AgCl), iodide (AgI), and three forms of silver fluorides. As a group, they are often referred to as the silver halides, and are often given the pseudo-chemical notation AgX. Although most silver halides involve silver atoms with oxidation states of +1 (Ag^+), silver halides in which the silver atoms have oxidation states of +2 (Ag^{2+}) are known, of which silver(II) fluoride is the only known stable one.

The light-sensitive chemicals used in photographic film and paper are silver halides.

Light sensitivity

[edit]

Silver halides are used in photographic film and photographic paper, including graphic art film and paper, where silver halide crystals in gelatin are coated on to a film base, glass or paper substrate. The gelatin is a vital part of the emulsion as the protective colloid of appropriate physical and chemical properties. Gelatin may also contain trace elements (such as sulfur) which increase the light sensitivity of the emulsion, although modern practice uses gelatin without such components. When absorbed by an AgX crystal, photons cause electrons to be promoted to a conduction band (de-localized electron orbital with higher energy than a valence band) which can be attracted by a sensitivity speck, which is a shallow electron trap, which may be a crystalline defect or a cluster of silver sulfide, gold, other trace elements (dopant), or combination thereof, and then combined with an interstitial silver ion to form silver metal speck.[1]

When a silver halide crystal is exposed to light, a sensitivity speck on the surface of the crystal is turned into a small speck of metallic silver (these comprise the invisible or latent image). If the speck of silver contains approximately four or more atoms, it is rendered developable - meaning that it can undergo development which turns the entire crystal into metallic silver. Areas of the emulsion receiving larger amounts of light (reflected from a subject being photographed, for example) undergo the greatest development and therefore results in the highest optical density.

Silver bromide and silver chloride may be used separately or combined, depending on the sensitivity and tonal qualities desired in the product. Silver iodide is always combined with silver bromide or silver chloride, except in the case of some historical processes such as the collodion wet plate and daguerreotype, in which the iodide is sometimes used alone (generally regarded as necessary if a daguerreotype is to be developed by the Becquerel method, in which exposure to strong red light, which affects only the crystals bearing latent image specks, is substituted for exposure to mercury fumes). Silver fluoride is not used in photography.

Silver halides are also used to make corrective lenses darken when exposed to ultraviolet light (see photochromism).

➔Option C is incorrect--Ans

Q23: XH4+ similar to NH4+

From diagram, X has 5 valance e-➔group 5 such as nitrogen

➔Option **D** is correct—Ans

Q24: PT

From PT: Period 1 : 2   Period 2: 8   Period 3:8 toal 18 element in first 3 period

➔Option **B** is correct—Ans

Q25: Iron extraction

Iron can be extracted by C in blast furnace or by electrolysis. Pig iron from blast furnace contains lot of impurities but is cheaper to operate.

➔Option **C** is correct—Ans

Q26: Fe vs Al

Al is more reactive than Fe, so when exposed to damp environment should corrode faster, however the layer of Al_2O_3 protect the Al.

➔Option **D** is correct—Ans

Q27: Francium (Fr) vs Al

Fr more metallic than Na. K thus never discharge in electrolysis of aqueous solution. Fr above C in reactivity series thus cannot be reduced by carbon and its oxide FrO_2 is very stable.

Only way to extract Fr is by electrolysis of molten Fr's salt such as FrCl

➔Option **B** is correct—Ans

Q28:

HCl limiting reactant

Solution1 : 0.05 mol

Solution 2: 0.05 mol but higher concentration faster reaction=Y

Solution 3: 0.1 mol highest volume of H2 produced=X

➔Option **B** is correct—Ans

Q29: Natural Ore

Hematite, also spelled as **haematite**, is the mineral form of iron(III) oxide (Fe_2O_3), one of several iron oxides. Hematite crystallizes in the rhombohedral system, and it has the same crystal structure as ilmenite and corundum. Hematite and ilmenite form a complete solid solution at temperatures above 950 °C.

