education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

EXEMPLAR 2008

MARKS: 150

TIME: 3 hours

This question paper consists of 17 pages, a 4-page data annexure, an answer sheet and 1 sheet of graph paper.

INSTRUCTIONS AND INFORMATION

1. Write your name and/or examination number (and centre number if applicable) in the appropriate spaces on the ANSWER BOOK, ANSWER SHEET and GRAPH PAPER.

2. Answer ALL the questions.

3. Answer SECTION A on the attached ANSWER SHEET.

4. Answer SECTION B in the ANSWER BOOK. Answer QUESTION 6.2 on the attached GRAPH PAPER.

5. Non-programmable calculators may be used.

6. Appropriate mathematical instruments may be used.

7. Number the 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, et cetera 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 attached ANSWER SHEET.

1.1 Compounds with the same molecular formula but different structural formulae (1)

1.2 The unstable intermediate compound formed during a chemical reaction (1)

1.3 An ionic solution that conducts electricity (1)

1.4 The reactant that donates electrons during a redox reaction (1)

1.5 The process of separating nitrogen from liquid air (1)
[5]

QUESTION 2: MATCHING ITEMS

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A – J) next to the question number (2.1 – 2.5) on the attached ANSWER SHEET.

COLUMN A		COLUMN B	
2.1	The functional group of an amide	A	negative electrode
2.2	A substance that decreases the activation energy of a reaction	B	$-NH_2$
2.3	Anode in an electrolytic cell	C	catalyst
2.4	Secondary cell	D	$-C(=O)-NH_2$
2.5	Ostwald process	E	isomer
		F	dry cell
		G	positive electrode
		H	ammonia
		I	car battery
		J	nitric acid

[5]

QUESTION 3: TRUE OR FALSE

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (3.1 – 3.5) on the attached ANSWER SHEET. Correct the statement if it is FALSE.

3.1 The simplest ketone has three carbon atoms. (2)

3.2 A reaction reaches equilibrium when the concentrations of the products and reactants are equal. (2)

3.3 If sulphur dioxide reacts with oxygen in an open container, equilibrium is reached after a while. (2)

3.4 The reactions $C(s) + O_2(g) \rightarrow CO_2(g)$ and $2KC\ell O_3(s) \rightarrow 2KC\ell(s) + 3O_2(g)$ are examples of redox reactions. (2)

3.5 During the industrial preparation of chlorine and sodium hydroxide, chemical energy is converted to electrical energy. (2)

[10]

QUESTION 4: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (4.1 – 4.5) on the attached ANSWER SHEET.

4.1 A simple reaction scheme is shown below.

$$CH_3CH = CH_2 \xrightarrow{HBr(g} X \xrightarrow[NaOH(aq)]{\text{reflux with}} Y + HBr$$

The formula for Y is …

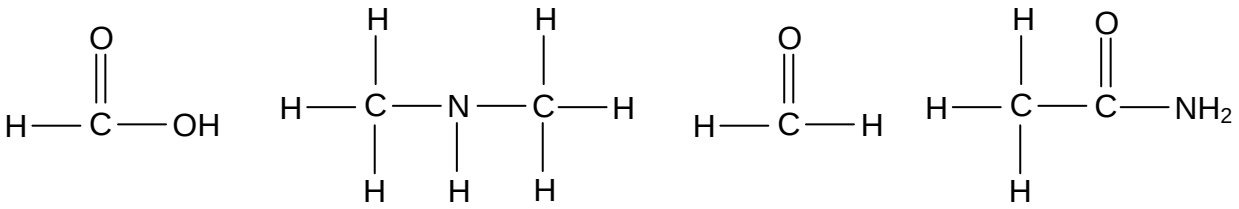
A CH_3CH_2COOH

B $CH_3CHOHCH_3$

C $CH_3CHBrCH_2OH$

D $CH_3CHOHCH_2Br$ (3)

4.2 The structural formulae for four compounds are shown below.



These compounds can be classified in the correct sequence as …

A Carboxylic acid, amine, amide, aldehyde

B Carboxylic acid, amide, aldehyde, amine

C Aldehyde, amine, carboxylic acid, amide

D Carboxylic acid, amine, aldehyde, amide (3)

4.3 The following reaction is in equilibrium in a closed container:

$$PC\ell_5(g) \rightleftharpoons PC\ell_3(g) + C\ell_2(g) \qquad \Delta H < 0$$

Which ONE of the following statements regarding the equilibrium is TRUE?

A Addition of a catalyst favours the forward reaction.

B Increasing the temperature has no effect on the yield of products.

C An increase in the concentration of $PC\ell_5(g)$ causes an increase in the concentration of the products.

