Hilton College

Department of Physical Sciences

2016

Trial Examination - Chemistry (Paper 2)

Marks: 200 **Time: 3 hours**

EXAMINER: Mr S van Wyk

MODERATOR: Mr T van Niekerk

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This paper consists of:
    - A question paper of **16 pages** and **8 questions.**
    - Two pages of data and formulae (Pages 15 and 16) which can be detached.

2. **Please check that your question paper is complete.**
3. Read the questions carefully.
4. It is in your own interest to write legibly and to set your work out neatly.
5. Use the data and formulae whenever necessary.
6. Start each question on a new page of your answer book.
7. Number your answers in the same way as the questions are numbered.
8. All working must be shown.
9. Units need not be used in the calculations.
    They **MUST** be shown in the answers, however.
10. No programmable calculators may be used.

QUESTION 1 MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Place a cross on the correct answer, using the Answer Grid on the inside of your Answer Book.

1.1 The correct chemical formula for aluminium chlorate is:

A $AlCl_3$

B $AlClO_3$

C $Al(ClO_3)_2$

D $Al(ClO_3)_3$

1.2 Which one of the following statements best describes the term “concentration”?

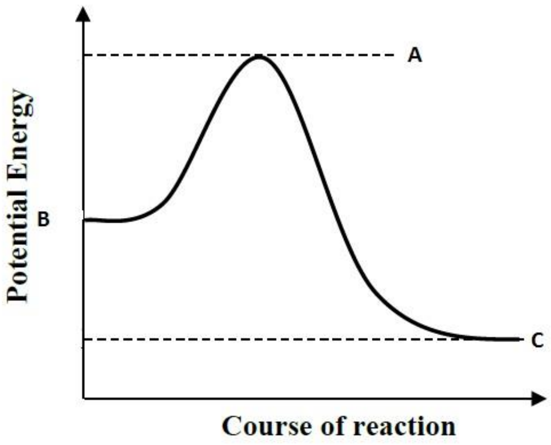
A The number of grams of mass of solute per unit volume.

B The number of moles of solute per unit volume of solution.

C The number of moles of solvent per unit mass of solute.

D The number of grams of moles of solute per unit volume of solvent.

1.3 Consider the following energy profile graph. Potential energy values A, B and C are indicated on the graph. The change in enthalpy for the forward reaction is given by:



A A – C

B B + C

C B – C

D A – B

1.4 An acid is defined as a:

A a proton donor

B a proton acceptor

C an electron donor

D an electron acceptor

1.5 Which one of the following indicators is most suitable for use in the titration of Nitric acid with lithium hydroxide?

	INDICATOR	**pH RANGE OF INDICATOR**
A	CRESOL BLUE	1,2 – 1,8
B	METHYL ORANGE	3,1 – 4,4
C	BROMOTHYMOL BLUE	6,0 – 7,6
D	PHENOLPHTHALEIN	8,4 - 10

1.6 One mole of ammonium chloride is heated to a temperature of above 340 degrees Celsius in order for it to decompose. This happens in a container of 1dm^3. The container is then sealed and the temperature remains constant.
The reaction reached equilibrium according to the following balanced chemical equation:

$$\mathbf{NH_4Cl_{(s)} \rightleftharpoons NH_{3(g)} + HCl_{(g)}}$$

At equilibrium, y moles of HCl had been produced. What is the value of the equilibrium constant, Kc?

A $\frac{1}{y+y}$

B $\frac{Y}{Y+Y}$

C y^2

D $\frac{2y}{y}$

1.7 Which of the following can reduce a solution of Ni^{2+} ions but not a solution of Zn^{2+} ions under standard conditions?

A Cd

B Mg

C Cu

D H_2

1.8 Consider the following reaction:

$$CH_2 = CH_2 + H_2 \rightarrow CH_3CH_3$$

What type of reaction is this?

A substitution

B addition

C elimination

D combustion

1.9 The correct IUPAC name for the molecule shown below is:

CH_3 CH (CH_3) CH (CH_2CH_3) CH_2 CH=CH_2

A Ethylheptane

B Methylethylheptane

C 2-methyl-3-ethylhex-5-ene

D 4-ethyl-5-methylhex-1-ene

1.10 In giant structures such as diamond and carbon graphite, melting and boiling points are high as a result of…..

A strong covalent bonds between atoms

B strong electrostatic forces between ions

C strong intermolecular forces between molecules

D hydrogen bonding **[20]**

QUESTION 2: CHEMICAL BONDING

2.1 Use only substances from the list below when answering questions 2.1.1 to 2.1.6. The state symbols (phase indicators) represent the physical state of each of the substances at room temperature.