Hematite is a mineral, colored black to steel or silver-gray, brown to reddish brown, or red. It is mined as the main ore of iron. Varieties include *kidney ore*, *martite* (pseudomorphs after magnetite), *iron rose* and *specularite* (specular hematite). While the forms of hematite vary, they all have a rust-red streak. Hematite is harder than pure iron, but much more brittle. Maghemite is a hematite- and magnetite-related oxide mineral.

Limestone is a sedimentary rock composed largely of the minerals calcite and aragonite, which are different crystal forms of calcium carbonate ($CaCO_3$). Many limestones are composed from skeletal fragments of marine organisms such as coral or foraminifera.

Limestone makes up about 10% of the total volume of all sedimentary rocks. The solubility of limestone in water and weak acid solutions leads to karst landscapes, in which water erodes the limestone over thousands to millions of years. Most cave systems are through limestone bedrock.

Limestone has numerous uses, including as building material, as aggregate to form the base of roads, as white pigment or filler in products such as toothpaste or paints, and as a chemical feedstock.

Mica classification [edit]

Chemically, micas can be given the general formula[2]

$X_2Y_{4-6}Z_8O_{20}(OH,F)_4$
in which X is K, Na, or Ca or less commonly Ba, Rb, or Cs;
Y is Al, Mg, or Fe or less commonly Mn, Cr, Ti, Li, etc.;
Z is chiefly Si or Al, but also may include Fe^{3+} or Ti.

Structurally, micas can be classed as dioctahedral ($Y = 4$) and trioctahedral ($Y = 6$). If the X ion is K or Na, the mica is a "common" mica, whereas if the X ion is Ca, the mica is classed as a "brittle" mica.

Quartz is the second-most-abundant mineral in the Earth's continental crust, after feldspar. It is made up of a continuous framework of SiO_4 silicon–oxygen tetrahedra, with each oxygen being shared between two tetrahedra, giving an overall formula SiO_2. There are many different varieties of quartz, several of which are semi-precious gemstones. Throughout the world, varieties of quartz have been since antiquity the most commonly used minerals in the making of jewelry and hardstone carvings.

➔Option **D** is correct

Q30: electrolysis of conc NaCl

Cathode: $2H^+ + 2e^- \rightarrow H_2$ (g)

Anode: $2Cl^- \rightarrow Cl_2$ (g) + $2e^-$

Option **B** is correct—Ans

Q31:

Mol of $CaCO_3$ ==mass/mr=50/(40+12+16*3)=0.5 mol

Mol CO_2=mol $CaCO_3$=0.5 mol

At rtp 1 mole =24 dm^3, 0.5 mol=12 dm^3

➔Option **A** is correct—Ans

Q32: Count of N atoms per mol

NH_4NO_3= 2 mol of N

$NaNO_3$= 1 mol of N

$(NH_4)_3PO_4$= 3 mol of N ---Highest

$(NH_4)_2SO_4$=2 mol of N

➔Option **C** is correct—Ans

Q33: Fuel

CO is colorless gas which can be burnt to form CO_2 by $2CO + O_2 \rightarrow 2CO_2$, all other hydrocarbon fuels could form soot in incomplete combustion.

➔Option **A** is correct—Ans

Q34: Essential property of fuel➔ exothermic reaction in combustion

➔Option **A** is essential—Ans

Q35: Plastic=polymer, raw material from crude oil refinery

➔Option **B** is main source of plastic raw material--Ans

Q36: Organic acid-COOH

Ethanol=neutral

Propane=neutral

Propanoic acid=weak acid react with Alkaline NaOH to form salt and water

Propanol=neutral

➔Option **C** is correct—Ans

Q37: Isomer, compound with same molecular formula but different structure

- **Isomers** are molecules or molecular compounds that are similar in that they have the same molecular formula, however have different arrangements of the atoms or groups of atoms (functional groups) involved.
- The word **Isomer** comes from the Greek words, *Isos* meaning equal and *meros*, meaning part, or to share.