D Increasing the temperature causes the value of the equilibrium constant to increase. (3)

4.4 Which statement is CORRECT for a Zn-Cu galvanic cell that operates under standard conditions?

A The concentration of the Zn^{2+} ions in the zinc half-cell gradually decreases.

B The concentration of the Cu^{2+} ions in the copper half-cell gradually increases.

C Negative ions migrate from the zinc half-cell to the copper half-cell.

D The intensity of the colour of the electrolyte in the copper half-cell gradually decreases. (3)

4.5 Which one of the following solutions can be stored in an aluminium container? (Use the Table of Standard Reduction Potentials.)

A $CuSO_4(aq)$

B $ZnSO_4(aq)$

C $NaC\ell(aq)$

D $Pb(NO_3)_2(aq)$ (3)
[15]

TOTAL SECTION A: 35

SECTION B

INSTRUCTIONS

1. Answer this section in the ANSWER BOOK.

2. In ALL calculations the formulae and substitutions must be shown.

3. Round off your answers to TWO decimal places.

QUESTION 5

Alcohols are used in a variety of chemical reactions and as preservatives in certain medicines. All alcohols are toxic. Although **ethanol** is the least toxic of all alcohols, it is still a poisonous substance. It is rapidly absorbed into the blood. High blood alcohol levels can cause brain poisoning. The body can reduce high blood alcohol levels by oxidising the alcohol. Contrary to what people believe, alcohol is a depressant and not a stimulant.

The following table indicates the effects of various blood alcohol levels:

The effects of blood alcohol levels	
% per volume	**Effect**
0,005 – 0,15	Loss of coordination
0,15 – 0,20	Severe intoxication
0,20 – 0,40	Loss of consciousness
0,50	Death

The liver enzyme, ADH, catalyses the oxidation of ethanol to **ethanal** and then to non-toxic **ethanoic acid**. The liver is able to remove only 28 grams of pure alcohol per hour.

5.1 Write down the NAMES of the homologous series to which the compounds ethanal and ethanoic acid respectively belong. (2)

5.2 Write down the structural formula of ethanal. (2)

5.3 Alcohols are prepared by the **hydration** of alkenes. Use structural formulae to write down the equation which represents the formation of ethanol. (3)

5.4 The warning on the labels of certain medicines reads as follows:

The effect of this medicine is aggravated by the simultaneous intake of alcohol.

Use the information in the passage above to justify this warning. (4)

[11]

QUESTION 6

The first six members of the alkanes occur as gases and liquids at normal temperatures. Alkanes are currently our most important fuels, but the use of alcohols as renewable energy source is becoming more and more important. Alcohols are liquids that might be a solution to the energy crisis.

6.1 Which chemical property of alkanes and alcohols make them suitable to be used as fuels? (2)

6.2 The table shows the boiling points of the first six alkanes and the first six alcohols.

Alkane	Boiling point (°C)	Alcohol	Boiling point (°C)
methane	- 164	methanol	65
ethane	- 89	ethanol	79
propane	- 42	1-propanol	97
butane	- 0,5	1-butanol	117
pentane	36	1-pentanol	138
hexane	69	1-hexanol	156

Draw a graph of boiling points versus number of carbon atoms for the first six ALCOHOLS. Choose 50 °C and 1 carbon atom as origin and use an appropriate scale. Plot the points and draw the best curve through the points. (5)

6.3 What trend in boiling point can be observed from the graph? (2)

6.4 Provide a reason for the trend mentioned in QUESTION 6.3 by referring to the type of intermolecular forces. (2)

6.5 Explain, referring to the type of intermolecular forces, why the boiling points of alcohols are higher than the boiling points of alkanes. (2)

6.6 People are always cautioned to keep liquids such as petrol (a mixture of alkanes) out of reach of children. Use the boiling points of alkanes and justify this precaution. (2)

6.7 Briefly explain why ethanol is a renewable energy source, while the alkanes are non-renewable. (2)

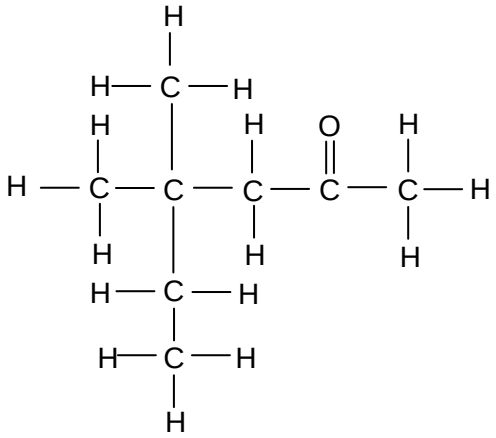
[17]

QUESTION 7

Consider the organic compounds labelled A – E.

A. $CH_3CH_2CH_2CH_2CH_2CH_3$

B.



