education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR CERTIFICATE EXAMINATION

PHYSICAL SCIENCES: CHEMISTRY (P2)

SEPTEMBER 2015

GRADE 12

MARKS: 150

TIME: 3 HOURS

This paper consists of 16 pages and 4 data sheets

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a MINIMUM of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1 : MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK

1.1 Which ONE of the following organic compounds does NOT contain a carbonyl group?

A Aldehydes

B Ketones

C Alcohols

D Esters (2)

1.2 Which ONE of the following is an unsaturated hydrocarbon?

A $CH_3CH_2CH_2OH$

B CH_2CHCH_3

C $CH_3CH_2(CH_3)CH_2CH_3$

D CH_3COOCH_3 (2)

1.3 Which ONE of the following redox reactions will occur spontaneously?

A $Cu(s) + 2H^+ \rightarrow Cu^{2+} + H_2(g)$

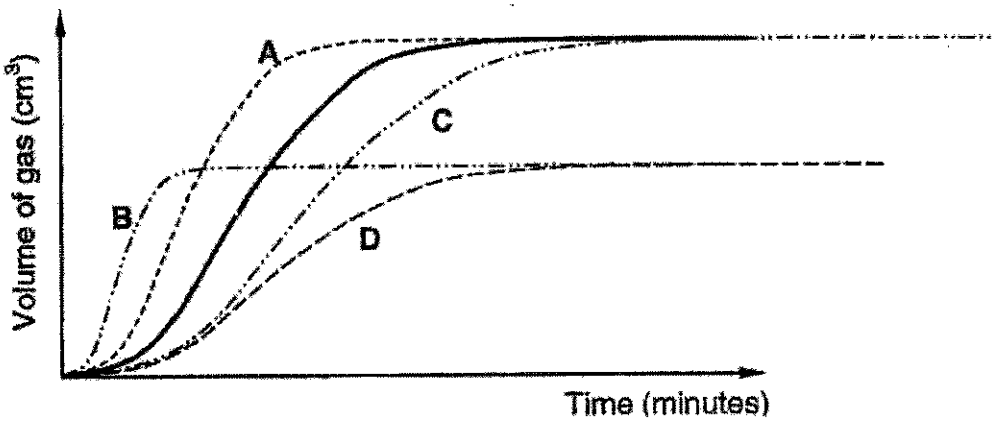
B $Mg(s) + 2H^+ \rightarrow Mg^{2+} + H_2(g)$

C $2Ag(s) + 2H^+ \rightarrow 2Ag^+ + H_2(g)$

D $Hg(\ell) + 2H^+ \rightarrow Hg^{2+} + H_2(g)$ (2)

1.4 In an experiment, a 2 g lump of zinc is added to excess dilute sulphuric acid. The experiment is repeated this time, adding 2 g powdered zinc to the same volume of the dilute acid.

The solid line in the graph below shows the volume of gas given off when the 2 g lump is used.



Which ONE of the DOTTED lines in the graph above is obtained when 2 g of powdered zinc is used? (2)

1.5 A catalyst is added to a system already at equilibrium. Which ONE of the combinations in the table below describes how the rates of the forward and reverse reactions are affected?

	FORWARD RATE	REVERSE RATE
A	Remains constant	Remains constant
B	Remains constant	Decreases
C	Increase	Remains constant
D	Increase	Increase

(2)

1.6 The reaction represented by the equation below has reached equilibrium. Hydrogen ions (H^+) are now added to the equilibrium mixture at a constant temperature.

$$Cr_2O_7^{2-}(aq) + H_2O(\ell) \rightleftharpoons 2CrO_2(aq) + 2H^+(aq)$$

What will the effect be on the concentration of the dichromate ions and the value of the equilibrium constant?

