

Basic Education

KwaZulu-Natal Department of Basic Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES: CHEMISTRY (P2)

PREPARATORY EXAMINATION

SEPTEMBER 2015

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MARKS : 150

TIME : 3 Hours

This question paper consists of 17 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name 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 subsections, 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

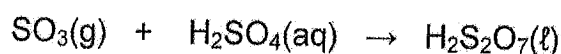
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 The primary nutrient needed by plants for the promotion of leaf growth is . . .

- A calcium.
- B nitrogen.
- C potassium.
- D phosphorus.

(2)

1.2 The equation below represents ONE of the steps during the industrial preparation of sulphuric acid:



Which ONE of the following is the INCORRECT name for $\text{H}_2\text{S}_2\text{O}_7$?

- A oleum.
- B sulphuric acid.
- C pyro-sulphuric acid.
- D fuming sulphuric acid.

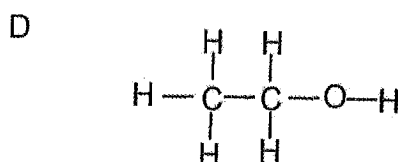
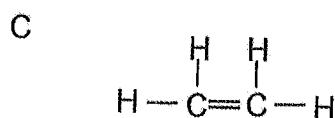
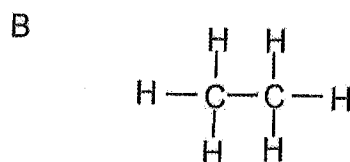
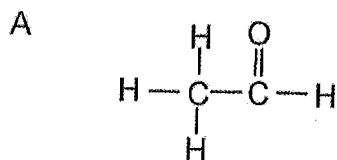
(2)

1.3 A solid **P** reacts with a solution **Q** in a flask to form products which remain in solution. Which ONE of the following changes will probably have little or no effect on the rate of the reaction?

- A Crushing the solid **P** into a fine powder.
- B Increasing the concentration of solution **Q**.
- C Reducing the pressure on the reaction mixture.
- D Adding a suitable catalyst to the reaction mixture.

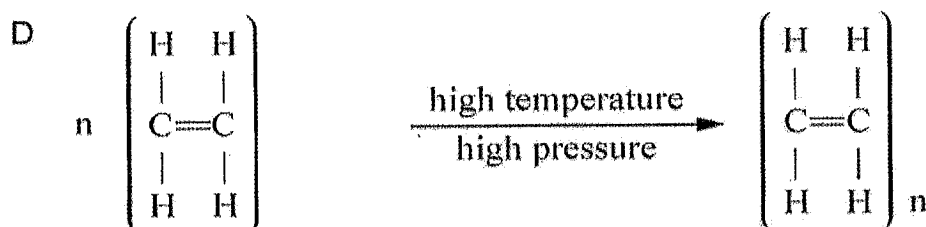
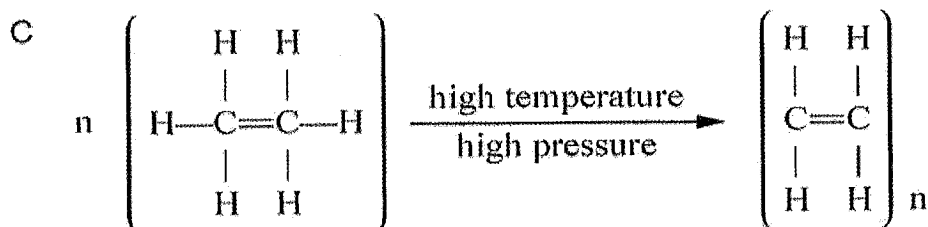
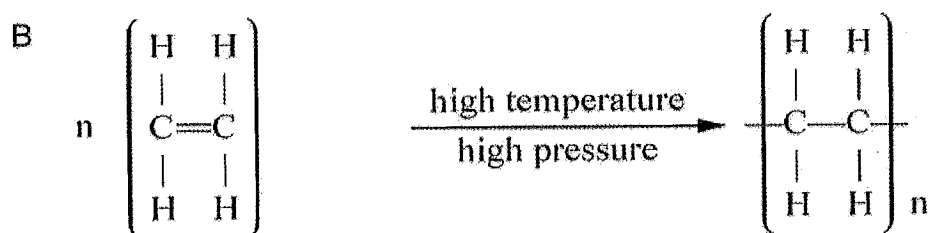
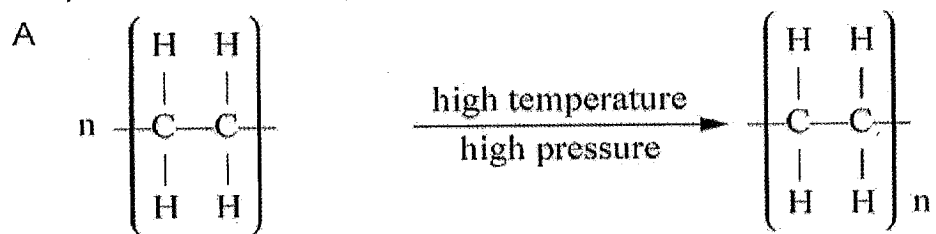
(2)

Which ONE of the following compounds will decolourise bromine water the fastest at room temperature?



(2)

- 1.5 Polyethene is manufactured when ethene is heated to a relatively high temperature under a high pressure. The reaction is correctly illustrated in:



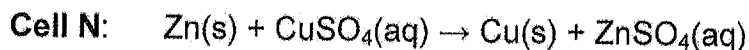
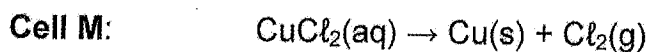
(2)

- 1.6 A learner is asked to name an organic compound X, according to the IUPAC system. She **incorrectly** names the compound as 2-chloro-4-ethylpentane. The correct name of the compound using the IUPAC system could be . . .

- A 2-chloro-4-methylhexane.
 B 4-chloro-2-methylhexane.
 C 4-chloro-2-methylpentane.
 D 2-chloro-2-methylpentane.

(2)

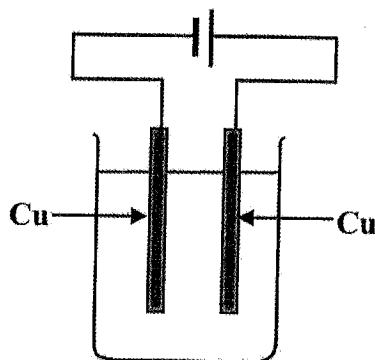
1.7 The reactions below occur in two different electrochemical cells M and N.



Which ONE of the following correctly describes the substance that forms at the CATHODE of each of these cells?

	Cell M	Cell N
A	$\text{Cl}_2(\text{g})$	$\text{Cu}(\text{s})$
B	$\text{Cu}(\text{s})$	$\text{Cu}(\text{s})$
C	$\text{Cl}_2(\text{g})$	$\text{ZnSO}_4(\text{aq})$
D	$\text{Cu}(\text{s})$	$\text{ZnSO}_4(\text{aq})$

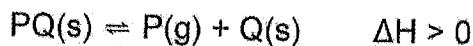
1.8 Copper is purified through electrolysis as represented in the simplified diagram below:



Which ONE of the following statements is CORRECT for this process?

