Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2013

PHYSICAL SCIENCES P2

MARKS: **150**

TIME: **3 hours**

* P H S C E 2 *

This question paper consists of 18 pages, including four data sheets and one answer sheet.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME (and/or exam number if applicable) in the appropriate spaces on the ANSWER SHEET and ANSWER BOOK.

2. Answer ALL the questions.

3. This question paper consists of TWO sections:
   SECTION A: 25 marks
   SECTION B: 125 marks.

4. Answer SECTION A on the attached ANSWER SHEET and SECTION B in the ANSWER BOOK.

5. Non-programmable calculators may be used.

6. Appropriate mathematical instruments may be used.

7. Number your answers correctly according to the numbering system used in this question paper.

8. Data Sheets and a Periodic Table are attached for your use.

9. Wherever motivations, discussions, etc. are required, be brief.

SECTION A

Answer this section on the attached ANSWER SHEET.

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for EACH of the following descriptions. Write only the word/term next to the question number (1.1−1.5) on the ANSWER SHEET.

1.1 All organic compounds containing only carbon and hydrogen atoms (1)

1.2 A substance which causes equilibrium to be established faster but has no effect on the equilibrium concentrations (1)

1.3 A chemical reaction in which there is a transfer of electrons (1)

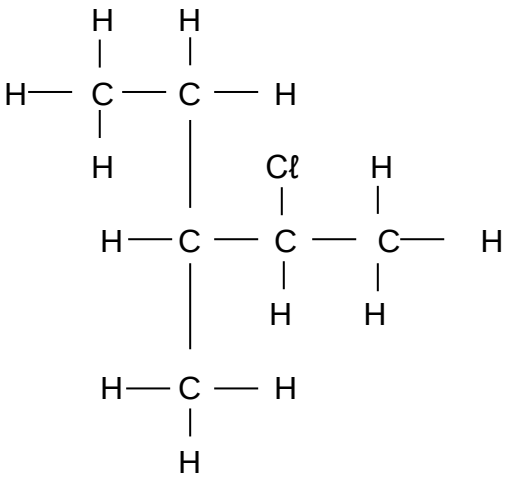
1.4 Addition of bromine (Br_2) to an alkene (1)

1.5 Batteries which cannot be recharged (1)
[5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and make a cross (X) in the appropriate block next to the question number (2.1−2.10) on the ANSWER SHEET.

2.1 Consider the organic compound which follows:



The IUPAC name of this compound is ...

A 2-chloro-1-ethyl-1-methylpropane.
B 2-chloro-3-methylpentane.
C 4-chloro-3-methylpentane.
D 2-chloro-3-ethyl-3-methylpropane. (2)

2.2 Identify the compound which belongs to the same homologous series as C_2H_6.

A C_4H_8
B C_3H_6
C C_2H_4
D C_3H_8 (2)

2.3 Which ONE of the following compounds will have the lowest boiling point?

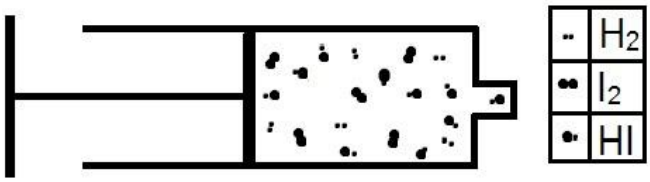
A propanol
B propanoic acid
C propene
D propane (2)

2.4 Identify the statement which is CORRECT.

A Butene is a good example of a saturated hydrocarbon.
B Propene can undergo hydrogenation to form propyne.
C Ethene can react with bromine in an addition reaction.
D Butene cannot have a branched isomer. (2)

2.5 A mixture of $H_2(g)$ and $I_2(g)$ is sealed in a gas syringe. The mixture is then allowed to reach equilibrium at a constant temperature according to the equation:

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



What will happen to the **concentration** and **yield** of HI if the piston is moved inwards while the temperature remains constant?

