SENIOR CERTIFICATE EXAMINATION

FEBRUARY / MARCH

2007

FUNCTIONAL PHYSICAL SCIENCE

SG

305-2/2 E

Second Paper

Chemistry

12 pages

305 2 2E SG

X05

GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

FUNCTIONAL PHYSICAL SCIENCE SG
(Second Paper: Chemistry)

TIME: 2 hours

MARKS: 150

REQUIREMENTS:

- An approved (non-programmable, scientific) pocket calculator. Candidates should supply their own calculators.

INSTRUCTIONS:

- Write your examination number in the spaces provided for this purpose on the front of your answer book.
- Answer ALL questions.
- Answer Question 1 on the **answer sheet** on the **inside cover** of your **answer book**. Make a cross (**X**) over the letter **A**, **B**, **C** or **D** to indicate the letter you have chosen.
- Answer all the other questions in the answer book. If you need to redo an answer, redo it on a new page. Number all answers clearly.
- Start each question on a new page.
- A data sheet is provided at the end of this question paper. It contains formulae and constants. The information provided may be useful in answering the questions.
- Rough work may be done on the blank pages at the back of your answer book.

QUESTION 1
MULTIPLE-CHOICE QUESTIONS

Study each item and the suggested answers which are indicated by the letters **A**, **B**, **C** and **D**. Make a cross (**X**) over the corresponding letter on the answer sheet after you have decided which is the correct one. If more than one cross appears in any answer, NO MARKS will be awarded.

EXAMPLE:

Pure ice melts at:

A. -4°C
B. 0°C
C. 0 K
D. 4°C

ANSWER:

A	~~B~~	C	D

1.1 Chlorine can be represented by the following:

$^{35}_{17}Cl$

From this we can presume that an atom of chlorine has _____.

A. 17 electrons
B. 18 nucleons
C. 35 protons
D. 35 electrons

1.2 An isotope has a mass of 23 and 12 neutral parts in its nucleus. Its chemical symbol is _____.

A. Na
B. F
C. Ca
D. Ne

1.3 The bond that keeps two chlorine atoms together in a chlorine molecule, consists of an electron _____.

A. that can be transferred from one atom to another
B. pair which is attracted by both atoms
C. that is attracted by both atoms
D. pair that is attracted very strongly by one of the atoms

1.4 The type of bond between the hydrogen atom and the chlorine atom can best be described as _____.

A. a non-polar, covalent bond
B. a polar, covalent bond
C. an ionic bond
D. a metallic bond

1.5 While energy is needed to break bonds, it is usually also released when bonds are formed. The heating of calcium carbonate ($CaCO_3$) is an example of a reaction where bonds _____.

A. play no part
B. are broken
C. are formed
D. remain unchanged

1.6 The energy needed to change 18 g water (1 mole) into water vapour is 41 kJ.

$$H_2O(\ell) \rightarrow H_2O(g)\ (\triangle H=+kJ)$$

This amount of energy is needed to _____.

A. break bonds keeping 1 mole water molecules together
B. form bonds to keep 1 mole water molecules together
C. change 1 mole water molecules into atoms
D. change 1 mole water molecules into ions

1.7 $CaCO_3(s) + \text{energy} \leftrightarrows CaO(s) + CO_2(g)$

The forward reaction will be favoured if _____.

A. the pressure is increased
B. the temperature is increased
C. the pressure is decreased
D. temperature and pressure are kept constant

1.8 In the Haber-process $N_2 + 3H_2 \leftrightarrows 2NH_3 + \text{heat}$

an increase of temperature at constant pressure will have the following effect:

A. The N_2 concentration decreases
B. The NH_3 concentration increases
C. The forward reaction will be favoured
D. The reverse reaction will be favoured

1.9 In the equation $Mg + S \rightarrow MgS$

A. S is oxidized.
B. Mg is a reducing agent.
C. the oxidation number of S increases.
D. Mg is reduced.

1.10 The oxidation number of an element which exists freely, is _____.

A. +2
B. -2
C. 0
D. +1

1.11 The reaction at the cathode of a zinc copper cell is _____.

A. $Zn \rightarrow Zn + \bar{e}$
B. $Zn \rightarrow Zn^{2+} + 2\bar{e}$
C. $Zn^{2+} + 2\bar{e} \rightarrow Zn$
D. $Cu^{2+} + 2\bar{e} \rightarrow Cu$