C. C_6H_6

D. $CH_3 — C\ell$

E. Methylamine

7.1 Write a balanced chemical equation for the preparation of compound D using an alkane as one of the reactants. (3)

7.2 Write down the IUPAC name for compound B? (2)

7.3 Write down the structural formula of an isomer of compound A that has only FOUR carbon atoms in the longest chain. (2)

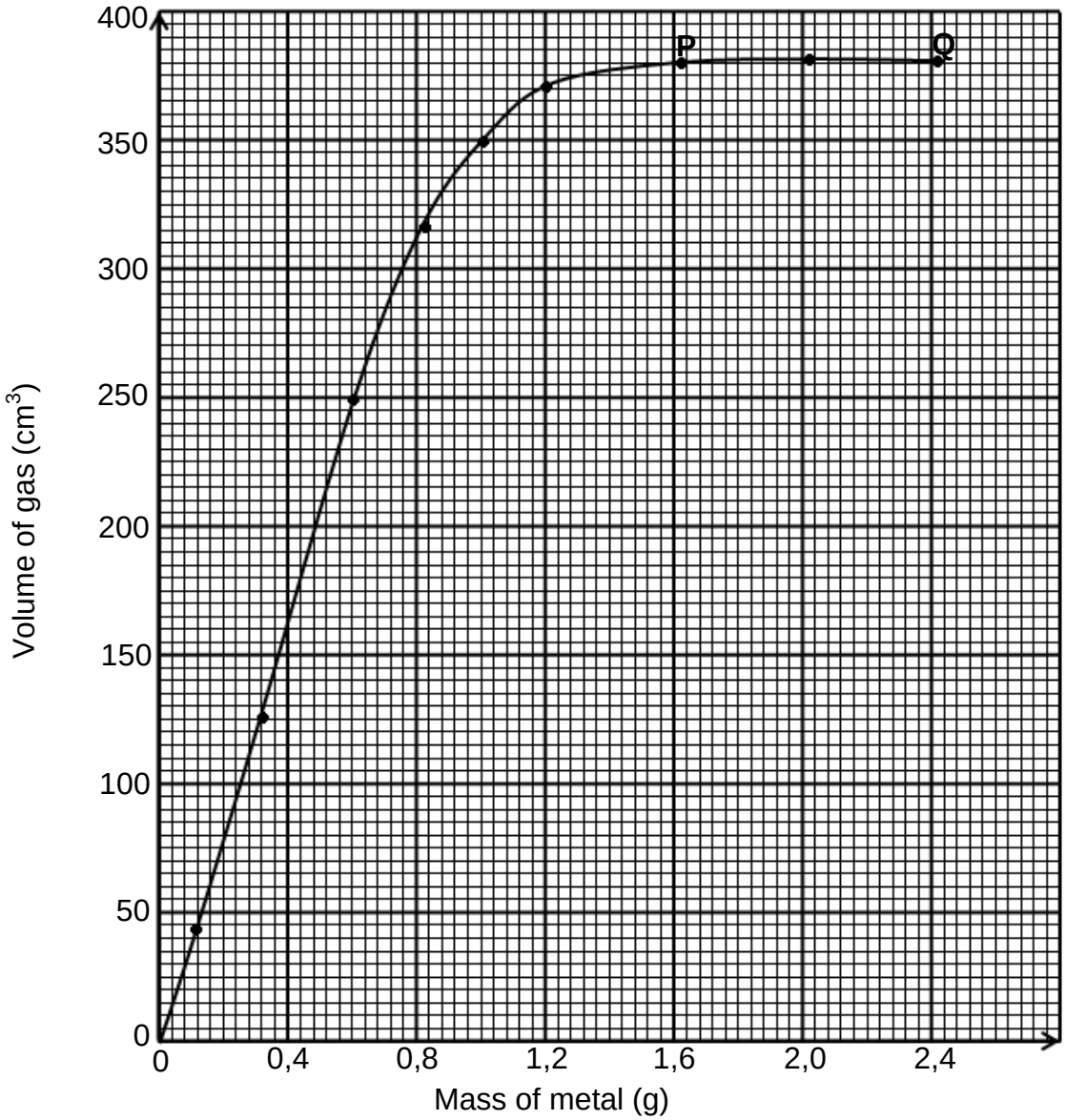
7.4 Write down the structural formula for compound C. (2)
[9]

QUESTION 8

A learner investigates the relationship between the mass of a metal and the volume of the gas produced when the metal reacts with dilute hydrochloric acid. During the investigation the learner adds the metal in amounts of 0,4 g to a certain volume of acid in a container. After the complete reaction between the metal and the acid, the learner measures the volume of gas that forms after each addition of the metal.