	[HI]	Yield of HI
A	Increases	Decreases
B	Decreases	Stays the same
C	Decreases	Increases
D	Increases	Stays the same

(2)

2.6 The equilibrium constant for the reaction:

$$2NO_2(g) \rightleftharpoons N_2O_4(g) + \text{energy}$$

is dependent on the …

A mass of NO_2 initially used.
B pressure on the gas mixture.
C temperature at which equilibrium is reached.
D catalyst used. (2)

2.7 For a particular reaction, $K_c = 0,001$. This means that at equilibrium, …

A the reaction has a low concentration of products.
B the reaction proceeds at a slow rate.
C the reaction has a high concentration of products.
D the pH of the solution is below 7. (2)

2.8 Which of the following standard electrochemical cells would have the highest emf?

A $2I^- \mid I_2 \parallel Ag^+ \mid Ag$
B $Mg \mid Mg^{2+} \parallel Mn^{2+} \mid Mn$
C $Cr \mid Cr^{2+} \parallel Cu^{2+} \mid Cu$
D $Pb \mid Pb^{2+} \parallel Hg^{2+} \mid Hg$ (2)

2.9 In a zinc-carbon cell (battery), the anode is …

A the carbon rod.
B the outer zinc container.
C the mixture of carbon and manganese paste.
D None of the above. (2)

2.10 In which ONE of the following industrial processes is nitrogen oxide (NO) formed at some stage of the process?

A the Haber process.
B the Ostwald process.
C the contact process.
D Fractional distillation of air. (2)

[20]

TOTAL SECTION A: 25

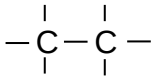
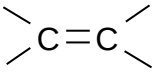
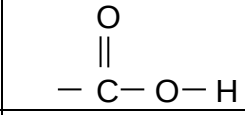
SECTION B

INSTRUCTIONS AND INFORMATION

1. Answer this section in the ANSWER BOOK.
2. Start each question on a NEW page.
3. Leave a line between two subsections, e.g. between QUESTIONS 3.1 and 3.2.
4. The formulae and substitutions must be shown in ALL calculations.
5. Round off your answers to TWO decimal places.

QUESTION 3 (Start on a new page.)

Consider the table below, then answer the questions which follow.

Homologous series	Name of example	Structure of functional group	Condensed structural formula of example
alkane	**A**		$CH_3CH_2CH_2CH_3$
alkene	3-methyl-2-pentene		**B**
C	propanoic acid		**D**
E	ethanal	**F**	CH_3CHO

3.1 Give the name and molecular formula for the example at **A**. (1 + 1) (2)

3.2 Give the condensed structural formulae for **B** and **D**. (2 + 2) (4)

3.3 Name the homologous series at **C** and **E**. (1 + 1) (2)

3.4 Draw the functional group which should occur at **F**. (1)

3.5 Define the term *isomer*. (2)

3.6 Refer to **D** in the table.

3.6.1 Draw the structural formula for an isomer of this compound. (2)

3.6.2 Give the IUPAC name for the isomer drawn in QUESTION 3.6.1 above. (2)

3.6.3 Name the homologous series which this isomer belongs to. (1)

[16]

QUESTION 4 (Start on a new page.)