NH_3 (g) Cl_2 (g) MgI_2 (aq)   Fe (s) P_2O_5 (s)   HBr (l)

Select one substance from the list that has:
(Only write down the number of the question and the formula of the substance.)

2.1.1 Pure covalent intramolecular bonds. (1)

2.1.2 Hydrogen bonding intermolecular forces. (1)

2.1.3 High melting point due to the electrostatic forces between the ions in the crystal lattice of the substance. (1)

2.1.4 Delocalised valence electrons. (1)

2.1.5 Dipole-dipole intermolecular forces. (1)

2.1.6 Ion-dipole intermolecular forces. (1)

2.2 Consider the table below, which shows the melting and boiling points of the noble gases.

	Noble Gases				
	He	**Ne**	**Ar**	**Kr**	**Xe**
M.P. ^{o} C	**-270**	**-249**	**-189**	**-157**	**-112**
B.P. ^{o} C	**-269**	**-246**	**-186**	**-152**	**-108**

2.2.1 Normal atmospheric temperature is taken as 20 ^{o}C.
What phase will Argon be at this temperature? (1)

2.2.2 Which type of intermolecular forces are likely to occur between the atoms of the noble gases? (1)

2.2.3 As the particles of the noble gases increase in mass, what happens to the melting and boiling points and what does this indicate about the strength of the intermolecular forces between these atoms of the noble gases. (1)

2.2.4 If you had to compare the boiling and melting points of the halogens with their adjacent noble gas. Mention the type of forces involved in both groups of substances and hence comment on the different phases of the two groups from period 4 onwards. (3)

[12]

QUESTION 3: ENERGY CHANGE AND REACTION RATES

Consider the reaction of sulphur tri-oxide decomposing to form sulphur di-oxide and oxygen.

Unbalanced equation: $SO_3\,(g) \rightarrow SO_2\,(g) + O_2\,(g)$

3.1 Define activation energy. (2)

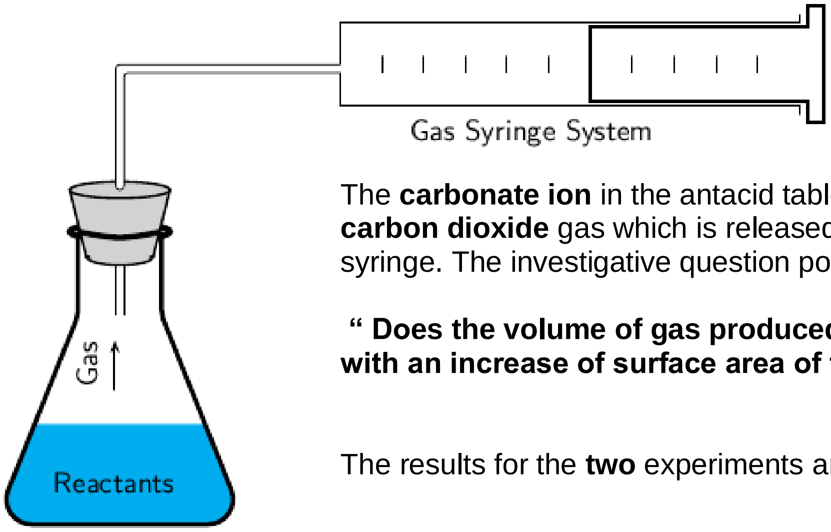
3.2 Write down a balanced equation for the reaction. (2)

3.3 In order for a reaction to take place, the colliding molecules require two factors to be present; **name** these two factors. (2)

3.4 Define reaction rate. (2)

3.5 Name **two** factors that affect reaction rates with specific reference to the reaction shown in this question. (2)

Mr Green's class decided to investigate the rate at which gas is released when an antacid tablet is placed into a weak acid solution. The apparatus was set up as per the diagram below.



The **carbonate ion** in the antacid tablet reacts to form **carbon dioxide** gas which is released from the flask into the syringe. The investigative question posed by Mr Green was;

" Does the volume of gas produced per second, increase with an increase of surface area of the tablet?"

The results for the **two** experiments are shown in the table below.