1.12 Which of the following is an oxidation reaction that takes place during electrolysis?

A. $Cl^{-} \rightarrow Cl + \bar{e}$
B. $Fe^{3+} + e^{-} \rightarrow Fe^{2+}$
C. $H_2O \rightarrow H^{+} + OH^{-}$
D. $Na^{1+} + Cl^{-1} \rightarrow NaCl$

1.13 Which one of the following is a strong oxidising agent?

A. Metals in group I
B. Noble gases
C. Elements in group VII
D. Oxides

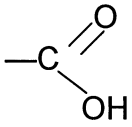
1.14 In methane, carbon has a valence of _____.

A. 1
B. 2
C. 3
D. 4

1.15 The functional group we use to identify carbolic acids is _____.

A. — OH

B. — X

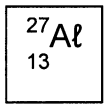
C. 

D. 

15x3=**[45]**

QUESTION 2
ATOMIC STRUCTURE

2.1 An element can be represented as follows:



2.1.1 Draw the energy level diagram of the element. (4)

2.1.2 Give the name of an element which has the same number of valence electrons as aluminium. (2)

2.1.3 What similarities are there in the properties of these elements? (2)

2.1.4 How does the atomic and mass number of elements change from the top to the bottom in the group? (2)

2.1.5 How many neutrons does an atom of aluminium have? (2)

2.1.6 How is the periodic table arranged? (2)

2.2 In an atom, electrons are encountered in energy levels around the nucleus.

2.2.1 In which energy level is an electron with the lowest energy found? (2)

2.2.2 What does it mean if an element has a low ionization potential? (2)

2.2.3 What is necessary to remove an electron from an atom? (2)

2.2.4 What type of particle is formed when an atom loses an electron? (2)

2.2.5 What will happen if an electron is transferred from one atom to another? (2)

[24]

QUESTION 3
CHEMICAL BONDING

3.1 Two chlorine atoms combine to form a chlorine molecule.

3.1.1 Draw a Lewis diagram of the molecule that is formed. (2)

3.1.2 What type of bond exists between these two atoms? (2)

3.1.3 Which orbitals will overlap here? (2)

3.2 Which type of bond do you expect to find when magnesium bonds with fluorine? (2)

3.3 Magnesium burns in oxygen with a bright white light and forms a white powder. Write down a chemical equation for this reaction, including the heat factor. (4)

[12]

QUESTION 4
INTERMOLECULAR FORCES

4.1 Water boils at 100°C, while ether already boils at 34°C.

4.1.1 In which of these liquids do we find the strongest intermolecular forces? (2)

4.1.2 What type of intermolecular force do we find between water molecules? (2)

4.1.3 What type of intermolecular force do we find between ether molecules? (2)

4.1.4 Which substance, water or ether, will evaporate the fastest at room temperature? (2)

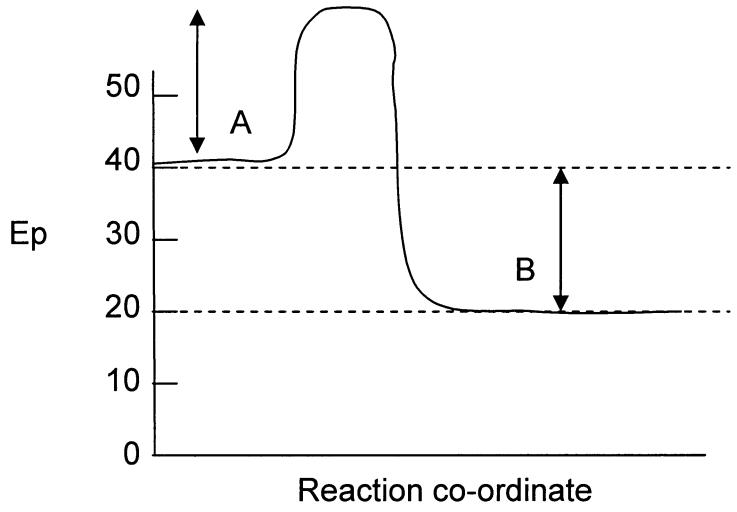
4.2 Sodium chloride (NaCl) dissolves better in water than in alcohol. Explain by referring to intermolecular forces. (4)

