DEPARTMENT OF EDUCATION
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION - 2005

PHYSICAL SCIENCE P2
CHEMISTRY

HIGHER GRADE

FEBRUARY/MARCH 2005

Marks: 200

2 Hours

This question paper consists of 15 pages,
a data sheet of 4 pages and 1 multiple-choice answer sheet.

GENERAL INSTRUCTIONS

1. Write your **examination number** (and **centre number** if applicable) in the appropriate spaces on the answer book.
2. Answer **ALL** the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. A data sheet is attached for your use.
6. Marks may be forfeited if instructions are not followed.

QUESTION 1

INSTRUCTIONS

1. Answer this question on the specially printed **ANSWER SHEET.** *[NOTE: The answer sheet may be either a separate sheet provided as part of your question paper, or printed as part of the answer book.]* Write your **EXAMINATION NUMBER** (and **centre number** if applicable) in the appropriate spaces if a separate answer sheet is used**.**

2. Four possible answers, indicated by A, B, C and D, are supplied with each question. Each question has only ONE correct answer. Choose only that answer, which in your opinion, is the correct or best one and mark the appropriate block on the answer sheet with a cross.

3. Do not make any other marks on the answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be deleted clearly by means of a diagonal line drawn across the page.

4. If more than one block is marked, no marks will be awarded for that answer.

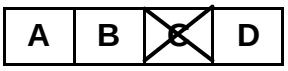
PLACE THE COMPLETED ANSWER SHEET INSIDE THE FRONT COVER OF YOUR ANSWER BOOK, IF A SEPARATE ANSWER SHEET HAS BEEN USED.

EXAMPLE:

QUESTION: The symbol for the SI unit of time is ...

A t.
B h.
C s.
D m.

ANSWER:



1.1 The boiling points of helium and argon are –269°C and –186°C respectively. This difference in boiling point is due to the presence of stronger …

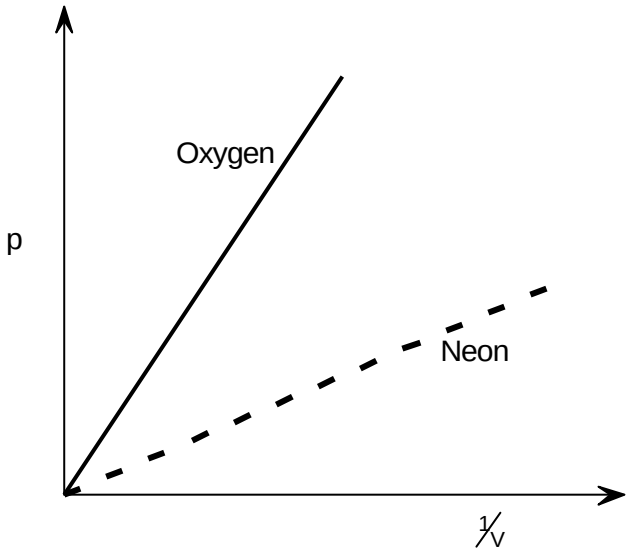
A ionic bonds between argon atoms.

B covalent bonds between helium atoms.

C hydrogen bonds between helium atoms.

D Van der Waals forces between argon atoms. (4)

1.2 An experiment was done with separate samples of oxygen and neon gas. The following graphs of pressure (p) versus the reciprocal of the volume ($\frac{1}{V}$) were obtained in each case:



If the same number of moles of gas were used in each experiment, which ONE of the following statements concerning the temperature of the gases is TRUE?

A The temperature of both gases was the same.

B The temperature of the neon was lower than that of the oxygen gas.

C The temperature of the neon was higher than that of the oxygen gas.

D No deductions about the temperature can be made from the graph. (4)

1.3 The reaction that occurs when H_2S gas is bubbled through an iron (III) chloride solution is:

$$2Fe^{3+}(aq) + H_2S(g) \rightarrow 2Fe^{2+}(aq) + S(s) + 2H^+(aq)$$

Which ONE of the following statements about this reaction is **NOT** correct?

A A yellow precipitate forms.

B The Fe^{3+} ions are reduced.

C The pH of the solution increases.

D The H_2S acts as a reducing agent. (4)

1.4 An unknown salt solution is added to a solution of silver nitrate and to a solution of sulphuric acid. A white precipitate forms in each case.The unknown salt solution is probably …

A barium chloride.

B lead nitrate.

C copper (II) chloride.

D barium nitrate. (4)

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

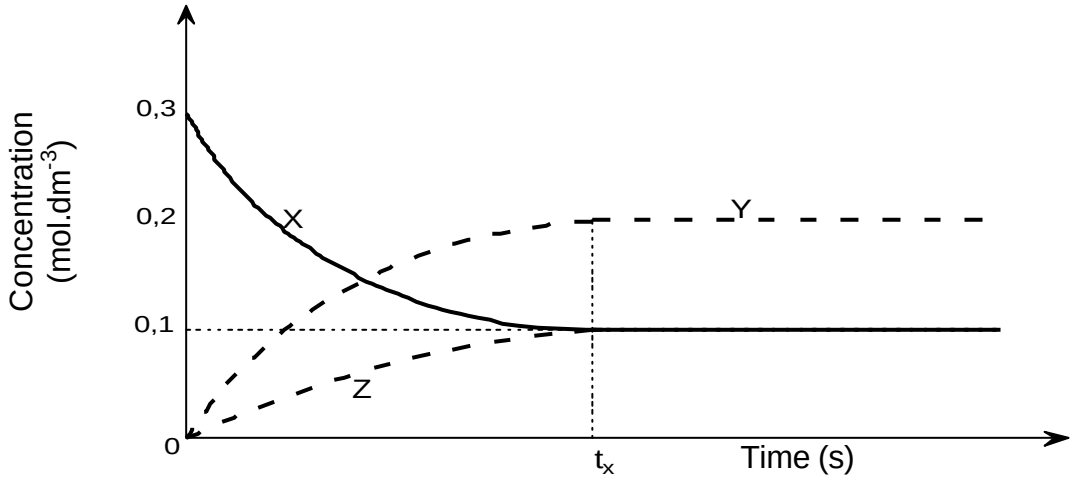
A Fractional distillation of air

B Haber process

C Ostwald process

D Contact process (4)

1.6 A gas X is placed in a sealed container at t = 0 s. The gas decomposes into gases Y and Z. A chemical equilibrium between the three gases is reached at t = t_x. The following graph of concentration versus time shows the changes that occurred during the reaction:



The equation for this reaction is:

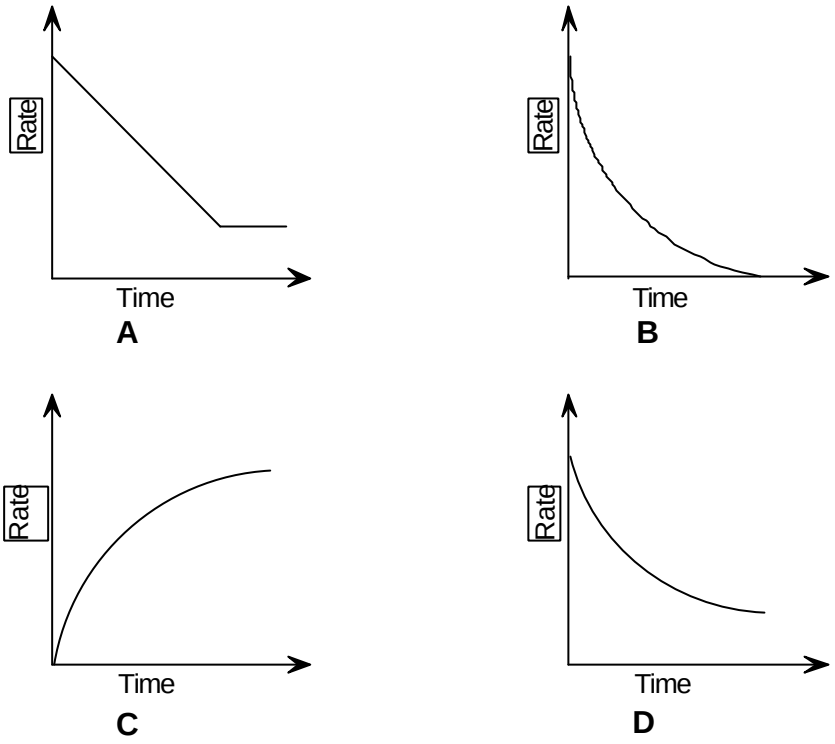
A $3X \equiv 2Y + Z$

B $X \equiv Y + Z$

C $X \equiv 2Y + Z$

D $2X \equiv 2Y + Z$ (4)

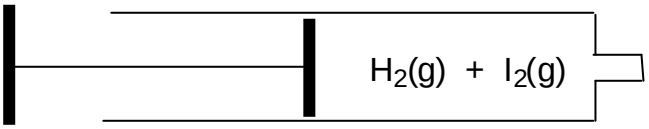
1.7 Which ONE of the following graphs of rate of reaction versus time is typical of a reaction between an excess of hydrochloric acid and a sample of powdered magnesium?



(4)

1.8 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:

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



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

(4)

1.9 Dilute nitric acid is gradually added to a flask of distilled water at 25°C. How does this affect the hydrogen ion concentration $[H^+]$ and the ionisation constant (K_w) of water?

	$[H^+]$	K_w
A	Increases	Increases
B	Increases	Decreases
C	Increases	Stays the same
D	Stays the same	Stays the same

(4)

1.10 Consider the following reversible reaction:

$$HPO_4^{2-}(aq) + H_2O(l) \equiv H_2PO_4^-(aq) + OH^-(aq)$$

The compounds HPO_4^{2-} and OH^- in this reaction can be described as …

A a conjugate acid-base pair.

B Lowry-Brönsted bases.

C Lowry-Brönsted acids.

D polyprotic acids. (4)

1.11 Which ONE of the following equations best explains why a solution of copper sulphate **should not be stored** in an aluminium container?

A $2Al^{3+} + 3Cu \rightarrow 3Cu^{2+} + 2Al$

B $Al^{3+} + Cu^{2+} \rightarrow Al^{2+} + Cu^{3+}$

C $2Al + 3Cu^{2+} \rightarrow 2Al^{3+} + 3Cu$

D $Al^{3+} + Cu^{+} \rightarrow Al^{2+} + Cu^{2+}$ (4)

1.12 The cell notation of an electrochemical cell is:

$$Mg(s) \mid Mg^{2+}(aq) \mid\mid Cu^{2+}(aq) \mid Cu(s)$$

The emf of the cell under standard conditions is 2,71 V. However, when a learner set up this cell, he/she found that the emf was only 1,20 V. Which ONE of the following factors most probably affected his/her results?

A The volume of the $Cu^{2+}(aq)$ solution.

B The concentration of the $Cu^{2+}(aq)$ solution.

C The size of the copper electrode.

D The concentration of the solution in the salt bridge. (4)

1.13 The half-reactions taking place in a certain hypothetical electrochemical cell are:

$X^{2+} + 2e^- \equiv X \qquad E° = +0,80\ V$

$Y^+ + e^- \equiv Y \qquad E° = -0,76\ V$

Which ONE of the following acts as the reducing agent?

A X^{2+}

B Y^+

C X

D Y (4)

1.14 Which ONE of the following compounds has the molecular formula $C_2H_4O_2$?

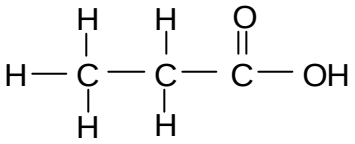
A Methanoic acid

B Ethanol

C Ethyl methanoate

D Ethanoic acid (4)

1.15 Consider the compound below:



This compound can be prepared by the oxidation of an …

A ester.

B alkene.

C alcohol.

D alkane. (4)

[60]

ANSWER QUESTIONS 2 – 10 IN THE ANSWER BOOK.

INSTRUCTIONS

1. Start each question on a new page in your answer book.
2. Leave one line between subsections, for example between QUESTIONS 2.1. and 2.2.
3. Give ALL formulae used and show your workings (this includes substitutions).
4. Number your answers in the same way that the questions are numbered.

QUESTION 2

2.1 Consider the following list of chemical substances:

A. $KNO_3(s)$ B. $CO_2(s)$ C. C(s)

D. $H_2O(l)$ E. Cu(s)

Select from the above list a substance which:
(Write only the letter representing the substance.)

2.1.1 Has allotropes (2)

2.1.2 Has Van der Waals forces between its particles (2)

2.1.3 Is a solid that can dissolve in a polar liquid (2)

2.1.4 Has metallic bonding between its atoms (2)

2.1.5 Can sublime at room temperature (undergoes sublimation) (2)

2.2 Explain why a real gas deviates from ideal gas behaviour at low temperatures. (3)

2.3 5,60 g of a diatomic gas occupies a volume of $3,00 \times 10^{-3}$ m^3 at a temperature of 25°C and a pressure of 165 kPa.

