



HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 11
PAPER 2- Chemistry



NOVEMBER 2015
TIME: 3 HRS

Total 151

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
SECTION B (131)

Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets and a periodic table are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places.

SECTION A

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

1.1 Identify the conjugate acid of HSO_4^- .

- A H_2SO_4
- B OH^-
- C H_3O^+
- D SO_4^{2-}

1.2 Indicate which ONE of the following reactions is a redox reaction:

- A $\text{AgCl}(\text{s}) \rightarrow \text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
- B $\text{Cu}^{2+}(\text{aq}) + 2\text{NO}_3^-(\text{aq}) \rightarrow \text{Cu}(\text{NO}_3)_2$
- C $2\text{Na}(\text{s}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NaCl}(\text{s})$
- D $\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2\text{KI}(\text{aq}) \rightarrow \text{PbI}_2(\text{s}) + 2\text{KNO}_3(\text{aq})$

1.3 The mass of carbon present in 10 g of carbon monoxide is ...

- A 1,20 g.
- B 4,29 g.
- C 0,83 g.
- D 2,36 g.

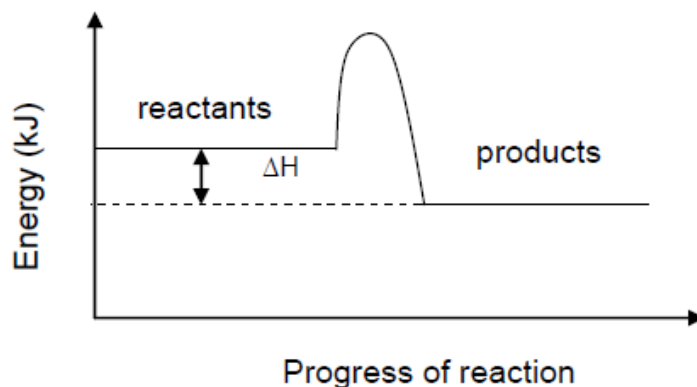
1.4 The minimum amount of energy that colliding particles (atoms, molecules or ions) must have for a reaction to start.

- A Ionisation energy.
- B Activation energy.
- C Lattice energy.
- D Bond energy.

1.5 0,1 mol of Na_2CO_3 is dissolved in water and the volume is made up to 1 dm^3 . What is the concentration of sodium carbonate solution, sodium ions and carbonate ions?

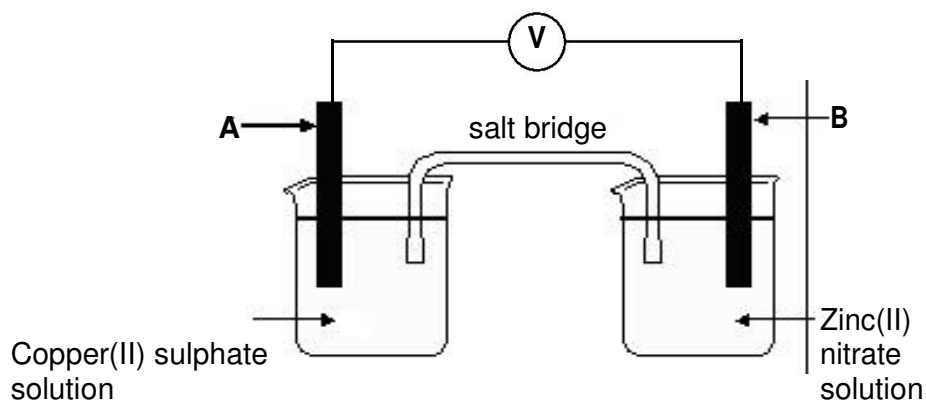
	Na_2CO_3 ($\text{mol}\cdot\text{dm}^{-3}$)	Na^+ ($\text{mol}\cdot\text{dm}^{-3}$)	CO_3^{2-} ($\text{mol}\cdot\text{dm}^{-3}$)
A.	0,2	0,1	0,1
B.	0,1	0,1	0,2
C.	0,2	0,2	0,1
D.	0,1	0,2	0,1

- 1.6 Consider the following graph which represents a change in energy during a chemical reaction.



ΔH in this reaction is ...

- A negative, since energy is gained.
 - B positive, since energy is gained.
 - C positive, since energy is lost.
 - D negative, since energy is lost.
- 1.7 The diagram below represents an electrochemical cell.



Consider the following statements regarding the above cell:

- I: It is a galvanic cell with **B** as anode.
- II: It is an electrolytic with **B** as anode.
- III: Copper(II) ions are reduced to copper at **A**.
- IV: Zinc(II) ions act as reducing agent.

Which of the above statements is/are true regarding the above cell?

