Education and Sport Development

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NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

MAY/JUNE 2018

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages, 4 data sheets and a graph paper.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on your ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK. Answer QUESTION 6.3 on the answer sheet.
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 subquestions, 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, etcetera 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 the letter (A-D) next to the question number (1.1-1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 Which ONE of the following compounds is having a carbonyl functional group between two carbon atoms …

A alcohols

B ketones

C aldehydes

D carboxylic acids (2)

1.2 Which ONE of the following pairs of reactants can be used to prepare the ester ethylmethanoate in the laboratory?

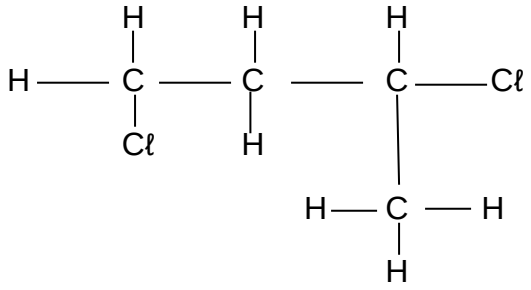
A ethane and methanoic acid

B methanol and ethanoic acid

C ethanol and methanoic acid

D ethane and methanol (2)

1.3 Consider the structure of an organic compound below:



The IUPAC name of this compound is …

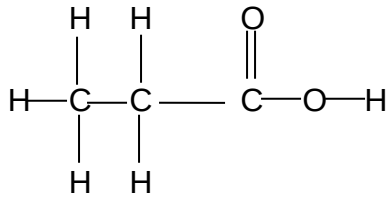
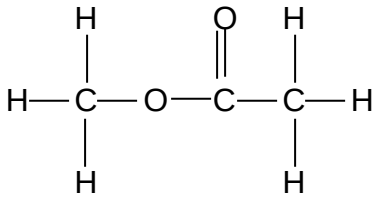
A 2,4-dichloro-2-methylpropane

B 1,3-dichloro-3-methylpropane

C 1,3-dichlorobutane

D 2,4-dichlorobutane (2)

1.4 Consider the two organic molecules F and G below:

	
Molecule F	**Molecule G**

Which one of the following represents the correct homologous series to which each molecule belongs?

	Molecule F	**Molecule G**
A	Ketones	Alcohols
B	Ketones	Carboxylic acids
C	Carboxylic acids	Esters
D	Esters	Ketones

(2)

1.5 Chemical equilibrium in a reaction is established when…

A no further reaction takes place.

B all the reactants are used up.

C the rates of the forward and the reverse reactions are equal.

D the concentrations of all the chemicals are the same. (2)

1.6 Which one of the following is most likely to change the equilibrium constant of a reversible reaction?

A temperature

B volume

C pressure

D catalyst (2)

1.7 Which ONE of the following is NOT a conjugate acid-base pair?

A H_3O^+ and OH^-

B NH_4^+ and NH_3

C $H_2PO_4^-$ and HPO_4^{2-}

D H_2CO_3 and HCO_3^- (2)

1.8 Consider the following chemical reaction

$$2HC\ell\,(aq) + CaCO_3(s) \rightarrow CaC\ell_2(aq) + H_2O(\ell) + CO_2(g)$$

Which combination of HCl(aq) and $CaCO_3$(g) will result in the fastest rate of CO_2(g) formation?

	$HC\ell$ (aq)	**$CaCO_3$(s)**
A	Concentrated	Chunks
B	Concentrated	Powder
C	Dilute	Chunks
D	Dilute	Powder

(2)

1.9 A solution has a pH = 1. This solution

A contains no OH^- ions

B neutralizes a hydrochloric acid solution of pH = 1

C contains a higher concentration of H_3O^+ ions than OH^- ions

D contains a higher concentration of OH^- ions than H_3O^+ ions (2)

1.10 If 4g of an impure sample of sodium carbonate requires 0,03 dm^3 of a 2 $mol.dm^{-3}$ hydrochloric acid solution for a complete reaction, what is the percentage purity of the sample?

