HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 2- CHEMISTRY

TRIALS 2018
EXAMINER: J. KNOX-WHITEHEAD **TIME: 3 HRS**
TOTAL 150

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (130)

   Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets and a periodic table are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places

SECTION A

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A-D)next to the question number (1.1-1.10) in the ANSWER BOOK.

1.1 In which ONE of the following options are the three compounds listed in order of increasing boiling point?

A Pentane, butan-1-ol, propanoic acid

B Propanoic acid, butan-1-ol, pentane

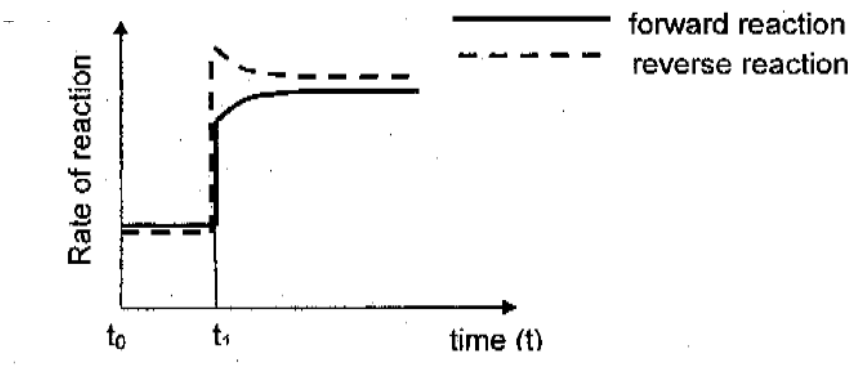
C Propanoic acid, pentane, butan-1-ol

D Butan-1-ol, propanoic acid, pentane (2)

1.2 The reaction represented by the equation below reaches equilibrium in a closed container at time t_0.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -198kJ$$

A change is now made to the equilibrium system at time t_1, as shown in the graph below.



Which ONE of the following correctly describes the change made to the equilibrium at t_1?

A Increase in the concentration of $O_2(g)$

B Increase in the concentration of $SO_3(g)$

C Increase in pressure by decreasing the volume

D Increase in temperature (2)

1.3 The following reaction reaches equilibrium in a closed container:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +206 kJ.mol^{-1}$$

Which ONE of the following changes in temperature and pressure would give the highest yield of products?

	Pressure	**Temperature**
A	Decreases	Increases
B	Increases	Decreases
C	Increases	Increases
D	Decreases	Decreases

(2)

1.4 Which ONE of the following compounds is produced in the Ostwald process?

A $N_2(g)$

B $NH_3(g)$

C $HNO_3(\ell)$

D $NH_4NO_3(s)$ (2)

1.5 A galvanic cell consists of the following half-cells:

$Pt(s),C\ell_2(g) \mid C\ell^-(aq)$ AND $Cu^{2+}(aq) \mid Cu(s)$

Which ONE of the following statements is TRUE while the cell is functioning?

A Cu(s) is oxidised.

B $C\ell^-(aq)$ is reduced.

C $C\ell_2(g)$ acts as reducing agent.

D Cu(s) acts as oxidising agent. (2)

1.6 Which ONE of the following is a product in ALL neutralisation reactions?

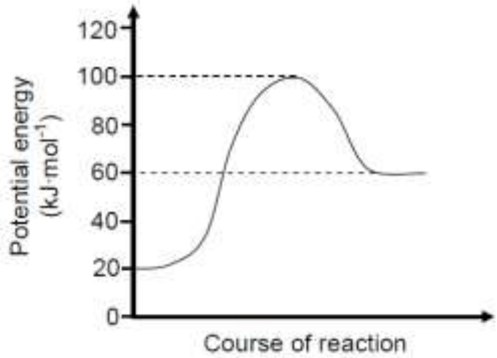
A H^+

B H_2O

C OH^-

D $NaC\ell$ (2)

