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 Which one of the following will have the smallest mass?

A. Helium nucleus
B. Electron
C. Proton
D. Neutron

1.2 The scattering of alfa-particles through gold foil in Rutherford's experiments proved that the nucleus of an atom _____.

A. is relatively large and is positively charged
B. is relatively large and is negatively charged
C. is relatively small and is positively charged
D. is relatively small and is negatively charged

1.3 The number of covalent bonds in a nitrogen molecule (N_2) is _____.

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

1.4 Which one of the following phenomena is due to hydrogen bonds between the molecules?

A. The electric conductivity of water
B. Ice that floats on water
C. The electrical conductivity of an NaCl-solution
D. The relatively low melting point of water

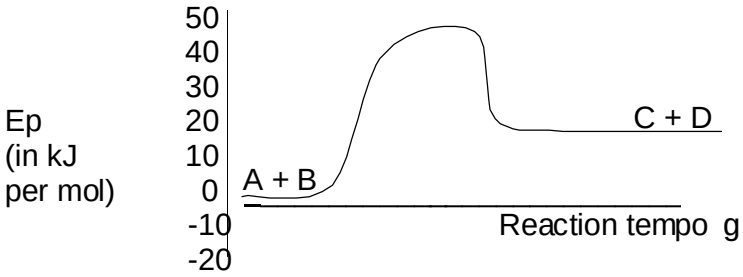
1.5 Metals are good conductors of electricity because they _____.

A. are the best conductors of heat
B. have high melting points
C. consist of ions
D. have a great number of free electrons

1.6 Iodine crystals (I_2) will easily dissolve in _____.

A. H_2O
B. CH_3OH
C. HCl
D. HF

1.7



The above diagram represents the potential energy diagram for the reaction:

A + B g C + D

The reaction is _____.

A. fast
B. slow
C. exothermic
D. endothermic

1.8 When a mixture of finely separated iron shavings and sulphur are heated, a chemical reaction takes place which involves the releasing of heat.

This is a typical example of a reaction that is _____.

A. endothermic, with relative high activation energy
B. exothermic, with relative high activation energy
C. exothermic, with relative low activation energy
D. endothermic, with relative low activation energy

1.9 The concentration of the products that form, in any chemical reaction that has reached equilibrium, can always be increased by _____.

A. reducing the temperature
B. reducing the pressure
C. increasing the temperature
D. increasing the concentration of the reactants

1.10 Study the following chemical reaction that takes place in a closed system:

$4Fe(s) + 3O_2(g)$ D $2Fe_2O_3(s)$ (r H= - 1 674 kJ)

To increase the [Fe] _____.

A. pressure must be increased on the system
B. Fe_2O_3 must be removed from the system
C. $O_2(g)$ must be released from the system
D. the system must be cooled down

1.11 The oxidation number of chlorine in potassium chlorate ($KClO_3$) is _____.

A. -3
B. -1
C. +5
D. -5

1.12 A reducing agent is a substance that _____.

A. loses electrons
B. gains protons
C. gains electrons
D. loses protons

1.13 Which of the following reactions is an example of oxidation?

I. Cu g $Cu^{2+} + 2e^-$
II. $Cu^{2+} + 2e$ g Cu
III. $Br_2 + 2e$ g $2Br^-$
IV. $2Br^-$ g $Br_2 + 2e^-$

A. I and IV
B. only I
C. only III
D. II and III

1.14 Halogens is the common name for the elements of group _____.

A. I
B. II
C. VII
D. VIII

1.15 The IUPAC-name for H–C= C–H is _____.

A. ethane
B. ethene
C. ethylene
D. ethyne

15x3=**[45]**

QUESTION 2
ATOMIC STRUCTURE

2.1 A certain element is represented by the following:

$$^{19}_{9}X$$

2.1.1 What is the name of this element? (2)

2.1.2 What is the atomic number of this element? (2)

2.1.3 How many nucleons does this atom have? (2)

2.1.4 How many electrons is in a neutral atom of this element? (2)

2.1.5 Draw the Aufbau-diagram for this element. (3)

2.1.6 How many valence electrons are there in an atom of this element? (2)

2.1.7 What do you know about the valence electron structure of atoms of the elements in the same group on the periodic table? (2)

2.2 $^{40}_{20}Ca$ and $^{39}_{20}Ca$ are two isotopes of calcium.