Time (s)	**20**	**40**	**60**	**80**	**100**	**120**
Expt. 1 Volume of gas (cm^3)	**9**	**18**	**24**	**29**	**32**	**35**
Expt. 2 Volume of gas (cm^3)	**18**	**28**	**32**	**35**	**35**	**35**

3.6 In which of the two experiments did the antacid have the greater surface area? Explain your answer. (2)

3.7 How can you increase the surface area of the antacid tablet? (1)

3.8 Name two variables that must stay the same in both the experiments. (2)

3.9 Name the dependent variable in this experiment? (1)

3.10 Why is the final volume in both experiments the same value? (2)

3.11 Draw a sketch graph of the variables for both the experiments on the same set of axes. Label both axis (no values needed) (2)

3.12 From the graph, state which experiment was faster. (1)

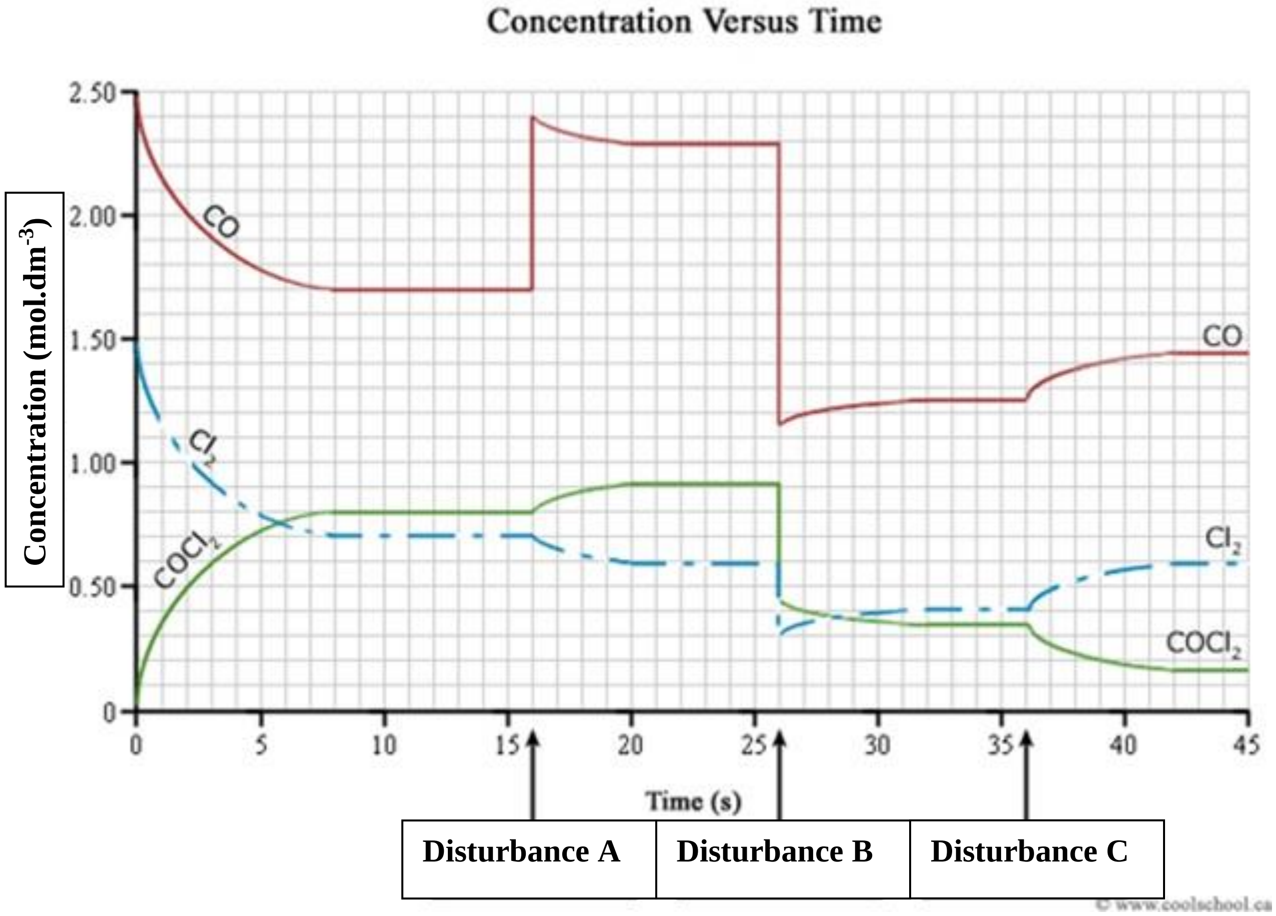
[21]

QUESTION 4: CHEMICAL EQUILIBRIUM

Below you see a graph of concentration vs time for the **reversable** reaction of phosgene into chlorine gas and carbon monoxide, The reaction equation is;

$$\mathbf{CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)}$$

Phosgene is produced by passing purified carbon monoxide and chlorine through a bed of porous activated carbon. Phosgene is highly toxic.