- A Cu is reduced at the positive electrode.
- B Cu is oxidised at the negative electrode.
- C Cu^{2+} ions are reduced at the positive electrode.
- D Cu^{2+} ions are reduced at the negative electrode.

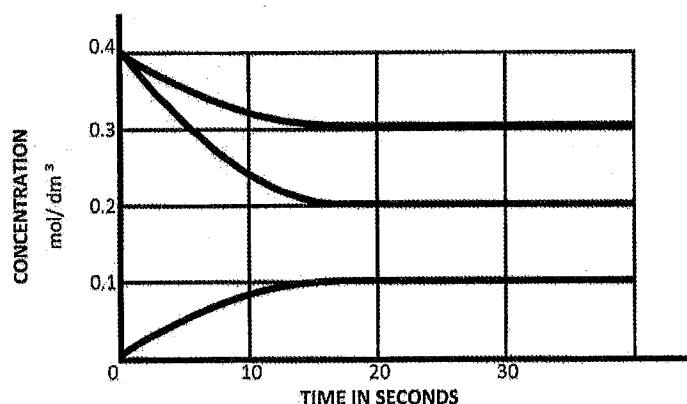
1.9 Consider the following hypothetical reaction that reached equilibrium in a closed container at 450°C :



Which ONE of the following changes will NOT affect the equilibrium position?

- A Increase in temperature.
- B Increase in the amount of $\text{Q}(\text{s})$.
- C Decrease in pressure at constant volume.
- D Increase in the volume of the container.

- 1.10 Reactants X and Y react in a sealed 1 dm³ container at constant temperature, to form product Z. The graphs below show the change in the concentration of the reactants, X and Y, and product, Z, with time.



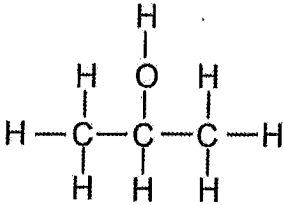
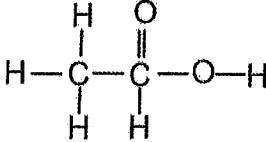
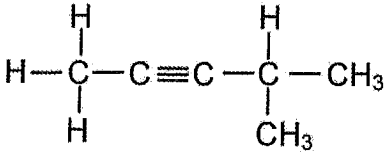
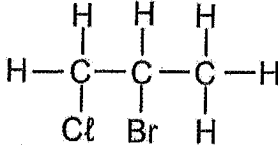
Which ONE of the following chemical equations represents the above reaction at equilibrium?

- A $X + 2Y \rightleftharpoons Z$
- B $2X + Y \rightleftharpoons Z$
- C $X + 2Y \rightleftharpoons 2Z$
- D $3X + 2Y \rightleftharpoons Z$

(2)
[20]

QUESTION 2 (Start on a new page.)

The letters **A** to **G** in the table below represent seven organic compounds.

A		B	
C	2-methylpropan-2-ol	D	CH ₃ CH ₂ CH ₂ CHO
E		F	

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 an aldehyde. (1)

2.1.2 Is a tertiary alcohol. (1)

2.1.3 contains a carboxyl group. (1)

2.2 Write down the IUPAC name of compound:

2.2.1 E (2)

2.2.2 F (2)

2.3 Write down the structural formula of:

2.3.1 a functional isomer of compound B. (2)

2.3.2 the functional group of compound A. (2)

2.4 Write down the letters of two compounds that belong to the same homologous series. (1)

2.5 Write down the general formula for compound E. (1)

2.6 A mixture of compound B, propan-1-ol and concentrated sulphuric acid are together heated in a test tube to produce an organic compound G and water.

2.6.1 Give a reason why the above mixture must not be heated over an open flame. (1)

2.6.2 Write down the name of the type of reaction that occurs. (1)

2.6.3 Write down the IUPAC name for compound G. (2)

2.6.4 Write down the structural formula for compound G. (2)
[19]

QUESTION 3 (Start on a new page.)

Learners investigate factors that influence the boiling points of organic compounds, A, B and C shown below:

A	B	C
$\text{CH}_3(\text{CH}_2)_2\text{COOH}$	$\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$	$\text{CH}_3(\text{CH}_2)_3\text{CHO}$

3.1 Write down the dependant variable for this investigation. (1)

3.2 The learners observe that all the compounds have almost the same molecular mass and therefore conclude that the boiling points of the three compounds are the same. Briefly explain why their conclusion is incorrect. (3)

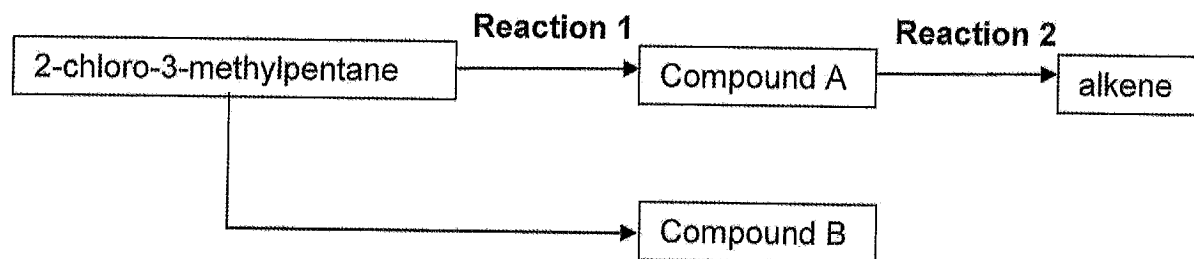
3.3 Define *vapour pressure*. (2)

3.4 Which compound **A**, **B** or **C** will have the lowest vapour pressure? Explain your answer by referring to the TYPE of INTERMOLECULAR FORCES present in each of these compounds. (5)

3.5 Write down the letter that represents the compound with the highest boiling point. (1)
[12]

QUESTION 4 (Start on a new page.)

The flow diagram below shows the reactions of 2-chloro-3-methylpentane under different conditions.

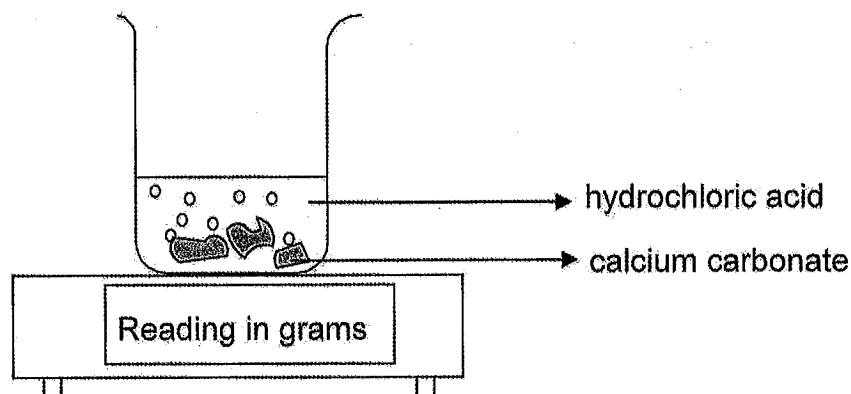


- 4.1 Classify 2-chloro-3-methylpentane as SATURATED or UNSATURATED and give a reason for the answer. (2)
- 4.2 Reaction 1 takes place in the presence of dilute sodium hydroxide. Name the type of substitution reaction that takes place. (1)
- 4.3 Write down the:
- 4.3.1 Structural formula for compound A. (2)
- 4.3.2 TWO reaction conditions for reaction 2. (2)
- 4.3.3 Name of the type of reaction of which reaction 2 is an example. (1)
- 4.3.4 Name of the alkene formed in reaction 2. (2)
- 4.4 Compound B is formed when 2-chloro-3-methylpentane reacts in the presence of concentrated sodium hydroxide.
- 4.4.1 Write down another reaction condition required for this reaction. (1)
- 4.4.2 Classify this reaction as SUBSTITUTION, ADDITION or ELIMINATION. (1)

[12]

QUESTION 5 (Start on a new page.)