[12]

QUESTION 5
ENERGY AND CHEMICAL BONDING

5.1 When sugar dissolves in water the temperature drops. Is this reaction endothermic or exothermic? (2)

5.2 Consider the following energy diagram for a reaction:



5.2.1 Is this reaction endo- or exothermic? (2)

5.2.2 Which energy change is represented by **B** on the graph? (2)

5.2.3 Which energy change is represented by **A** on the graph? (2)
[8]

QUESTION 6
CHEMICAL EQUILIBRIUM

6.1 A mixture of dinitrogen tetroxide and nitrogen dioxide is placed in a sealed gas syringe.

Equation: $N_2O_4(g) \leftrightarrows 2\ NO_2(g)$
(Colourless) (Brown)

6.1.1 "The chemical reaction above is at equilibrium". What does this statement mean? (4)

6.1.2 If the pressure on the plunger is increased and the volume of the gas is reduced, the colour of the gas mixture turns lighter. Why does this happen? (2)

6.1.3 The plunger of the gas syringe is now pulled out to increase the volume of the gas. What will you observe now? Explain your answer. (4)
[10]

QUESTION 7
REDOX REACTIONS

7.1 When does oxidation occur in a chemical reaction? (2)

7.2 Consider the following reaction:

$$Zn + 2HC\ell \leftrightarrows ZnC\ell_2 + H_2$$

7.2.1 Which substance is oxidised? (2)

7.2.2 Which substance is reduced? (2)

7.2.3 Give the name of $HC\ell$. (1)
[7]

QUESTION 8
ELECTROCHEMISTRY

8.1 When lead bromide is melted and electrolysis takes place between two carbon electrodes, certain reactions take place at the anode and cathode.