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4.1 In this experiment the reaction is allowed to reach **dynamic chemical equilibrium** in a cylinder fitted with a movable piston.

4.1.1 State Le Chatelier's principle. (3)

4.1.2 What is meant by dynamic chemical equilibrium? (2)

4.2 Whilst keeping the temperature constant, the pressure of the cylinder increases as a result of making the volume of the cylinder smaller.

State the effect of the change on each of the following:
(Answer only increases, decreases or no effect.)

4.2.1 the rate of the reverse reaction (1)

4.2.2 the yield of CO. (1)

4.3 Apply Le Chatelier's principle to explain your answer in question 4.2.2. (3)

4.4 Identify the change (stress) which was introduced to the reaction at time labelled, **disturbance B**, and explain the subsequent changes in the concentrations of all the substances immediately after the time, labelled disturbance B.
Note: there was no change in temperature. (4)

4.5 At time labelled disturbance C, the temperature was increased.

4.5.1 Is the forward reaction endothermic or exothermic? (1)

4.5.2 Consider the changes in concentration shown in the graph at the time labelled disturbance C and apply Le Chatelier's principle to explain your answer to question 4.5.1. (4)

4.6 Calculate the Kc value of this reaction when it has reached equilibrium after 10s. (3)

4.7 Explain, with reference to the equilibrium constant calculated in Q4.6, the significance of the value, and hence, the yield. (2)

4.8 Which is the only factor that will cause a change in the Kc value of a reaction? (1)

[25]

QUESTION 5: ACIDS AND BASES

5.1 When there is a transfer of protons in a reaction we call them acid-base reactions. What is the other name given to these types of reactions? (1)

5.2 From the list of acids below, give the FORMULA of a **diprotic** acid and a **triprotic** acid.

Nitric Acid **Sulphurous Acid** **Sulphuric Acid** **Carbonic Acid**

Hydrochloric acid **Phosphoric Acid** (2)

Consider the hydrolysis of $NaCO_3$ in water as represented by the balanced chemical equations below:

$$\mathbf{H_2O(\ell) \rightleftharpoons OH^{-}(aq) + H^{+}(aq)}$$

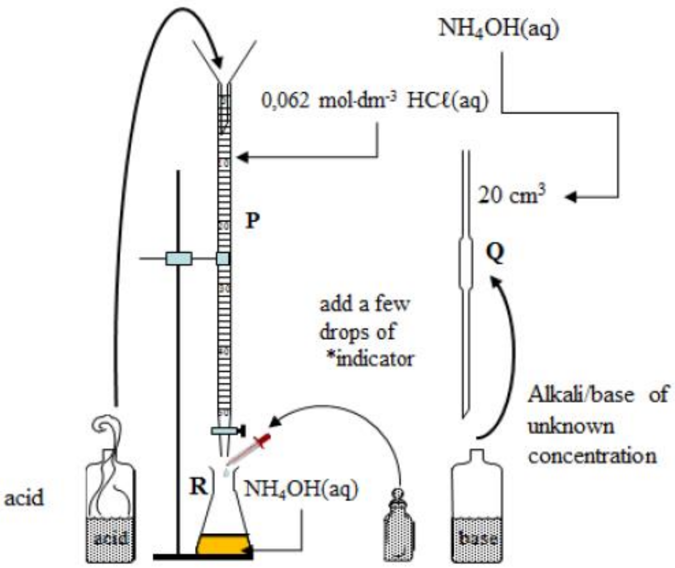
$$\mathbf{CO_3^{-2} + H_2O \rightleftharpoons OH^{-} + HCO_3^{-}}$$

5.3 With reference to the above equations, explain why an aqueous solution of the salt Na_2CO_3 would be basic? (4)

5.4 A pupil determines the concentration of aqueous ammonia ($NH_3(aq)$ or $NH_4OH(aq)$) by titrating $20cm^3$ of the solution, against hydrochloric acid, of concentration 0,062 $mol.dm^{-3}$.

The volume of HCl added when the end point was reached is 22 cm^3.

The apparatus used in this experiment is shown in the diagram below.