2.3.1 Calculate the molar formula mass of the gas. (6)

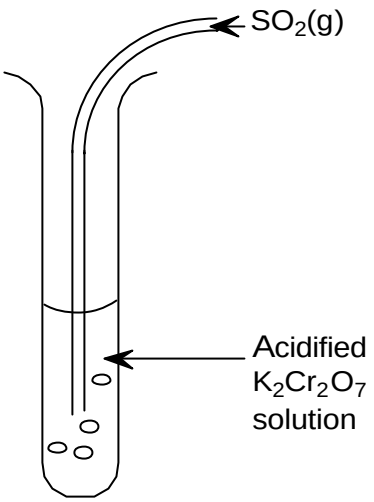
2.3.2 Give the name or formula of the gas. (2)
[21]

QUESTION 3 (START ON A NEW PAGE)

Sulphur dioxide gas is produced in the laboratory, through the reaction between sodium sulphite and dilute hydrochloric acid.

3.1 Write the balanced chemical equation for this reaction. (3)

The sulphur dioxide gas is bubbled through an acidified solution of potassium dichromate. The solution changes green in colour.



3.2 Write the formula of the ion responsible for the green colour. (2)

3.3 Use the Table of Standard Reduction Potentials to write down the balanced equation for this reaction. This equation can be left in ionic form. (6)

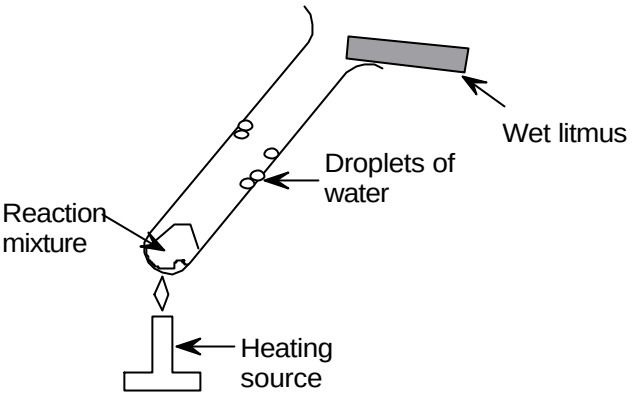
3.4 Identify the oxidising agent in this reaction. (2)
[13]

QUESTION 4 (START ON A NEW PAGE)

4.1 Equal quantities of ammonium chloride crystals and a calcium compound are mixed together and placed in a test tube.

The test tube is then heated and a piece of wet litmus paper is placed at the mouth of the test tube.

After a few seconds, a strong smell is noticed and small droplets of water form on the sides of the test tube.



4.1.1 Write the **NAME** of the calcium compound. (2)

4.1.2 Write the colour of the litmus paper after the reaction took place. (1)

4.1.3 Write the **NAME** of the product responsible for the colour change in QUESTION 4.1.2. (2)

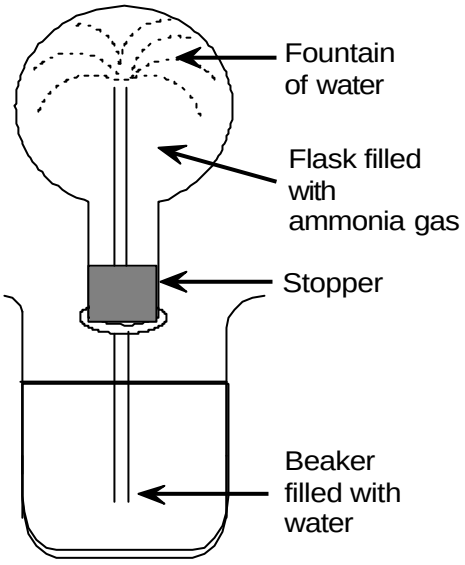
4.1.4 Explain, with the aid of a balanced equation, why water droplets form on the side of the test tube. (4)

4.2 A round bottomed flask is filled with ammonia gas.

The flask is sealed with a stopper which has a glass tube through it.

The flask is then inverted and placed over a beaker of water as shown in the sketch.

It is observed that water rises up in the tube and forms a fountain in the flask.



Explain why the water rises up the tube into the flask. (4)
[13]

QUESTION 5 (START ON A NEW PAGE)

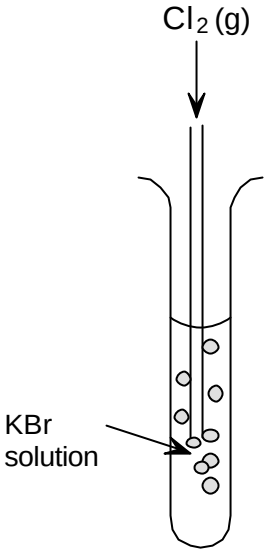
Chlorine gas is prepared in the school laboratory by using potassium permanganate and hydrochloric acid.

5.1 Write a balanced equation for this reaction. (4)
(The equation may be in ionic form without spectator ions.)

5.2 *Chlorine gas (Cl_2) is bubbled through an aqueous solution of KBr in a test tube.*

The solution changes colour.

5.2.1 Write balanced equation that will explain this colour change. (3)

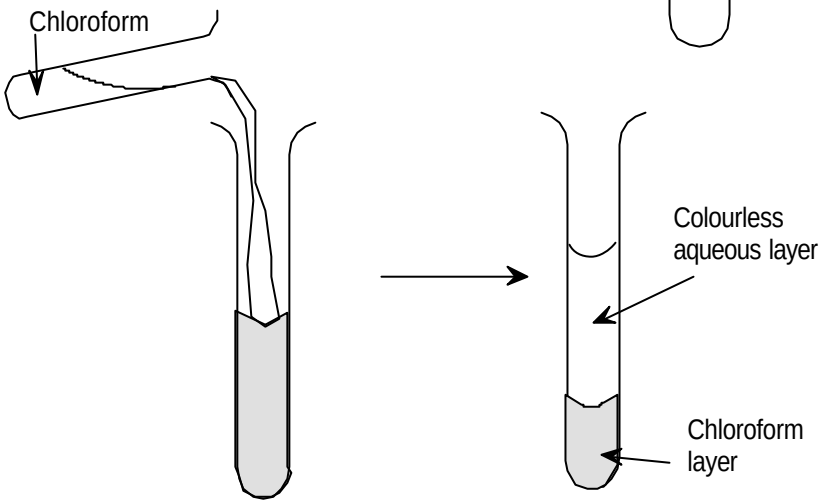


Some chloroform is then added to this test tube.

The test tube is carefully shaken.

The solution separates into two layers.

The aqueous layer becomes colourless, while the chloroform layer takes on a colour.