In an experiment to investigate factors that affect the rate of chemical reactions, a sample of calcium carbonate is placed in a beaker. The beaker is then placed on a sensitive mass meter and an **EXCESS** of hydrochloric acid is added to the beaker.



The experiment is repeated four times under different conditions, using the **same volume of HCl** in all four experiments. The HCl is **EXCESS** in all the experiments.

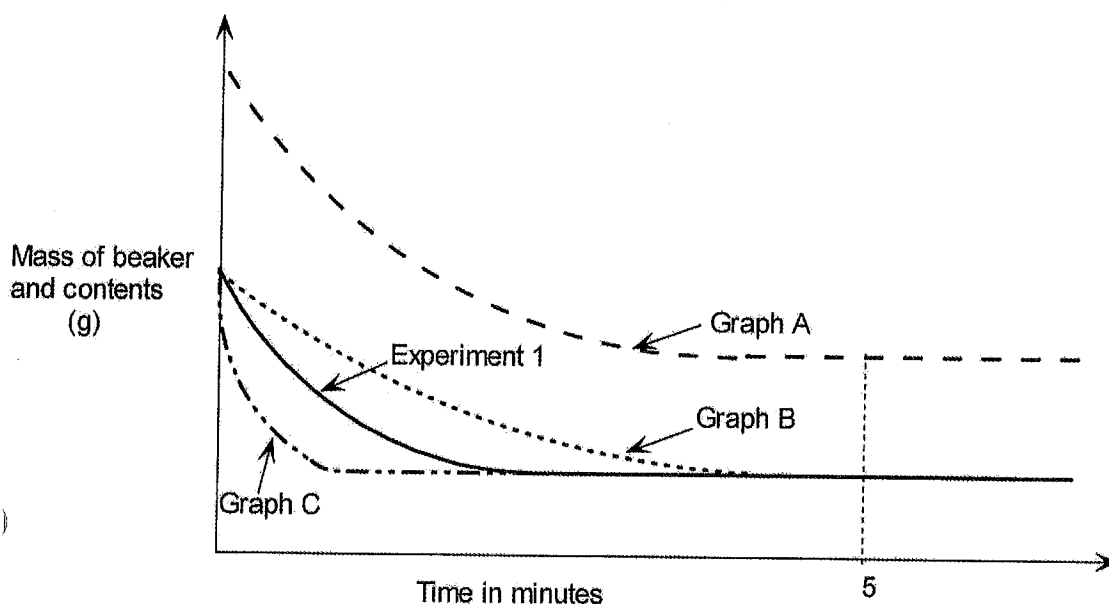
- 5.1 Will the reading on the mass meter INCREASE, DECREASE or REMAIN THE SAME as the reaction progresses? Give a reason for your answer. (3)
- 5.2 Give a reason why the same volume of excess HCl is used in all the experiments. (1)
- 5.3 Write down the NAME or FORMULA of the limiting reagent in this experiment. (1)

The conditions for the experiments are shown in the table below:

Experiment	Mass of CaCO_3 (g)	Concentration of HCl (mol dm^{-3})	Temperature of HCl ($^{\circ}\text{C}$)	State of $\text{CaCO}_3(\text{s})$
1	10	2	25	Granules
2	20	2	25	Granules
3	10	2	15	Granules
4	10	2	25	Powder

During each experiment, the mass of the beaker and its contents is recorded every minute.

The graphs below indicate the changes in mass of the beaker and its contents during the reaction, as a function of time, for the four experiments:



5.4 Give a reason why the graphs are all straight lines after 5 minutes. (1)

5.5 Which ONE of the graphs A, B or C, represents the results of:

5.5.1 Experiment 2 (2)

5.5.2 Experiment 3 (2)

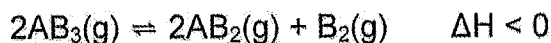
5.5.3 Experiment 4 (2)

5.6 Use the collision theory to explain the answer to QUESTION 5.5.3 above. (3)

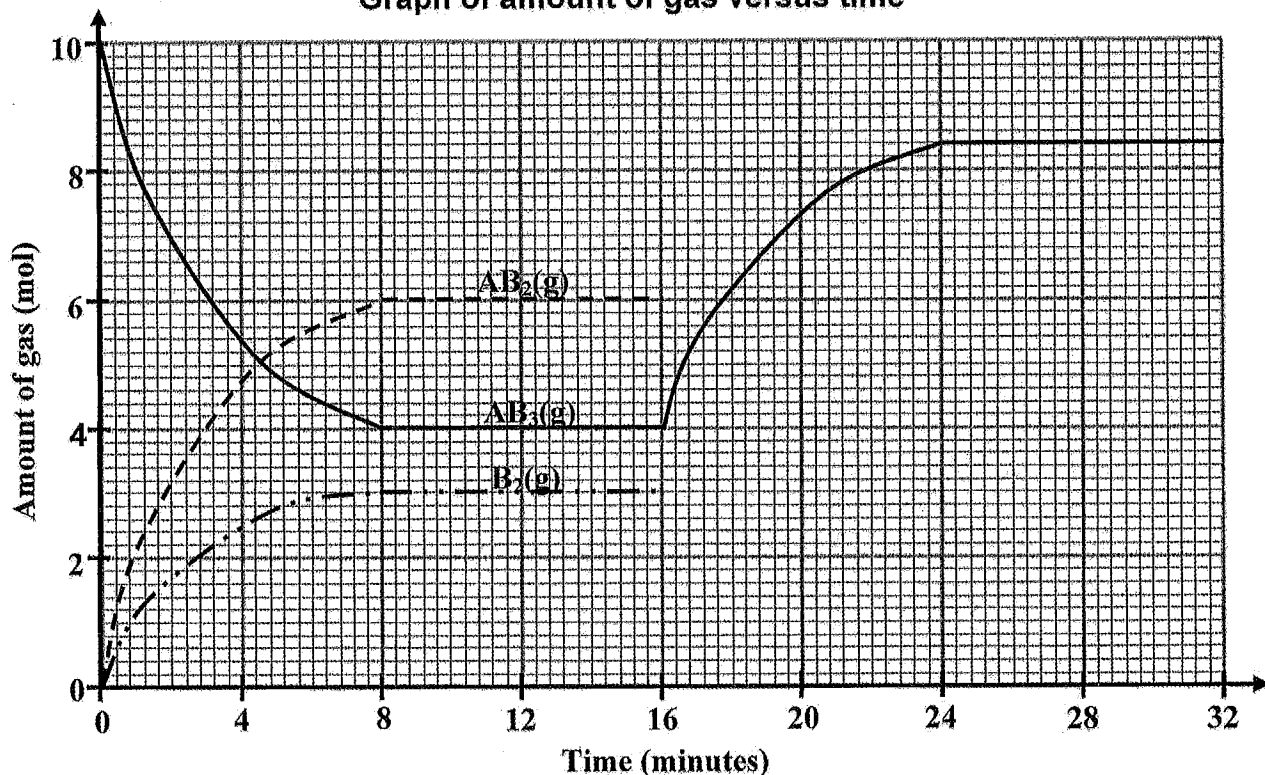
[15]