8.1 State a possible hypothesis for this investigation? (2)

The learner plotted the graph shown below after conducting the investigation.



8.2 Name TWO variables that must be controlled during this investigation. (4)

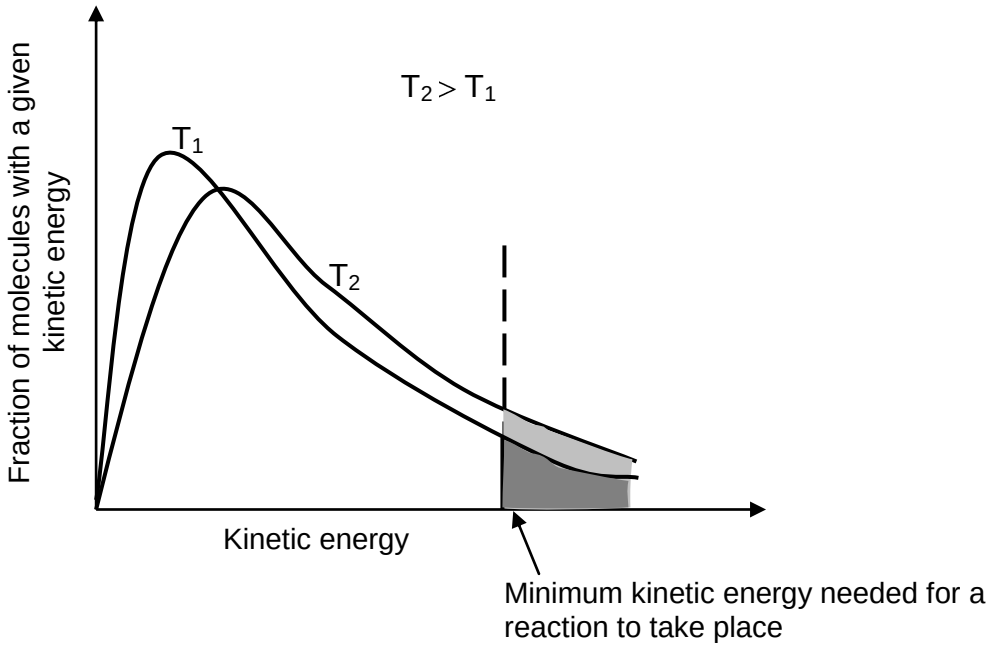
8.3 What conclusion can be drawn from the section PQ on the graph? (2)

8.4 Use the graph to predict the volume of gas that will be produced when 0,4 g of the metal reacts with the acid. (2)

[10]

QUESTION 9

In general a teaspoonful of sugar dissolves much quicker in hot water than in the same amount of cold water. Use the graph below and your knowledge of the collision theory to explain this observation.



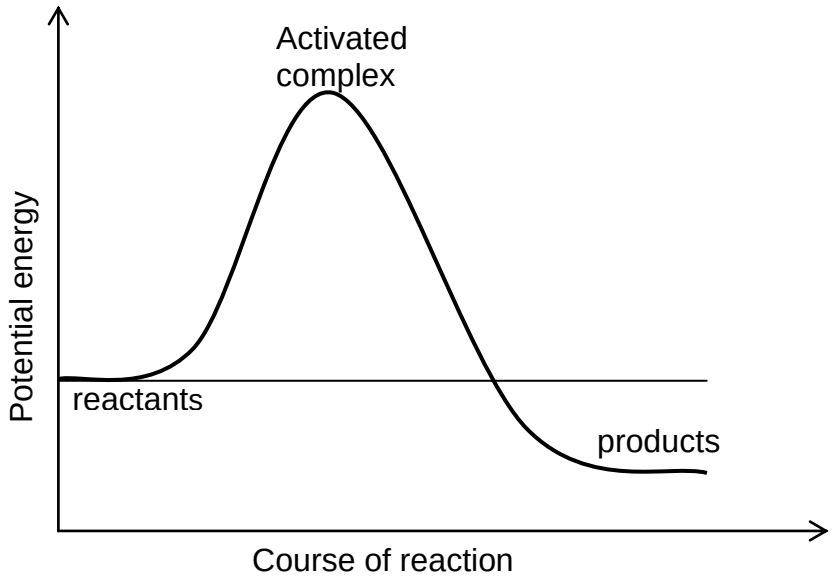
[5]

QUESTION 10

In a limited supply of oxygen, such as in a car which is not tuned properly, octane burns incompletely to produce, amongst others, carbon monoxide. The following balanced chemical equation represents the reaction during which carbon monoxide forms:

$$2C_8H_{18}(\ell) + 17O_2(g) \rightarrow 16CO(g) + 18H_2O(g) \qquad \Delta H < 0$$

The reaction can be represented by the potential energy graph below.



