education

Department:
Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION - 2005

PHYSICAL SCIENCE P2
CHEMISTRY

STANDARD GRADE

OCTOBER/NOVEMBER 2005

Marks: 150

2 Hours

This paper consists of 14 pages and a datasheet of 4 pages.

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. Data sheets are 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 SI unit of time is ...

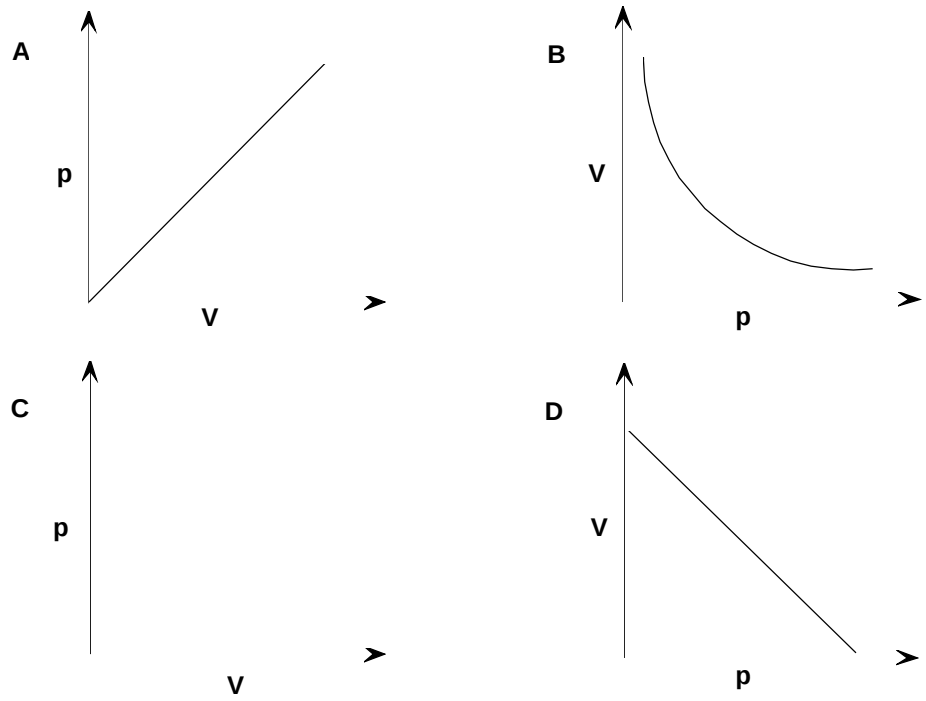
A t.
B h.
C s.
D m.

ANSWER:

A	B	C	D

QUESTION 1

1.1 Which one of the graphs below shows the correct relationship between pressure and volume for an enclosed gas at constant temperature?



(3)

1.2 Which one of the following statements about the properties of hydrogen sulphide gas (H_2S) is **INCORRECT**?

A H_2S can be collected by the upward displacement of air.

B H_2S is a reducing agent when it reacts with SO_2.

C H_2S forms a black precipitate when it is bubbled through a solution of zinc sulphate.

D H_2S smells like rotten eggs. (3)

1.3 Which one of the following statements about chlorine is **CORRECT**?

A Chlorine is a strong reducing agent.

B Chlorine is a reddish gas at room temperature.

C Chlorine is prepared industrially through the electrolysis of sodium chloride.

D Chlorine is prepared in the laboratory by adding a solution of $AgNO_3$ to a solution of sodium chloride. (3)

1.4 Which one of the following is a **CORRECT** reason why F_2 has a lower boiling point than Cl_2?

A F_2 has hydrogen bonding between its molecules.

B F_2 has strong Van der Waals forces between its molecules.

C F_2 is polar and Cl_2 is non-polar.

D F_2 has a smaller molecular mass than Cl_2. (3)

1.5 Which one of the reactions below best explains why nitrate compounds are used in the manufacture of fire works?

A $2NaNO_3 + H_2SO_4 \rightarrow 2HNO_3 + Na_2SO_4$

B $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

C $2KNO_3 \rightarrow 2KNO_2 + O_2$

D $KNO_3 \rightarrow K^+ + NO_3^-$ (3)

1.6 Hydrochloric acid and zinc pellets are allowed to react in an open conical flask. Which one of the following will **NOT** increase the reaction rate?