QUESTION 6 (Start on a new page.)

The following equation represents a hypothetical reaction that reaches equilibrium in a 2 dm³ closed container at 500 °C after 8 minutes.



Graph of amount of gas versus time



- 6.1 At 16 minutes, one of the conditions affecting the equilibrium is changed at constant volume and a new equilibrium is thereafter established. Calculate, the K_c value at the new equilibrium. (8)
- 6.2 Which condition, CONCENTRATION or TEMPERATURE was changed? (2)
- 6.3 Was the condition identified in QUESTION 6.2 INCREASED or DECREASED? (1)
- 6.4 Use Le Chatelier's principle to explain the answer to QUESTION 6.3. (3)
- 6.5 How does the equilibrium constant, K_c , between $t = 8$ minutes and $t = 16$ minutes compare to that between $t = 24$ minutes and $t = 32$ minutes? Write down only GREATER THAN, SMALLER THAN or EQUAL TO. (1)
- 6.6 How will the K_c value be affected if the volume of the container, is decreased from 2 dm³ to 1 dm³ after 32 minutes, while keeping the temperature constant. (1)

[16]

QUESTION 7 (Start on a new page.)

- 7.1 A solution of an unknown, diprotic acid has a concentration of $0,02 \text{ mol.dm}^{-3}$ and a pH of 3,5.

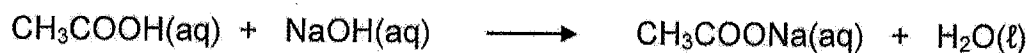
7.1.1 Explain what is meant by a *diprotic acid*. (1)

7.1.2 Calculate the concentration of the hydrogen ions in this solution. (2)

7.1.3 How does the strength of this unknown acid compare to that of sulphuric acid of the same concentration? Choose from, STRONGER THAN, WEAKER THAN or EQUAL TO. (1)

7.1.4 Explain the answer to QUESTION 7.1.3. (2)

- 7.2 A solution of vinegar can be neutralised by a solution of sodium hydroxide. The following reaction occurs:



Phenolphthalein is colourless in an acidic medium and pink in an alkaline medium.

7.2.1 The sodium acetate formed during the neutralisation of vinegar by sodium hydroxide can undergo hydrolysis. What will the colour of phenolphthalein be in a solution of sodium acetate. (1)

7.2.2 Write a balanced equation to explain the answer to QUESTION 7.2.1. (3)

- 7.3 An unknown carbonate has the formula X_2CO_3 . A grade 12 learner is requested to identify element X.

The learner adds 0,212 g of the carbonate into a conical flask containing 25 cm^3 of nitric acid solution of concentration $0,2 \text{ mol.dm}^{-3}$. The nitric acid is in excess. She notices that the carbonate reacts completely.

The balanced equation for the reaction reaction:



She uses 10 cm^3 of a NaOH solution of concentration $0,1 \text{ mol.dm}^{-3}$ to exactly neutralise the excess nitric acid.

The balanced equation for the reaction reaction is:

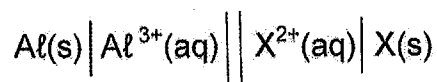


7.3.1 Calculate the number of moles of $\text{HNO}_3(\text{aq})$, that reacted with the unknown carbonate. (5)

7.3.2 Provide a name for X, by performing the relevant calculations. (5)
[20]

QUESTION 8 (Start on a new page.)

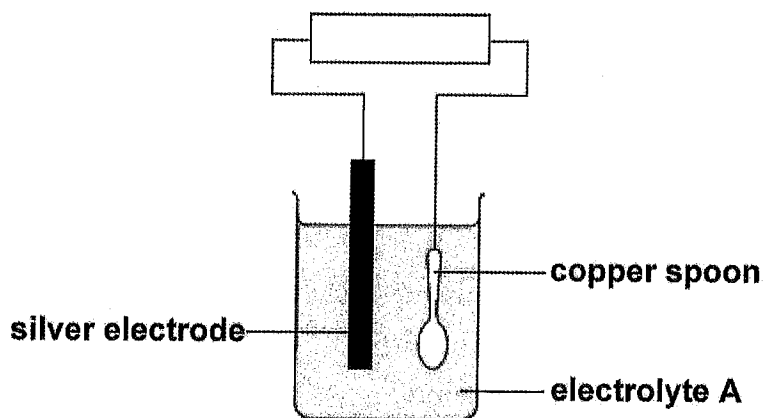
The cell notation of a **standard galvanic (voltaic) cell** containing an unknown metal electrode X is shown below:



- 8.1 State the function of the component of the cell represented by the double vertical lines in the above cell notation. (1)
- 8.2 State TWO standard conditions that are applicable to the $\text{Al}^{3+} \mid \text{Al}$ half-cell. (2)
- 8.3 The emf of the above cell under standard conditions is 2,0 V. Identify metal X, using a calculation. (5)
- 8.4 Refer to the relative strengths of reducing agents, to explain why aluminium is the anode of this cell. (3)
- 8.5 Will the intensity of the colour of the electrolyte in the cathode half-cell INCREASE or DECREASE as the cell operates? Explain the answer with the aid of a relevant half-reaction. (4)
- [15]**

QUESTION 9

The diagram below illustrates one of the uses of electrolysis.



- 9.1 Give the use of electrolysis illustrated in the above diagram. (1)
- 9.2 Which electrode (CATHODE/ANODE) will the copper spoon represent? (1)
- 9.3 Write down the FORMULA of the cation present in electrolyte A. (1)
- 9.4 Write down the half-reaction responsible for the change that occurs at the surface of the spoon. (2)
- 9.5 Give a reason why the concentration of the electrolyte remains constant during electroplating. (2)
- [7]**

QUESTION 10 (Start on a new page.)

10.1 One of the processes during the industrial preparation of fertilisers involves the reaction between nitrogen and hydrogen to produce ammonia.

10.1.1 Write down the name of the process during which ammonia is produced in the industry. (1)

Ammonia reacts with oxygen to produce a **GAS B**, in the presence of a catalyst.