10.1 By comparing the activation energies of the forward and reverse reactions, explain whether it will be easier to form products from reactants or reactants from products. (2)

10.2 Use the chemical equation above and give a reason why vehicles with incorrectly tuned engines are a health hazard. (2)

10.3 Part of the action of catalytic converters is to speed up the complete oxidation of carbon monoxide (CO) and petrol (C_8H_{18}) from incorrectly tuned engines according to the equations below.

$$2C_8H_{18}(\ell) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g) \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

$$2CO(g) + O_2 \rightarrow 2CO_2(g) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

Why should people support legislation that makes catalytic converters a necessary component of exhaust systems of automobiles? (2)
[6]

QUESTION 11

11.1 Many industries use ammonia as a coolant in their plants. Ammonia is also used in the fertiliser industry. The ammonia is manufactured by the Haber process in the presence of a catalyst at a temperature of 500 °C. The equilibrium process may be represented by the equation below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H < 0$$

The temperature is now decreased to 100 °C.
Explain whether or not the ammonia can now be produced profitably. (3)

11.2 Ammonia is used in the industrial preparation of nitric acid. One of the reactions in this process, shown below, reached equilibrium in a closed container at a temperature of 1 000 °C.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$$

The initial concentrations of $NH_3(g)$ and $O_2(g)$ were both equal to 1 mol·dm^{-3}.
At equilibrium it is found that the concentration of $NH_3(g)$ has changed by 0,25 mol·dm^{-3}.

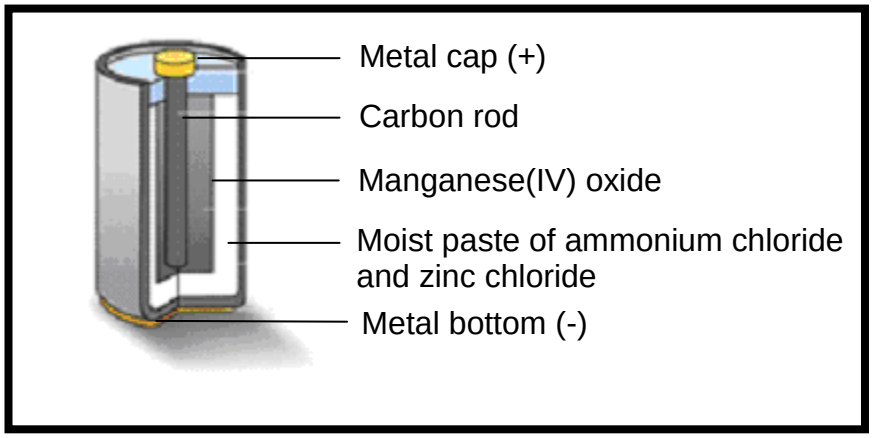
11.2.1 Calculate the value of the equilibrium constant (K_C) at the given temperature. (9)

11.2.2 Is the yield of NO high or low at this temperature? Give a reason for your answer. (3)

[15]

QUESTION 12

A dry cell, as shown in the diagram below, does not contain a liquid electrolyte. The electrolyte in a typical zinc-carbon cell is a moist paste of ammonium chloride and zinc chloride.



The paste of ammonium chloride reacts according to the following half-reaction:

$$2NH_4^+(aq) + 2e^- \rightarrow 2NH_3(g) + H_2(g) \ldots (i)$$

Manganese(IV) oxide is included in the cell to remove the hydrogen produced during half-reaction (i), according to the following reaction:

$$2MnO_2(s) + H_2(g) \rightleftharpoons Mn_2O_3(s) + H_2O(\ell) \ldots (ii)$$

The combined result of these two half-reactions can be represented by the following half reaction:

$$2NH_4^+(aq) + 2MnO_2(s) + 2e^- \rightleftharpoons Mn_2O_3(s) + 2NH_3(g) + H_2O(\ell) \ldots (iii)$$

12.1 Explain why it is important that the hydrogen produced in half-reaction (i) is removed by the manganese(IV) oxide. (2)

In a zinc-carbon cell, such as the one above, half-reaction (iii) and the half-reaction that takes place in the Zn/Zn^{2+} half-cell, produce an emf of 1,5 V under standard conditions.