- A I and III
- B III and IV
- C II and IV
- D I, III and IV

1.8 The general formula of the homologous series to which but-2-ene belongs is ...

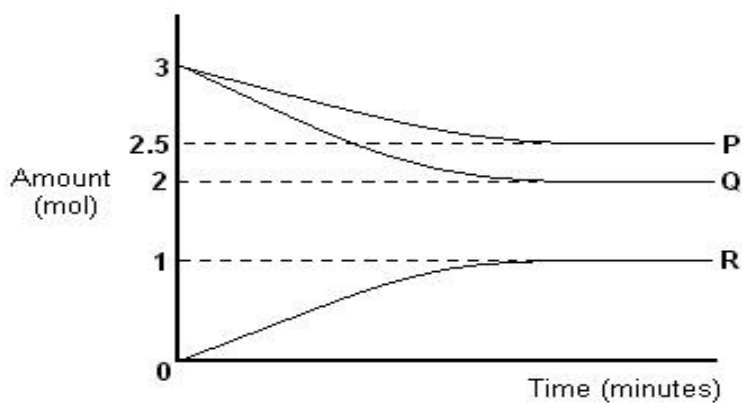
- A C_nH_{2n+2} .
- B $C_{n+1}H_{2n}$.
- C C_nH_{2n} .
- D C_nH_{2n-2} .

1.9 $CH_3-CH(CH_3)-CH_2-COOH$

The IUPAC name of the above organic compound is ...

- A 2-methyl butanoic acid.
- B pentanoic acid.
- C 3-methyl butanoic acid.
- D methyl butanoic acid.

1.10 The accompanying graph shows the change in the amounts of substances P, Q and R with time during a reaction.



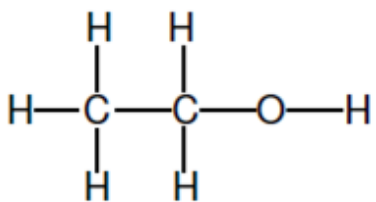
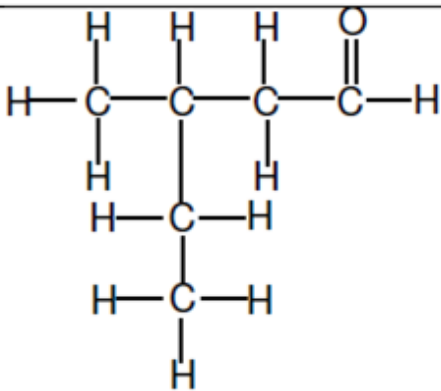
The equation for the reaction can be represented as ...

- A $P + 2Q \rightarrow 2R$
- B $2P + Q \rightarrow R$
- C $3P + 2Q \rightarrow R$
- D $5P + 2Q \rightarrow 2R$

[2 X 10 = 20]

QUESTION 2

The letters **A** to **H** in the table below represent eight organic compounds.

A		B	
C	CH₃CH(CH₃)CHCHCH(CH₃)CH₂CH₃	D	1,2-dibromo-3-methylbutane
E	Propanoic acid	F	CH₃CCCH(C₂H₅)CH₂CH₃
G	CH₃CH(CH₃)CH₂CH(CH₃)CH₂CH₃	H	4-methylpentan-2-one

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

2.1.1 A compound with a carboxyl group as functional group (1)

2.1.2 An alkene (1)

2.1.3 An aldehyde (1)

2.1.4 A saturated hydrocarbon (1)

2.1.5 Two compounds that are functional isomers (1)

2.2 Write down the IUPAC name of:

2.2.1 Compound **B** (2)

2.2.2 Compound **F** (2)

2.2.3 Compound **G** (2)

2.3 Write down the structural formula of:

2.3.1 Compound **D** (2)

2.3.2 Compound **H** (2)

[15]

Question 3

There are two isomers for the organic compound with molecular formula C₄H₁₀.

- 3.1 Define the term *isomer*. (2)
- 3.2 Write down the structural formulae of the two isomers and also give their IUPAC names. (4)
- 3.3 Two isomers of C₂H₄O₂ are placed in test tubes marked x and y.
- 3.3.1 The contents of test tube X has a pleasant smell. Draw the structural formula of the compound in test tube X. (2)
- 3.3.2 What test would you perform to confirm the contents of test tube Y? (1)
- 3.3.3 Draw the structural formula of the contents of test tube Y. (2)
- 3.3.4 In what common household item is the contents of Y found? (1)
- [12]**

Question 4

When 0,05 moles of CaCO_{3(s)} is placed in a reaction vessel containing 25,00 cm³ of a HCl solution of concentration 0,2 mol.dm⁻³, carbon dioxide gas is produced.



The gas is collected in a syringe.