$$Na_2CO_3 + 2HC\ell \rightarrow 2NaC\ell + H_2O + CO_2$$

A 62,89 %

B 27,38 %

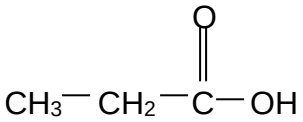
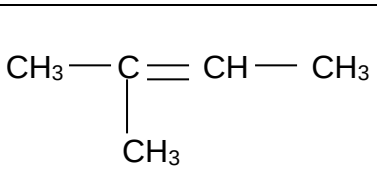
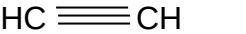
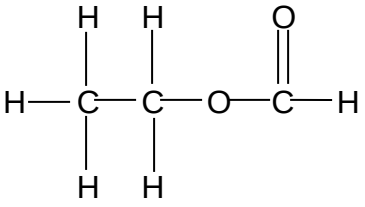
C 79,50 %

D 91,32 % (2)

[20]

QUESTION 2

Study the following organic compounds, represented by the letters **A** to **I** in the table below:

A	2-methylbutane	F	
B		G	Pentane
C	$CHC\ell_3$	H	
D	Butan-1-ol	I	
E	Butan-2-ol		

2.1 Write down the letter(s) that represent(s) the following:

2.1.1 Two compounds that are CHAIN ISOMERS. (1)

2.1.2 A PRIMARY ALCOHOL. (1)

2.1.3 A weak MONOPROTIC ACID. (1)

2.2 Write down:

2.2.1 The IUPAC name of compound **B**. (2)

2.2.2 The NAME of the homologous series to which compound **C** belongs. (1)

2.2.3 A balanced chemical equation for the complete combustion of compound **H** using MOLECULAR FORMULAE. (3)

2.3 Compound **I** is the product of an esterification reaction.
Write down the:

2.3.1 IUPAC name for compound **I** (2)

2.3.2 STRUCTURAL FORMULA of the alcohol from which compound **I** is synthesized. (2)

2.3.3 IUPAC name of the carboxylic acid from which it is synthesized. (1)

2.4 "Propanoic acid is a functional isomer of compound **I**"
Explain this statement fully. In your explanation, give the molecular formulae and structural formulae of both isomers and indicate any difference and similarities. (4)
[18]

QUESTION 3

A student performs an experiment to determine the boiling points of different organic compounds. He then recorded the results on the table given below.

	Name	**Formula**	**Molecular mass ($g.mol^{-1}$)**	**Boiling point (^0C)**
A	Petan-1-ol	$CH_3(CH_2)_4OH$	88	138
B	Pentanal	$CH_3(CH_2)_3CHO$	86	103
C	Butanoic acid	$CH_3(CH_2)CO_2H$	88	164
D	Ethyl ethanoate	$CH_3CO_2C_2H_5$	88	77
E	Hexane	$CH_3(CH_2)_4CH_3$	86	69

3.1 Define the term *boiling point*. (2)

3.2 For this experiment give the:

3.2.1 Independent variable (1)
3.2.2 Dependent variable (1)

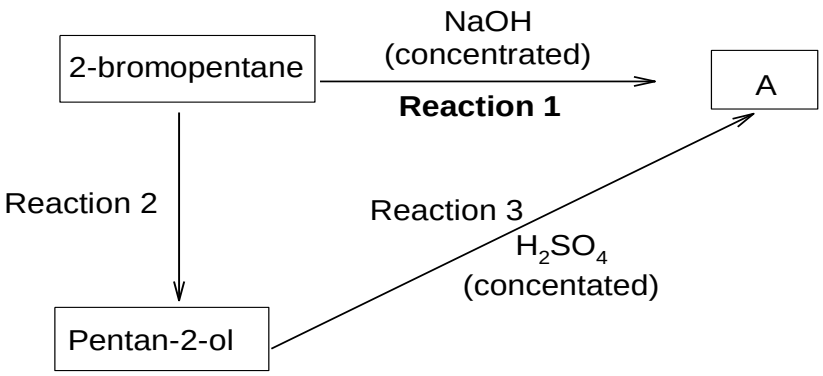
3.3 Provide an investigative question for this experiment. (2)