12.2 Write down the half-reaction occurring at the anode. (2)

12.3 Write down the net ionic equation occurring in the zinc-carbon cell. (2)

12.4 Calculate the reduction potential for the cathode half-reaction. (4)

12.5 When in use the zinc casing of the dry cell becomes thinner, because it is oxidised. When not in use, it still corrodes. Give a reason for the latter observation. (2)

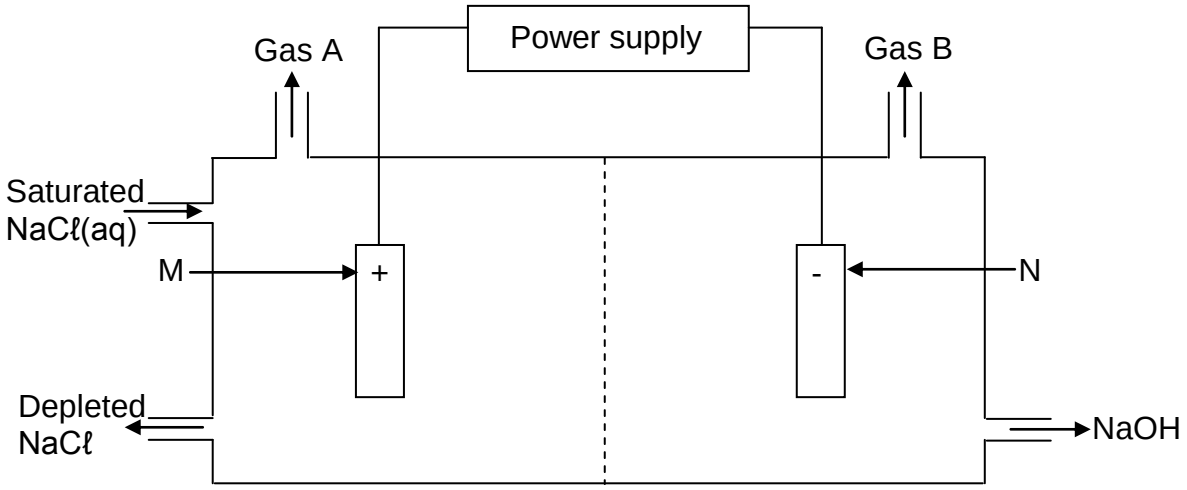
12.6 Dry cells are generally discarded when 'flat'. Why is the carbon rod the most useful part of the cell, even when the cell is flat? (2)

[14]

QUESTION 13

Chloralkali manufacturing process

The chloralkali (also called 'chlorine-caustic') industry is one of the largest electrochemical technologies in the world. Chlorine is produced using three types of electrolytic cells. The simplified diagram below shows a membrane cell.



13.1 Give TWO reasons why the membrane cell is the preferred cell for the preparation of chlorine. (2)

13.2 Why do you think it is advisable to use inert electrodes in this process? (2)

13.3 Write down the equation for the half-reaction taking place at electrode M. (2)

13.4 Which gas is chlorine gas? Write down only Gas A or Gas B. (2)

13.5 Briefly explain how sodium hydroxide forms in this cell. (3)
[11]

QUESTION 14

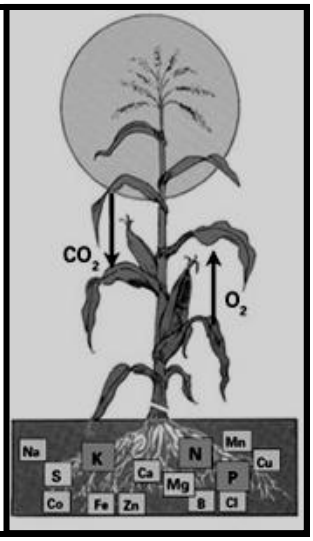
Why we need fertilisers

There is likely to be a gap between food production and demand in several parts of the world by 2020. Demand is influenced by population growth and urbanisation, as well as income levels and changes in dietary preferences.