1.7 Consider the following potential energy diagram for a chemical reaction:

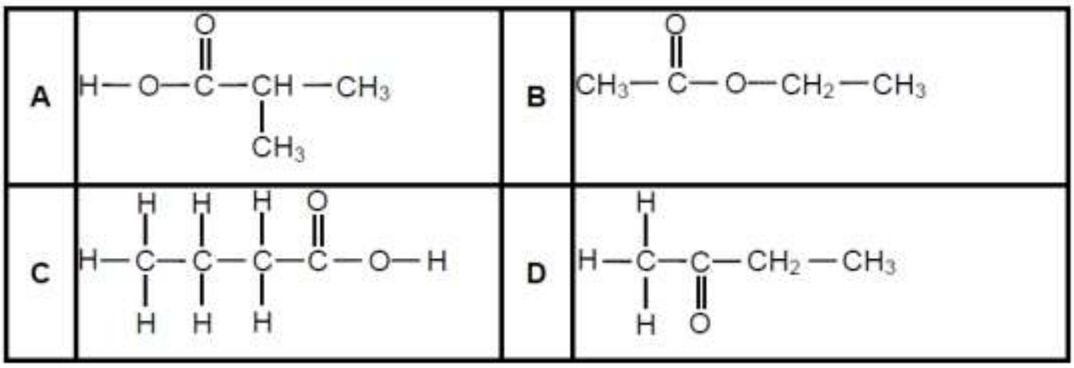


Which ONE of the following shows the values of the total energy change and the activation energy for this reaction?

	Energy change ($kJ.mol^{-1}$)	Activation energy ($kJ.mol^{-1}$)
A	80	40
B	60	100
C	40	80
D	-40	80

(2)

1.8 Which ONE of the following is a functional isomer of butanoic acid?



(2)

1.9 Which ONE of the following is a NON-SPONTANEOUS redox reaction? Refer to the Table of Standard Reduction Potentials (Table 4A or 4B).

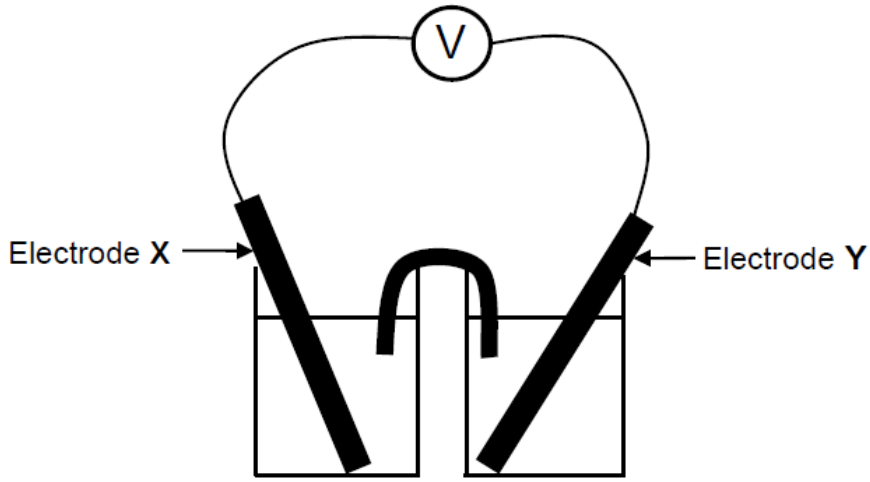
A $Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g)$

B $Cu(s) + FeC\ell_2(aq) \rightarrow CuC\ell_2(aq) + Fe(s)$

C $2AgNO_3(aq) + Cu(s) \rightarrow Cu(NO_3)_2(aq) + 2Ag(s)$

D $2A\ell(s) + 3Ni(NO_3)_2(aq) \rightarrow 2A\ell(NO_3)_3(aq) + 3Ni(s)$ (2)

1.10 In the electrochemical cell below the letters **X** and **Y** represent two metal electrodes.



When the cell is functioning, ELECTRODE **X** GAINS MASS.

Which ONE of the following is the CORRECT cell notation for this cell?