10.1.2 Write down the name given to the reaction described above. (1)

10.1.3 Write down a balanced equation for the reaction between ammonia and oxygen. (3)

The flow diagram below shows further reactions of **GAS B**, to form NITRIC ACID.

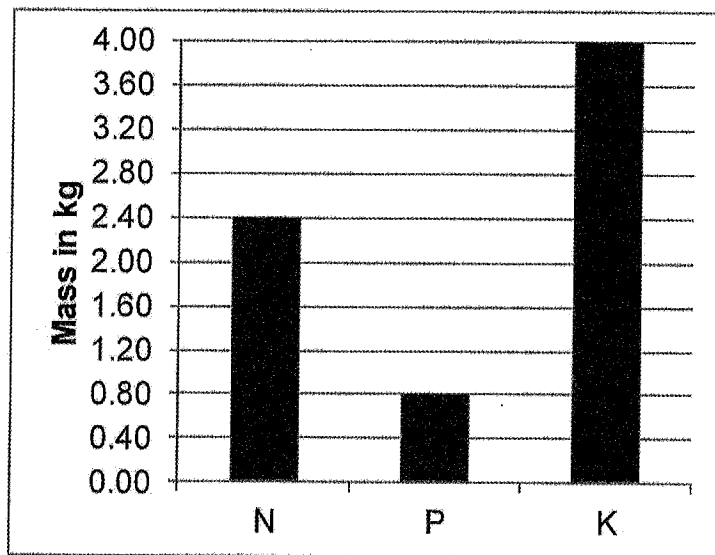


10.1.4 Write down the name or formula of the reagent required to react with **GAS B** to produce **GAS C**. (1)

Ammonia reacts with sulphuric acid to produce a fertilizer **E**.

10.1.5 Write down a balanced equation to show the preparation of fertilizer **E**. (3)

- 10.2 The following bar graph represents the mass, in kg, of nitrogen, phosphorous and potassium present in the 20 kg bag of fertilizer represented next to the graph.



FERTILISER

W : X : Y (Z)

20 kg

Use the above information to determine the values for:

10.2.1 W : X : Y (2)

10.2.2 Z (3)
[14]

GRAND TOTAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

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

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ} / E_{\text{sel}}^{\circ} = E_{\text{katode}}^{\circ} - E_{\text{anode}}^{\circ}$ or/of $E_{\text{cell}}^{\circ} = E_{\text{reduction}}^{\circ} - E_{\text{oxidation}}^{\circ} / E_{\text{sel}}^{\circ} = E_{\text{reduksie}}^{\circ} - E_{\text{oksidasie}}^{\circ}$ or/of $E_{\text{cell}}^{\circ} = E_{\text{oxidising agent}}^{\circ} - E_{\text{reducing agent}}^{\circ} / E_{\text{sel}}^{\circ} = E_{\text{oksideermiddel}}^{\circ} - E_{\text{reduseermiddel}}^{\circ}$	