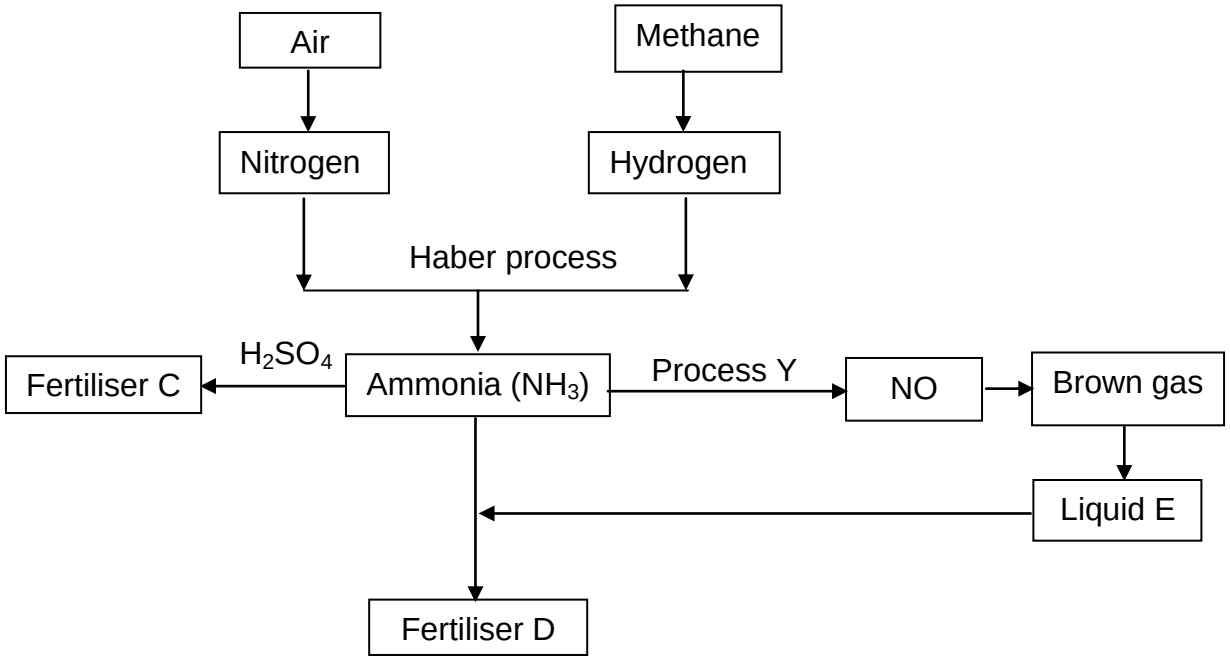
The facts are as follows:

- There is an increasing world population to feed
- Most soils in the world used for large-scale, intensive production of crops lack the necessary nutrients for the crops

Conclusion: Fertilisers are needed!



The flow diagram below shows the main steps in the industrial preparation of two important solid fertilisers.



14.1 Write down the balanced chemical equation for the formation of the brown gas. (3)

14.2 Write down the name of process Y. (2)

14.3 Write down the chemical formula of liquid E. (2)

14.4 Write down the chemical formulae of fertilisers C and D respectively. (4)

The following extract comes from an article on fertilisers:

A world without food for its people –
A world with an environment poisoned through the actions of man –
Are two contributing factors towards a disaster scenario.

14.5 Write down THREE ways in which the use of fertilisers poisons the environment. (6)
[17]

TOTAL SECTION B: 115

GRAND TOTAL: 150

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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

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*

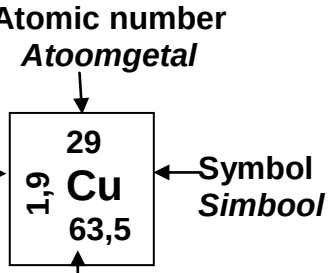


TABLE 4A: STANDARD REDUCTION POTENTIALS/ *TABEL 4A: STANDAARD REDUKSIEPOTENSIALE*

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+}	+ 1,82
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,52
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,28
$O_2(g) + 4H^+ + 3e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,06
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,78
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,78
$Fe^{3+} + e^-$	$\rightleftharpoons$	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
$SO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 4e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 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	– 0,04
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	– 0,13
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	– 0,14
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	– 0,25
$Co^{2+} + 2e^-$	$\rightleftharpoons$	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
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	– 0,74
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	– 0,76
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	– 0,83
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	– 1,18
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 1,66
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	– 2,37
$Na^+ + e^-$	$\rightleftharpoons$	Na	– 2,71
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	– 2,87
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	– 2,90
$K^+ + e^-$	$\rightleftharpoons$	K	– 2,92
$Li^+ + e^-$	$\rightleftharpoons$	Li	– 3,04

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

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

Half-reactions/*Halfreaksies*			E^{θ} (V)
$Li^+ + e^-$	$\rightleftharpoons$	Li	– 3,04
$K^+ + e^-$	$\rightleftharpoons$	K	– 2,92
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	– 2,90
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	– 2,87
$Na^+ + e^-$	$\rightleftharpoons$	Na	– 2,71
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	– 2,37
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 1,66
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	– 1,18
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	– 0,83
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	– 0,76
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	– 0,74
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	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	– 0,25
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	– 0,14
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	– 0,13
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	– 0,04
$2H^+ + 2e^-$	$\rightleftharpoons$	$H_2(g)$	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
$SO_4^{2-} + 4H^+ + 4e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 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
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,78
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,78
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,06
$O_2(g) + 4H^+ + 3e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,28
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,52
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,82
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

NAME/EXAMINATION NUMBER _____

PHYSICAL SCIENCES P2 GRADE 12 ANSWER SHEET
FISIESE WETENSKAPPE V2 GRAAD 12-ANTWOORDBLAD

QUESTION 1/*VRAAG 1*

1.1 _____ (1)

1.2 _____ (1)

1.3 _____ (1)

1.4 _____ (1)

1.5 _____ (1)
[5]