A $Y(s) \mid Y^{2+}(aq) \parallel X^{+}(aq) \mid X(s)$

B $X(s) \mid X^{+}(aq) \parallel Y^{2+}(aq) \mid Y(s)$

C $X^{+}(aq) \mid X(s) \parallel Y(s) \mid Y^{2+}(aq)$

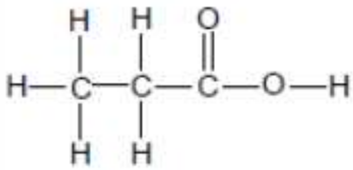
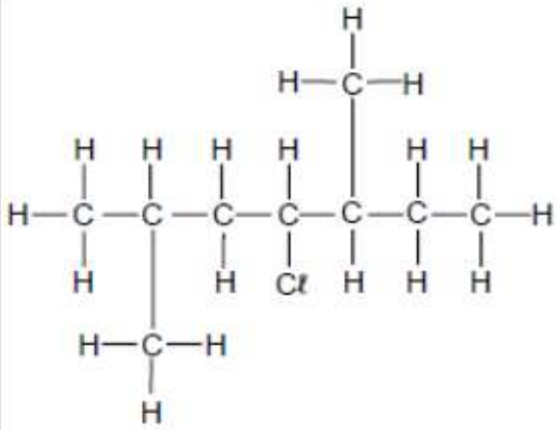
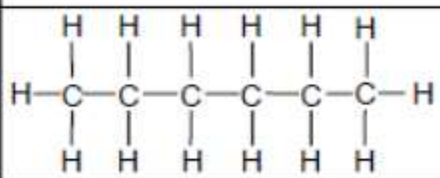
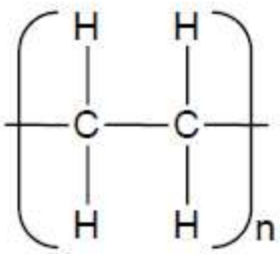
D $Y^{2+}(aq) \mid Y(s) \parallel X(s) \mid X^{+}(aq)$ (2)

[20]

SECTION B

QUESTION 2

The letters **A** to **F** in the table below represent six organic compounds.

A		**B**	
C	C_4H_8	**D**	$CH_3CH_2COCH_3$
E	$CH_3CH(CH_3)CH_2OH$	**F**	
G			

Use the information in the table (where applicable) to answer the questions that follow.

2.1 Write down the LETTER that represents a compound that:
(A compound may be used more than once.)

2.1.1 Is a haloalkane (1)

2.1.2 Has a hydroxyl group as functional group (1)

2.1.3 Belongs to the same homologous series as ethanoic acid (1)

2.2 Write down the:

2.2.1 IUPAC name of compound **B** (3)

2.2.2 IUPAC name of compound **E** (2)

2.2.3 Structural formula of the functional group of compound **D** (1)

2.3 Compound **C** has CHAIN and POSITIONAL isomers.

2.3.1 Define the term *positional isomer*. (2)

2.3.2 Write down the IUPAC name of each of the TWO positional isomers of compound **C**. (4)

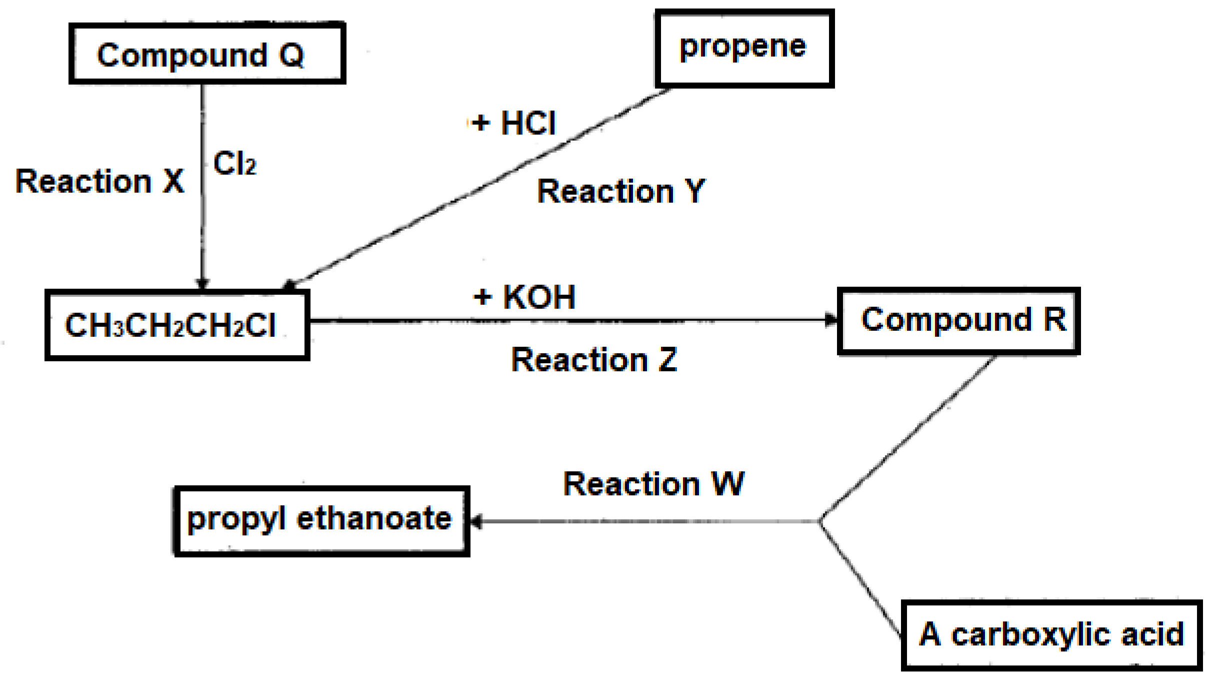
2.4.1 Name the monomer that forms compound **G** when it undergoes addition polymerisation. (1)