8.1.1 Which substance is formed at the negative electrode? (2)

8.1.2 Which process takes place at the anode? (2)

8.1.3 Why must lead bromide be melted for the experiment to take place? (2)

8.1.4 Write down the half-reaction that takes place at the cathode. (2)

8.2 Use the potential table and predict which of the following metals is the negative pole of the electrochemical cell:

8.2.1 Zn/Ag cell (2)

8.2.2 Zn/Fe cell (2)
[12]

QUESTION 9
PROPERTIES OF ELEMENTS

9.1 A small piece of burning lithium is lowered into a gas cylinder which contains oxygen.

9.1.1 What will you observe? (2)

9.1.2 Which substance is formed? (2)

9.1.3 Write down the balanced chemical equation of the reaction of lithium with oxygen. (4)

9.2 Give the name of the elements of group I. (2)
[10]

QUESTION 10
ORGANIC CHEMISTRY

10.1 What is a **halo-alkane**? (2)

10.2 Write down the structure formulae of the following:

10.2.1 Buthane (2)

10.2.2 Methanol (2)

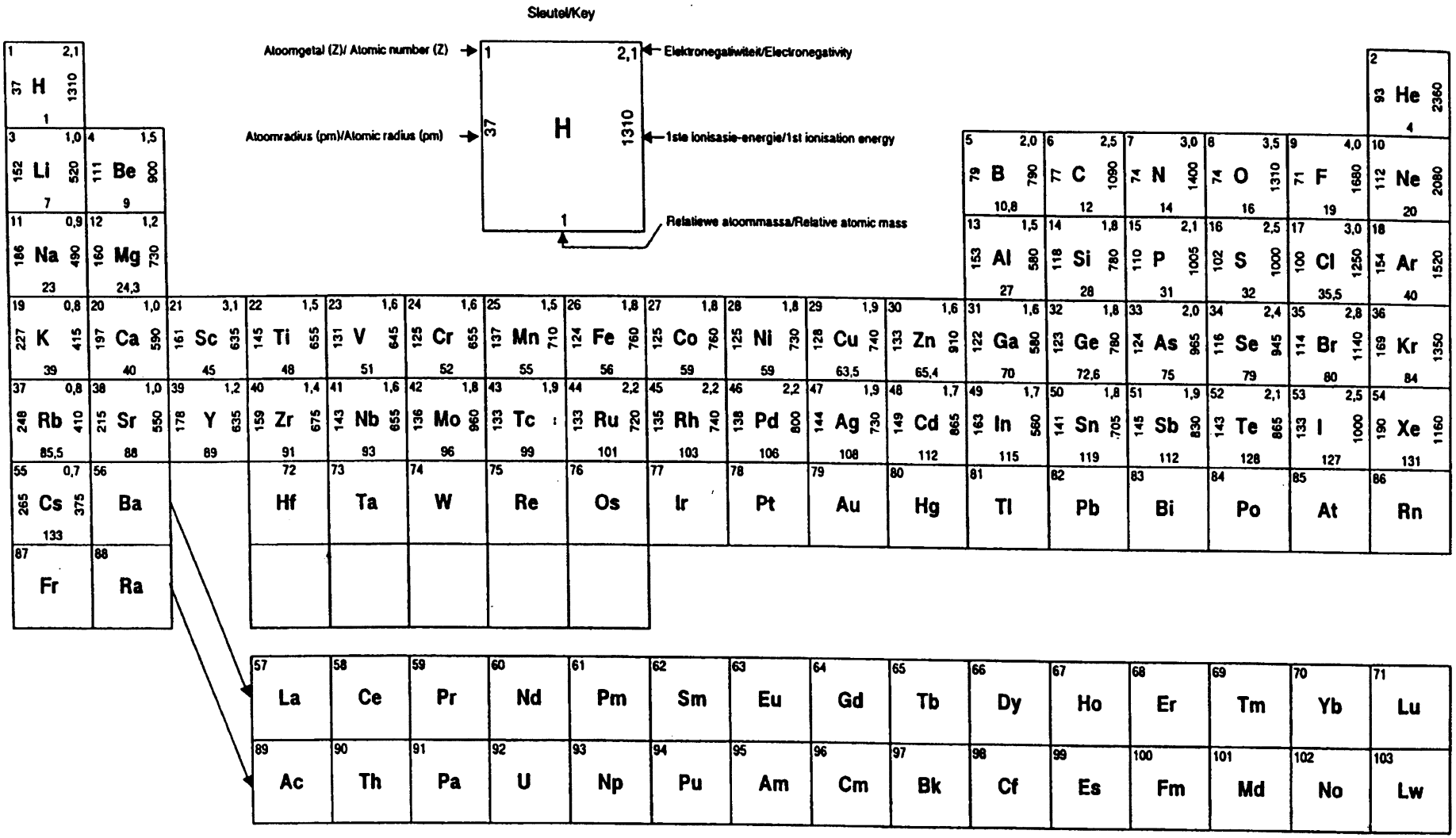
10.2.3 Dichlorethane (2)

10.2.4 Ethanoic acid (2)
[10]

TOTAL: 150

PERIODIEKE TABEL / PERIODIC TABLE

TABEL 2 / TABLE 2



ELEKTRONEGATIWITEITSVERSKIL ELECTRONEGATIVITY DIFFERENCE	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2
% IONIES % IONIC	0.5	1.0	2.0	4.0	6.0	9.0	12	15	19	22	26	30	34	39	43	47	51	55	59	63	67	70	74	76	79	82	84	86	88	89	91	92