A Increasing the temperature

B Adding a suitable catalyst

C Increasing the concentration of the hydrochloric acid

D Closing the flask with a stopper (3)

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

$$2HI_{(g)} \rightleftharpoons H_{2(g)} + I_{2(g)}$$

If the pressure in the container is increased by decreasing its volume, which one of the statements below is **INCORRECT**?

A The rate of the forward reaction increases.

B The rate of the reverse reaction increases.

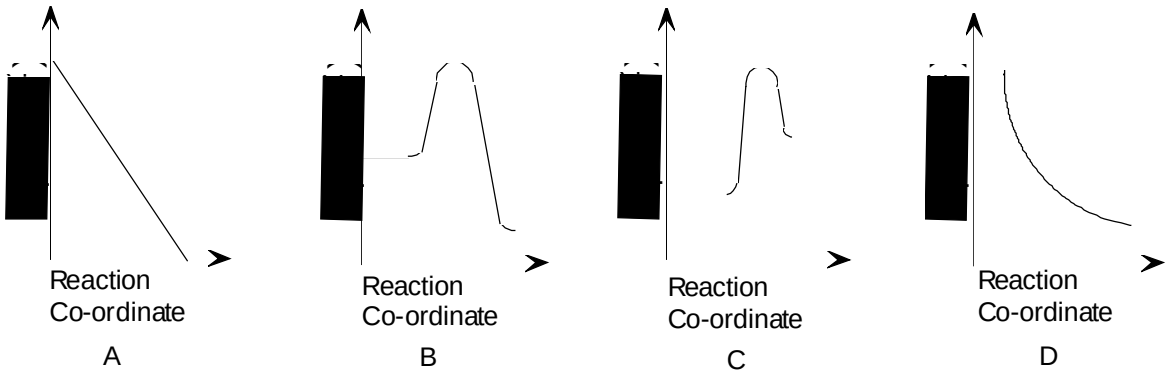
C Both the rate of the forward and reverse reactions remain unchanged.

D Both the rate of the forward and reverse reactions increase. (3)

1.8 Consider the reversible reaction below:

$$Zn_{(s)} + 2S_{(s)} + O_{2(g)} \rightleftharpoons ZnS_{(s)} + SO_{2(g)} \qquad \Delta H < 0$$

Which one of the graphs below will be the **CORRECT** representation of the change in E_p for the forward reaction?



(3)

1.9 If base **X** is titrated against acid **Y**, the pH of the solution at the endpoint is 8. The base **X** and acid **Y** can respectively be identified as:

	Base X	Acid Y
A	Strong base	Weak acid
B	Weak base	Weak acid
C	Weak base	Strong acid
D	Strong base	Strong acid

(3)

1.10 Consider the following acid-base equilibrium

$$HCO_3^- + H_2O \rightleftharpoons H_2CO_3 + OH^-$$

A conjugate acid-base pair in this reaction is …

A H_2CO_3 and H_2O
B H_2CO_3 and OH^-
C H_2O and OH^-
D H_2O and HCO_3^-

(3)

1.11 Which one of the following 0,1 mol.dm^{-3} solutions contains the lowest $[H^+]$?

A HCl
B CH_3COOH
C H_2SO_4
D NaOH

(3)

1.12 When a standard Zn-Cu electrochemical cell is in operation, oxidation occurs at the anode. Which one of the following statements concerning the anode half cell is **CORRECT**?

A The solution turns from blue to colourless.
B There is an increase in the mass of the anode.
C The anode donates electrons.
D A precipitate is formed. (3)

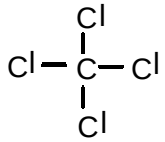
1.13 Which one of the following is a stronger reducing agent than H_2?

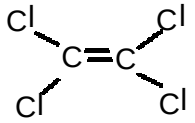
A Al
B H_2S
C Fe^{2+}
D Cu (3)

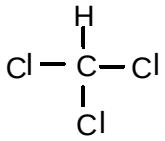
1.14 Which one of the following compounds has isomers?