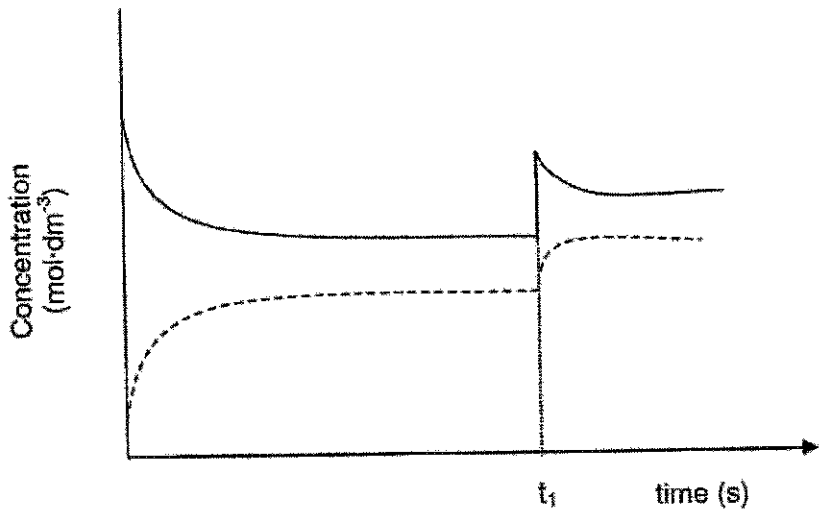
	$[Cr_2O_7^{2-}]$	K_c
A	Increases	Decreases
B	Decreases	Increases
C	Decreases	Stays the same
D	Increases	Stays the same

(2)

1.7 Consider the CONCENTRATION-TIME GRAPH below for the following equilibrium:

$$2\,HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

Which ONE of the following occurs at time t_1 on the graph below.



A Addition of H_2

B Addition of HI

C Addition of a catalyst

D A decrease in volume

(2)

1.8 Which ONE of the following solutions has the highest conductivity?

A 0,1 mol·dm^{-3} H_2CO_3

B 0,1 mol·dm^{-3} $(COOH)_2$

C 0,1 mol·dm^{-3} HNO_3

D 0,1 mol·dm^{-3} CH_3COOH (2)

1.9 Which ONE of the solutions below is acidic?

A KCℓ (aq)

B Na_2SO_4 (aq)

C $NH_4Cℓ$ (aq)

D CH_3COONa (aq)

(2)

1.10 Nitrogen, phosphorus and potassium are ingredients in fertilisers. They are essential nutrients for plant growth. Your lawn already has a well-developed root system. You need a fertilizer that will provide nutrients for rapid growth and green leaves, to protect the lawn during extreme dry conditions.

Which ONE of the following fertiliser mixtures will you use on your lawn?

A 7:1:1

B 1:1:5

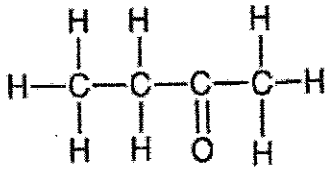
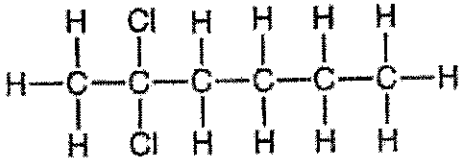
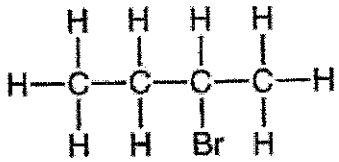
C 2:5:1

D 8:1:5 (2)

[20]

QUESTION 2 : (Start on a new page)

Study the organic compounds represented by the letters A to G in the table below.

A	$CH_3CH_2COOCH_2CH_3$	B	
C		D	$CH_3CH_2C(CH_3)_2CH_2CH(CH_3)_2$
E	Pentanoic acid	F	$CH_3CH_2CHCH_2$
G			

2.1 Write down the LETTER(S) that represent(s) each of following:
(A compound may be used more than once)

2.1.1 An alkyl halide (1)

2.1.2 A compound containing a carboxyl group (1)

2.1.3 An ester (1)

2.1.4 Two compounds that are structural isomers (2)

2.1.5 A ketone (1)

2.2 Write down the:

2.2.1 Structural formula of compound D (2)

2.2.2 IUPAC name of compound D (2)

2.3 Compound G is formed from compound F

2.3.1 Name the type of reaction that produces compound G (1

2.3.2 Give the FORMULA of the other compound that reacted with compound F to form compound G. (1

2.4 Give the IUPAC NAMES of the two compounds that will react to form COMPOUND A. (2

[1

QUESTION 3 : (Start on a new page)