5.2.2 Give the **FORMULA** of the solute (dissolved substance) in the aqueous layer (top layer). (2)

5.2.3 Give the **FORMULA** of the solute (dissolved substance) in the chloroform layer (bottom layer). (2)

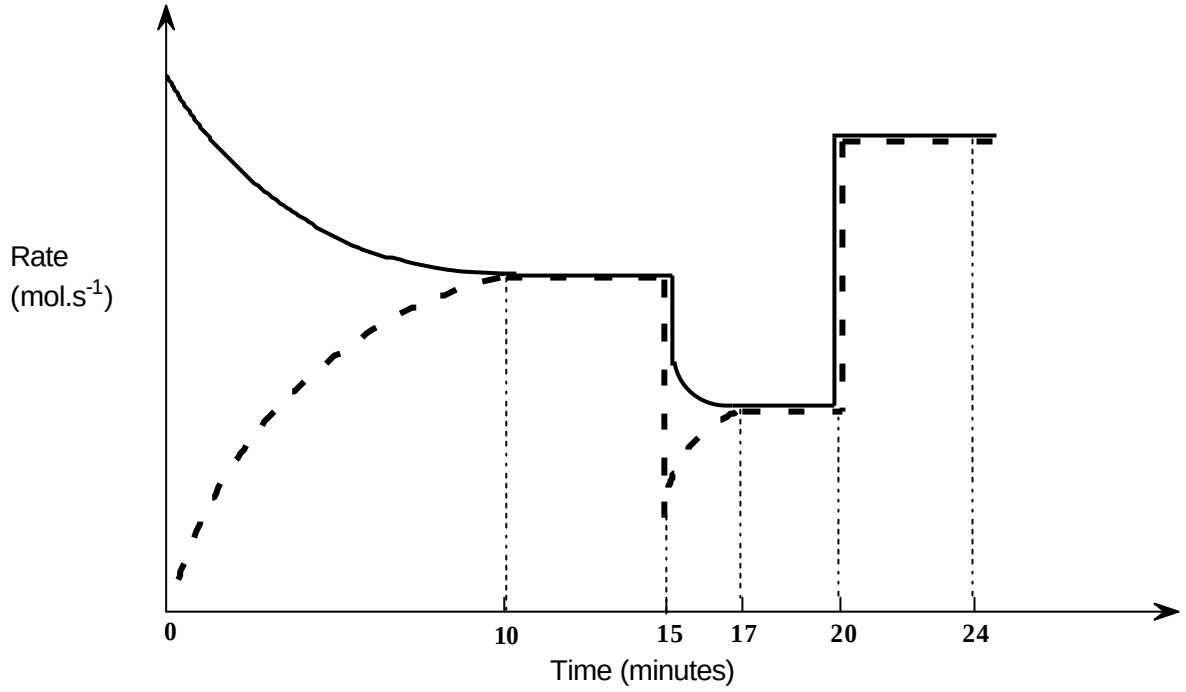
5.3 A learner decides to prepare chlorine using another method.
She takes some MnO_2 and adds it to a 1 $mol.dm^{-3}$ HCl solution in a test tube.
No reaction takes place. Use the Table of Standard Reduction Potentials and explain why she was not successful in preparing chlorine in this way. (4)
[15]

QUESTION 6 (START ON A NEW PAGE)

Nitrogen and oxygen gases react in a sealed container according to the following equation:

$$O_2(g) + N_2(g) \equiv 2NO(g)$$

After the reaction reaches equilibrium, certain changes are made. The following graph of rate of reaction versus time illustrates the situation.



6.1 Write the equation of the reaction represented by the dashed line (- -) on this graph. (2)

6.2 What is represented by the section of the graph between the 10th and 15th minute? Explain your answer. (3)

6.3 A temperature change takes place at t = 15 minutes.

6.3.1 Was the temperature increased or decreased at t = 15 minutes? (1)

6.3.2 Explain whether the forward reaction is exothermic or endothermic. (3)

6.3.3 What effect does this temperature change have on the equilibrium constant (Kc)?
(Write only INCREASES, DECREASES or NO EFFECT.) (2)

6.4 A pressure change is introduced at t = 20 minutes.

6.4.1 Was the pressure increased or decreased? (1)

6.4.2 Explain how this change in pressure affects the amounts of each gas at equilibrium. (3)
[15]

QUESTION 7 (START ON A NEW PAGE)

Consider the hypothetical reaction that takes place between gases A_2 and B in a closed container:

$$A_2(g) + 2B(g) \equiv 2AB(g) \qquad \Delta H > 0$$
colourless colourless dark red

X mol of gas A_2 and 2,0 mol of gas B are sealed in a 1,0 dm^3 container. After a few minutes equilibrium is established and the contents of the container turns light red.

7.1 At equilibrium it is found that 0,40 mol of gas AB is present in the container. The value of K_c is 0,50.
Determine X, the quantity (in mol) of gas A_2 that was **originally** sealed in the container. (8)

7.2 More moles of B are added to the container. Will the value of K_c be **GREATER THAN**, **LESS THAN** or **EQUAL** to 0,50? (2)

7.3 The container and its contents are now heated. What effect will this have on the colour of the contents of the container? (2)
[12]

QUESTION 8 (START ON A NEW PAGE)

8.1 Eight grams (8,0 g) of sodium hydroxide are dissolved in 350 cm^3 of distilled water. 15 cm^3 of this solution neutralises 20 cm^3 of a sulphuric acid solution.

The balanced equation for this reaction is:

$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

Calculate the concentration of the sulphuric acid solution. (7)

8.2 An environmental disaster threatens the small town of Bafanaville.
There has been a large spillage of concentrated hydrochloric acid (HCl) into the town's only water storage dam.
The pH of the water has decreased to 4.

8.2.1 Explain, with the aid of a chemical equation, why the pH of the dam water decreased. (4)

The Municipality decides to add quantities of soda ash (Na_2CO_3) to the water of the dam, hoping that the pH will be restored to a value close to 7.

8.2.2 Calculate the mass of soda ash (Na_2CO_3) required to neutralise each 1 dm^3 of the acidified dam water. (9)

8.2.3 Besides neutralisation, what other effect will the addition of the Na_2CO_3 have on the water in the dam? (2)
[22]

QUESTION 9 (START ON A NEW PAGE)

9.1 A standard electrochemical cell is set up using the following half-reactions:

$Ce^{3+} + 3e^- \rightarrow Ce \quad E^o = -2,30\ V$

$Pd^{2+} + 2e^- \rightarrow Pd \quad E^o = +0,99\ V$

9.1.1 Write the oxidation half-reaction for this cell. (2)

9.1.2 Write the balanced equation for the nett overall cell reaction. (3)

9.1.3 Calculate the emf of this cell. (4)

9.2 Metals A, B and C form only divalent ions (ions with a valency of 2).

Metal A can displace B^{2+} ions from its aqueous solutions.