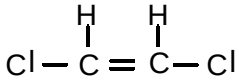
A C_2H_6
B C_2H_4
C C_3H_2
D C_4H_8 (3)

1.15 The structural formula for chloroform is:

A 

B 

C 

D 

(3)

[45]

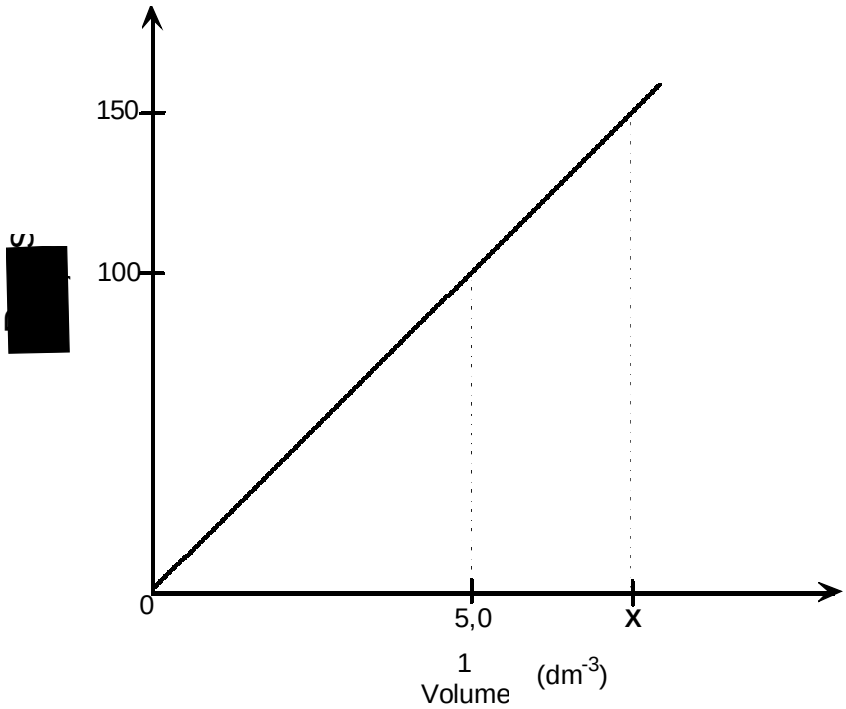
ANSWER QUESTIONS 2 – 8 IN YOUR ANSWER BOOK.

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 The relationship between the volume and pressure of an enclosed gas was investigated in the school laboratory. The temperature of the container and its contents were kept constant. The results were used to obtain a graph of pressure (p) versus the reciprocal of volume ($\frac{1}{V}$), shown below.



2.1.1 Write down the mathematical relationship between pressure and volume of the enclosed gas. (2)

2.1.2 Calculate the value of X in the graph above. (Note that X is the reciprocal of the volume.) (4)

*The relationship above is only true if it is assumed that the gas under investigation is an **ideal gas.***

2.1.3 Under what conditions will the behaviour of a real gas **deviate** from that of an ideal gas? (4)

2.2 Consider the boiling points of the hydrogen compounds of the halogens with their respective molar masses. The boiling points of the compounds are determined by their intermolecular forces.