A learner investigates the relationship between the structural isomers of pentane and their boiling points. The results obtained were recorded as shown below:

COMPOUND	MOLECULAR FORMUA	BOILING POINT (°C)
Pentane	C_5H_{12}	36
2-methylbutane	C_5H_{12}	28
2,2-dimethylpropane	C_5H_{12}	10

3.1 Define the term *structural isomer.* (2)

3.2 Name the homologous series to which the compounds belong. (1)

3.3 For this investigation write down the:

3.3.1 Dependent variable (1)

3.3.2 Independent variable (1)

3.3.3 Conclusion that can be drawn from the above results (2)

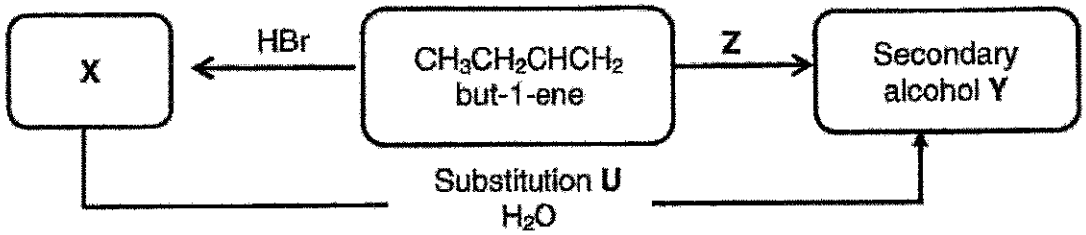
3.4 Refer to MOLECULAR STRUCTURE, INTERMOLECULAR FORCES and ENERGY needed, to explain your conclusion in QUESTION 3.3.3. (4)

3.5 What precaution should the learners take when carrying out the experiment? Give a reason. (2)

[13]

QUESTION 4 : (Start on a new page)

In industry alkenes are used in the synthesis of a variety of organic compounds. The flow diagram below illustrates some of the many possible reactions.



4.1 Use structural formulae to write a balanced equation for the formation of COMPOUND **X.** (4)

4.2 Name the type of reaction that takes place when but-1-ene is converted to COMPOUND **X.** (1)

4.3 Write down the structural formula and IUPAC name of the SECONDARY ALCOHOL **Y,** that is formed. (3)

4.4 Name the type of substitution reaction **U** that takes place when COMPOUND **X** is converted to the SECONDARY ALCOHOL **Y.** (1)

4.5 With the aid of a catalyst, but-1-ene can be converted directly to the secondary alcohol, without the formation of the intermediate compound **X.**

4.5.1 Besides but-1-ene, write down the NAME of the other reactant needed for this reaction **Z.** (1)

4.5.2 Write down the FORMULA of the catalyst that can be used. (1)

4.5.3 Name the type of REACTION **Z** that will take place during this direct conversion. (1)

4.6 Instead of adding water to compound X, concentrated sodium hydroxide is added and the mixture is heated.

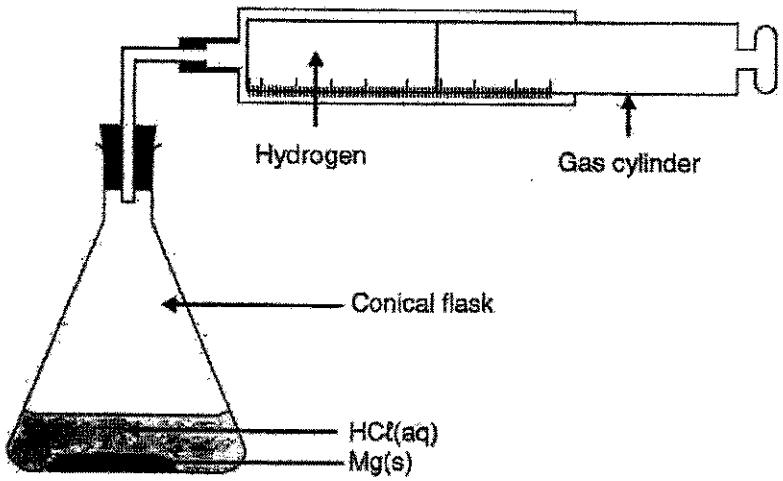
4.6.1 Write down the IUPAC name of the organic product that is formed. (1)