Metal C can displace A^{2+} ions from its aqueous solutions.

9.2.1 Which ONE of the three ions is the strongest oxidising agent? (2)

9.2.2 Which TWO of the metals would you use to construct a standard electrochemical cell with the highest potential difference? (2)

[13]

QUESTION 10 (START ON A NEW PAGE)

10.1 Consider the following list of organic compounds:

A: $CH_3-CH_2-CH_2-CH_3$

B: $CH_3-\underset{\underset{O}{\|}}{C}-OH$

C: $CH_3-CH_2-O-\underset{\underset{O}{\|}}{C}-H$

D: $CH_3-CH=CH-CH_3$

E: $CH_3-\underset{\underset{OH}{|}}{CH_2}$

F: $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_3$

G: $CH\equiv C-\underset{\underset{CH_3}{|}}{CH}-CH_3$

10.1.1 Using STRUCTURAL FORMULAE, write an equation for the preparation of an ester. Choose the reactants from the above list. (4)

10.1.2 Write the letters representing TWO compounds in this list that are isomers of each other. (2)

10.1.3 Write the IUPAC name of compound C. (2)

10.1.4 Write the IUPAC name of compound D. (2)

10.2 A bottle of wine, which contains ethanol, is opened and left to stand for a few days. After a while it begins to turn sour, and to smell like vinegar.
A chemical reaction has taken place.

10.2.1 Is this reaction an ADDITION, OXIDATION, ACID-BASE or ESTERIFICATION reaction? (2)

10.2.2 Give the IUPAC name and STRUCTURAL FORMULA of the product responsible for the smell. (4)
[16]

TOTAL: 200

SENIOR CERTIFICATE EXAMINATION - MARCH 2005

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

DATA FOR PHYSICAL SCIENCE
PAPER 2 (CHEMISTRY)

GEGEWENS VIR NATUUR- EN SKEIKUNDE
VRAESTEL 2 (CHEMIE)

TABEL 1: FISIESE KONSTANTE

TABLE 1: PHYSICAL CONSTANTS

Avogadro-konstante Avogadro's constant	N_A of/or L	6,02 x 10^{23} mol^{-1}
Molêre gaskonstante Molar gas constant	R	8,31 $J.K^{-1}.mol^{-1}$
Standaarddruk Standard pressure	p^q	1,013 x 10^5 Pa
Molêre gasvolume by STD Molar gas volume at STP	V_m	22,4 $dm^3.mol^{-1}$
Standaardtemperatuur Standard temperature	T^q	273 K

TABEL 2: FORMULES

TABLE 2: FORMULAE

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$
$pV = nRT$	$K_w = [H^+][OH^-] = 10^{-14}$ by/at 298 K
$n = \frac{m}{M}$	$pH = -\log[H^+]$
$c = \frac{n}{V}$	$E^q_{sel} = E^q_{oksideermiddel} - E^q_{reduseermiddel}$
$c = \frac{m}{MV}$	$E^q_{cell} = E^q_{oxidising\ agent} - E^q_{reducing\ agent}$
	$E^q_{sel} = E^q_{katode} - E^q_{anode}$
	$E^q_{cell} = E^q_{cathode} - E^q_{anode}$

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

SLEUTEL / KEY

Atoomgetal
Atomic number

Elektronegatiwiteit
Electronegativity

Simbool
Symbol

Relatiewe atoommassa (benaderd)
Relative atomic mass
(approximately)

I	II	III	IV	V	VI	VII	0
2,1 **H** 1							**He** 4
1,0 **Li** 7	1,5 **Be** 9	2,0 **B** 11	2,5 **C** 12	3,0 **N** 14	3,5 **O** 16	4,0 **F** 19	**Ne** 20
0,9 **Na** 23	1,2 **Mg** 24	1,5 **Al** 27	1,8 **Si** 28	2,1 **P** 31	2,5 **S** 32	3,0 **Cl** 35,5	**Ar** 40
0,8 **K** 39	1,0 **Ca** 40	1,3 **Sc** 45	1,5 **Ti** 48	1,6 **V** 51	1,6 **Cr** 52	1,5 **Mn** 55	1,8 **Fe** 56	1,8 **Co** 59	1,8 **Ni** 59	1,9 **Cu** 63,5	1,6 **Zn** 65	1,6 **Ga** 70	1,8 **Ge** 73	2,0 **As** 75	2,4 **Se** 79	2,8 **Br** 80	**Kr** 84
0,8 **Rb** 86	1,0 **Sr** 88	1,2 **Y** 89	1,4 **Zr** 91	**Nb** 92	1,8 **Mo** 96	1,9 **Tc**	2,2 **Ru** 101	2,2 **Rh** 103	2,2 **Pd** 106	1,9 **Ag** 108	1,7 **Cd** 112	1,7 **In** 115	1,8 **Sn** 119	1,9 **Sb** 122	2,1 **Te** 128	2,5 **I** 127	**Xe** 131
0,7 **Cs** 133	0,9 **Ba** 137	**La** 139	1,6 **Hf** 179	**Ta** 181	**W** 184	**Re** 186	**Os** 190	**Ir** 192	**Pt** 195	**Au** 197	**Hg** 201	1,8 **Tl** 204	1,8 **Pb** 207	1,9 **Bi** 209	2,0 **Po**	2,5 **At**	**Rn**
0,7 **Fr**	0,9 **Ra** 226	**Ac**															

Ce 140	**Pr** 141	**Nd** 144	**Pm**	**Sm** 150	**Eu** 152	**Gd** 157	**Tb** 159	**Dy** 163	**Ho** 165	**Er** 167	**Tm** 169	**Yb** 173	**Lu** 175
Th 232	**Pa**	**U** 238	**Np**	**Pu**	**Am**	**Cm**	**Bk**	**Cf**	**Es**	**Fm**	**Md**	**No**	**Lr**