3.4 Why is a student using compounds of comparable molecular masses? (Ranging from 86 – 88 $g.mol^{-1}$) during this experiment? (1)

3.5 Explain the difference in the boiling points of **A**, **B** and **C**. (4)
[11]

QUESTION 4

4.1 The flow diagram shows how two compounds can be formed from 2-bromopentane.



Reaction 1 takes place in the presence of concentrated sodium hydroxide. Write down:

4.1.1 An additional reaction condition for this reaction. (1)

4.1.2 The type of reaction of which **Reaction 1** is an example. (1)

4.1.3 The **structural formula** of compound **A**. (2)

Reaction 2 takes in the presence of a certain inorganic compound. Write down the:

4.1.4 NAME of the inorganic compound (1)

4.1.2 Type of reaction of which reaction 2 is an example. (1)

Reaction 3 takes place in the presence of concentrated sulphuric acid and heat.

4.1.6 Write down the type of reaction that converts pentan-2-ol to compound **A**. (1)

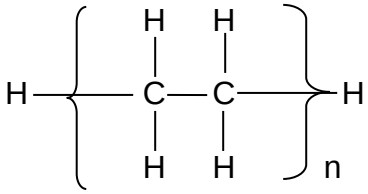
4.2 The balanced equation for the reaction of ethanol and ethanoic acid is given below.

$$C_2H_6O + C_2H_4O_2 \rightarrow C_4H_8O_2 + H_2O$$

4.2.1 What type of reaction is reaction is represented in the equation above? (1)

4.2.2 Write down the NAME or FORMULA of the catalyst used in this reaction. (1)

4.3 The structural formula of a polymer is shown below



Write down the:

4.3.1 STRUCTURAL FORMULA of the monomer that is used to prepare the above polymer. (2)

4.3.2 Type of polymerisation reaction (ADDITION or CONDENSATION) that is used to prepare this polymer. (1)

[12]

QUESTION 5 (Start on a new page.)

Learners perform THREE investigations (A, B and C) to study THREE factors which affect the rate of a chemical reaction. They use the reaction between solid calcium carbonate ($CaCO_3$) and EXCESS hydrochloric acid ($HC\ell$) solution, represented by the balanced equation below, in all three investigations.

$$CaCO_3(s) + 2HC\ell(aq) \longrightarrow CaC\ell_2(aq) + CO_2(g) + H_2O(g)$$

The calcium carbonate is **COMPLETELY COVERED** in all the investigations.

5.1 **INVESTIGATION A:**

The learners conduct two experiments using the conditions as shown in the table below.

	Mass of $CaCO_3$ (g)	**State of $CaCO_3$**	**Concentration of $HC\ell$ ($mol.dm^{-3}$)**	**Temperature of $HC\ell$ (^0C)**
Experiment 1	2	Powder	0,2	25
Experiment 2	2	Lumps	0,2	25

5.1.1 Which factor influencing reaction rate is being investigated? (1)

5.1.2 The learners now repeat **Experiment 1**, but use 4 g of calcium carbonate in excess acid.
What happens to the rate of the reaction? Use the collision theory to explain your answer. (3)

5.1.3 If the learners do NOT use excess acid in the reaction of the 2 g of calcium carbonate, they find that 15% of the mass of the original sample of $CaCO_3$ remains unreacted after completion of the reaction.

Calculate the volume of acid (in dm^3) of the given concentration needed to react with the remaining calcium carbonate. (5)

5.2 **INVESTIGATION B:**

The learners conduct two experiments using the conditions in the table below.