4.6.2 Name the TYPE of reaction that takes place. (1)

[14]

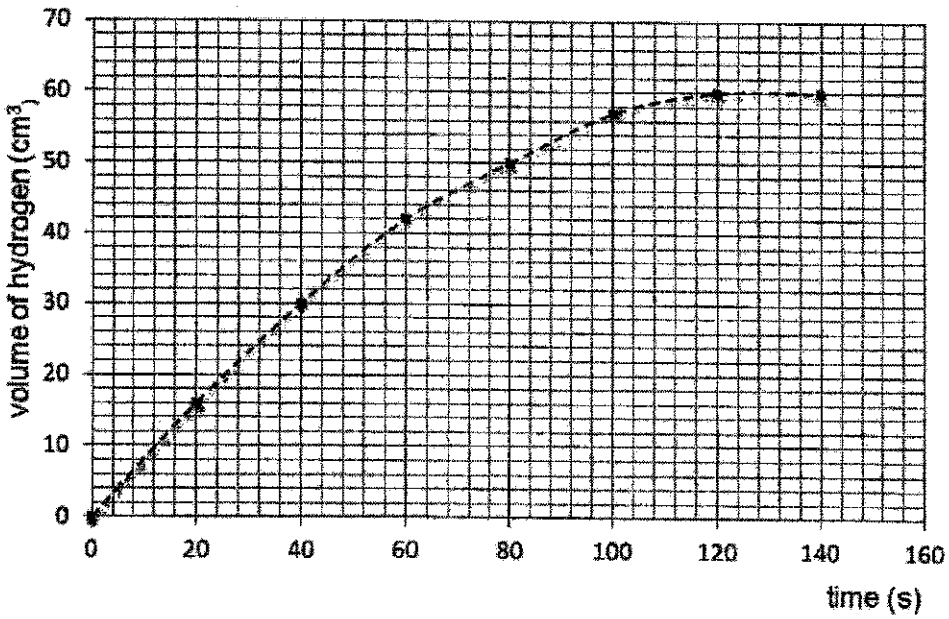
QUESTION 5 : (Start on a new page)

Learners use the reaction between magnesium powder and dilute hydrochloric acid to investigate some of the factors that affect the rate of a reaction. They use the apparatus shown below.



After the investigation, learners displayed their results graphically as shown below:

Graph of volume of H_2 versus time



5.1 Write down the balanced equation for the reaction of magnesium with hydrochloric acid. (3)

5.2 For this investigation, identify the:

5.2.1 Dependent variable (1)

5.2.2 Independent variable (1)

5.3 Use the graph to determine the volume of gas produced at t = 80 s. (1)

5.4 What will be the average rate for this reaction for the first 60 seconds? (2)

5.5 Redraw (not to scale) the basic outline of the graph above in your answer book. Label the graph as Q .

On the same set of axes, draw sketch graphs to represent how the following changes in conditions would affect the shape of the graph Q.
Label the new graphs "A" and "B".

5.5.1 The temperature of the reaction mixture is decreased.(Graph A) (2)

5.5.2 Half the amount of the powdered magnesium is now used with the same amount of dilute acid. (Graph B) (2)

5.6 What else could be added to the reaction mixture to make the reaction go faster? (1)

5.7 In each of the experiments learners use an excess of HCℓ(aq). Give a reason why the excess HCℓ(aq) will not influence the result. (2)

[15]

QUESTION 6 : (Start on a new page)

Scientists prepare an ester in a laboratory.
They first weigh 15 g of ethanoic acid and 11,5 g of ethanol. They carefully place the acid and alcohol into a conical flask and then add a few drops of concentrated sulphuric acid to the mixture.

The equilibrium reaction is represented by the equation below.

$$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

At equilibrium the mixture contained 3 g of ethanoic acid.