Apparatus for carrying out a titration

5.4.1 In a 0,1 $mol.dm^{-3}$ aqueous solution of ammonia the concentration of hydroxide ions, [$OH^{-}(aq)$] is 0,001$mol.dm^{-3}$. Use this information to decide whether ammonia is a strong or weak base. Explain your answer briefly. (3)

5.4.2 The equation for the reaction occuring during the titration is :

$$\mathbf{NH_4OH(aq) + HCl(aq) \rightarrow NH_4Cl(aq) + H_2O(l)}$$

Calculate the concentration of the ammonia solution. (5)

5.5 In order to standardize a solution of sodium hydroxide, a student titrates exactly 24 cm^3 of a solution of oxalic acid **$(COOH)_2$** of concentration 0.5 $mol.dm^{-3}$ against 20 cm^3 of the base.

$$\mathbf{(COOH)_{2(aq)} + 2NaOH_{(aq)} \rightarrow (COONa)_{2(aq)} + 2H_2O_{(l)}}$$

5.5.1 Define neutralisation. (1)

5.5.2 Determine the concentration of the base used in this reaction (5)

5.5.3 Using your answer in Question 5.4.2, calculate the mass of $NaOH_{(s)}$ that was used to neutralize the acid? (3)

5.6 Solution A is ethanoic acid of concentration 0,02 $mol.dm^{-3}$
Solution B is nitric acid of concentration 0,02 $mol.dm^{-3}$
Solution C is nitric acid of concentration 0,2 $mol.dm^{-3}$

5.6.1 Explain what a ***concentrated*** acid solution is? (2)

Which solution (A, B or C?) would you expect to have :

5.6.2 the higher pH? Explain your answer. (3)

5.6.3 the higher K_c value. Explain your answer. (2)

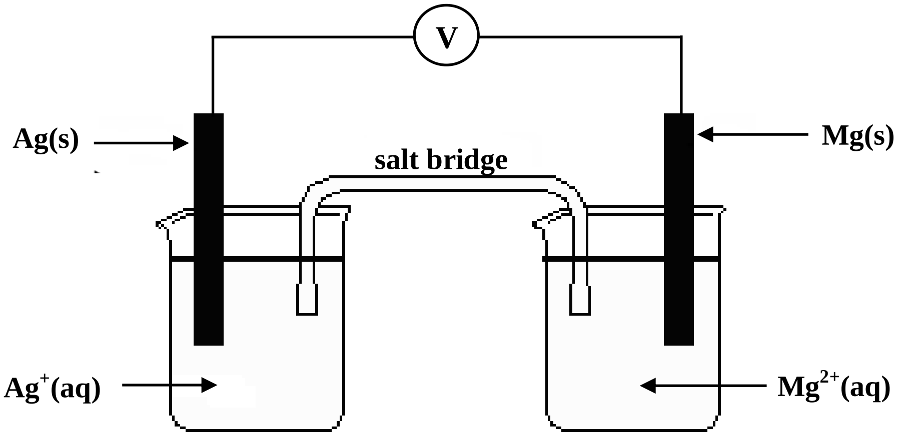
5.6.4 the greater electrical conductivity? Explain your answer (2)

5.7 Give the chemical **names** of an acid and a base that could form the salt, ammonium sulphate, in a neutralization reaction. (2)

[35]

QUESTION 6: GALVANIC CELL

The diagram below represents a galvanic (voltaic) cell functioning under standard conditions with magnesium and silver as electrodes.
A voltmeter connected across the electrodes shows an initial reading of **3.17 V**



6.1 State TWO standard conditions under which this cell operates. (2)

6.2 Explain briefly how the salt bridge ensures electrical neutrality while the cell is Functioning. (2)

6.3 In which direction do electrons flow in the external circuit when this cell delivers a current? Write down only 'from Mg to Ag' or 'from Ag to Mg'. (1)

6.4 Identify the anode of this cell. (1)

6.5 Write down the cell notation (symbolic notation) of this cell. (3)

6.6 Write down the balanced equation for the net (overall) cell reaction that takes place in this cell. **Omit the spectator ions but include phase indicators.** (3)

6.7 How will an increase in the concentration of the Ag^+ ions influence the current that the cell delivers?
Write down only **INCREASES, DECREASES or REMAINS THE SAME** and explain the answer. (3)

6.8 What will happen to the emf of this cell as the reaction approaches equilibrium? (1)

The masses of the 2 electrodes before the cell is connected are measured and recorded :

Magnesium electrode = 12,15 g and Silver electrode = 7,3 g

After some time, a solid deposit that had formed on the silver electrode was removed and dried. The deposit has a mass of **2,7 g.**