2.4.2 Name one use of the above polymer. (1)

[17]

QUESTION 3

In the flow diagram below, **W**, **X**, **Y** and **Z** represent four types of organic reactions. **Q** and **R** represent organic compounds.



3.1 Write down the STRUCTURAL FORMULA for compound **Q**. (1)

3.2 State the reaction condition needed for reaction **X**. (1)

Not counted

3.3 Name the type of addition reaction represented by reaction **Y**. (1)

3.4 Reaction **Z** represents a substitution reaction. Write down the structural formula of compound **R**. (2)

3.5 Give the NAME of FORMULA of the catalyst needed for reaction **W**. (1)

3.6 Use structural formulae to write down a balanced equation for the preparation of propyl ethanoate in reaction **W**. (6)

[12]

QUESTION 4

The relationship between strength of intermolecular forces and boiling point is investigated using four organic compounds. The compounds and their boiling points are given in the table below.

Compound	Boiling point (°C)
butane	-1
2-methylbutane	27,7
pentane	36,1
2-methylpropan-2-ol	82

4.1 Write down the definition of the term "*boiling point*." (2)

4.2 Which substance(s) will be a liquid at 50 °C? (1)

4.3 Name the type of intermolecular force(s) found between butane molecules. (1)

4.4 Refer to the strength of intermolecular forces, the type of intermolecular forces and/or structure of the molecules and energy in order to explain the difference between the boiling points of the following substances:

4.4.1 pentane and 2-methylbutane (4)

4.4.2 pentane and 2-methylpropan-2-ol (4)

4.5 Which substance will have the lowest vapour pressure at 50 °C? (1)

4.6 A sample of butane (C_4H_{10}) of mass 26 g burns in excess oxygen. 34 g of CO_2 forms. The balanced equation for this reaction is given below:

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

Calculate the percentage by mass of pure butane gas in the sample. (5)

[18]

QUESTION 5

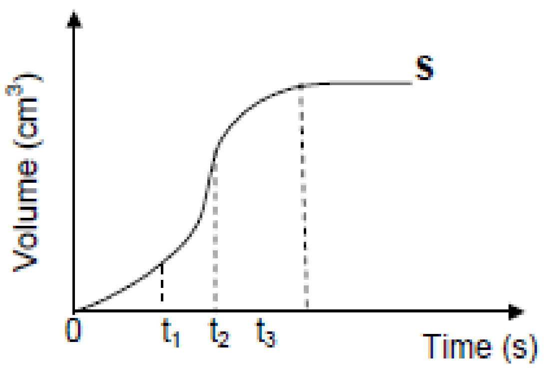
A group of learners uses the reaction of clean magnesium ribbon with dilute hydrochloric acid to investigate factors that influence reaction rate. The balanced equation for the reaction is:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g) \qquad \Delta H < 0$$

5.1 In one of the experiments 5 g magnesium ribbon was added to the hydrochloric acid solution.

5.1.1 If 30 cm^3 dilute hydrochloric acid solution of concentration 1,5 $mol{\cdot}dm^{-3}$ is USED UP in 1 minute, calculate the average reaction rate in $mol{\cdot}s^{-1}$. (5)

The volume of hydrogen gas produced as a function of time in this experiment is represented by graph **S** below. (The graph is NOT drawn to scale.)