4.1 An alkene, dissolved in a non-polar solvent with a Pt catalyst, reacts with hydrogen gas to form propane.

4.1.1 Name the alkene that takes part in this chemical reaction. (1)

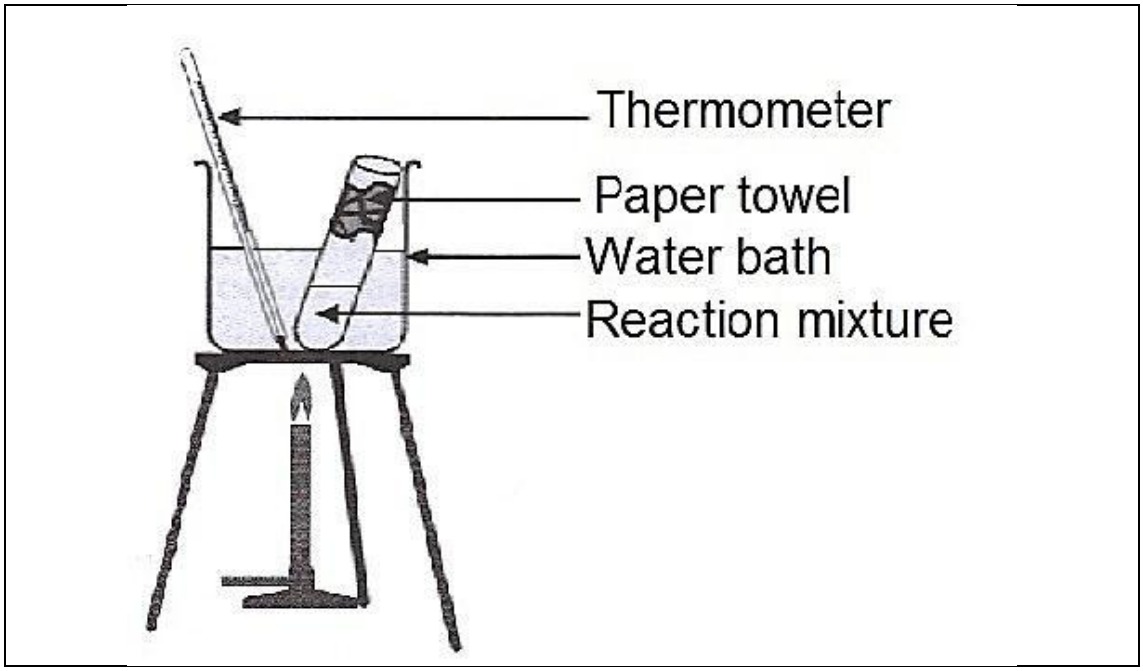
4.1.2 Use structural formulae to show the balanced chemical equation for the reaction. (3)

4.1.3 What type of chemical reaction takes place here? (2)

4.1.4 Identify the compound in the reaction that is an example of a saturated hydrocarbon. (1)

4.1.5 Give the general formula for the alkenes. (2)

4.2 Esters are known for their pleasant smells and can be prepared by using a carboxylic acid as one of the reactants. An ester with six carbon atoms is prepared using the apparatus below. Butanoic acid is one of the reactants.



4.2.1 Name the other reactant needed to form the above-mentioned ester. (1)

4.2.2 Give the molecular formula for the catalyst needed for this reaction. (1)

4.2.3 Give the name AND structural formula of the ester formed during this preparation. (2 + 2) (4)

[15]

QUESTION 5 (Start on a new page.)

Methyl methanoate and ethanoic acid are two organic compounds with different properties, yet they have the same molecular formula, that is, $C_2H_4O_2$.

5.1 Which ONE of the above-mentioned compounds will have the higher boiling point? Give a reason for your answer. (1 + 2) (3)

5.2 Identify the compound which will have the higher vapour pressure. Give a reason for your answer. (1 + 2) (3)

5.3 Which ONE of ethanoic acid or butanoic acid will have the higher vapour pressure? Give a reason for your answer. (1 + 2) (3)

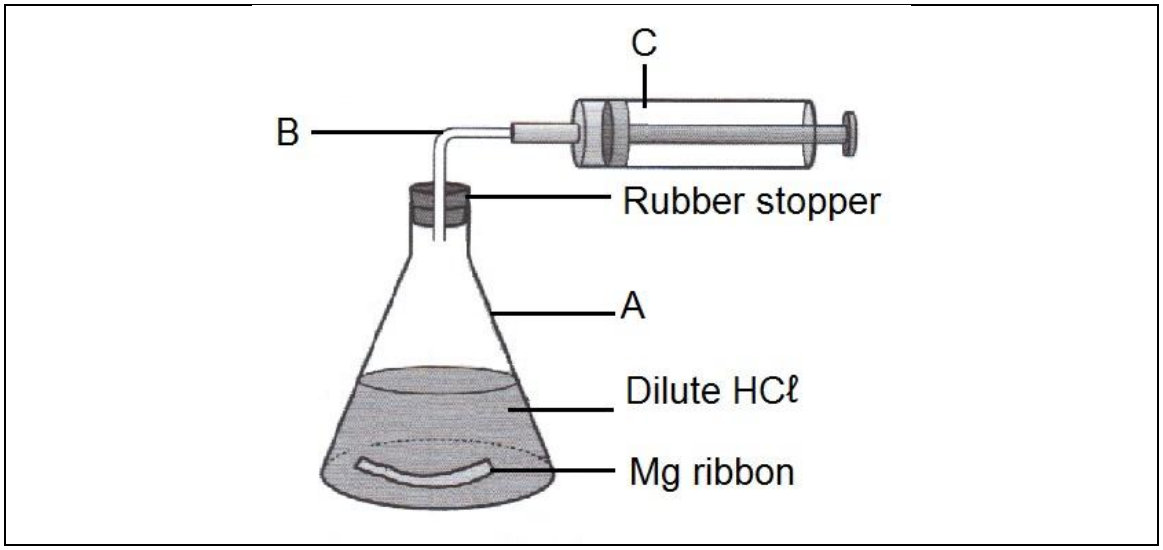
[9]