6.1 State *Le Chatelier's* principle. (2)

6.2 Write down the expression for the equilibrium constant, Kc, for this reaction. (Use all the reactants and products in the expression) (2)

6.3 Calculate the value of the equilibrium constant, K_c. (8)

6.4 What mass of water will be present in the equilibrium mixture? (2)

6.5 Use your knowledge of Le Chatelier's principle to briefly explain how the removal of water affects the yield of the ester. (2)

6.6 What is the role of *the few drops of concentrated sulphuric acid*? (1)

[17]

QUESTION 7 : (Start on a new page)

7.1 A bottle in a laboratory contains dilute sulphuric acid of unknown concentration. Learners wish to determine the concentration of the sulphuric acid solution. To do this they titrate the sulphuric acid against a standard potassium hydroxide solution.

The balanced equation for the reaction taking place is:

$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$

7.1.1 What is a standard solution? (1)

7.1.2 Calculate the mass of KOH which he must use to make 300 cm^3 of a 0.2 $mol \cdot dm^{-3}$ KOH solution. (3)

7.1.3 Calculate the pH of the 0.2 $mol \cdot dm^{-3}$ KOH solution. (5)

7.1.4 Which one of the indicators listed in the table below should he use in this titration? Explain your answer.

INDICATOR	pH
Methyl orange	2.9 – 4.0
Methyl red	4.4 – 6.0
Bromothymol blue	6.0 – 10.0
phenolpthalein	8.3 – 10.0

(2)

7.1.5 During the titration the learners finds that 15 cm^3 of the KOH solution neutralises 20 cm^3 of the H_2SO_4 solution. Calculate the concentration of the H_2SO_4 solution. (4)

7.2 An impure sample of calcium oxalate, CaC_2O_4, with a mass of 0.803 g, is titrated with 15.70 cm^3 of a 0.101 $mol \cdot dm^{-3}$ $KMnO_4$.

The net reaction is...

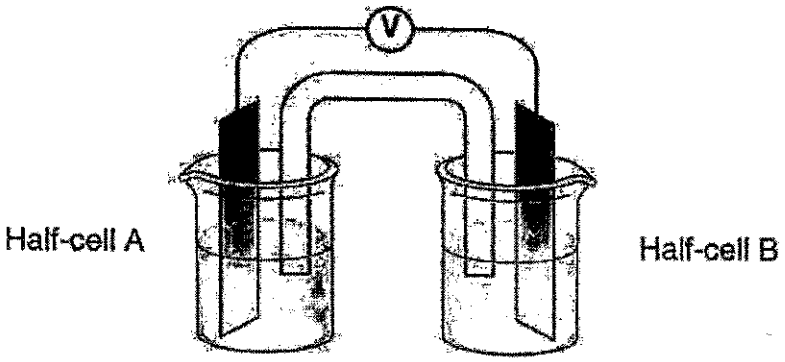
$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

Calculate the percentage purity of the CaC_2O_4 in the original sample. (6)

[21]

QUESTION 8 : (Start on a new page)

A learner sets up an electrochemical cell as represented in the diagram below. The cell consist of a Mg electrode dipped into a $Mg(NO_3)_2$ solution, and a Pb electrode dipped into a $Pb(NO_3)_2$ solution.



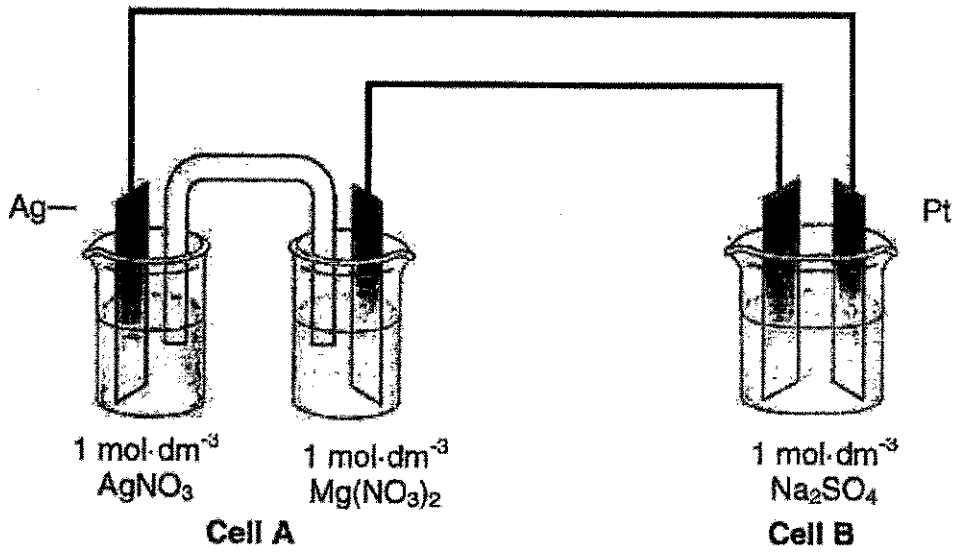
8.1 Write down the half- reaction that takes place in half cell A. (2)