NAME	MOLAR MASS ($g.mol^{-1}$)	BOILING POINT (°C)
HF	20,01	19,5
HCl	36,46	-84,9
HBr	80,92	-67,0
HI	127,90	-35,4

2.2.1 What is the trend in the boiling points with an increase in molar mass from HCl to HI? (2)

2.2.2 Give a reason for the trend in boiling points with an increase in molar mass as observed in QUESTION 2.2.1. (2)

2.2.3 Name the intermolecular force that causes HF to have a higher boiling point than the other halides. (2)

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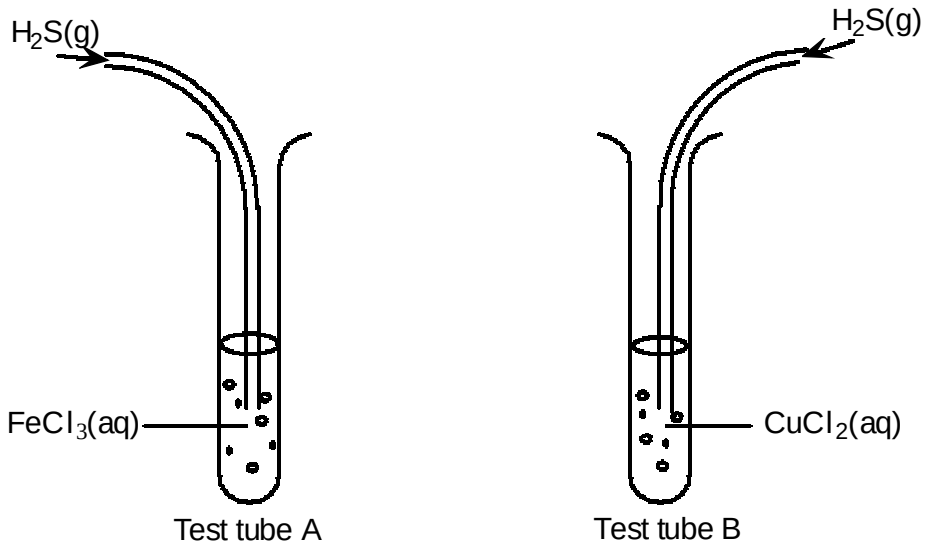
QUESTION 3 (START ON A NEW PAGE)

Hydrogen sulphide gas (H_2S) can be prepared through the reaction of FeS and hydrochloric acid.

3.1 Write the balanced equation for the preparation of hydrogen sulphide by this method. (3)

The H_2S gas is now bubbled through two test tubes A and B. Test tube A contains a solution of $FeCl_3$ and test tube B contains a solution of $CuCl_2$



3.2 A redox reaction takes place in test tube A. Write down the colour change that will be observed as a result of this redox reaction. (2)

3.3 Does H_2S act as an **oxidising** or **reducing agent** in test tube A? (1)

3.4 Write down the equation of a half reaction to support your answer in QUESTION 3.3. (2)

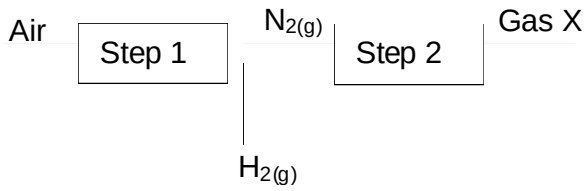
3.5 Write down **two** observations that will be made in test tube B when H_2S reacts with $CuCl_2$. (2)

3.6 Write the balanced equation for the reaction that takes place in test tube B. (3)

3.7 What type of reaction takes place in test tube B?
Write only **REDOX** or **ION EXCHANGE**. (1)
[14]

QUESTION 4 (START ON A NEW PAGE)

4.1 Consider the flow diagram that represents an important industrial process. This process consists of two steps. In Step 1, N_2 is obtained from air. In Step 2 N_2 is reacted with H_2.

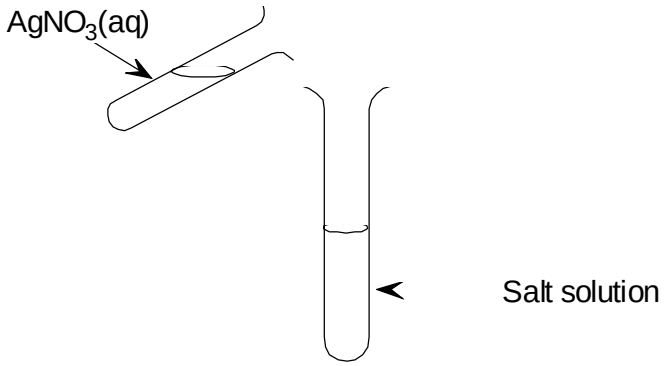


4.1.1 Name the method that is used to obtain $N_2(g)$ from air in Step 1. (1)

4.1.2 Write down the balanced equation for the reaction that takes place between N_2 and H_2 in Step 2 of the process. (3)

4.1.3 Give the **NAME** of Gas X produced in Step 2. (2)

4.2 Susan is provided with a salt that is said to be potassium iodide. She conducts a test by adding a silver nitrate solution ($AgNO_3(aq)$) to a solution of the salt. She makes an observation that confirms that the salt is potassium iodide (KI).