QUESTION 6 (Start on a new page.)

6.1 The reaction between magnesium ribbon and hydrochloric acid is used in an experiment by some learners to investigate the factors that influence the rate of a chemical reaction. The reaction that takes place is:

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

The diagram below shows the basic setup for this investigation.



6.1.1 Give the label for any ONE of the apparatus A, B **or** C. (1)

6.1.2 Name ONE apparatus not shown in the diagram which is important for this investigation. (1)

6.1.3 In TWO steps, describe the procedure the learners should follow to measure the rate of the reaction. (4)

6.1.4 In what way will the rate at which H_2 gas is formed be affected if heat was added to apparatus A? Write only INCREASES, DECREASES or STAYS THE SAME as your answer. (1)

6.1.5 Use the collision theory to explain the conclusion you came to in QUESTION 6.1.4. (2)

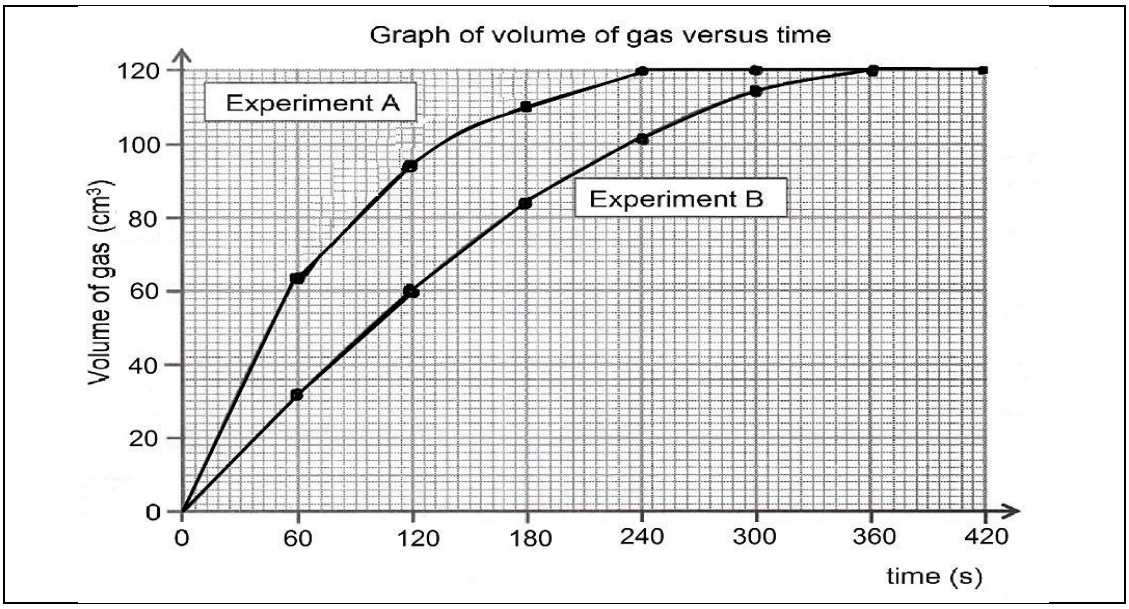
6.1.6 In terms of energy, what type of a reaction is this? Explain your answer. (3)

6.1.7 Draw a sketch graph to illustrate the energy changes referred to in QUESTION 6.1.6. (2)

6.1.8 Assume the learners use magnesium powder (with the same mass as the magnesium ribbon) in place of the magnesium ribbon. Will the rate of the reaction INCREASE, DECREASE or STAY THE SAME? (1)

6.1.9 Explain your answer to QUESTION 6.1.8 by referring to the collision theory. (2)

6.2 In one experiment (A), the learners use 50 cm^3 of HCℓ of known concentration and in another, experiment (B), they use 25 cm^3 of the same HCℓ diluted to 50 cm^3 with distilled water. The graph which follows represents the results obtained.