	Mass of $CaCO_3$ (g)	**State of $CaCO_3$**	**Concentration of $HC\ell$ ($mol.dm^{-3}$)**	**Temperature of $HC\ell$ (^0C)**
Experiment 3	2	lumps	0,2	25
Experiment 4	2	lumps	1,0	25

5.2.1 Identify the independent variable in this investigation B. [1]

5.2.2 The reactions in both **Experiments 3** and **4** run to completion. How will the yield of CO_2 produced in **experiment 4** compare to that of **experiment 3?**
Write down SMALLER THAN, LARGER THAN or EQUAL TO. (1)

5.2.3 Give a reason for your answer to QUESTION 5.2.2 (1)

5.3 **INVESTIGATION C:**

The learners conduct two experiments using the conditions as shown below.

	Mass of $CaCO_3$ (g)	**State of $CaCO_3$**	**Concentration of HCℓ ($mol.dm^{-3}$)**	**Temperature of HCℓ (^0C)**
Experiment 5	4	powder	0,2	25
Experiment 6	4	powder	0,2	35

5.3.1 In which experiment,5 or 6,will the particles have the highest kinetic energy? (1)

5.3.2 On the same set of axes, sketch the graphs of the number of molecules versus kinetic energy (also known as a Maxwell-Boltzmann distribution curve) for each of **experiment 5** and **experiment 6**

* Label both axes

***** Clearly indicate the graph of **experiment 5** and **experiment 6** (4)

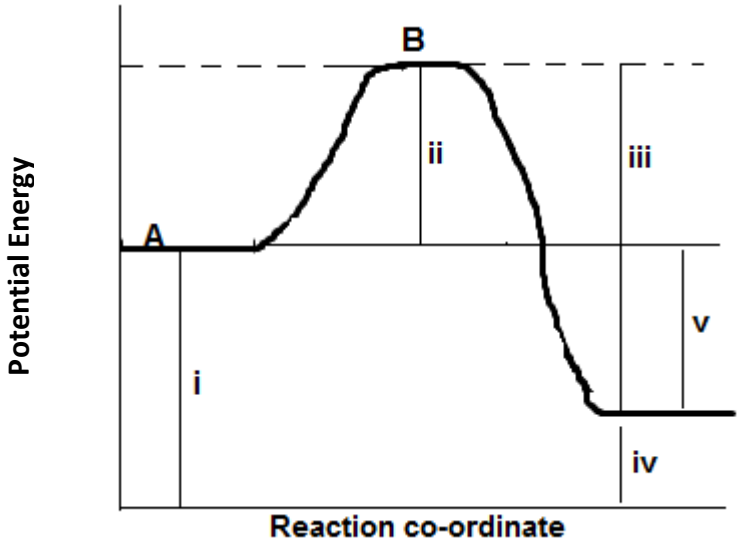
[17]

QUESTION 6 (Start on a new page.)

In order to investigate the rate of the reaction between zinc and sulphuric acid, zinc and an excess of a 2 mol.dm^{-3} sulphuric acid react in a reaction vessel. The balanced chemical equation for this reaction is

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

Consider the potential energy profile for this reaction as illustrated below:



6.1 Define the term "*heat of reaction*" (2)

6.2 The graph is marked with numbers (i – v) to represent the various energies in the energy profile.

6.2.1 Label numbers (i – v) correctly that are illustrated in the energy profile. (5)

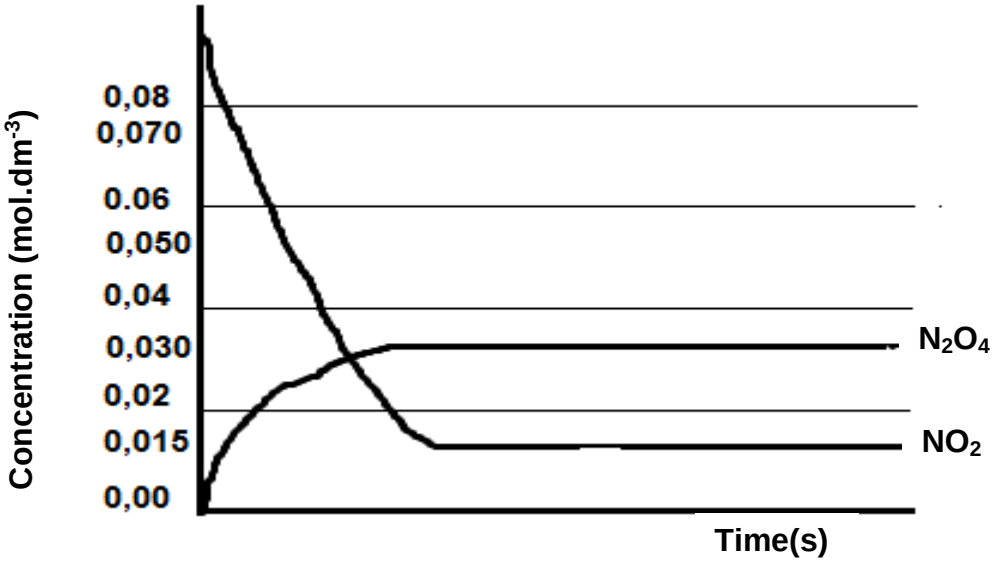
6.2.2 Name the type of the reaction this graph represents. Explain your answer. (2)

6.3 The same reaction takes place in the presence of a catalyst.
On the potential energy profile provided, show how the graph would change in the presence of a catalyst. (2)

6.4 How would the presence of a catalyst affect the values of the energies labelled (ii) and (v) ? (3)
[14]

QUESTION 7 (Start on a new page)

Study the graph below which represents an equilibrium system at a certain temperature:



7.1 Why is this an example of "*dynamic equilibrium*"? (2)

7.2 State Le Chatelier's principle. (2)

7.3 From the given graph, identify the reactants and the products for the reaction. Give a reason for your answer. (3)

7.4 Write down a balanced chemical equation for the reversible reaction. (3)

7.5 Calculate the value of the equilibrium constant for the reaction above at the conditions as shown. (4)

7.6 Which one of the oxides (NO_2 and N_2O_4) would be expected to have the highest concentration at equilibrium? Explain your answer. (3)

[17]

QUESTION 8

A group of learners use 35 cm^3 standard solution of 0,1 $mol.dm^{-3}$ sodium hydroxide solution to standardize an oxalic acid solution of volume 40cm^3. At the end-point , 12 cm^3 of the sodium hydroxide remains unreacted.

8.1 Define a *standard* solution. (2)

8.2 The net ionic equation is given:

$$C_2H_2O_4 + 2\ OH^- \rightleftharpoons C_2O_4^{2-} + 2H_2O$$

Identify the conjugate acid-base pairs. (4)

8.3 Calculate

8.3.1 The number of moles of sodium hydroxide in the original standard solution. (3)

8.3.2 The concentration of the oxalic acid. (6)

8.4 The learners have the following indicators available to them:

Indicator	pH range
A	5- 8
B	9-12
C	3-6

Which indicator must the learners use? Give a reason. (3)

8.5 In another titration using the same volume of the oxalic acid of unknown concentration the learners use a 35 cm^3 solution of sodium hydroxide of concentration 0,5 $mol.dm^{-3}$. How will the time taken to reach the end point be affected? Write DECREASES, INCREASES OR REMAINS THE SAME. Explain your answer. (3)

[21]

QUESTION 9 (Start on a new page.)