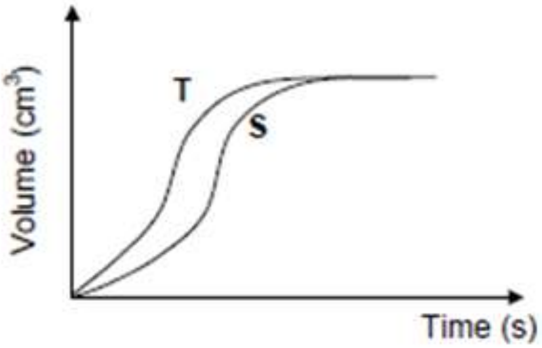


5.1.2 How does the rate of the reaction change between:
(Write down INCREASES, DECREASES or NO CHANGE.)

(a) t_1 and t_2
Use the collision theory to explain the answer. (4)

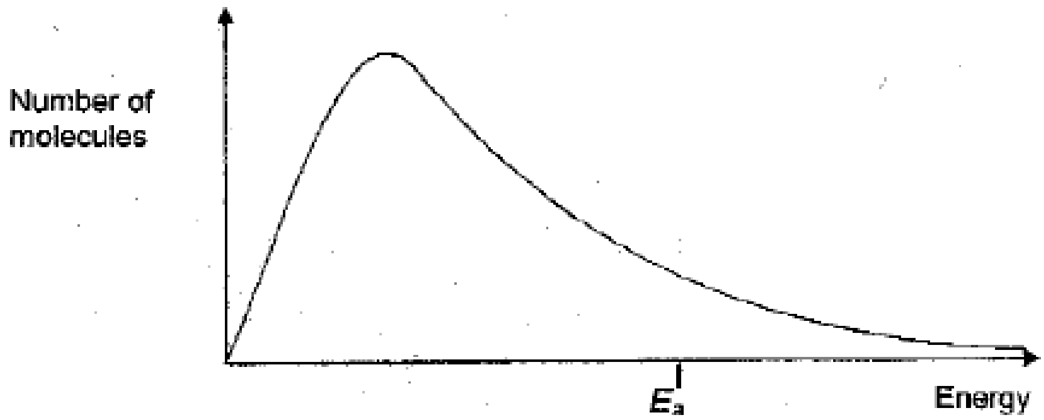
(b) t_2 and t_3
Give a reason for the answer without referring to the graph. (2)

5.2 In another experiment they add 5 g of magnesium to 30 cm^3 of dilute hydrochloric acid of concentration 1,5 $mol{\cdot}dm^{-3}$. They obtained graph T below. (The graph is NOT drawn to scale.)



Give TWO possible conditions that could lead to graph T being different from graph S. (2)

5.3 The diagram below shows the Maxwell-Boltzmann energy distribution curve for a sample of gas at a fixed temperature. E_a is the activation energy for the decomposition of this gas.



5.3.1 Redraw the above curve in your ANSWER BOOK. Use a dotted line to sketch, on the same set of axes, the curve that will be obtained for the same sample of gas at a higher temperature. (2)

5.3.2 How will the addition of a catalyst influence the rate of a chemical reaction? Write down INCREASES, DECREASES or REMAINS THE SAME. (1)

[16]

QUESTION 6

Carbon dioxide reacts with carbon in a closed system to produce carbon monoxide, CO(g), according to the following balanced equation:

$$CO_2(g) + C(s) \rightleftharpoons 2CO(g) \qquad \Delta H > 0$$

6.1 What does the double arrow indicate in the equation above? (1)

6.2 Is the above reaction an EXOTHERMIC reaction or an ENDOTHERMIC reaction? Give a reason for the answer. (2)

Initially an unknown amount of carbon dioxide is exposed to hot carbon at 800 °C in a sealed 2 dm^3 container. The equilibrium constant, K_c, for the reaction at this temperature is 14.

At equilibrium it is found that 168,00 g carbon monoxide is present.

6.3 How will the equilibrium concentration of the product compare to that of the reactants? Choose from LARGER THAN, SMALLER THAN or EQUAL TO.