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

Increasing oxidising ability / Toenemende oksideervermoë ↑

Halfreaksie / Half-reaction	E° /volt
$F_2 + 2e^- \cdot 2F^-$	+2,87
$H_2O_2 + 2H^+ + 2e^- \cdot 2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^- \cdot Mn^{2+} + 4H_2O$	+1,51
$Au^{3+} + 3e^- \cdot Au$	+1,42
$Cl_2 + 2e^- \cdot 2Cl^-$	+1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \cdot 2Cr^{3+} + 7H_2O$	+1,33
$O_2 + 4H^+ + 4e^- \cdot 2H_2O$	+1,23
$MnO_2 + 4H^+ + 2e^- \cdot Mn^{2+} + 2H_2O$	+1,21
$Pt^{2+} + 2e^- \cdot Pt$	+1,20
$Br_2 + 2e^- \cdot 2Br^-$	+1,09
$NO_3^- + 4H^+ + 3e^- \cdot NO + 2H_2O$	+0,96
$Ag^+ + e^- \cdot Ag$	+0,80
$NO_3^- + 2H^+ + e^- \cdot NO_2 + H_2O$	+0,80
$Hg^{2+} + 2e^- \cdot Hg$	+0,79
$Fe^{3+} + e^- \cdot Fe^{2+}$	+0,77
$O_2 + 2H^+ + 2e^- \cdot H_2O_2$	+0,68
$I_2 + 2e^- \cdot 2I^-$	+0,54
$SO_2 + 4H^+ + 4e^- \cdot S + 2H_2O$	+0,45
$2H_2O + O_2 + 4e^- \cdot 4OH^-$	+0,40
$Cu^{2+} + 2e^- \cdot Cu$	+0,34
$SO_4^{2-} + 4H^+ + 2e^- \cdot SO_2 + 2H_2O$	+0,17
$Cu^{2+} + e^- \cdot Cu^+$	+0,16
$Sn^{4+} + 2e^- \cdot Sn^{2+}$	+0,15
$S + 2H^+ + 2e^- \cdot H_2S$	+0,14
$2H^+ + 2e^- \cdot H_2$	**0,00**
$Fe^{3+} + 3e^- \cdot Fe$	-0,04
$Pb^{2+} + 2e^- \cdot Pb$	-0,13
$Sn^{2+} + 2e^- \cdot Sn$	-0,14
$Ni^{2+} + 2e^- \cdot Ni$	-0,25
$Co^{2+} + 2e^- \cdot Co$	-0,28
$Cd^{2+} + 2e^- \cdot Cd$	-0,40
$Fe^{2+} + 2e^- \cdot Fe$	-0,44
$Cr^{3+} + 3e^- \cdot Cr$	-0,74
$Zn^{2+} + 2e^- \cdot Zn$	-0,76
$2H_2O + 2e^- \cdot H_2 + 2OH^-$	-0,83
$Mn^{2+} + 2e^- \cdot Mn$	-1,18
$Al^{3+} + 3e^- \cdot Al$	-1,66
$Mg^{2+} + 2e^- \cdot Mg$	-2,37
$Na^+ + e^- \cdot Na$	-2,71
$Ca^{2+} + 2e^- \cdot Ca$	-2,87
$Sr^{2+} + 2e^- \cdot Sr$	-2,89
$Ba^{2+} + 2e^- \cdot Ba$	-2,90
$Cs^+ + e^- \cdot Cs$	-2,92
$K^+ + e^- \cdot K$	-2,93
$Li^+ + e^- \cdot Li$	-3,05

Increasing reducing ability / Toenemende reduseervermoë ↓

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

Increasing oxidising ability / Toenemende oksideervermoë ↓

Halfreaksie / Half-reaction	E° /volt
$Li^+ + e^- \cdot Li$	-3,05
$K^+ + e^- \cdot K$	-2,93
$Cs^+ + e^- \cdot Cs$	-2,92
$Ba^{2+} + 2e^- \cdot Ba$	-2,90
$Sr^{2+} + 2e^- \cdot Sr$	-2,89
$Ca^{2+} + 2e^- \cdot Ca$	-2,87
$Na^+ + e^- \cdot Na$	-2,71
$Mg^{2+} + 2e^- \cdot Mg$	-2,37
$Al^{3+} + 3e^- \cdot Al$	-1,66
$Mn^{2+} + 2e^- \cdot Mn$	-1,18
$2H_2O + 2e^- \cdot H_2 + 2OH^-$	-0,83
$Zn^{2+} + 2e^- \cdot Zn$	-0,76
$Cr^{3+} + 3e^- \cdot Cr$	-0,74
$Fe^{2+} + 2e^- \cdot Fe$	-0,44
$Cd^{2+} + 2e^- \cdot Cd$	-0,40
$Co^{2+} + 2e^- \cdot Co$	-0,28
$Ni^{2+} + 2e^- \cdot Ni$	-0,25
$Sn^{2+} + 2e^- \cdot Sn$	-0,14
$Pb^{2+} + 2e^- \cdot Pb$	-0,13
$Fe^{3+} + 3e^- \cdot Fe$	-0,04
$2H^+ + 2e^- \cdot H_2$	**0,00**
$S + 2H^+ + 2e^- \cdot H_2S$	+0,14
$Sn^{4+} + 2e^- \cdot Sn^{2+}$	+0,15
$Cu^{2+} + e^- \cdot Cu^+$	+0,16
$SO_4^{2-} + 4H^+ + 2e^- \cdot SO_2 + 2H_2O$	+0,17
$Cu^{2+} + 2e^- \cdot Cu$	+0,34
$2H_2O + O_2 + 4e^- \cdot 4OH^-$	+0,40
$SO_2 + 4H^+ + 4e^- \cdot S + 2H_2O$	+0,45
$I_2 + 2e^- \cdot 2I^-$	+0,54
$O_2 + 2H^+ + 2e^- \cdot H_2O_2$	+0,68
$Fe^{3+} + e^- \cdot Fe^{2+}$	+0,77
$Hg^{2+} + 2e^- \cdot Hg$	+0,79
$NO_3^- + 2H^+ + e^- \cdot NO_2 + H_2O$	+0,80
$Ag^+ + e^- \cdot Ag$	+0,80
$NO_3^- + 4H^+ + 3e^- \cdot NO + 2H_2O$	+0,96
$Br_2 + 2e^- \cdot 2Br^-$	+1,09
$Pt^{2+} + 2e^- \cdot Pt$	+1,20
$MnO_2 + 4H^+ + 2e^- \cdot Mn^{2+} + 2H_2O$	+1,21
$O_2 + 4H^+ + 4e^- \cdot 2H_2O$	+1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^- \cdot 2Cr^{3+} + 7H_2O$	+1,33
$Cl_2 + 2e^- \cdot 2Cl^-$	+1,36
$Au^{3+} + 3e^- \cdot Au$	+1,42
$MnO_4^- + 8H^+ + 5e^- \cdot Mn^{2+} + 4H_2O$	+1,51
$H_2O_2 + 2H^+ + 2e^- \cdot 2H_2O$	+1,77
$F_2 + 2e^- \cdot 2F^-$	+2,87

↑ Increasing reducing ability / Toenemende reduseervermoë

ANTWOORDBLAD
ANSWER SHEET

NATUUR- EN SKEIKUNDE HG (TWEEDE VRAESTEL) PHYSICAL SCIENCE HG (SECOND PAPER)