Ammonium chloride crystals, $NH_4C\ell$ (s), dissolve in water to form ammonia and chloride ions. The balanced chemical equation is given below:

$$NH_4^+(aq) + H_2O(\ell) \rightleftharpoons NH_3(aq) + H_3O^+(aq)$$

9.1 What is meant by "*hydrolysis of a salt*"? (2)

9.2 Is ammonium chloride ACIDIC or BASIC in aqueous solution? Explain your answer. (2)

9.3 A certain fertilizer consists of 92% ammonium chloride. A sample of mass X g of this fertilizer is dissolved in 100 cm^3 of a 0,10 $mol.dm^{-3}$ sodium hydroxide solution, NaOH (aq). The NaOH is in excess. The balanced equation for the reaction is:

$$NH_4C\ell\ (s) + NaOH(aq) \rightarrow NH_3(g) + H_2O(\ell) + NaC\ell(s)$$

9.3.1 Calculate the number of moles of sodium hydroxide in which the sample is dissolved. (3)

9.3.2 Calculate the pH of a 0,5 $mol.dm^{-3}$ sodium hydroxide solution at 25 ^0C. (4)

9.4 A gaseous compound contains 30,43% nitrogen and 69,57% oxygen by mass.
Determine the empirical formula of the gas. (5)

9.5 If 23 g of this gas occupies a volume of 5,6 dm^3 at STP, determine the molecular formula of the gas. (4)

[20]

TOTAL MARKS: 150

DATA FOR PHYSICAL SCIENCES GRADE 12

PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = N/N_A$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = V/Vm$
$\frac{CaVa}{CbVb} = \frac{n_a}{n_b}$	pH = -log$\left[H_3O^+\right]$
Kw = $\left[H_3O^+\right]\left[OH^-\right]$ = 1x10^{-14} at 298K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidisingagent} - E^{\theta}_{reducingagent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 H 1																	2 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	10 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	18 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	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 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	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	59	60	61	62	63	64	65	66	67	68	69	70	71
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
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

KEY/*SLEUTEL*

- **Atomic number** / ***Atoomgetal***
- **Electronegativity** / ***Elektronegatiwiteit***
- **Symbol** / ***Simbool***
- **Approximate relative atomic mass** / ***Benaderde relatiewe atoommassa***

Example: 29 / 1,9 / Cu

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

TABLE 4A: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			E^{θ} (V)
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,82
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,52
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,28
$O_2(g) + 4H^+ + 3e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,06
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,78
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,78
$Fe^{3+} + e^-$	$\rightleftharpoons$	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
$SO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 4e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 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	– 0,04
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	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
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	– 0,41
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	– 0,44
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	– 0,74
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	– 0,74
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	– 0,76
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	– 0,83
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	– 1,18
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 1,66
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	– 2,37
$Na^+ + e^-$	$\rightleftharpoons$	Na	– 2,71
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	– 2,87
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	– 2,90
$K^+ + e^-$	$\rightleftharpoons$	K	– 2,92
$Li^+ + e^-$	$\rightleftharpoons$	Li	– 3,04

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

TABLE 4B: STANDARD REDUCTION POTENTIALS

Half-reactions/*Halfreaksies*			E^{θ} (V)
$Li^+ + e^-$	$\rightleftharpoons$	Li	− 3,04
$K^+ + e^-$	$\rightleftharpoons$	K	− 2,92
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	− 2,90
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	− 2,87
$Na^+ + e^-$	$\rightleftharpoons$	Na	− 2,71
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	− 2,37
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	− 1,18
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	− 0,76
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	− 0,74
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	− 0,74
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	− 0,44
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	$\rightleftharpoons$	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
$2H^+ + 2e^-$	$\rightleftharpoons$	$H_2(g)$	0,00
$S + 2H^+ + 2e^-$	$\rightleftharpoons$	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	$\rightleftharpoons$	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	$\rightleftharpoons$	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 4e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	$\rightleftharpoons$	Cu	+ 0,52
$I_2 + 2e^-$	$\rightleftharpoons$	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,78
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,78
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,06
$O_2(g) + 4H^+ + 3e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,28
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,52
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,82
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

NSC

ANSWERSHEET

NAME: _____ **GRADE 12:** _____

QUESTION 6.3

Hand in this answersheet together your answer book.