Give a reason for the answer. (No calculation is required.) (2)

6.4 Calculate the initial amount (in moles) of $CO_2(g)$ present. (9)

6.5 State how EACH of the following will affect the yield of CO(g) at equilibrium. Choose from INCREASES, DECREASES or REMAINS THE SAME.

6.5.1 More carbon is added at constant temperature. (1)

6.5.2 The pressure is increased. (1)

6.5.3 The temperature is increased. (1)
[17]

QUESTION 7

7.1 Give a reason why oxalic acid is a weak acid. (1)

7.2 A standard solution of $(COOH)_2$ of concentration 0,20 mol·dm^{-3} is prepared by dissolving a certain amount of $(COOH)_2$ in water in a 250 cm^3 volumetric flask.

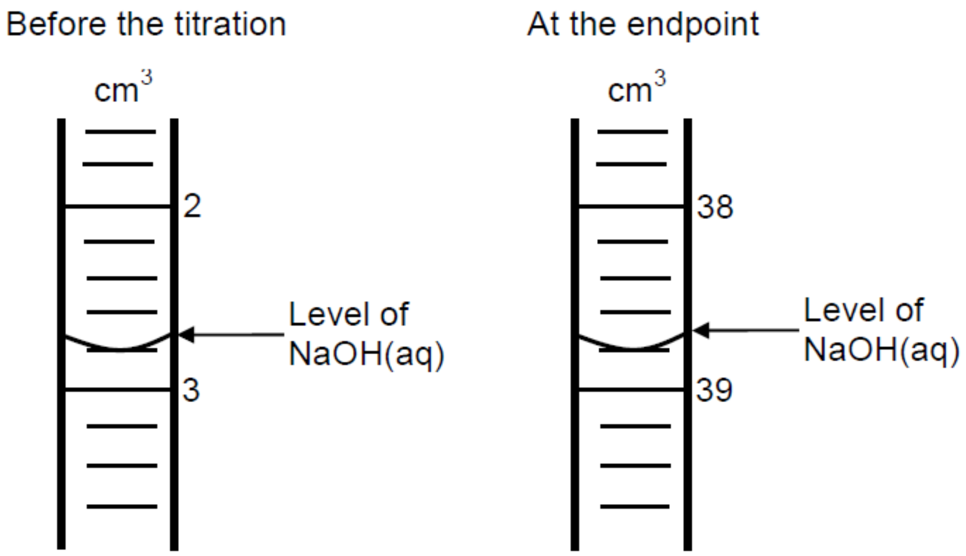
Calculate the mass of $(COOH)_2$ needed to prepare the standard solution. (4)

7.3 During a titration 25 cm^3 of the standard solution of $(COOH)_2$ prepared in QUESTION 7.3 is neutralised by a sodium hydroxide solution from a burette.

The balanced equation for the reaction is:

$$(COOH)_2(aq) + 2NaOH(aq) \rightarrow (COONa)_2(aq) + 2H_2O(\ell)$$

The diagrams below show the burette readings before the titration commenced and at the endpoint respectively.



7.3.1 Use the burette readings and calculate the concentration of the sodium hydroxide solution. (5)

7.3.2 Write down a balanced equation that explains why the solution has a pH greater than 7 at the endpoint. (3)

[13]