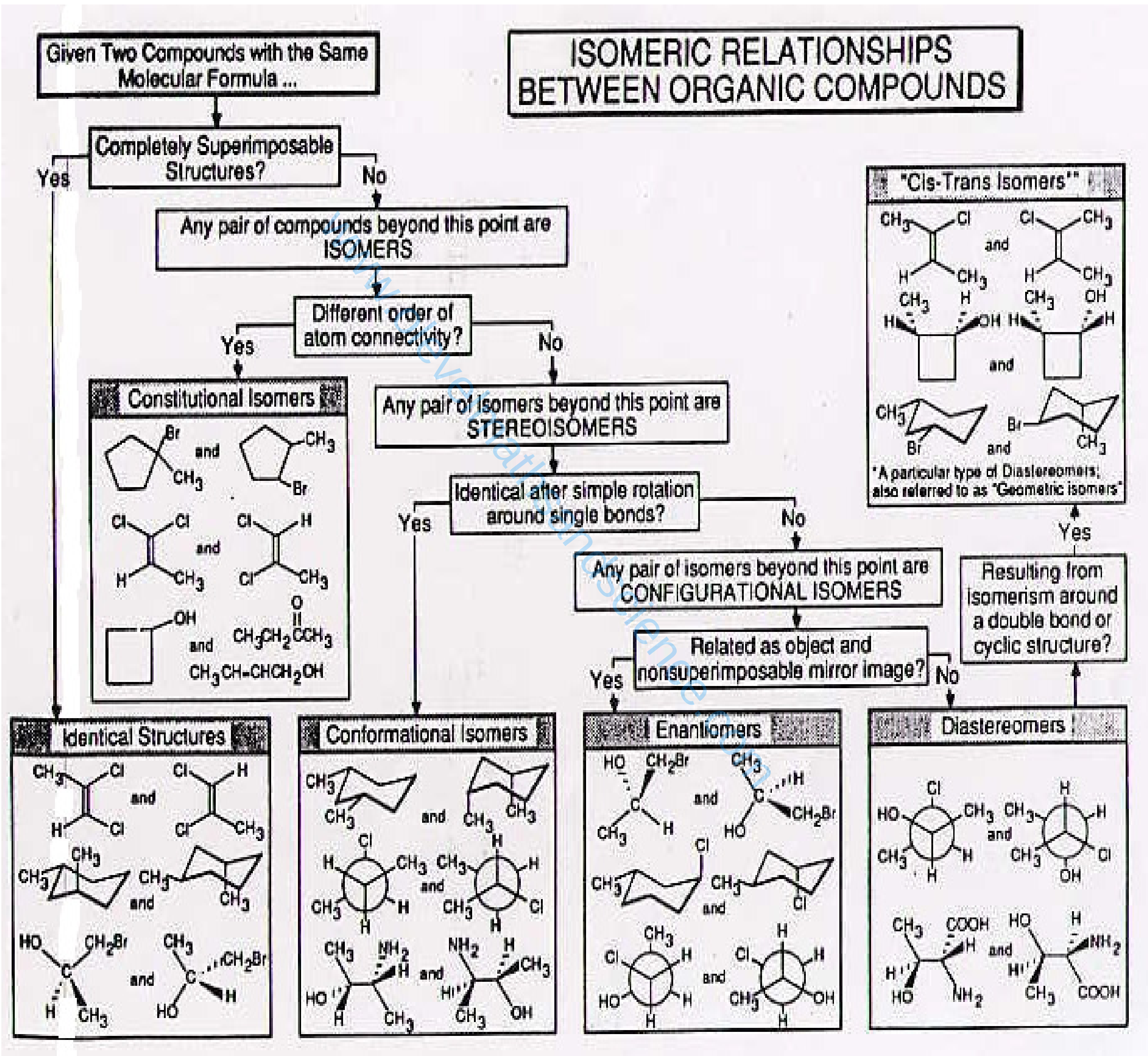
A: CH_4 vs C_2H_6 not isomers

B: C_2H_5Cl same formula and identical structure

C: C_2H_5Cl vs C_2H_4Cl not isomer

D: $C_2H_2Cl_2$ same formula but different structure=isomers

Option **D** is correct—Ans



Q38: Addition reaction→ not elimination of products

A: substitution reaction

B: Bromination (addition)