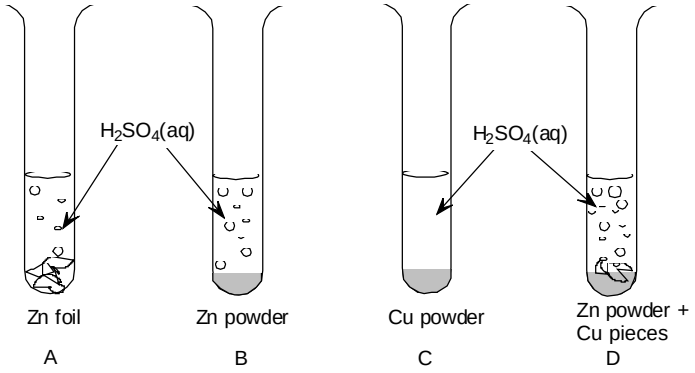
4.2.1 Write down the balanced equation for the reaction between potassium iodide and silver nitrate. (3)

4.2.2 Write down the observation that Susan made in the reaction in QUESTION 4.2.1 that confirmed that the salt was KI. (2)

[11]

QUESTION 5 (START ON A NEW PAGE)

5.1 A series of experiments were carried out to compare the reactions of zinc foil, zinc powder, copper powder and a mixture of zinc powder and copper pieces with diluted sulphuric acid with a concentration of 1 mol.dm^{-3}.



If a reaction occurs, hydrogen gas is produced. The number of gas bubbles in the test tubes indicate the rate of the reactions taking place.

5.1.1 In one of the test tubes no reaction is observed. Refer to the relative strength of oxidising agents and reducing agents to explain the reason for the observation. (4)

5.1.2 Arrange the test tubes in order of **increasing** rate of reaction. (From the lowest to the highest rate.) (Use only the symbols A, B, C and D.) (2)

5.1.3 Give a reason for the difference between the rate of the reaction in test tube B and test tube D. (2)

Test tube A is now placed in a beaker with hot water and allowed to stand.

5.1.4 Write down how the observation in test tube A will now change. (2)

5.2 Consider the following reaction at equilibrium in a closed container:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + \text{heat}$$

5.2.1 Is the heat of reaction (ΔH) positive or negative for the above reaction? (1)

5.2.2 Is the forward reaction endothermic or exothermic? (1)

5.2.3 Will the number of moles of $SO_3(g)$ **INCREASE, DECREASE** or **STAY THE SAME** when the pressure in the container is increased by decreasing the volume? (2)

The temperature of the system is now increased.

5.2.4 How will this change affect the rate of the forward reaction? (Write only **INCREASES, DECREASES** or **NO EFFECT**.) (2)

5.2.5 How will this change affect the **yield** of SO_3? (Write only **INCREASES, DECREASES** or **NO EFFECT**.) (2)

[18]

QUESTION 6 (START ON A NEW PAGE)

6.1 Write down:

6.1.1 The meaning of the term **diprotic acid**. (2)

6.1.2 The formula of a **diprotic acid**. (1)

6.2 Magnesium hydroxide is often used as medicine to relieve an upset stomach. The pH of the HCl(aq) in the stomach is approximately 1. The balanced equation for the reaction that takes place in the stomach is:

$$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$$

6.2.1 Will the pH in the stomach **INCREASE, DECREASE** or **STAY THE SAME** after taking a dose of $Mg(OH)_2$? (2)

During a titration a sample of $Mg(OH)_2$ is neutralised by 23 cm^3 of HCl with a concentration of 0,1 $mol.dm^{-3}$.

6.2.2 Calculate the number of moles of HCl needed to neutralise the $Mg(OH)_2$. (3)

6.2.3 Calculate the number of moles of $Mg(OH)_2$ present in the sample. (2)

6.2.4 Calculate the mass of the $Mg(OH)_2$ sample. (3)

6.3 Plaster of paris which is used to support fractured bones, consists of calcium sulphate ($CaSO_4$). The fracture is covered with cotton and linen material that is totally submerged in wet plaster of paris (calcium sulphate). This bandage quickly hardens.