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

KEY/SLEUTEL

Electronegativity → **9, Cu** ← Symbol
Elektronegatiwiteit → **9, Cu** ← Simbool

Atomic number
Atoomgetal

Approximate relative atomic mass
Benaderde relatiewe atoommassa

1 H	2 He																	18 Ar	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
3 Li	4 Be																	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
5 B	6 C	7 N	8 O	9 F	10 Ne	11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
55 Cs	56 Ba	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	87 Fr	88 Ra	89 Ac																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
87 Fr	88 Ra	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og	119 Nh	120 Ds	121 Rg	122 Cn	123 Nh	124 Ds	125 Rg	126 Cn	127 Nh	128 Ds	129 Rg	130 Cn	131 Nh	132 Ds	133 Nh	134 Ds	135 Nh	136 Ds	137 Nh	138 Ds	139 Nh	140 Ds	141 Nh	142 Ds	143 Nh	144 Ds	145 Nh	146 Ds	147 Nh	148 Ds	149 Nh	150 Ds	151 Nh	152 Ds	153 Nh	154 Ds	155 Nh	156 Ds	157 Nh	158 Ds	159 Nh	160 Ds	161 Nh	162 Ds	163 Nh	164 Ds	165 Nh	166 Ds	167 Nh	168 Ds	169 Nh	170 Ds	171 Nh	172 Ds	173 Nh	174 Ds	175 Nh	176 Ds	177 Nh	178 Ds	179 Nh	180 Ds	181 Nh	182 Ds	183 Nh	184 Ds	185 Nh	186 Ds	187 Nh	188 Ds	189 Nh	190 Ds	191 Nh	192 Ds	193 Nh	194 Ds	195 Nh	196 Ds	197 Nh	198 Ds	199 Nh	200 Ds	201 Nh	202 Ds	203 Nh	204 Ds	205 Nh	206 Ds	207 Nh	208 Ds	209 Nh	210 Ds	211 Nh	212 Ds	213 Nh	214 Ds	215 Nh	216 Ds	217 Nh	218 Ds	219 Nh	220 Ds	221 Nh	222 Ds	223 Nh	224 Ds	225 Nh	226 Ds	227 Nh	228 Ds	229 Nh	230 Ds	231 Nh	232 Ds	233 Nh	234 Ds	235 Nh	236 Ds	237 Nh	238 Ds	239 Nh	240 Ds	241 Nh	242 Ds	243 Nh	244 Ds	245 Nh	246 Ds	247 Nh	248 Ds	249 Nh	250 Ds	251 Nh	252 Ds	253 Nh	254 Ds	255 Nh	256 Ds	257 Nh	258 Ds	259 Nh	260 Ds	261 Nh	262 Ds	263 Nh	264 Ds	265 Nh	266 Ds	267 Nh	268 Ds	269 Nh	270 Ds	271 Nh	272 Ds	273 Nh	274 Ds	275 Nh	276 Ds	277 Nh	278 Ds	279 Nh	280 Ds	281 Nh	282 Ds	283 Nh	284 Ds	285 Nh	286 Ds	287 Nh	288 Ds	289 Nh	290 Ds	291 Nh	292 Ds	293 Nh	294 Ds	295 Nh	296 Ds	297 Nh	298 Ds	299 Nh	300 Ds	301 Nh	302 Ds	303 Nh	304 Ds	305 Nh	306 Ds	307 Nh	308 Ds	309 Nh	310 Ds	311 Nh	312 Ds	313 Nh	314 Ds	315 Nh	316 Ds	317 Nh	318 Ds	319 Nh	320 Ds	321 Nh	322 Ds	323 Nh	324 Ds	325 Nh	326 Ds	327 Nh	328 Ds	329 Nh	330 Ds	331 Nh	332 Ds	333 Nh	334 Ds	335 Nh	336 Ds	337 Nh	338 Ds	339 Nh	340 Ds	341 Nh	342 Ds	343 Nh	344 Ds	345 Nh	346 Ds	347 Nh	348 Ds	349 Nh	350 Ds	351 Nh	352 Ds	353 Nh	354 Ds	355 Nh	356 Ds	357 Nh	358 Ds	359 Nh	360 Ds	361 Nh	362 Ds	363 Nh	364 Ds	365 Nh	366 Ds	367 Nh	368 Ds	369 Nh	370 Ds	371 Nh	372 Ds	373 Nh	374 Ds	375 Nh	376 Ds	377 Nh	378 Ds	379 Nh	380 Ds	381 Nh	382 Ds	383 Nh	384 Ds	385 Nh	386 Ds	387 Nh	388 Ds	389 Nh	390 Ds	391 Nh	392 Ds	393 Nh	394 Ds	395 Nh	396 Ds	397 Nh	398 Ds	399 Nh	400 Ds	401 Nh	402 Ds	403 Nh	404 Ds	405 Nh	406 Ds	407 Nh	408 Ds	409 Nh	410 Ds	411 Nh	412 Ds	413 Nh	414 Ds	415 Nh	416 Ds	417 Nh	418 Ds	419 Nh	420 Ds	421 Nh	422 Ds	423 Nh	424 Ds	425 Nh	426 Ds	427 Nh	428 Ds	429 Nh	430 Ds	431 Nh	432 Ds	433 Nh	434 Ds	435 Nh	436 Ds	437 Nh	438 Ds	439 Nh	440 Ds	441 Nh	442 Ds	443 Nh	444 Ds	445 Nh	446 Ds	447 Nh	448 Ds	449 Nh	450 Ds	451 Nh	452 Ds	453 Nh	454 Ds	455 Nh	456 Ds	457 Nh	458 Ds	459 Nh	460 Ds	461 Nh	462 Ds	463 Nh	464 Ds	465 Nh	466 Ds	467 Nh	468 Ds	469 Nh	470 Ds	471 Nh	472 Ds	473 Nh	474 Ds	475 Nh	476 Ds	477 Nh	478 Ds	479 Nh	480 Ds	481 Nh	482 Ds	483 Nh	484 Ds	485 Nh	486 Ds	487 Nh	488 Ds	489 Nh	490 Ds	491 Nh	492 Ds	493 Nh	494 Ds	495 Nh	496 Ds	497 Nh	498 Ds	499 Nh	500 Ds	501 Nh	502 Ds	503 Nh	504 Ds	505 Nh	506 Ds	507 Nh	508 Ds	509 Nh	510 Ds	511 Nh	512 Ds	513 Nh	514 Ds	515 Nh	516 Ds	517 Nh	518 Ds	519 Nh	520 Ds	521 Nh	522 Ds	523 Nh	524 Ds	525 Nh	526 Ds	527 Nh	528 Ds	529 Nh	530 Ds	531 Nh	532 Ds	533 Nh	534 Ds	535 Nh	536 Ds	537 Nh	538 Ds	539 Nh	540 Ds	541 Nh	542 Ds	543 Nh	544 Ds	545 Nh	546 Ds	547 Nh	548 Ds	549 Nh	550 Ds	551 Nh	552 Ds	553 Nh	554 Ds	555 Nh	556 Ds	557 Nh	558 Ds	559 Nh	560 Ds	561 Nh	562 Ds	563 Nh	564 Ds	565 Nh	566 Ds	567 Nh	568 Ds	569 Nh	570 Ds	571 Nh	572 Ds	573 Nh	574 Ds	575 Nh	576 Ds	577 Nh	578 Ds	579 Nh	580 Ds	581 Nh	582 Ds	583 Nh	584 Ds	585 Nh	586 Ds	587 Nh	588 Ds	589 Nh	590 Ds	591 Nh	592 Ds	593 Nh	594 Ds	595 Nh	596 Ds	597 Nh	598 Ds	599 Nh	600 Ds	601 Nh	602 Ds	603 Nh	604 Ds	605 Nh	606 Ds	607 Nh	608 Ds	609 Nh	610 Ds	611 Nh	612 Ds	613 Nh	614 Ds	615 Nh	616 Ds	617 Nh	618 Ds	619 Nh	620 Ds	621 Nh	622 Ds	623 Nh	624 Ds	625 Nh	626 Ds	627 Nh	628 Ds	629 Nh	630 Ds	631 Nh	632 Ds	633 Nh	634 Ds	635 Nh	636 Ds	637 Nh	638 Ds	639 Nh	640 Ds	641 Nh	642 Ds	643 Nh	644 Ds	645 Nh	646 Ds	647 Nh	648 Ds	649 Nh	650 Ds	651 Nh	652 Ds	653 Nh	654 Ds	655 Nh	656 Ds	657 Nh	658 Ds	659 Nh	660 Ds	661 Nh	662 Ds	663 Nh	664 Ds	665 Nh	666 Ds	667 Nh	668 Ds	669 Nh	670 Ds	671 Nh	672 Ds	673 Nh	674 Ds	675 Nh	676 Ds	677 Nh	678 Ds	679 Nh	680 Ds	681 Nh	682 Ds	683 Nh	684 Ds	685 Nh	686 Ds	687 Nh	688 Ds	689 Nh	690 Ds	691 Nh	692 Ds	693 Nh	694 Ds	695 Nh	696 Ds	697 Nh	698 Ds	699 Nh	700 Ds	701 Nh	702 Ds	703 Nh	704 Ds	705 Nh	706 Ds	707 Nh	708 Ds	709 Nh	710 Ds	711 Nh	712 Ds	713 Nh	714 Ds	715 Nh	716 Ds	717 Nh	718 Ds	719 Nh	720 Ds	721 Nh	722 Ds	723 Nh	724 Ds	725 Nh	726 Ds	727 Nh	728 Ds	729 Nh	730 Ds	731 Nh	732 Ds	733 Nh	734 Ds	735 Nh	736 Ds	737 Nh	738 Ds	739 Nh	740 Ds	741 Nh	742 Ds	743 Nh	744 Ds	745 Nh	746 Ds	747 Nh	748 Ds	749 Nh	750 Ds	751 Nh	752 Ds	753 Nh	754 Ds	755 Nh	756 Ds	757 Nh	758 Ds	759 Nh	760 Ds	761 Nh	762 Ds	763 Nh	764 Ds	765 Nh	766 Ds	767 Nh	768 Ds	769 Nh	770 Ds	771 Nh	772 Ds	773 Nh	774 Ds	775 Nh	776 Ds	777 Nh	778 Ds	779 Nh	780 Ds	781 Nh	782 Ds	783 Nh	784 Ds	785 Nh	786 Ds	787 Nh	788 Ds	789 Nh	790 Ds	791 Nh	792 Ds	793 Nh	794 Ds	795 Nh	796 Ds	797 Nh	798 Ds	799 Nh	800 Ds	801 Nh	802 Ds	803 Nh	804 Ds	805 Nh	806 Ds	807 Nh	808 Ds	809 Nh	810 Ds	811 Nh	812 Ds	813 Nh	814 Ds	815 Nh	816 Ds	817 Nh	818 Ds	819 Nh	820 Ds	821 Nh	822 Ds	823 Nh	824 Ds	825 Nh	826 Ds	827 Nh	828 Ds	829 Nh	830 Ds	831 Nh	832 Ds	833 Nh	834 Ds	835 Nh	836 Ds	837 Nh	838 Ds	839 Nh	840 Ds	841 Nh	842 Ds	843 Nh	844 Ds	845 Nh	846 Ds	847 Nh	848 Ds	849 Nh	850 Ds	851 Nh	852 Ds	853 Nh	854 Ds	855 Nh	856 Ds	857 Nh	858 Ds	859 Nh	860 Ds	861 Nh	862 Ds	863 Nh	864 Ds	865 Nh	866 Ds	867 Nh	868 Ds	869 Nh	870 Ds	871 Nh	872 Ds	873 Nh	874 Ds	875 Nh	876 Ds	877 Nh	878 Ds	879 Nh	880 Ds	881 Nh	882 Ds	883 Nh	884 Ds	885 Nh	886 Ds	887 Nh	888 Ds	889 Nh	890 Ds	891 Nh	892 Ds	893 Nh	894 Ds	895 Nh	896 Ds	897 Nh	898 Ds	899 Nh	900 Ds	901 Nh	902 Ds	903 Nh	904 Ds	905 Nh	906 Ds	907 Nh	908 Ds	909 Nh	910 Ds	911 Nh	912 Ds	913 Nh	914 Ds	915 Nh	916 Ds	917 Nh	918 Ds	919 Nh	920 Ds	921 Nh	922 Ds	923 Nh	924 Ds	925 Nh	926 Ds	927 Nh	928 Ds	929 Nh	930 Ds	931 Nh	932 Ds	933 Nh	934 Ds	935 Nh	936 Ds	937 Nh	938 Ds	939 Nh	940 Ds	941 Nh	942 Ds	943 Nh	944 Ds	945 Nh	946 Ds	947 Nh	948 Ds	949 Nh	950 Ds	951 Nh	952 Ds	953 Nh	954 Ds	955 Nh	956 Ds	957 Nh	958 Ds	959 Nh	960 Ds	961 Nh	962 Ds	963 Nh	964 Ds	965 Nh	966 Ds	967 Nh	968 Ds	969 Nh	970 Ds	971 Nh	972 Ds	973 Nh	974 Ds	975 Nh	976 Ds	977 Nh	978 Ds	979 Nh	980 Ds	981 Nh	982 Ds	983 Nh	984 Ds	985 Nh	986 Ds	987 Nh	988 Ds	989 Nh	990 Ds	991 Nh	992 Ds	993 Nh	994 Ds	995 Nh	996 Ds	997 Nh	998 Ds	999 Nh	1000 Ds	1001 Nh	1002 Ds	1003 Nh	1004 Ds	1005 Nh	1006 Ds	1007 Nh	1008 Ds	1009 Nh	1010 Ds	1011 Nh	1012 Ds	1013 Nh	1014 Ds	1015 Nh	1016 Ds	1017 Nh	1018 Ds	1019 Nh	1020 Ds	1021 Nh	1022 Ds	1023 Nh	1024 Ds	1025 Nh	1026 Ds	1027 Nh	1028 Ds	1029 Nh	1030 Ds	1031 Nh	1032 Ds	1033 Nh	1034 Ds	1035 Nh	1036 Ds	1037 Nh	1038 Ds	1039 Nh	1040 Ds	1041 Nh	1042 Ds