C: Addition polymerization

D: Hydration(addition)

→Option **A** is not an addition reaction—Ans

Q39: from the diagram, the monomers structure should be:

$H_2C = CH$

|

CH_3 Molecular formula is: C_3H_6

→Option **C** is correct—Ans

Q40: Empirical formula=simplest ratio

A: $(C_2H_4)_n=(CH_2)_{2n}$

B: $(C_3H_6)_n=(CH_2)_{3n}$

C: $(C_4H_8)_n=(CH_2)_{4n}$

D: $(C_8H_8)_n=(CH)_{8n}$ ** empirical formula CH

➔Option **D** is correct—Ans

NgeeAnn Secondary School

Pure Chemistry Prelim Exam Paper 3-2011

A1:

a) Colored Compound➔look for transition element➔CuCl2

Properties	
Molecular formula	$CuCl_2$
Molar mass	134.45 g/mol (anhydrous) 170.48 g/mol (dihydrate)
Appearance	yellow-brown solid (anhydrous) blue-green solid (dihydrate)
Odor	odorless

b) all carbonate insoluble except Na,K,NH4➔ silver carbonate

c) Ammonia salt solution react with NaOH to produce NH3➔ Ammonia Sulphate

d) Amphoteric react with acid and base ➔ Al2O3

e) element that is liquid at rtp➔ Br2

A2: atomic number=8➔Oxygen

a) N=8 p=8 e=10 2 extra electrons thus an **-2 charged anion**

b) Likely to be group **6**

c) Bonding between non-metallic element➔ **covalent bond** such as CO2.

A3:

(a) single molecular solid at 20C: A,C,E,F possible based on MP, but should be poor conductor of electricity due to covalent structure➔ A such as organic hydrocarbon.

(b) Soluble ionic salt: high MP, good conductor in both aqueous and liquid➔C

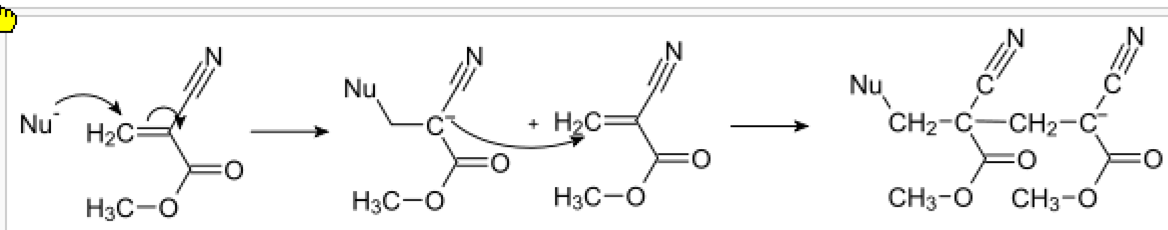
©Liquid at 20C➔ D with MP-BP temp range contain 20C

A4:

(a) Caesium from PT Period 6 group 1➔ A

(b) Cs compared to Li had larger atomic, the outer electron was less attracted by the nuclei thus contain higher KE which make Cs much more reactive (metallic behavior) than Li.

A5: Additon polymerization speed up by presence of water or base which act as catalyst.



Polymerization of methyl-2-cyanoacrylate

The sweet smell come from the ester functional group COO

A6:

a) Fossil fuels are hydrocarbon compound which burnt to produce CO_2, H_2O & energy which were used for various function such as power generation, heating etc.

b) Excessive CO_2 dissolved into rain water to form acid rain which damages the environments thus was considered an air pollutant.

c) $N_2 + O_2 \rightarrow 2NO$ which occur at high temperature as high activation energy id required to break the N-N triple bond.

d) NO further oxidized to NO_2 which dissolve into rain water to form acid rain:

$2NO + H_2O + 3/2O_2 \rightarrow 2HNO_3$

CO is toxic gas which reduces the blood's ability to carry oxygen.

e) SO_2 which are released from burning of fuels like coke or from volcano activities.