6.2.1 State an investigative question for this investigation. (2)

6.2.2 What volume of gas was formed during the first two minutes in Experiment B? (1)

6.2.3 How much time (in minutes) elapsed before Experiment A reached completion? (1)

6.2.4 Which experiment (Experiment A or Experiment B) took place at the faster rate? Refer to the graph and give a reason for your answer. (2)

6.2.5 What conclusion can be drawn from the results obtained? (2)

[25]

QUESTION 7 (Start on a new page.)

The second step in an important industrial process sees sulphur dioxide react with oxygen in the presence of a catalyst, vanadium(V) oxide, to form sulphur trioxide according to the following chemical equation:

$$2\ SO_2\ (g)\ +\ O_2\ (g)\ \rightleftharpoons\ 2\ SO_3\ (g)\quad \Delta H = -193\ kJ$$

7.1 Write down the balanced chemical equation for the reaction which takes place in the first step of this process. (2)

7.2 The temperature of the reaction vessel is increased.

7.2.1 Will the forward or reverse reaction be favoured? (2)

7.2.2 Use Le Chatelier's principle to explain your answer in QUESTION 7.2.1. (2)

7.3 Some changes, listed below, are brought about to the equilibrium system. Use only the words INCREASES, DECREASES or STAYS THE SAME as your answer to indicate the effect of the change on the amount of SO_2 at equilibrium.

7.3.1 The pressure on the mixture was increased by decreasing the volume. (1)

7.3.2 Additional O_2 was injected into the container at constant volume. (1)

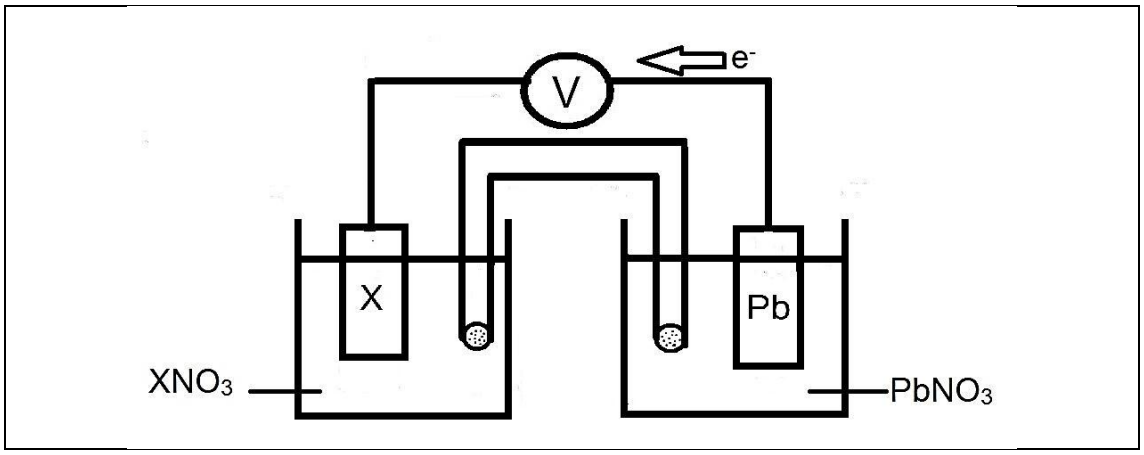
7.3.3 More vanadium(V) oxide was added. (1)

7.4 Assume 0,3 mol of SO_2 gas and 0,15 mol of O_2 gas are sealed in a rigid container with a volume of 2 dm^3. The reaction takes place at a certain temperature and at equilibrium it is found that 0,10 mol of SO_2 is still present in the container. Calculate the equilibrium constant for the reaction at this temperature. (8)

[17]

QUESTION 8 (Start on a new page.)