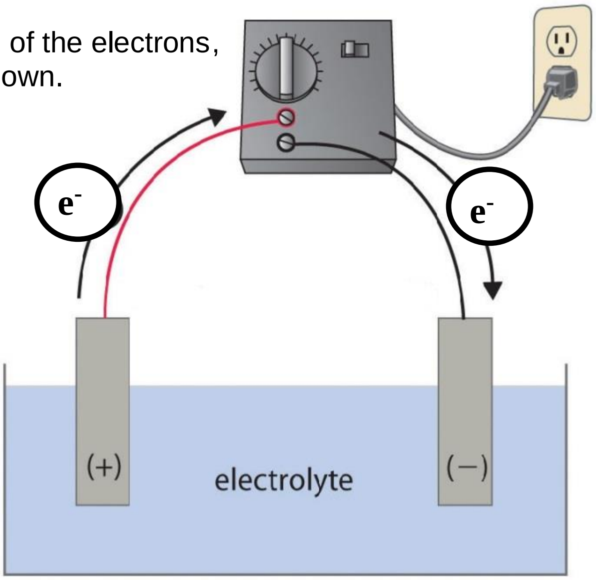
6.9.1 Calculate the final mass of the magnesium electrode. (6)

6.9.2 The 2,7 g silver deposit was formed over a period of 30 minutes. Calculate the strength of the current that was flowing through the wire.

Note: I mole of electrons carry a charge of 96 500 C. (4)

[26]

QUESTION 7: ELECTROLYSIS



The diagram alongside shows an electrolytic cell, the direction of the electrons, are shown and the charges on the inert electrodes are also shown.

The electrolyte solution is a solution of **lithium bromide.**

The electricity is switched on and the reaction is taking place.

Answer the questions that follow on the next page.

7.1 Give the name of the **positive** electrode (the electrode on the left).(Anode or Cathode) (1)

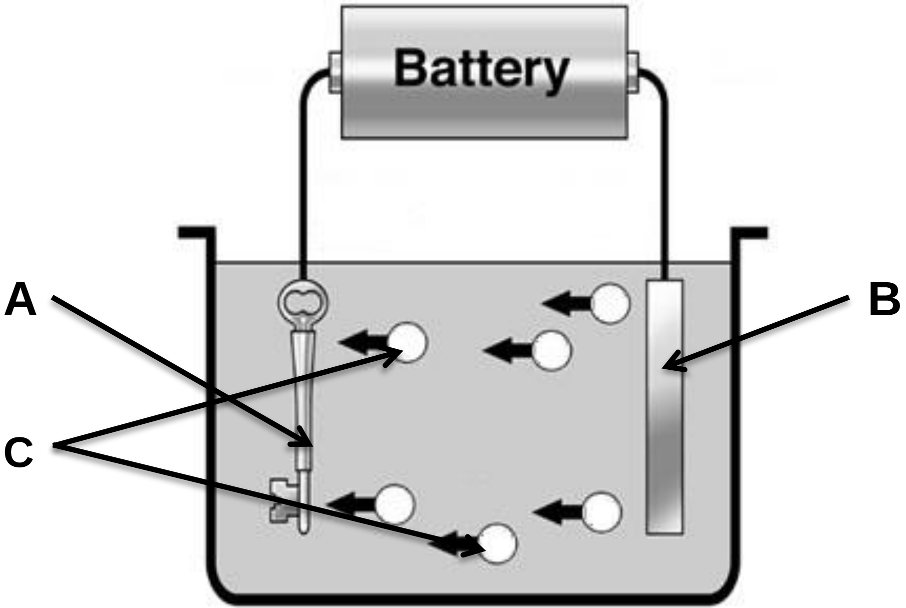
7.2 Write down the half-reaction that occurs at the **positive** electrode. (2)

7.3 Write down the half-reaction that occurs at the **negative** electrode. (2)

7.4 What would you observe at the **positive** electrode. (1)

7.5 Write a fully balanced chemical equation for this electrolysis reaction. (3)

Consider the following diagram which is used to electroplate metal items:



In this diagram the user is wanting to gold plate the key.

7.6.1 Label the two electrodes labelled A and B. **(anode or cathode)** (2)

7.6.2 **Name** a possible electrolytic solution that can be used in the solution of this cell. (2)

7.6.3 **Name the ions**, as indicated by the letter **C,** in the diagram above. (1)

7.6.4 State the energy conversion in this cell. (2)

7.7 Over the past 20 years, in the Chlor-Alkali Industry, many improvements have been made in order to extract products from brine more efficiently, using a safer process..