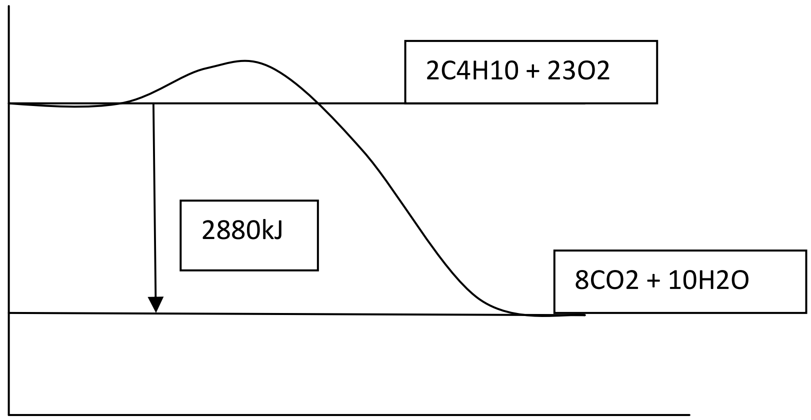
A7:

a) $2C_4H_{10}\ (g) + 13O_2\ (g) \rightarrow 8CO_2\ (g) + 10\ H_2O\ (l)$

b) number of mol=600/24000

total energy release= 600/24000* 2880= **72** KJ ##

c)



d) Energy used to break the bonds are lower than energy released from bonds formation thus the reaction is exothermic.

A8:

a)

1) Mol of NaOH=Mole of CH3COOH= 26.25*0.001*1=0.02625 mol

Molar concentration of X= mol/volume=0.02625/(25*0.001)=**1.05 mol/dm3** ##

2) mass concentration of CH3COOH= molar concentration * mr

= 1.05* (12*2+4+16*2)/1000=0.063 g/cm#

Given the density of X is 1.05 g/cm3, thus % of CH3COOH by mass

= 0.063/1.05=**6%**

b) compute #/mol CH3COOH and compare

$/mol for X= 4/(125*1.05*0.001)=$30.5

$/mol for Y= 8/(250*0.833*0.001)=$38.4 X is cheaper and is a better buy.

A9:

a) SO_4^{2-}

OS of sulfur= +6

b) SO_2 the OS of sulfur is +4 thus the Sulfur was oxidized to +6 in the reaction.

A10:

a) The solution is called "Electrolyte"

b) Fresh water : H^+, OH^- Seawater: Na^+ Cl^-

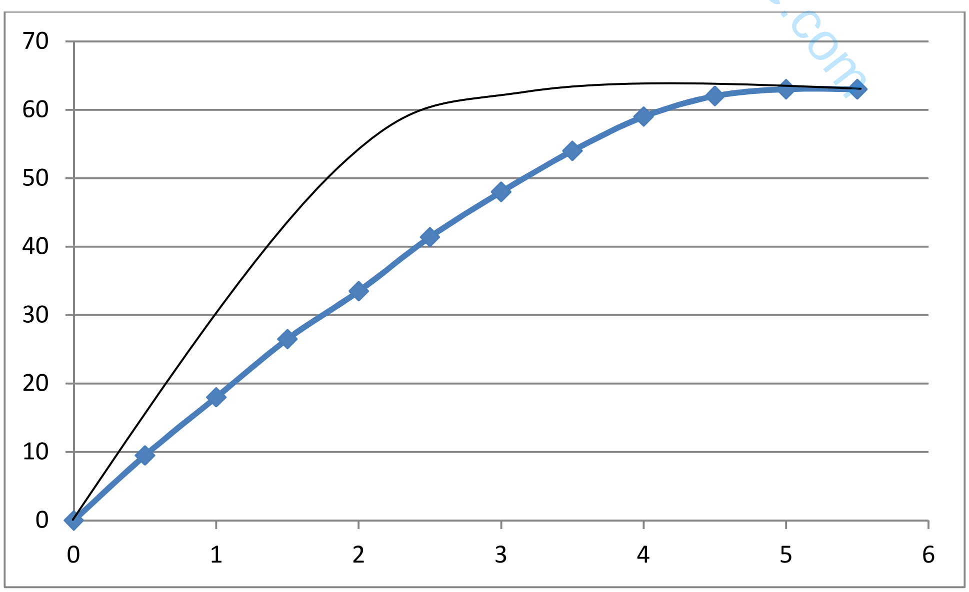
c) simple cell: Cathode Copper, Anode Zn, electrolyte : NaCl solution