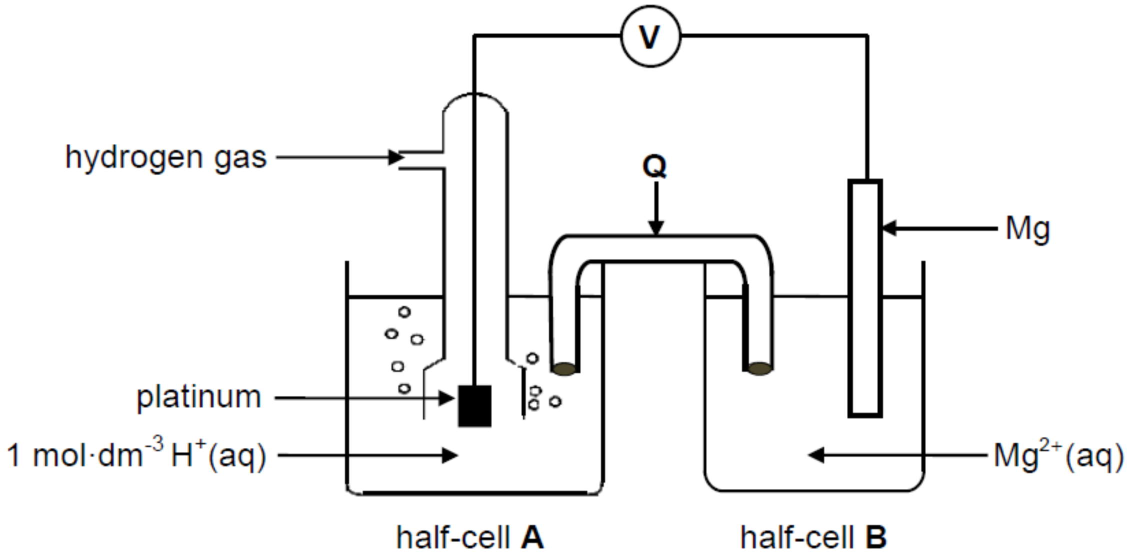
QUESTION 8

Magnesium (Mg) reacts with a dilute hydrochloric acid solution, $HC\ell(aq)$, according to the following balanced equation:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

8.1 Write down the FORMULA of the oxidising agent in the reaction above. (1)

The reaction of magnesium with hydrochloric acid is used in an electrochemical cell, as shown in the diagram below. The cell functions under standard conditions.



8.2 Write down the:

8.2.1 Energy conversion that takes place in this cell (1)

8.2.2 Function of Q (1)

8.2.3 Half-reaction that takes place at the cathode (2)

8.2.4 Cell notation of this cell (3)

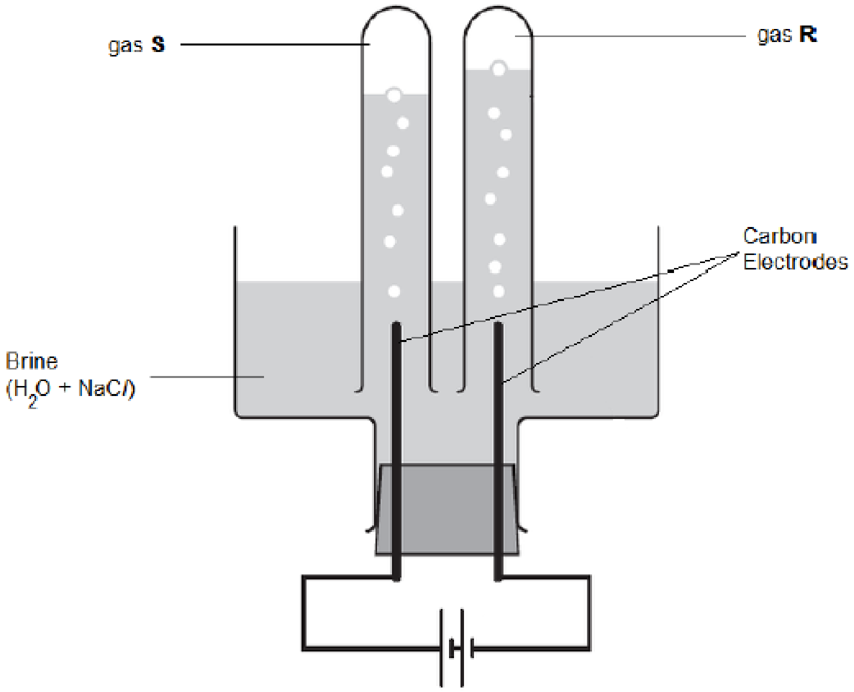
8.3 Calculate the initial emf of this cell. (4)

8.4 How will the addition of concentrated acid to half-cell A influence the answer to QUESTION 8.3? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

[13]

QUESTION 9

A solution of sodium chloride in water ($NaCℓ + H_2O$) is used as an electrolyte in an electrolytic cell that is set up as shown in the sketch below:



The equation for the net cell reaction that occurs, is

$$2NaCℓ(aq) + 2H_2O(ℓ) \rightarrow 2NaOH(aq) + H_2(g) + Cℓ_2(g)$$

9.1 Define the term "*electrolysis*". (2)

9.2 Identify

9.2.1 gas **S** (1)