7.7.1 Name the **three** main products extracted from brine in the Chlor-alkali industry. (3)

7.7.2 Name the two types of Chlor-Alkali Industrial cells that are no longer in use, as a result of the health hazards they pose to humans, and name the hazards each of them pose. (4)

[23]

QUESTION 8: ORGANIC CHEMISTRY

Some reactions of organic compounds are shown below.

A $CH_3CH_2OH \rightarrow CH_2{=}CH_2 + H_2O$

B $C_5H_{12} + O_2 \rightarrow CO_2 + H_2O$

C $CH_2{=}CH_2 + HBr \rightarrow CH_3CH_2Br$

D $HCOOH + C_2H_5OH \xrightarrow{H_2SO_4}$ **product X** $+ H_2O$

8.1 Name the type of reaction depicted in each of the reactions shown above. (4)

The following questions refer to reaction B.

B $C_5H_{12} + O_2 \longrightarrow CO_2 + H_2O$

8.2.1 Rewrite and balance the equation for reaction B. (2)

There are three isomers which have the formula C_5H_{12}, the most common being *pentane.*

8.3.1 Define the term ***isomer*****.** (2)

8.3.2 **Draw** and **name** the structural formulae of **TWO** other isomers of C_5H_{12}. (6)

108 g of C_5H_{12} reacts completely in reaction B.

8.4.1 Calculate the mass of CO_2 released when 108 g of C_5H_{12} reacts completely with O_2. (5)

8.4.2 Name a gas which is likely to form when the C_5H_{12} reacts ***incompletely*** with O_2. (1)

8.4.3 In reaction D, name and draw the structural formula for product X. (4)

Refer to the following table showing the boiling points of five organic compounds:

Compound	**Formula**	**Boiling point (^oC)**
Butane	C_4H_{10}	-0,5
Butene	C_4H_8	-6,5
Butanol	C_4H_9OH	76
Butanone	C_4H_8O	80
Butanal	C_4H_8O	118

8.5.1 Which of the above compounds would be gases at room temperature?(25^{o}C) (2)

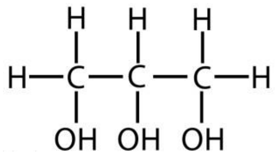
8.5.2 To which homologous series do butene and butanol belong, respectively? (2)

Despite the fact that all five compounds in the table have the same length carbon chain , they have significantly different boiling points.

Explain the differences in boiling point between:

8.6.1 butane and butene (4)

Glycerol, traditionally used in softening agents in baked goods, plasticizers in shortening, and stabilizers in ice cream, has the following structural formula with multiple hydroxyl groups.



8.7.1 Give the IUPAC name for glycerol and draw its condensed structural formula. (3)

8.7.2 Is the following compound a primary, secondary or tertiary alcohol?

$$CH_3C(CH_3)OHCH_3$$

Explain how you got to the answer. (3)

[38]

[200 Marks]

PERIODIC TABLE:

Key

Atomic number (Z) | 1 2.1 **H** 1 | **Electronegativity**

Relative atomic mass

	I	**II**											**III**	**IV**	**V**	**VI**	**VII**	**0**
1	1 2.1 **H** 1																	2 **He** 4
2	3 1.0 **Li** 7	4 1.5 **Be** 9											5 2.0 **B** 10.8	6 2.5 **C** 12	7 3.0 **N** 14	8 3.5 **O** 16	9 4.0 **F** 19	10 **Ne** 20
3	11 0.9 **Na** 23	12 1.2 **Mg** 24.3											13 1.5 **Aℓ** 27	14 1.8 **Si** 28	15 2.1 **P** 31	16 2.5 **S** 32	17 3.0 **Cℓ** 35.5	18 **Ar** 40
4	19 0.8 **K** 39	20 1.0 **Ca** 40	21 1.3 **Sc** 45	22 1.5 **Ti** 48	23 1.6 **V** 51	24 1.6 **Cr** 52	25 1.5 **Mn** 55	26 1.8 **Fe** 56	27 1.8 **Co** 59	28 1.8 **Ni** 59	29 1.9 **Cu** 63.5	30 1.6 **Zn** 65.4	31 1.6 **Ga** 70	32 1.8 **Ge** 72.6	33 2.0 **As** 75	34 2.4 **Se** 79	35 2.8 **Br** 80	36 **Kr** 84
5	37 0.8 **Rb** 85.5	38 1.0 **Sr** 88	39 1.2 **Y** 89	40 1.4 **Zr** 91	41 1.6 **Nb** 93	42 1.8 **Mo** 96	43 1.9 **Tc** 99	44 2.2 **Ru** 101	45 2.2 **Rh** 103	46 2.2 **Pd** 106	47 1.9 **Ag** 108	48 1.7 **Cd** 112	49 1.7 **In** 115	50 1.8 **Sn** 119	51 1.9 **Sb** 121	52 2.1 **Te** 128	53 2.5 **I** 127	54 **Xe** 131
6	55 **Cs** 133	56 **Ba** 137.3		72 **Hf** 178.5	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 200.6	81 **Tℓ** 204.4	82 **Pb** 207	83 **Bi** 209	84 **Po** -	85 **At** -	86 **Rn** -
7	87 **Fr**	88 **Ra**																