Eksamennommer **Examination number**													

DEPARTEMENT VAN ONDERWYS
DEPARTMENT OF EDUCATION

SENIORSERTIFIKAAT-EKSAMEN/SENIOR CERTIFICATE EXAMINATION

NATUUR- EN SKEIKUNDE HOËR GRAAD TWEEDE VRAESTEL (CHEMIE)
PHYSICAL SCIENCE HIGHER GRADE SECOND PAPER (CHEMISTRY)

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D
1.11	A	B	C	D
1.12	A	B	C	D
1.13	A	B	C	D
1.14	A	B	C	D
1.15	A	B	C	D

Vir die gebruik van die nasiener For the use of the marker	
Punte behaal Marks obtained	
Nasiener se paraaf Marker's initials	
Nasiener se nommer Marker's number	

MULTIPLE CHOICE/ *MEERVOUDIGE KEUSE VRAE*

1.1	D	1.2	B	1.3	C	1.4	A	1.5	C
1.6	D	1.7	B	1.8	D	1.9	C	1.10	B
1.11	C	1.12	B	1.13	D	1.14	D	1.15	C

4 x 15 =[60]

QUESTION 2/*VRAAG 2*

2.1.1 C YY

2.1.2 B YY

2.1.3 A YY

2.1.4 E YY

2.1.5 B YY (10)

2.2 At low temperature the **intermolecular forces** in real gases **becomes stronger** (plays a larger role) resulting in a **decrease in pressure/volume**. [OR gas tends to liquify] Y Y Y (3)

*By lae temperature word **intermolekulêre kragte** in ware gasse **sterker** (speel 'n belangriker rol) wat 'n **verlaging in druk/volume** veroorsaak[OF gas neig om te vervloei.*

2.3.1 T = 298 K

$V = 3 \times 10^{-3}\ m^3$

$p = 165 \times 10^{3}$ Pa

m = 5,6 g

$$pV = nRT \qquad \therefore\ n = \frac{pV}{RT} = \frac{165 \times 10^{3} \times 3 \times 10^{-3}}{8{,}31 \times 298} = 0{,}2 \text{ mol}$$

(Y Y Y Y)

$$M = \frac{m}{n} = \frac{5{,}6}{0{,}2} = 28 \text{ g.mol}^{-1}$$ Y (6)

2.3.2 Nitrogen (N_2) / *Stikstof (N_2)* YY (2)

[21]

QUESTION 3/ *VRAAG 3*

3.1 $Na_2SO_3 + 2HC\ell \rightarrow 2NaC\ell + SO_2 + H_2O$ (**1 balancing/ *balansering***) (3)

3.2 Cr^{3+} (2)

3.3 $SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$ (x3)

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

$Cr_2O_7^{2-} + 3SO_2 + 2H^+ \rightarrow 2Cr^{3+} + 3SO_4^{2-} + H_2O$ (6)

3.4 $Cr_2O_7^{2-}$ OR $K_2Cr_2O_7$ OR/*OF* potassium dicromate/ *kaliumdichromaat* (2)

[13]

QUESTION 4/ *VRAAG 4*

4.1.1 calcium hydroxide/ *kalsiumhidroksied* $[Ca(OH)_2]$ (**1 only/ *alleenlik***) (2)

4.1.2 blue/ *blou* (1)

4.1.3 ammonia/ *ammoniak* (NH_3) (2)

4.1.4 $Ca(OH)_2 + 2NH_4C\ell \rightarrow CaC\ell_2 + 2NH_3 + 2H_2O$ (**1 balancing/ *balansering***)
Water is product of this reaction. (4)
Water is 'n produk van die reaksie

4.2 As ammonia **dissolves** in water, the **pressure in the flask decreased** and the water is forced up the tube. (4)
*Soos die ammoniak in die water **oplos**, sal die **druk in die fles verlaag** en water in die buisie opgeforseer word.*

[13]

QUESTION 5/ *VRAAG 5*

5.1 $2C\ell^- \rightarrow C\ell_2 + 2e^-$

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

$2MnO_4^- + 10C\ell^- + 16H^+ \rightarrow 2Mn^{2+} + 5C\ell_2 + 8H_2O$

OR/OF $2KMnO_4 + 16HC\ell \rightarrow 5C\ell_2 + 2MnC\ell_2 + 2KC\ell + 8H_2O$ (4)

5.2.1 $C\ell_2 + 2KBr \rightarrow 2KC\ell + Br_2$ (**1 balancing/*balansering***) (3)

5.2.2 $KC\ell$ [potassium chloride/*kaliumchloried*] (2)

5.2.3 Br_2 [bromine/ *broom*] (2)

5.3 $C\ell^-$ is not a **strong enough RA** to reduce **MnO_2 to Mn^{2+}**
or MnO_2 is not a **strong enough OA** to oxidise **$C\ell^-$ to $C\ell_2$** (4)
*$C\ell^-$ in nie 'n **sterk genoeg RM** om **MnO_2 na Mn^{2+}** te reduseer nie*
*of MnO_2 is nie 'n **sterk genoeg OM** om **$C\ell^-$ na $C\ell_2$** te oksideer nie*

[15]

QUESTION 6/ *VRAAG 6*

6.1 $2NO \rightarrow O_2 + N_2$ (2)

6.2 Equilibrium is reached. The rates of the forward and reverse reactions are equal. (3)
Ewewig is bereik. Die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugewaartse reaksie

6.3.1 decreased/ *afgeneem* (1)

6.3.2 exothermic At 15 min the **rate of the forward reaction is greater** than the rate of the reverse reaction, i.e. a **decrease in temperature** favoured the forward reaction. (3)
*Eksotermies. By 15 min is die **tempo van die voorwaartse reaksie groter** as die tempo van die terugwaartse reaksie, d.i. 'n **afname in temperatuur** bevoordeel die voorwaartse reaksie*

6.3.3 Increases/ *neem toe* (2)

6.4.1 Increased/ toe ge*neem* (1)

6.4.2 Increase in pressure increased both rates. As the number of moles of gas molecules of the reactant and product is equal, the quantity of each gas will be **the same**. (3)
*Toename in druk verhoog beide reaksietempos. Aangesien die aantal mol van gasmolekules van die reagense en produkte dieselfde is, sal die hoeveelheid van elke gas **dieselfde** wees.*

[15]

QUESTION 7/ *VRAAG 7*

7.1

	A_2	+	2B	→	2AB
initial (mol) *mol aanvanklik*	x		2		0
used/formed *gebruik/gevorm*	0,2		0,4		0,4
Eq (mol) *Ew (mol*	x –0,2		1,6		0,4
[Eq] / *[Ewewig]*	x –0,2		1,6		0,4