8.1 A galvanic (voltaic) cell containing an unknown metal electrode **X** is represented in the diagram below. The initial reading on the voltmeter is 0,93 V. Assume the cell operates under standard conditions.



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

8.1.2 Identify metal X by calculating the standard reduction potential of the unknown metal. (5)

8.1.3 Give the cell notation for this cell. (3)

8.1.4 Identify the oxidising agent in this cell. (1)

8.1.5 Write the half-reaction that occurs at the anode. (2)

8.1.6 In which direction, from half-cell X to the Pb half-cell or from the Pb half-cell to half-cell X, do cations move within the salt bridge to maintain electrical neutrality? Explain how you arrived at your answer. (4)

8.2 Electrolysis is an important industrial process and is used to extract aluminium from its mineral ore, bauxite, by means of the Hall-Heroult process. After iron, aluminium is the second most widely used metal. The main cost to produce aluminium is in the electrical energy consumed. An aluminium smelter uses huge amounts of electricity.

8.2.1 What type of energy conversion takes place during the production of aluminium? (2)

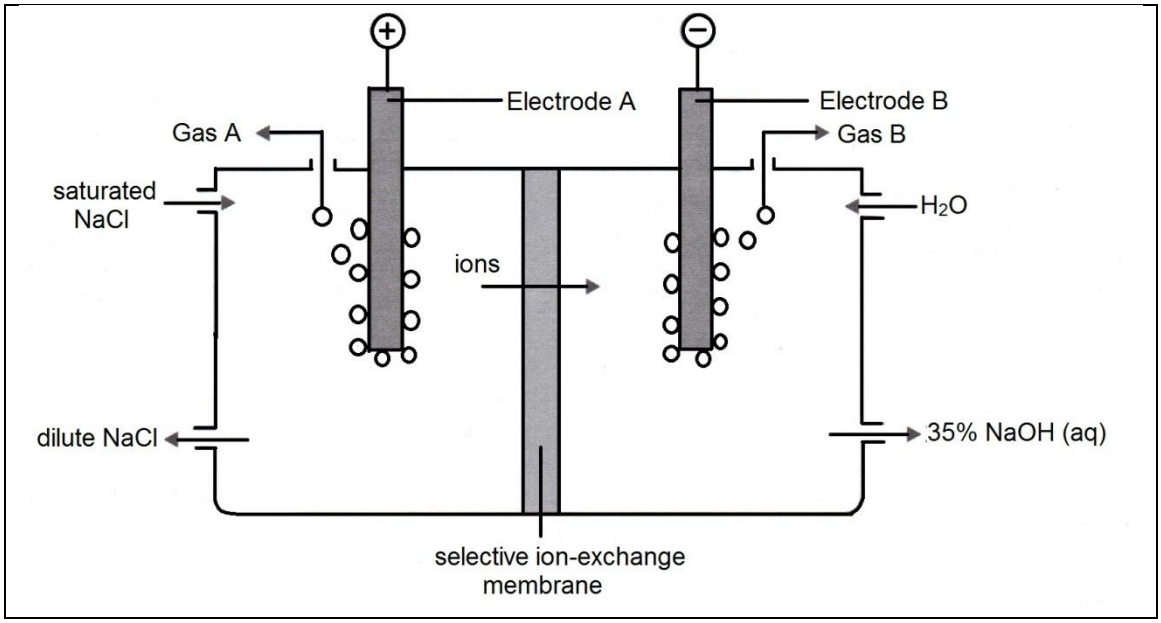
8.2.2 Name TWO advantages that the use of aluminium has over that of iron. (2)

8.2.3 Environmentalists argue that the production of aluminium is a huge contributor to the greenhouse effect and global warming. In what way does the production of aluminium contribute to the greenhouse effect and/or global warming? (2)

[23]

QUESTION 9 (Start on a new page.)