8.2 Write down the overall net reaction for the cell. (3)

8.3 Calculate the emf of this cell. (4)

8.4 How will an increase in $[Mg^{2+}(aq)]$ influence the value of the cell's emf calculated in QUESTION 8.3. Write down only INCREASES, DECREASES or STAYS THE SAME. (1)

8.5 Consider the following apparatus consisting of a galvanic cell joined to an electrolytic cell....



8.5.1 On the diagram above, in which direction will electrons flow in the top wire as the reaction proceeds? Choose between Pt to Ag OR Ag to Pt (1)

8.5.2 Which metal is the cathode in cell A? (1)

For Cell B, write down the equation for the reactions taking place at the:

8.5.3 Anode (2)

8.5.4 Cathode (2)

[16]

QUESTION 9 : (Start on a new page)

Aluminium is extracted from its ore by the electrolysis of molten aluminium oxide. The aluminium oxide is dissolved in molten cryolite. On average it takes about 15.7 kWh of electricity to produce 1 kg of aluminium. This is what makes aluminium smelting so expensive.

9.1 Explain why aluminium oxide is dissolved in molten cryolite ? (1)

9.2 Explain why the aluminium oxide needs to be in molten state. (1)

9.3 What is the major environmental problems associated with the manufacture of aluminium? (1)

9.4 During electrolysis the aluminium ion (Al^{3+}) is attracted towards the cathode. Give the half reaction that takes place at the ANODE. (2)

9.5 Explain why we should recycle as much aluminium as possible. (1)

9.6 In nature aluminium reacts with oxygen to form $A\ell_2O_3$.The balanced equation for the reaction is shown below.

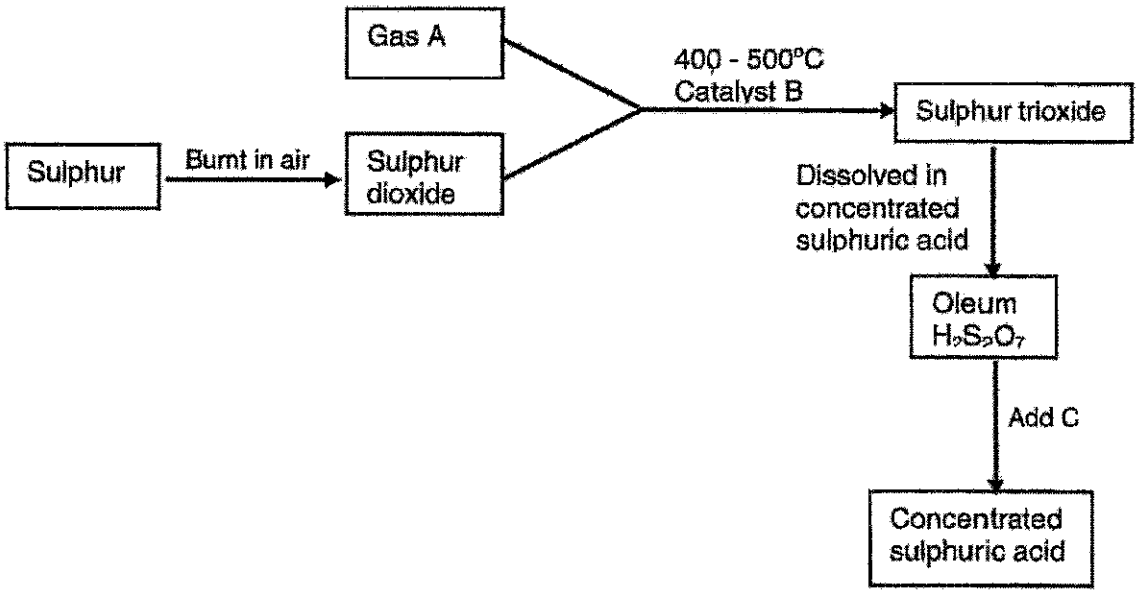
$$4A\ell + 3O_2 \rightarrow 2A\ell_2O_3$$