Y Y Y Y

$$K_C = \frac{[AB]^2}{[A_2][B]^2} = \frac{(0,4)^2}{(x - 0,2)(1,6)^2} = 0,5$$

Y YY Y

$$\therefore\ 0,5\,[(x - 0,2)(1,6)^2] = (0,4)^2$$

$$\therefore\ 1,28x - 0,256 = 0,16$$

$$\therefore\ x = 0,325\ \text{mol}$$ Y

(8)

If it was not shown how concentrations were obtained and they are:
Correct – give marks in substitution (Max:**5/8**)

Incorrect – only mark for correct K_c expression (Max: **1/8)**

As daar nie aangedui word hoe konsentrasies verkry is nie en dit is:
***Korrek** – gee punte vir substitusies (Maks: **5/8**)*

***Foutief** – slegs een punt vir korrekte K_c-uitdrukking (Maks: **1/8**)*

If table or calculations were shown but is wrong, carry that to the substituition.
No mark for the answer (Max: **4/8)**
As tabel of berekeninge aangedui word maar dit is foutief, dra oor na die substitusie.
*Geen punt vir antwoord. (Maks: **4/8**)*

7.2 equal/ *gelyk* YY (2)

7.3 turns darker/deeper red/ *word donkerder rooi* YY (2)
[12]

QUESTION 8 /VRAAG 8

8.1 $[NaOH] = \frac{m}{MxV} = \frac{8}{40 \times 0,35}$ YY = 0,57 mol.dm^{-3} YY

$n(NaOH) = cV$ Y $= 0,57 \times 15 \times 10^{-3}$ Y $= 0,0085$ mol

2 mol NaOH neutralises 1 mol H_2SO_4 Y

$\therefore n(H_2SO_4) = ½ \times 0,0085 = 4,3 \times 10^{-3}$ mol

$\therefore [H_2SO_4] = \frac{n}{V} = \frac{4,3 \times 10^{-3}}{20 \times 10^{-3}}$ Y = 0,21 mol.dm^{-3} Y

OR

$\frac{c_a V_a}{c_b V_b} = \frac{1}{2}$ Y

$\therefore \frac{c_a \times 20}{0,57 \times 15}$ Y $= \frac{1}{2}$ Y

$\therefore c_a = 0,21$ mol.dm^{-3} Y

OR/OF

$p_a V_a c_a = p_b V_b c_b$ Y

$\therefore 2 \times 20 \times c_a = 1 \times 15 \times 0,57$ Y

$\therefore c_a = 0,21$ mol.dm^{-3} Y

(7)

8.2.1 $HC\ell + H_2O \rightarrow H_3O^+ + C\ell^-$ YY or/*of* $HC\ell \rightarrow H^+ + C\ell^-$

$HC\ell$ ionises/dissociates to form H_3O^+/ H^+ in water. YY
Increase in H_3O^+/ H^+ results in decrease in pH YY (4)
$HC\ell$ ioniseer/dissosieer om H_3O^+/ H^+ in water te vorm
Toename in H_3O^+/ H^+ veroorsaak 'n afname in pH

8.2.2 pH = 4
$[H^+] = 1 \times 10^{-4}$ mol.dm^{-3} YY
$2\ HC\ell + Na_2CO_3 \rightarrow 2NaC\ell + CO_2 + H_2O$
2 mol of $HC\ell$ neutralises/*neutraliseer* 1 mol Na_2CO_3 Y YY
no. of mol of Na_2CO_3 required to neutralise $HC\ell$ / Y
aantal mol Na_2CO_3 benodig om $HC\ell$ te neutraliseer

$\therefore = ½ \times 1 \times 10^{-4}$ mol
$\therefore = 0,5 \times 10^{-4}$ mol Y

Mass of Na_2CO_3 required: $m = nxM = 0,5 \times 10^{-4} \times 106$ g $= 5,3 \times 10^{-3}$g YY Y Y (9)
Massa Na_2CO_3 benodig:

8.2.3 Increase salinity/ More $NaC\ell$ in water YY (2)
Verhoog soutgehalte van water/ Meer $NaC\ell$ in water

[22]

QUESTION 9/*VRAAG 9*

9.1.1 $Ce \rightarrow Ce^{3+} + 3e^-$ YY (2)

9.1.2 $\underline{Pd^{2+} + 2e^- \rightarrow Pd}$
$2Ce + 3Pd^{2+} \rightarrow 2Ce^{3+} + 3Pd$ YYY (3)

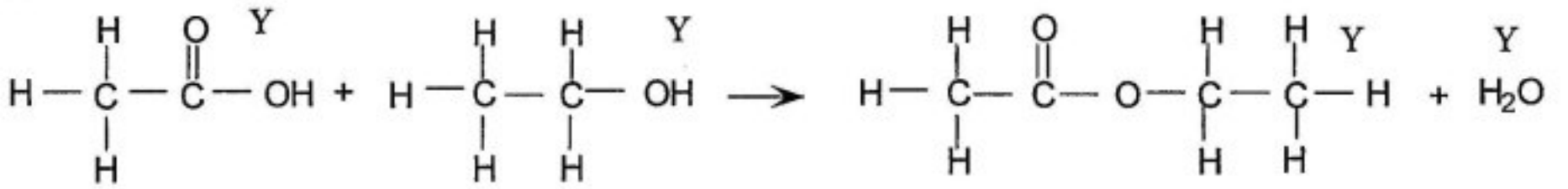
9.1.3 $E^\circ_{cell/sel} = E^\circ_{OA} - E^\circ_{RA}$ YY OR $E^\circ_{cell/sel} = E^\circ_{CAT} - E^\circ_{AN}$
$= ^{YY}0,99 - (^{Y}-2,3)$
$= 3,29V$ YY (4)

9.2.1 B^{2+} YY (2)

9.2.2 B and/*en* C YY (2)
[13]

QUESTION 10/ *VRAAG 10*

10.1.1



(4)

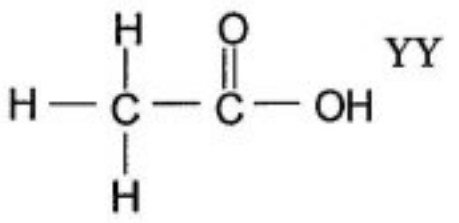
10.1.2 A and/*en* F YY (2)

10.1.3 ethylmethanoate / *etielmetanoaat* YY (2)

10.1.4 but – 2 –ene YY (2)

10.2.1 Oxidation/ *Oksidasie* YY (2)

10.2.2 Ethanoic acid/ *Etanoësuur* YY (2)



(2)
[16]
TOTAL: 200