Having a lot of calcium hydroxide powder, Nelson and Rosemary decided to make their own calcium sulphate.

6.3.1 Write down the **NAME** of the acid that they should use to make calcium sulphate. (2)

6.3.2 Write down the balanced equation for the reaction that takes place between the $Ca(OH)_2$ and the acid. (3)

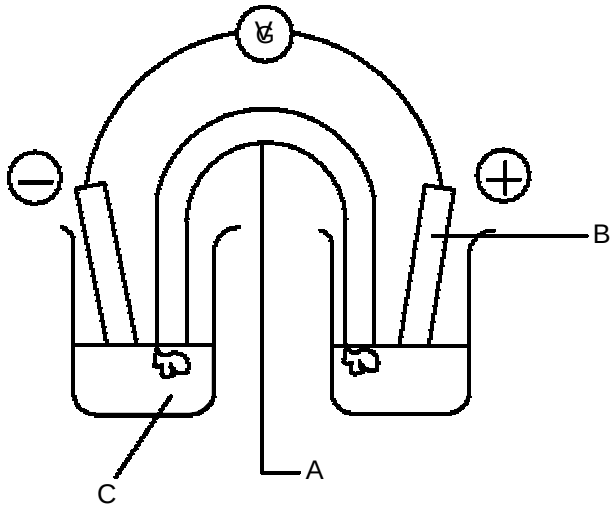
Nelson spilled some of the acid on the table. He wants to wipe it off with a cloth, wet with ammonium hydroxide. When he opens the bottle of ammonium hydroxide, Rosemary immediately complains about a sharp pungent smell.

6.3.3 Write down the balanced equation of the reaction that explains the formation of the compound that has a sharp pungent smell. (3)

[21]

QUESTION 7 (START ON A NEW PAGE)

Consider the following sketch of a Zn-Cu electrochemical cell.



7.1 Provide labels for:

7.1.1 component A (1)

7.1.2 electrode B (1)

7.1.3 electrolyte (salt solution) C (1)

7.2 Write down one function of component A. (2)

7.3 Write down the formula of a suitable electrolyte (salt solution) that can be used in A. (2)

7.4 In which direction does the positive ions move in A? (Towards the anode half cell or the cathode half cell?) (1)

7.5 Write down the formula of the oxidising agent in this cell. (2)

7.6 Write down the equation for the half reaction occurring at the negative electrode. (2)
[12]

QUESTION 8 (START ON A NEW PAGE)

8.1 Give the **general formula** of the homologous series to which hexane belongs. (2)

8.2 Write down the balanced equation for the complete combustion of hexane. (3)

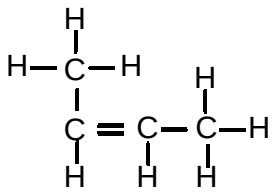
8.3 Complete the table below in your answer book. Only write down the question number and the correct answer.

Example	Functional group
Tetrachloromethane	8.3.1
CH_3COOH	8.3.2

(4)

8.4 Write down the systematic (IUPAC) name of each of the following organic compounds:

8.4.1  (2)

8.4.2 

(2)
[13]

TOTAL: 150

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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)

TABLE 1: PHYSICAL CONSTANTS
TABEL 1: FISIESE KONSTANTES

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^{θ}	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^{θ}	273 K

TABLE 2: FORMULAE
TABEL 2: FORMULES

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

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

KEY/SLEUTEL

Atoomgetal
Atomic number

Elektronegatiwiteit
Electronegativity

Simbool
Symbol

Relatiewe atoommassa (benaderd)
Relative atomic mass (approximately)

I	II										III	IV	V	VI	VII	0
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

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

Increasing oxidising ability / Toenemende oksideervermoë ↑

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

Increasing reducing ability / Toenemende reduseervermoë ↓

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

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

Increasing oxidising ability / Toenemende oksideervermoë ↓

↑ **Increasing reducing ability / Toenemende reduseervermoë**

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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
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