$Zn \rightarrow Zn^{2+} + 2e^-$ (Oxidation at Anode)

$2H^+ + 2e^- \rightarrow H_2$ (g) (Reduction at Cathode)

A11:

a) $Mg + 2HCl \rightarrow MgCl_2 + H_2$ (g)



Given mass of Mg=0.0699 g

Mol of Mg= 0.0699/24 mol from the balanced reaction formula

Mol of H_2=mol of Mg=2.9125*10^-3 mol

Max volume of H_2 from graph= 60*0.001 dm^3

Molar volume of H_2/dm^3= 60*0.001/(2.9125*0.001)=20.6 dm^3/mol obtained from experiment

Compare to std rtp 24 dm^3 per mol the value of 20.6 was lower, 1 possible reason is that the Magnesium contain impurities which reduced the actual mol of H_2 produced.

c) Increase concentration of HCl will speed up the reaction due to increase collision between the molecules of the reactant.

d) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

assume same mass of 0.0699, the mol of $CaCO_3$=0.0699/(40+12+16*3)=6.99*10^-4

Mol of CO_2=Mol of $CaCO_3$=6.99*10^-4

Volume of CO_2=24 *6.99*10^-4=**16.8 cc** ##

B12:

a)

1) Test for chlorine: Moist litmus blue paper→ Red→ colorless

2) NaCl is white color salt. The light green Cl_2 decolorized as Cl_2 was used out.

b) F displaced Cl^- due to higher reactivity

$F_2(g) + 2NaCl(s) \rightarrow 2NaF(s) + Cl_2(g)$ at P

$Cl_2(g) + 2NaI(s) \rightarrow 2NaCl(s) + I_2(g)$ at Q

Violet color, cooled to form black I_2 solid at R, noted that I_2 sublimate and does not have liquid state.

B13:

Choice-A

a) Isooctane→ C_8H_{18}

Cetane→$C_{16}H_{34}$

$C_8H_{18} + 25/2O_2 \rightarrow 8CO_2 + 9H_2O$

b) Cl_2 substitutes H in Alkane when there is sun-light (UV radiation)

c) Cracking with catalyst such as Silicon oxides and aluminum oxides

$C_{16}H_{34} \rightarrow C_2H_6 + 2C_3H_6 + 2C_4H_8$

Alkane   Alkene which undergo bromination

d) Isomers→ structural isomers or geometrical isomers

e) glycerol is an alcohol (functional group) so when acidified $KMnO_4$ was added, it would be oxidized to carboxylic acid + H_2O

Chromium(III)	Cr^{3+}	Blue-green
Chromate	$CrO_4{}^{2-}$	Colorless or Yellow(sometimes)
Dichromate	$Cr_2O_7{}^{2-}$	Orange
Manganese(II)	Mn^{2+}	Colourless
Manganate(VII) (*Permanganate*)	$MnO_4{}^{-}$	Deep violet
Manganate(VI)	$MnO_4{}^{2-}$	Dark green
Manganate(V)	$MnO_4{}^{3-}$	Deep blue

Color change from violet to colorless.

Choice B:

a) Milk is a solution of compounds into water, some of these compound decompose upon heating, so direct heating for evaporation to dryness is not appropriate. Few methods possible:

Evaporation methods

These methods rely on measuring the mass of water in a known mass of sample. The moisture content is determined by measuring the mass of a food before and after the water is removed by evaporation:

$$\%\text{Moisture} = \frac{M_{INITIAL} - M_{DRIED}}{M_{INITIAL}} \times 100$$

Here, $M_{INITIAL}$ and M_{DRIED} are the mass of the sample before and after drying, respectively. The basic principle of this technique is that water has a lower boiling point than the other major components within foods, *e.g.,* lipids, proteins, carbohydrates and minerals. Sometimes a related parameter, known as the *total solids,* is reported as a measure of the moisture content. The total solids content is a measure of the amount of material remaining after all the water has been evaporated:

Distillation Methods

Distillation methods are based on *direct* measurement of the amount of water removed from a food sample by evaporation: %Moisture = 100 ($M_{WATER}/M_{INITIAL}$). In contrast, evaporation methods are based on *indirect* measurement of the amount of water removed from a food sample by evaporation: %Moisture = 100 ($M_{INITIAL}$ - M_{DRIED})/$M_{INITIAL}$. Basically, distillation methods involve heating a weighed food sample ($M_{INITIAL}$) in the presence of an organic solvent that is immiscible with water. The water in the sample evaporates and is collected in a graduated glass tube where its mass is determined (M_{WATER}).

b)	C	H	O
	42.1	6.43	51.47
	42.1/12	6.43/1	51.47/16
	3.51	6.43	3.22
Simplest ratio	1	1.83	0.92
Number	12	22	11
In 1 molecule			

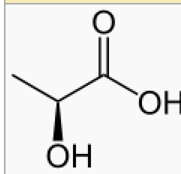
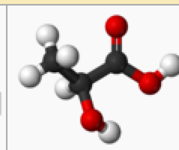
Lactose is a disaccharide sugar that is found most notably in milk and is formed from galactose and glucose. Lactose makes up around 2~8% of milk (by weight), although the amount varies among species and individuals. It is extracted from sweet or sour whey. The name comes from lac or lactis, the Latin word for milk, plus the -ose ending used to name sugars. It has a formula of **$C_{12}H_{22}O_{11}$.**

Lactic acid, also known as **milk acid**, is a chemical compound that plays a role in various biochemical processes and was first isolated in 1780 by the Swedish chemist Carl Wilhelm Scheele. Lactic acid is a carboxylic acid with the chemical formula $C_3H_6O_3$. It has a hydroxyl group adjacent to the carboxyl group, making it an alpha hydroxy acid (AHA).

In solution, it can lose a proton from the acidic group, producing the **lactate** ion (to be specific, an anion due to being negatively charged with an extra electron) $CH_3CH(OH)COO^-$. Compared to acetic acid, its pK_a is 1 unit smaller, meaning lactic acid loses its proton ten times as easily as acetic acid does. This higher acidity is the consequence of the intramolecular hydrogen bridge between the α-hydroxyl and the carboxylate group, making the latter less capable of keeping its proton tight.

Lactic acid is miscible with water or ethanol, and is hygroscopic.

Lactic acid is chiral and has two optical isomers. One is known as L-(+)-lactic acid or (*S*)-lactic acid and the other, its mirror image, is D-(−)-lactic acid or (*R*)-lactic acid.

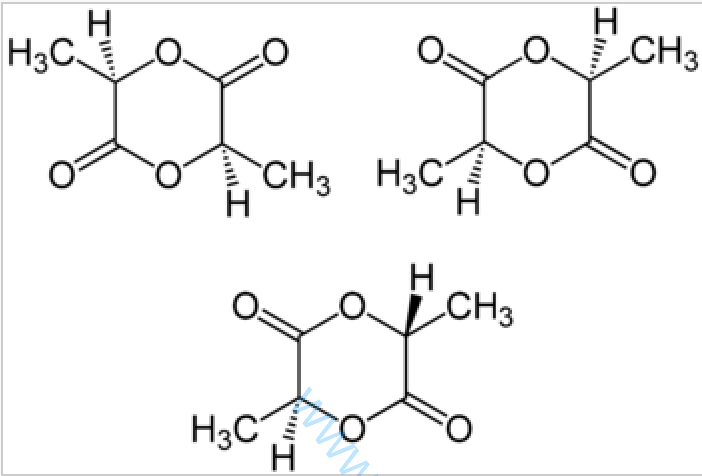
Lactic acid	
 L-Lactic acid	
IUPAC name [hide]	
2-Hydroxypropanoic acid	
Other names [hide]	
Milk acid	
Identifiers	

d) Since there is a –OH functional group and a -COOH functional group, it is possible for the molecule to perform condensation reaction, however, due to close proximity of the 2 functional groups, 2 molecules form a di-ester of lactic acid instead of a polymer directly.