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

Half-reactions/Halfreaksies	E° (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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 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
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 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 reducerende vermoë

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

Increasing oxidising ability/Toenemende oksiderende vermoë

Half-reactions/Halfreaksies	E° (V)
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	-3,05
$\text{K}^{+} + \text{e}^{-} \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^{+} + \text{e}^{-} \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^{-}$	-0,83
$\text{Zn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^{-} \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}$	+0,40
$\text{SO}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^{+} + \text{e}^{-} \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-}$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-} \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^{+} + \text{e}^{-} \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}(\text{l})$	+0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\text{l}) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+1,07
$\text{Pt}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-} \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-}$	+1,36
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}$	+2,87

Increasing reducing ability/Toenemende reduserende vermoë

C

C



Basic Education

KwaZulu-Natal Department of Basic Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P2

MEMORANDUM

SEPTEMBER 2015

PREPARATORY EXAMINATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS : 150

N.B. This memorandum consists of 8 pages.

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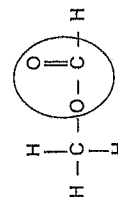
QUESTION 1

- 1.1 B ✓✓ (2)
1.2 B ✓✓ (2)
1.3 C ✓✓ (2)
1.4 C ✓✓ (2)
1.5 B ✓✓ (2)
1.6 A ✓✓ (2)
1.7 B ✓✓ (2)
1.8 D ✓✓ (2)
1.9 B ✓✓ (2)
1.10 D ✓✓ (2)
- 10 x 2 = [20]

QUESTION 2

- 2.1
2.1.1 D ✓ (1)
2.1.2 C ✓ (1)
2.1.3 B ✓ (1)
2.2
2.2.1 4-methylpent-2-yne ✓ (2)
2.2.2 2-bromo-1-chloropropane ✓ (2)

IF	4 methylpent 2 yne	1/2
IF	2 bromo 1 chloropropane	1/2



Marking criteria:

Whole structure correct 2/2
Only functional group correct 1/2

Notes:

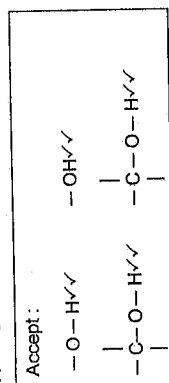
- If two or more functional groups 0/2
- Condensed or semi-structural formula Max 1/2
- Molecular formula 0/2

(2)

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2.3.2 R - O - H ✓✓



2.4 A, C ✓

2.5 C₁₇H₂₆-2 ✓

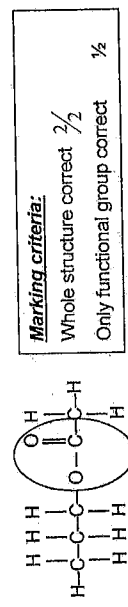
2.6

2.6.1 alcohols are flammable/burn easily ✓

2.6.2 esterification/condensation ✓

2.6.3 propyl ✓ ethanoate ✓

2.6.4



QUESTION 3

3.1 Boiling point ✓

3.2 The compound contains different functional groups ✓ and different types of intermolecular forces with varying degrees of strength ✓
The amount of energy required to overcome the intermolecular forces is therefore different ✓

3.3 The pressure exerted by a vapour ✓ in equilibrium with its solid/liquid phase ✓

3.4 A ✓
A: In addition to London forces and dipole-dipole forces, there are two sites for hydrogen bonding. ✓
B: In addition to London forces and dipole-dipole forces, there is one site for hydrogen bonding. ✓
C: In addition to London forces, there are also dipole-dipole forces. ✓
The intermolecular forces in A is the strongest. ✓

3.5 A ✓

QUESTION 4

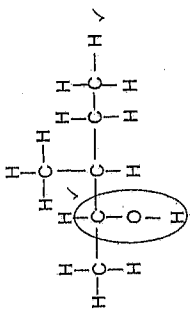
4.1 saturated ✓
ANY ONE

- It has ONLY single bonds. ✓
- It has single bonds between C atoms. ✓
- It has no double OR triple bonds OR multiple bonds. ✓
- It contains the maximum number of H atoms bonded to C atoms. ✓
- Each C atom is bonded to four other atoms. ✓