P.T.O. / *b.o.*

STANDARD REDUCTION POTENTIALS OF A NUMBER OF HALF-REACTIONS
STANDAARD-REDUKSIEPOTENSIALE VAN VERSKEIE HALF-REAKSIES

Increasing oxidising ability / *Toenemende oksideervermoë* ↓

Increasing reducing ability / *Toenemende reduseervermoë* ↑

Half-reaction / *Half-reaksie*	E^{θ} volts / *volt*
$Li^+ + e^- \rightleftarrows Li$	-3,05
$K^+ + e^- \rightleftarrows K$	-2,93
$Cs^+ + e^- \rightleftarrows Cs$	-2,92
$Ba^{2+} + 2e^- \rightleftarrows Ba$	-2,90
$Sr^{2+} + 2e^- \rightleftarrows Sr$	-2,89
$Ca^{2+} + 2e^- \rightleftarrows Ca$	-2,87
$Na^+ + e^- \rightleftarrows Na$	-2,71
$Mg^{2+} + 2e^- \rightleftarrows Mg$	-2,37
$A\ell^{3+} + 3e^- \rightleftarrows A\ell$	-1,66
$Mn^{2+} + 2e^- \rightleftarrows Mn$	-1,18
$2H_2O + 2e^- \rightleftarrows H_2 + 2OH^-$	-0,83
$Zn^{2+} + 2e^- \rightleftarrows Zn$	-0,76
$Cr^{3+} + 3e^- \rightleftarrows Cr$	-0,74
$Fe^{2+} + 2e^- \rightleftarrows Fe$	-0,44
$Cd^{2+} + 2e^- \rightleftarrows Cd$	-0,40
$Co^{2+} + 2e^- \rightleftarrows Co$	-0,28
$Ni^{2+} + 2e^- \rightleftarrows Ni$	-0,25
$Sn^{2+} + 2e^- \rightleftarrows Sn$	-0,14
$Pb^{2+} + 2e^- \rightleftarrows Pb$	-0,13
$Fe^{3+} + 3e^- \rightleftarrows Fe$	-0,04
$2H^+ + 2e^- \rightleftarrows H_2$	**0,00**
$S + 2H^+ + 2e^- \rightleftarrows H_2S$	+0,14
$Sn^{4+} + 2e^- \rightleftarrows Sn^{2+}$	+0,15
$Cu^{2+} + e^- \rightleftarrows Cu^+$	+0,16
$SO_4^{2-} + 4H^+ + 2e^- \rightleftarrows SO_2 + 2H_2O$	+0,17
$Cu^{2+} + 2e^- \rightleftarrows Cu$	+0,34
$2H_2O + O_2 + 4e^- \rightleftarrows 4OH^-$	+0,40
$SO_2 + 4H^+ + 4e^- \rightleftarrows S + 2H_2O$	+0,45
$I_2 + 2e^- \rightleftarrows 2I^-$	+0,54
$O_2(g) + 2H^+ + 2e^- \rightleftarrows H_2O_2$	+0,68
$Fe^{3+} + e^- \rightleftarrows Fe^{2+}$	+0,77
$Hg^{2+} + 2e^- \rightleftarrows Hg$	+0,79
$NO_3^- + 2H^+ + e^- \rightleftarrows NO_2(g) + H_2O$	+0,80
$Ag^+ + e^- \rightleftarrows Ag$	+0,80
$NO_3^- + 4H^+ + 3e^- \rightleftarrows NO(g) + 2H_2O$	+0,96
$Br_2(\ell) + 2e^- \rightleftarrows 2Br^-$	+1,09
$Pt^{2+} + 2e^- \rightleftarrows Pt$	+1,20
$MnO_2 + 4H^+ + 2e^- \rightleftarrows Mn^{2+} + 2H_2O$	+1,21
$O_2(g) + 4H^+ + 4e^- \rightleftarrows 2H_2O$	+1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftarrows 2Cr^{3+} + 7H_2O$	+1,33
$C\ell_2(g) + 2e^- \rightleftarrows 2C\ell^-$	+1,36
$Au^{3+} + 3e^- \rightleftarrows Au$	+1,42
$MnO_4^- + 8H^+ + 5e^- \rightleftarrows Mn^{2+} + 4H_2O$	+1,51
$H_2O_2 + 2H^+ + 2e^- \rightleftarrows 2H_2O$	+1,77
$F_2(g) + 2e^- \rightleftarrows 2F^-$	+2,87

$E^{\circ}_{CELL} = E^{\circ}_{CATHODE} - E^{\circ}_{ANODE}$ / $E^{\circ}_{SEL} = E^{\circ}_{KATODE} - E^{\circ}_{ANODE}$

END / *EINDE*