In one reaction, 8,1 g of aluminium reacts with 8 g of oxygen. Determine the limiting reactant. (5)

[11]

QUESTION 10 : (Start on a new page)

10.1 The synthesis of Sulphuric acid is made possible by a method called the contact process. A flow diagram for that process is shown in the following diagram.



10.1.1 Name gas A. (1)

10.1.2 Name catalyst B. (1)

10.1.3 Name liquid C. (1)

10.1.4 Sulphur trioxide reacts with water to form/produce sulphuric acid. Explain why it is never done that way. (1)

10.1.5 Write down a balanced chemical equation to illustrate how concentrated sulphuric is formed from oleum. (2)

10.2 One of the main uses of ammonia is to manufacture nitrogenous fertilisers such as ammonium sulphate. Name the substance that is used to neutralise ammonia to make this fertiliser. (1)

10.3 Write down a balanced equation to show how this reaction mentioned in QUESTION 10. 2 TAKES PLACE. (2)

[9]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

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/*TABEL 2: FORMULES*

$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$c=\frac{n}{V}$ OR / OF $c=\frac{m}{MV}$	$n=\frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b}=\frac{n_a}{n_b}$	pH = -log[H_3O^+]
Kw = [H_3O^+][OH^-] = 1×10^{-14} at 298 K	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ / $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ / $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$ $E^\theta_{cell} = E^\theta_{oxidisingagent} - E^\theta_{reducingagent}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