2.2.1 In which way do these atoms differ? (2)

2.2.2 Write the electron configuration of calcium. (2)

2.2.3 Write down the general ion that calcium will form. (2)

2.2.4 How many valence electrons are there in the calcium ion? (2)

[23]

QUESTION 3
CHEMICAL BONDING

3.1 3.1.1 What type of bond do you expect when magnesium and fluorine combine? (2)

3.1.2 Use Lewis structures to explain the formation of bonds between these elements. (4)

3.1.3 What kind of forces hold the magnesium and fluorine together? (2)

3.2 Draw the Lewis-structure of the bond NH_3. (3)

3.3 What is **electronegativity**? (2)

3.4 Use the electronegativity values on the periodic table and determine the type of bond in:

3.4.1 NaCl (2)

[15]

QUESTION 4
INTERMOLECULAR FORCES

Study the diagram below and answer the questions that follow.

Substance	Melting point	Boiling point	Electrical conductivity	
	°C	°C	Solid	Liquid
A	-95	110,6	poor	poor
B	1083	2582	poor	good
C	712	1412	good	good
D	0	100	poor	poor
E	-39	357	good	good
F	16,7	118	poor	poor

4.1 Which THREE substances are liquids at room temperature? (6)

4.2 Which TWO substances are probably metals? (4)

4.3 Which substance is probably water? (2)

4.4 Which substance consists of ions? (2)

[14]

QUESTION 5
ENERGY AND CHEMICAL BONDING

5.1 Explain the concept **activation energy**. (2)

5.2 Briefly describe what an **endothermic reaction** is. (2)

5.3 Draw a simple potential energy diagram of magnesium that burns in oxygen. (4)

5.4 If a spark is brought close to a mixture of hydrogen and oxygen gasses in a test tube, the mixture ignites with a loud pop. Explain this in energy terms. (2)

[10]

QUESTION 6
CHEMICAL EQUILIBRIUM

In industry ammonia is prepared according to the following reaction:

$N_2(g) + 3H_2(g)$ D $2NH_3(g)$ (r H=-92 kJ)

6.1 State TWO factors other than concentration which can be adjusted to ensure a high production of ammonia (NH_3). (4)

6.2 What disadvantage does a low temperature have on the production of the NH_3? (2)

6.3 In industry why is a catalyst added? (2)

[8]

QUESTION 7
REDOX REACTION

Chlorine gas is bubbled through a potassium bromide solution in a test tube.

The following reaction takes place: Cl_2 + 2 KBr ? 2KC l + Br_2

7.1 What do you observe? (2)

7.2 Write down the oxidation half-reaction of the above reaction. (2)

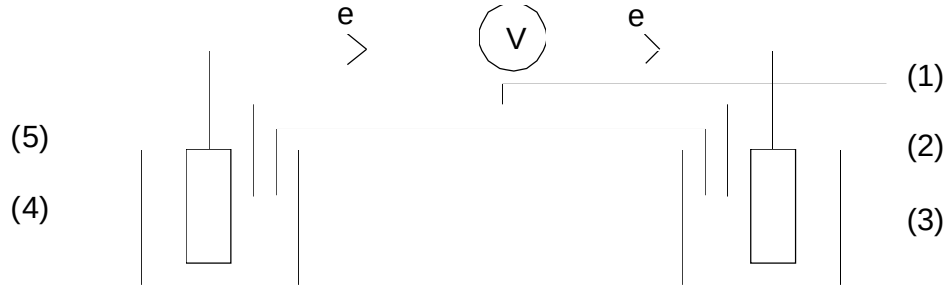
7.3 Write down the reduction half-reaction of the above reaction. (2)

7.4 Will any reaction occur when bromine gas is bubbled through potassium chloride? (2)

[8]

QUESTION 8
ELECTROCHEMISTRY

8.1 Label the following diagram of the zinc copper cell:



(5)