4.2 hydrolysis ✓

4.3

4.3.1



Marking criteria:
Whole structure correct 2/2
Only functional group correct 1/2

Notes

- Accept -OH as condensed in structural formula. 0/2
- If two or more functional groups 0/2
- Condensed or semi-structural formula: Max. 1/2
- Molecular formula/Molekulêre formule: 0/2

4.3.2 Concentrated sulphuric acid ✓
Heat ✓

4.3.3 Elimination or dehydrohalogenation ✓

4.3.4 3-methyl-2-pentene ✓
Accept: 3-methyl-2-pentene
If hyphens missing 1/2

4.4.1 heat ✓

4.4.2 elimination ✓

QUESTION 5

- 5.1 decrease ✓
A gaseous product ✓ forms which escapes. ✓ (3)
- 5.2 To ensure a fair test ✓ OR
To have ONLY ONE independent variable. ✓ (1)
- 5.3 CaCO_3 /calcium carbonate ✓ (1)
- 5.4 The reaction is complete ✓/All the calcium carbonate has reacted. ✓/The calcium carbonate is completely used up. ✓ (1)
- 5.5.1 A ✓✓ (2)
- 5.5.2 B ✓✓ (2)
- 5.5.3 C ✓✓ (2)
- 5.6 In experiment 4 the CaCO_3 was powder.
Largest surface area ✓
Greater number of effective collisions occurred per unit time ✓
Greater gradient of graph/shorter time to reach completion. ✓ (3)

QUESTION 6

6.1

	AB_3	AB_2	B_2	
Initial quantity (mol)	4	6	3	
Change (mol)	+4,4	-4,4	-2,2	ratio✓
Quantity at equilibrium (mol)	8,4	1,6	0,8	✓
Equilibrium concentration (mol.dm ⁻³)	4,2	0,8	0,4	Divide by 2✓

$$K_c = \frac{[\text{AB}_2]^2 [\text{B}_2]}{[\text{AB}_3]^3}$$

$$= \frac{(0,8^2)(0,4)}{4,2^3}$$

$$= 0,015 \quad (8)$$

Reading of number of initial number of moles correctly from the graph✓
Using the correct ratio to calculate the change✓
Correct calculation of the change✓
Subtracting the change from the initial number of moles to get values at equilibrium✓
Dividing by 2 to get concentration at equilibrium✓
Correct Kc expression(formulae in square brackets)✓
Substitution of concentrations into Kc expression✓
Correct answer: 0,015✓

- 6.2 Temperature ✓✓ (2)
- 6.3 Increased ✓ (1)
- 6.4 According to LCP an increase in temperature favours the endothermic reaction. ✓
In this case the reverse reaction✓
Number of mol of AB_3 increased. ✓ (3)
- 6.5 Smaller than ✓ (1)
- 6.6 No change ✓ (1)

QUESTION 7

- 7.1.1 An acid that contains 2 protons (H^+)✓ (1)
- 7.1.2
- $$\text{pH} = -\log[\text{H}^+] \quad \checkmark$$
- $$3,5 = -\log[\text{H}_3\text{O}^+] \quad \checkmark$$
- $$[\text{H}_3\text{O}^+] = 3,16 \times 10^{-4} \text{ mol.dm}^{-3} \quad \checkmark$$
- [7.1.3 weaker than✓ (2)]
- [7.1.4 The calculated concentration of the H^+ ions is less than the concentration of the acid. ✓ (1)]

- The acid does not ionise completely while sulphuric acid ionises completely. ✓ (2)
- 7.2.1 pink✓ (1)
- 7.2.2 $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{OH}^-$ LHS✓ RHS✓ BAL✓ (3)
- 7.3.1 $n(\text{HNO}_3)_{\text{initial}} = cV = 0,2 \times 0,025 = 0,005 \text{ mol} \quad \checkmark (5 \times 10^{-3})$
- $n(\text{HNO}_3)_{\text{reacted with NaOH}} = n(\text{NaOH}) = 0,1 \times 0,01 = 0,001 \text{ mol} \quad \checkmark (1 \times 10^{-3})$
- $n(\text{HNO}_3)_{\text{reacted with } \text{X}_2\text{CO}_3} = 0,005 - 0,001 = 0,004 \text{ mol} \quad \checkmark (4 \times 10^{-3})$ (5)

Positive marking from question 7.3.1

$$7.3.2 \quad n(\text{X}_2\text{CO}_3) = \frac{1}{2}n(\text{HNO}_3) = \frac{1}{2}(0,004) \quad \checkmark = 0,002 \text{ mol} \quad (2 \times 10^{-3})$$

$$n = \frac{m}{M} \quad \checkmark$$

$$0,002 = \frac{0,212}{M} \quad \checkmark$$

$$M = \frac{106 \text{ g.mol}^{-1}}{106 - (12 + 3(16))} \quad \checkmark$$

$$M(X) = \frac{106 - (12 + 3(16))}{2} \quad \checkmark$$

$$= 23 \text{ g.mol}^{-1} \quad \checkmark$$

(5) [20]

QUESTION 10

- 10.1.1 Haber process ✓ (1)
 10.1.2 catalytic oxidation of ammonia ✓ (1)
 10.1.3 $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$ LHS ✓ RHS ✓ BAL ✓ (3)
 10.1.4 oxygen (O_2) ✓ (1)
 10.1.5 $2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$ LHS ✓ RHS ✓ BAL ✓ (3)

10.2.1 mass W : X : Y
 2,4 : 0,8 : 4

Ratio $\frac{2,4}{0,8} : \frac{0,8}{0,8} : \frac{4}{0,8}$
 3 : 1 : 5 ✓

W : 3
 X : 1
 Y : 5 ✓

10.2.2 $Z = \frac{2,4 + 0,8 + 4}{20} \times 100$
 = 36% ✓

TOTAL MARKS: [150]

QUESTION 8

- 8.1 - complete the internal circuit ✓ or
 - maintain electrical neutrality ✓ (1)
 8.2 - $c(\text{electrolyte}) = 1 \text{ mol} \cdot \text{dm}^{-3}$ ✓
 - $T = 25^\circ\text{C} / 298 \text{ K}$ ✓ (2)
 8.3 E° cell = E° cathode - E° anode ✓
 = E° cathode - (-1,66) ✓
 E° anode = 0,34 V ✓
 X is Cu ✓ (5)
 8.4 Cu^{2+} is a stronger oxidising agent (than Al).
 Al is therefore oxidized. ✓
Oxidation takes place at the anode. ✓ (3)
 8.5 decrease ✓
 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ✓ ✓
 $c(\text{Cu}^{2+})$ decreases ✓ (4)

[15]

QUESTION 9

- 9.1 electroplating ✓ (1)
 9.2 cathode ✓ (1)
 9.3 Ag^+ ✓ (1)
 9.4 $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$ ✓ (2)
 9.5 The rate at which Ag^+ is reduced at the cathode is equal to the rate at which
 the silver anode is oxidized ✓ to produce Ag^+ ✓ (2)

[7]