Lactide is the cyclic di-ester of lactic acid, i.e., 2-hydroxypropionic acid. Lactic acid cannot form a lactone as other hydroxy acids do because the hydroxy group is too close to the carboxylic group. Instead, lactic acid first forms a dimer, which is similar to a 5-hydroxyacid. The dimer contains a hydroxy group at a convenient distance from the carboxylic group for the formation of a lactone. Indeed, the dimer readily forms a six-membered cyclic diester known as **lactide**. Lactides may be prepared by heating lactic acid in the presence of an acid catalyst.

In general, a **lactide** is the cyclic diester, i.e., the **di**-lactone of two molecules of any 2-hydroxycarboxylic acid.

Lactic acid is chiral; two enantiomeric forms, (*R*)-lactic acid and (*S*)-lactic acid, may exist. Thus, lactide formed from two equivalents of lactic acid consists of two stereocenters. Three different stereoisomers of lactide are known:

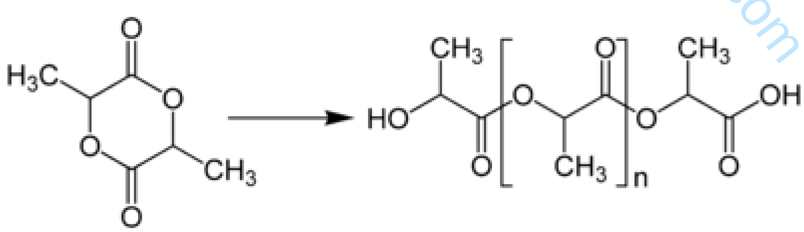


(*R*,*R*)-Lactide (left above), (*S*,*S*)-lactide (right above) and *meso*-lactide (below)

However, with suitable catalyst, the lactide can be polymerized into polyesters (With ester group as linkage) as follows:

Polymerization [edit]

Lactide can be polymerized to polylactic acid (polylactide) using suitable catalysts, with either syndiotactic or a heterotactic stereocontrol, to give materials with many useful properties:[4]

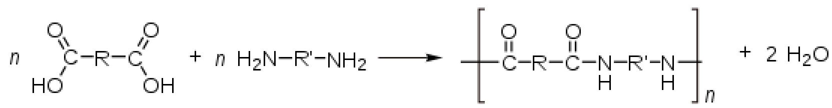


e) Nylon: condensation reaction with formation of amide linkages

Nylon is a generic designation for a family of synthetic polymers known generically as polyamides, first produced on February 28, 1935, by Wallace Carothers at DuPont's research facility at the DuPont Experimental Station. Nylon is one of the most commonly used polymers.

Nylon 5,10, made from pentamethylene diamine and sebacic acid, was studied by Carothers even before nylon 6,6 and has superior properties, but is more expensive to make. In keeping with this naming convention, "nylon 6,12" (N-6,12) or "PA-6,12" is a copolymer of a 6C diamine and a 12C diacid. Similarly for N-5,10 N-6,11; N-10,12, etc. Other nylons include copolymerized dicarboxylic acid/diamine products that are *not* based upon the monomers listed above. For example, some aromatic nylons are polymerized with the addition of diacids like terephthalic acid (→ Kevlar, Twaron) or isophthalic acid (→ Nomex), more commonly associated with polyesters. There are copolymers of N-6,6/N6; copolymers of N-6,6/N-6/N-12; and others. Because of the way polyamides are formed, nylon would seem to be limited to unbranched, straight chains. But "star" branched nylon can be produced by the condensation of dicarboxylic acids with polyamines having three or more amino groups.

The general reaction is:



A molecule of water is given off and the nylon is formed. Its properties are determined by the R and R' groups in the monomers. In nylon 6,6, R = 4C and R' = 6C alkanes, but one also has to include the two carboxyl carbons in the diacid to get the number it donates to the chain. In Kevlar, both R and R' are benzene rings.

End of paper