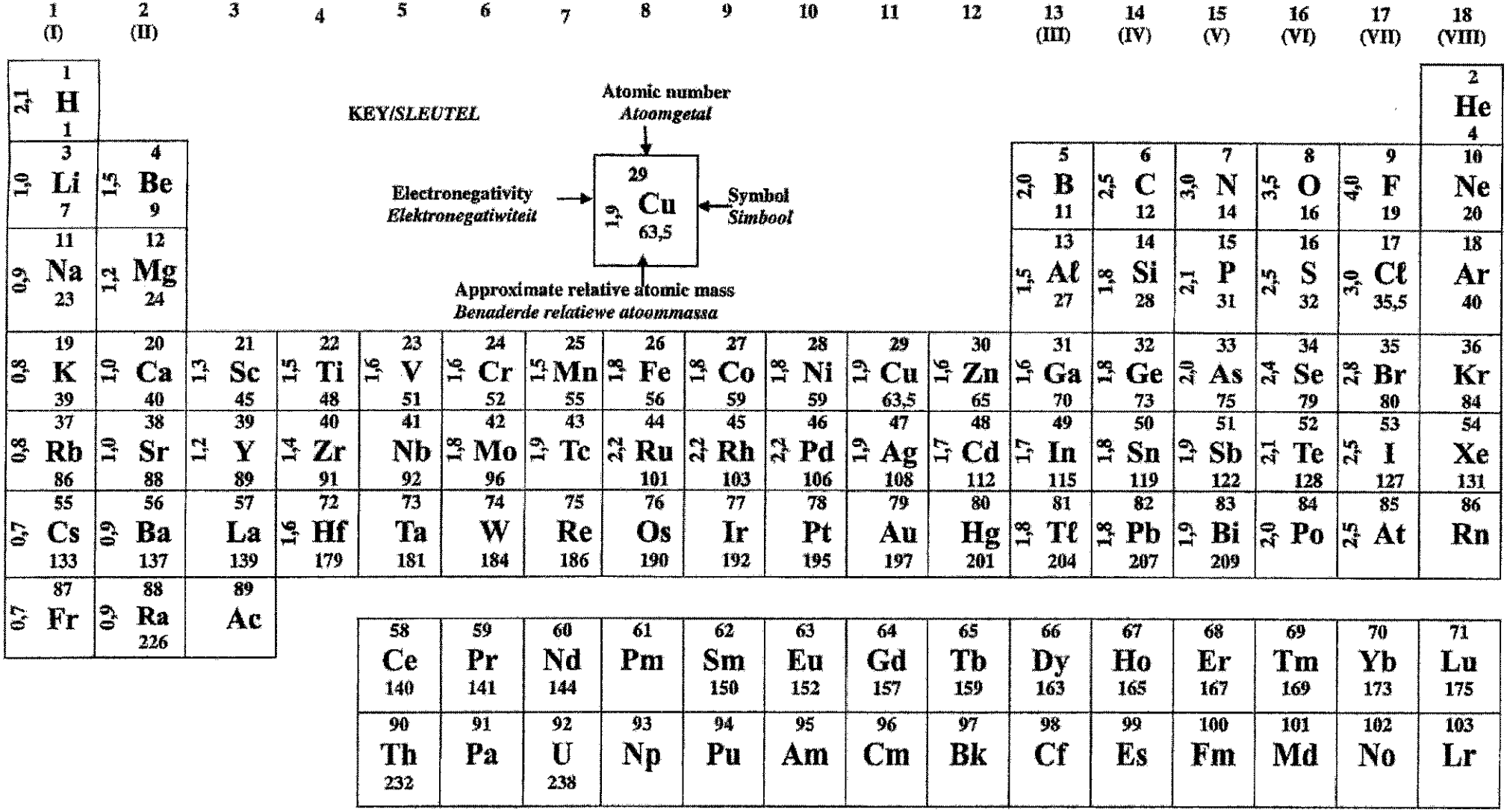


TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Half-reactions/*Halfreaksies*	E^{θ} (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+ 1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^- \rightleftharpoons 2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$Br_2(\ell) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(\ell)$	+ 0,85
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+ 0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	**0,00**
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	− 0,06
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	− 0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	− 0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	− 0,27
$Co^{2+} + 2e^- \rightleftharpoons Co$	− 0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	− 0,40
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	− 0,41
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	− 0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	− 0.74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	− 0,76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	− 0,83
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	− 0,91
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	− 1,18
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	− 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	− 2,36
$Na^+ + e^- \rightleftharpoons Na$	− 2,71
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	− 2,87
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	− 2,89
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	− 2,90
$Cs^+ + e^- \rightleftharpoons Cs$	− 2,92
$K^+ + e^- \rightleftharpoons K$	− 2,93
$Li^+ + e^- \rightleftharpoons Li$	− 3,05

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Half-reactions/*Halfreaksies*	E^{θ} (V)
$Li^+ + e^- \rightleftharpoons Li$	−3,05
$K^+ + e^- \rightleftharpoons K$	−2,93
$Cs^+ + e^- \rightleftharpoons Cs$	−2,92
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	−2,90
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	−2,89
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	−2,87
$Na^+ + e^- \rightleftharpoons Na$	−2,71
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	−2,36
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	−1,66
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	−1,18
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	−0,91
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	−0,83
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	−0,76
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	−0,74
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	−0,44
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	−0,41
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	−0,40
$Co^{2+} + 2e^- \rightleftharpoons Co$	−0,28
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	−0,27
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	−0,14
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	−0,13
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	−0,06
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	**0,00**
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+0,14
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+0,15
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+0,16
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+0,17
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+0,34
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+0,40
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+0,45
$Cu^+ + e^- \rightleftharpoons Cu$	+0,52
$I_2 + 2e^- \rightleftharpoons 2I^-$	+0,54
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+0,68
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0,77
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+0,80
$Ag^+ + e^- \rightleftharpoons Ag$	+0,80
$Hg^{2+} + 2e^- \rightleftharpoons Hg(\ell)$	+0,85
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+0,96
$Br_2(\ell) + 2e^- \rightleftharpoons 2Br^-$	+1,07
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+1,20
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+1,23
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+1,33
$C\ell_2(g) + 2e^- \rightleftharpoons 2C\ell^-$	+1,36
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+1,51
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+1,81
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+2,87

Increasing reducing ability/*Toenemende reduserende vermoë* ↑