QUESTION 2/*VRAAG 2*

2.1 _____ (1)

2.2 _____ (1)

2.3 _____ (1)

2.4 _____ (1)

2.5 _____ (1)
[5]

QUESTION 3/*VRAAG 3*

3.1 _____

_____ (2)

3.2 _____

_____ (2)

3.3 _____

_____ (2)

3.4 _____

_____ (2)

3.5 _____

_____ (2)
[10]

QUESTION 4/*VRAAG 4*

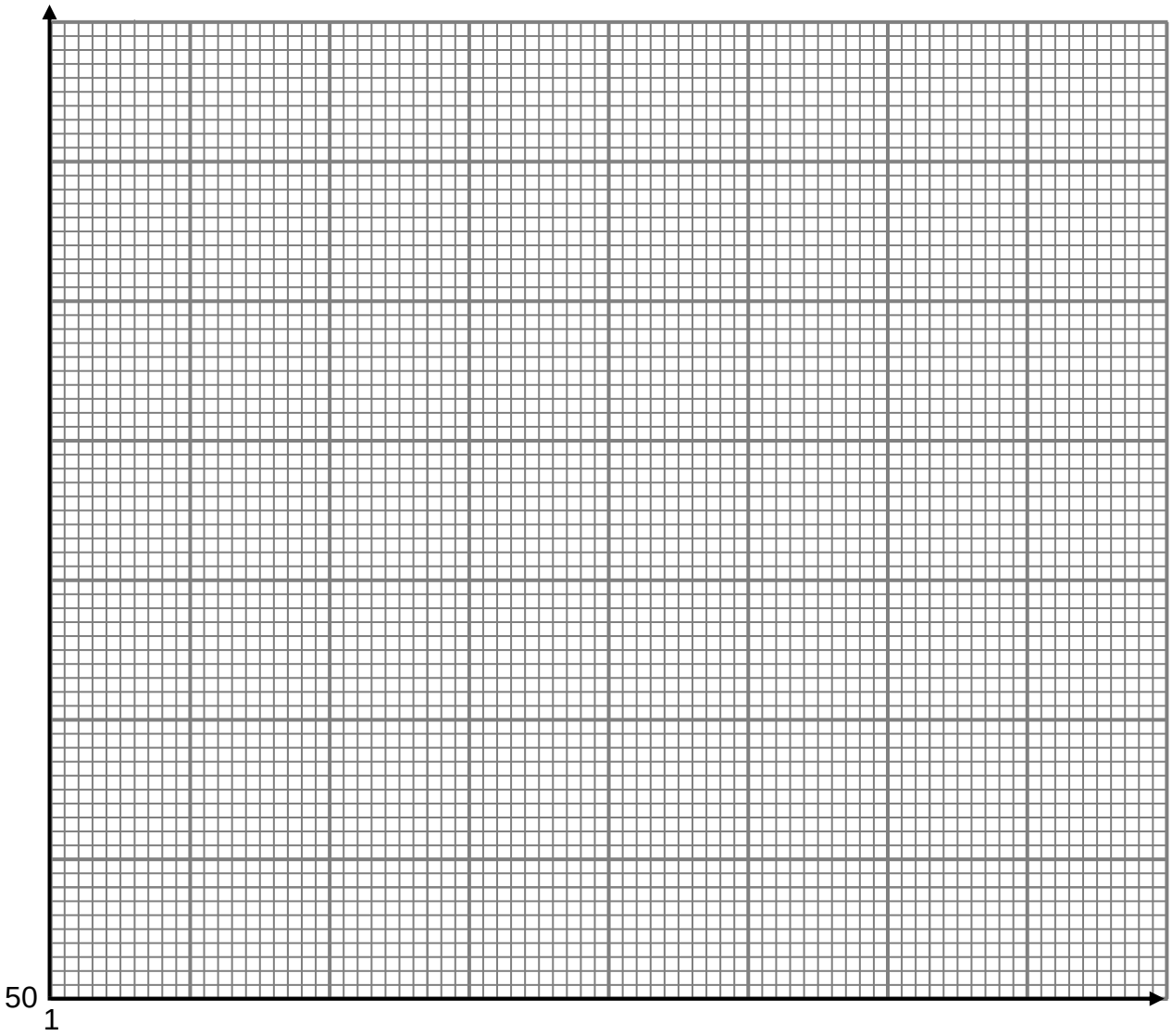
4.1	A	B	C	D
4.2	A	B	C	D
4.3	A	B	C	D
4.4	A	B	C	D
4.5	A	B	C	D

(5 x 3) [15]

TOTAL SECTION A/*TOTAAL AFDELING A:* 35

NAME/EXAMINATION NUMBER

QUESTION 6.2



(5)