8.2 Write down the reduction half-reaction. (3)

8.3 Write down the oxidation half-reaction. (3)

8.4 Which electrode's mass will increase? (1)
[12]

QUESTION 9
PROPERTIES OF ELEMENTS

9.1 What will you observe if a small piece of sodium is added to a bowl of water? (2)

9.2 What colour will lithmus have if you add it to the above-mentioned reaction? (2)

9.3 Write down a balanced chemical equation for the above-mentioned reaction. (3)

9.4 Which gas is released here? (2)
[9]

QUESTION 10
ORGANIC CHEMISTRY

10.1 Which TWO products form when any hydro carbon completely burns in oxygen? (2)

10.2 Give the name of each of the following bonds:

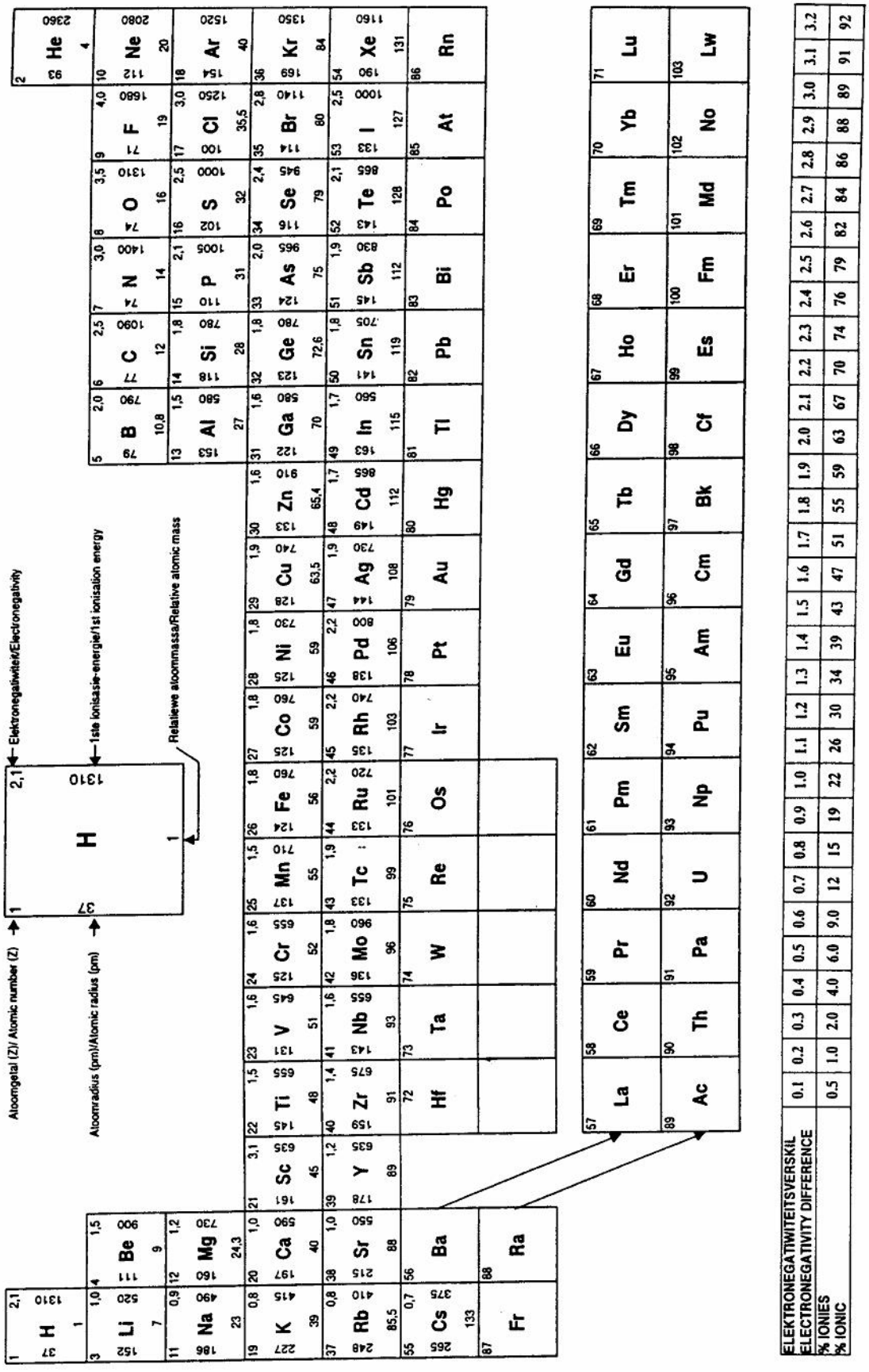
10.2.1 CCl_4 (2)

10.2.2 CH_3COOH (2)
[6]

TOTAL: 150

PERIODIEKE TABEL / PERIODIC TABLE

TABEL 2 / TABLE 2



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*° CELL = *E*° CATHODE − *E*° ANODE** / **E° *SEL* = E° *KATODE* − E° *ANODE

END / *EINDE*