9.1 Consider the diagram of a membrane cell and answer the questions which follow.



9.1.1 Which electrode (A or B) is the anode? (1)

9.1.2 Name the gas which is formed at the anode. (1)

9.1.3 State ONE risk associated with the manufacture of the gas mentioned in QUESTION 9.1.2. (2)

9.1.4 Write the half reaction which occurs at the anode. (2)

9.1.5 NAME the ions which are allowed to flow through the selective ion-exchange membrane. (1)

9.2 Ammonium nitrate and ammonium sulphate are two important nitrogen containing inorganic fertilisers. Both ammonium salts are prepared from PRODUCT A, which is a product of the Haber process. Ammonium sulphate is formed when PRODUCT A reacts with PRODUCT B, which is a product of the contact process. Ammonium nitrate is prepared from PRODUCT A and PRODUCT C, which is a product of the Ostwald process.

9.2.1 Identify PRODUCT A. (1)

9.2.2 Show by means of a balanced chemical equation how EITHER ammonium sulphate OR ammonium nitrate is formed. (3)

9.2.3 Why are these fertilisers said to be inorganic? (1)

9.2.4 Give ONE reason why nitrogen is such an important primary nutrient for plants. (2)

9.3 Zinc-carbon and alkaline batteries (cells) are relatively inexpensive (cheap), but useful batteries. They are basically the same except that the electrolyte in the zinc-carbon battery is ammonium chloride whereas in the alkaline battery it is potassium hydroxide. The overall chemical equation for the reaction in ONE of these two cells is:

$$Zn(s) + 2MnO_2(s) + 2NH_4^+(aq) \longrightarrow Mn_2O_3 +(s) + H_2O + Zn^{2+}(aq) + 2NH_3(aq)$$

9.3.1 Identify the type of cell (zinc-carbon OR alkaline) where the above overall chemical equation will occur. (2)

9.3.2 Which of these two batteries delivers the higher current for a longer period of time? (1)

9.3.3 Name ONE appliance which uses this type of battery. (1)

9.3.4 Name ONE disadvantage of these types of batteries. (2)

[20]

TOTAL SECTION B: 125
GRAND TOTAL: 150

NATIONAL SENIOR CERTIFICATE
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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*

NAAM/*NAME*	SIMBOOL/*SYMBOL*	WAARDE/*VALUE*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume teen STD*	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$c = \frac{n}{V}$ or $c = \frac{m}{MV}$
$q = I\,\Delta t$ $W = Vq$	$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

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

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)
2,1 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2.0 5 B 11	2.5 6 C 12	3.0 7 N 14	3.5 8 O 16	4.0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1.5 13 Aℓ 27	1.8 14 Si 28	2.1 15 P 31	2.5 16 S 32	3.0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 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	1,8 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 88 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

KEY/ *SLEUTEL*

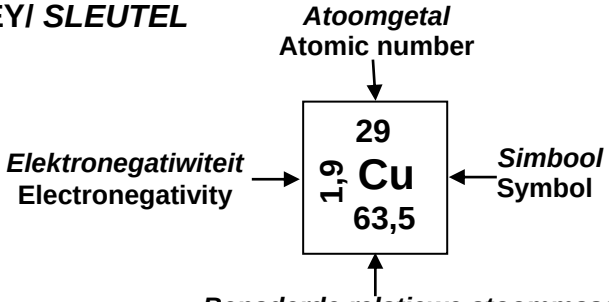

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

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 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* ↑

PHYSICAL SCIENCES – PAPER 2
FISIESE WETENSKAPPE – VRAESTEL 2

ANSWER SHEET/*ANTWOORDBLAD*

NAME/*NAAM*: ……..

SECTION A/*AFDELING A*

QUESTION 1: ONE WORD ITEMS/*VRAAG 1: EENWOORD-ITEMS*

1.1 **……** (1)

1.2 **……** (1)

1.3 **……** (1)

1.4 **……** (1)

1.5 **……** (1)
[5]

QUESTION 2: MULTIPLE CHOICE QUESTIONS/
VRAAG 2: MEERVOUDIGEKEUSE-VRAE

2.1	A	B	C	D
2.2	A	B	C	D
2.3	A	B	C	D
2.4	A	B	C	D
2.5	A	B	C	D
2.6	A	B	C	D
2.7	A	B	C	D
2.8	A	B	C	D
2.9	A	B	C	D
2.10	A	B	C	D

(10 x 2) **[20]**

TOTAL SECTION A/*TOTAAL AFDELING A*: 25