57 **La**	58 **Ce**	59 **Pr**	60 **Nd**	61 **Pm**	62 **Sm**	63 **Eu**	64 **Gd**	65 **Tb**	66 **Dy**	67 **Ho**	68 **Er**	69 **Tm**	70 **Yb**	71 **Lu**
89 **Ac**	90 **Th**	91 **Pa**	92 **U**	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lw**

Chemistry Formulae

$I = Q / t$ $n = m / M$	$E^\ominus_{\text{cell}} = E^\ominus_{\text{cathode}} - E^\ominus_{\text{anode}}$ $E^\ominus_{\text{cell}} = E^\ominus_{\text{oxidising agent}} - E^\ominus_{\text{reducing agent}}$
$V = n V_m$ $c = n / V$	$K_w = [H_3O^+] [OH^-]$ at 298 K

STANDARD ELECTRODE POTENTIALS

Increasing oxidising ability

Increasing reducing ability

Half –reaction			E°/ volt
$Li^+ + e^-$	⇌	Li	-3.05
$K^+ + e^-$	⇌	K	-2.93
$Cs^+ + e^-$	⇌	Cs	-2.92
$Ba^{2+} + 2e^-$	⇌	Ba	-2.90
$Sr^{2+} + 2e^-$	⇌	Sr	-2.89
$Ca^{2+} + 2e^-$	⇌	Ca	-2.87
$Na^+ + e^-$	⇌	Na	-2.71
$Mg^{2+} + 2e^-$	⇌	Mg	-2.37
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	-1.66
$Mn^{2+} + 2e^-$	⇌	Mn	-1.18
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	-0.83
$Zn^{2+} + 2e^-$	⇌	Zn	-0.76
$Cr^{2+} + 2e^-$	⇌	Cr	-0.74
$Fe^{2+} + 2e^-$	⇌	Fe	-0.44
$Cd^{2+} + 2e^-$	⇌	Cd	-0.40
$Co^{2+} + 2e^-$	⇌	Co	-0.28
$Ni^{2+} + 2e^-$	⇌	Ni	-0.25
$Sn^{2+} + 2e^-$	⇌	Sn	-0.14
$Pb^{2+} + 2e^-$	⇌	Pb	-0.13
$Fe^{3+} + 3e^-$	⇌	Fe	-0.04
$2H^+ + 2e^-$	⇌	$H_2(g)$	0.00
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+0.14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+0.15
$Cu^{2+} + e^-$	⇌	Cu^+	+0.16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+0.17
$Cu^{2+} + 2e^-$	⇌	Cu	+0.34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+0.40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+0.45
$I_2 + 2e^-$	⇌	$2I^-$	+0.54
$O_2(g) + 2H^+ + e^-$	⇌	H_2O_2	+0.68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+0.77
$Hg^{2+} + 2e^-$	⇌	Hg	+0.79
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+0.80
$Ag^+ + e^-$	⇌	Ag	+0.80
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+0.96
$Br_2 + 2e^-$	⇌	$2Br^-$	+1.09
$Pt^{2+} + 2e^-$	⇌	Pt	+1.20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+1.21
$O_2 + 4H^+ + 4e^-$	⇌	$2H_2O$	+1.23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+1.33
$C\ell_2 + 2e^-$	⇌	$2C\ell^-$	+1.36
$Au^{3+} + 3e^-$	⇌	Au	+1.42
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+1.51
$H_2O_2 + 2H^+ + e^-$	⇌	$2H_2O$	+1.77
$F_2(g) + 2e^-$	⇌	$2F^-$	+2.87