9.2.2 gas **R** (1)

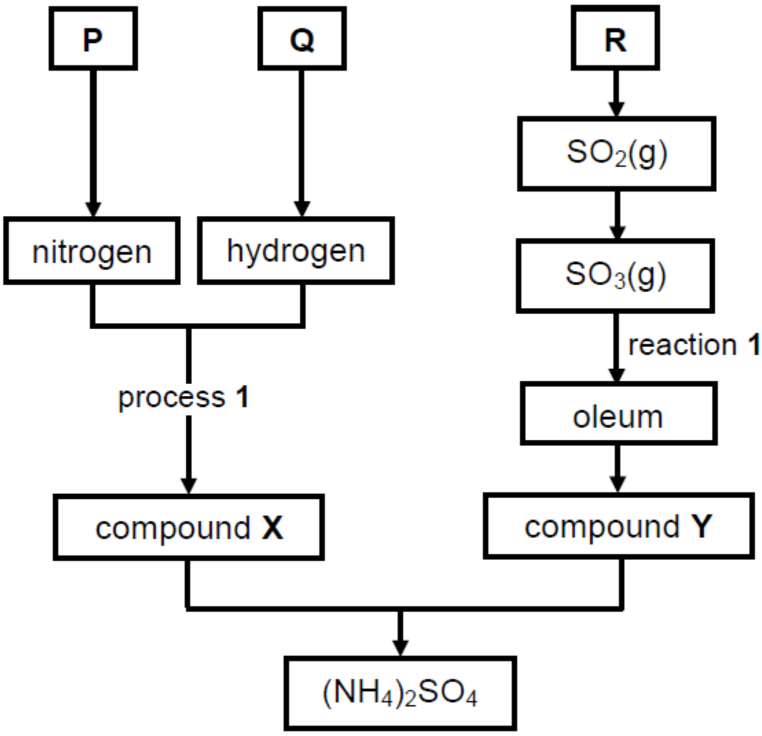
9.3 Explain why sodium metal, Na(s), does not form during the electrolysis of NaCℓ. (2)

9.4 Initially 0,5 dm^3 of the NaCℓ electrolyte with a concentration of 2,5 $mol \cdot dm^{-3}$ is used. How many moles of the electrolyte will be left after 2,24 dm^3 $Cℓ_2$ formed at STP? (4)

[10]

QUESTION 10

A chemical company produces ammonium sulphate, $(NH_4)_2SO_4$, starting from the raw materials **P**, **Q** and **R**, as shown in the flow diagram below.



10.1 Write down the NAME of raw material:

10.1.1 **P** (1)

10.1.2 **Q** (1)

10.1.3 **R** (1)

10.2 Write down the:

10.2.1 NAME of process **1** (1)

10.2.2 NAME of compound **X** (1)

10.2.3 FORMULA of compound **Y** (1)

10.2.4 Balanced equation for reaction **1** (3)

10.3 The company compares the nitrogen content of ammonium sulphate with that of ammonium nitrate, NH_4NO_3.

10.3.1 Determine, by performing the necessary calculations, which ONE of the two fertilisers has the higher percentage of nitrogen per mass. (4)

10.3.2 Write down the name of the process that should be included in the flow diagram above if the company wants to prepare ammonium nitrate instead of ammonium sulphate. (1)

[14]

TOTAL 150

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INFORMATION FOR PHYSICAL SCIENCES GR 12
PAPER 2 (CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^{5}$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^{3}\cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*	29
Electronegativity / *Elektronegatiwiteit*	1,9
Symbol / *Simbool*	Cu
Approximate relative atomic mass / *Benaderde relatiewe atoommassa*	63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											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
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	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	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 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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TABLE 4A: STANDARD REDUCTION POTENTIALS

Half-reactions			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Al^{3+} + 3e^-$	⇌	Al	− 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$Na^+ + e^-$	⇌	Na	− 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	− 2,93
$Li^+ + e^-$	⇌	Li	− 3,05

Increasing oxidising ability ↑

Increasing reducing ability ↓

CAPS

TABLE 4B: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↓   Increasing reducing ability ↑

Half-reactions			E^θ (V)
$Li^+ + e^-$	⇌	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	− 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**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
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87