- 4.1 What is a limiting reagent? (1)
- 4.2 Calculate which reagent will be in excess. (5)
- 4.3 What is the maximum mass of CaCl₂ that can be produced in this reaction (theoretical yield). (4)

If the volume of the CO_{2(g)} collected in the syringe was 0,023 dm³ at STP,

- 4.4 Calculate the percentage yield of the calcium chloride. (5)

[15]

QUESTION 5

5.1 Define the term *reaction rate* in words. (2)

Learners use the reaction between IMPURE POWDERED calcium carbonate and excess hydrochloric acid to investigate reaction rate. The balanced equation for the reaction is:



They perform four experiments under different conditions of concentration, mass and temperature as shown in the table below. They use identical apparatus in the four experiments and measure the volume of gas released in each experiment.

	EXPERIMENT			
	1	2	3	4
Concentration of acid ($\text{mol}\cdot\text{dm}^{-3}$)	1	0,5	1	1
Mass of impure calcium carbonate (g)	15	15	15	25
Initial temperature of acid ($^{\circ}\text{C}$)	30	30	40	40

5.2 The results of experiments **1** and **3** are compared in the investigation.

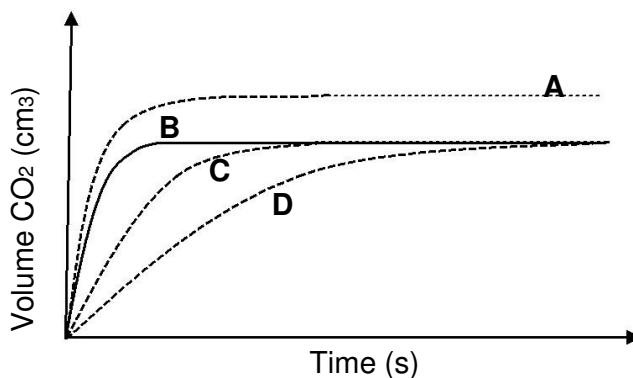
Write down the:

5.2.1 Independent variable (1)

5.2.2 Dependent variable (1)

5.3 Use the collision theory to explain why the reaction rate in experiment **4** will be higher than that in experiment **3**. (3)

The learners obtain graphs **A**, **B**, **C** and **D** below from their results.

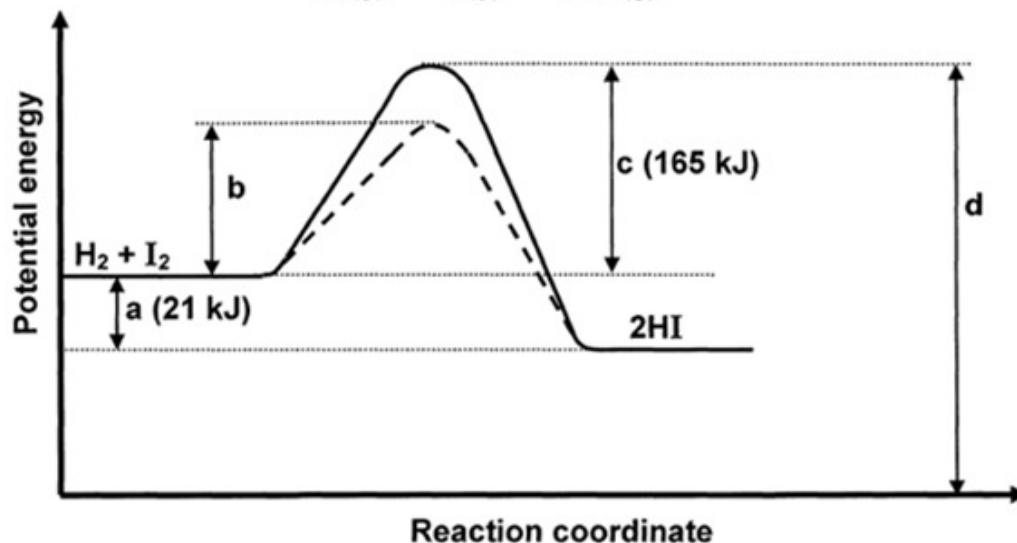
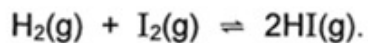


- 5.4 Which ONE of the graphs (**A**, **B**, **C** or **D**) represents experiment **1**? Fully explain the answer by comparing experiment **1** with experiments **2**, **3** and **4**. (6)
- 5.5 When the reaction in experiment **4** reaches completion, the volume of gas formed is $4,5 \text{ dm}^3$. Assume that the molar gas volume at $40 \text{ }^\circ\text{C}$ is equal to $25,7 \text{ dm}^3$. Calculate the mass of the impurities present in the calcium carbonate. (5)

[18]

Question 6

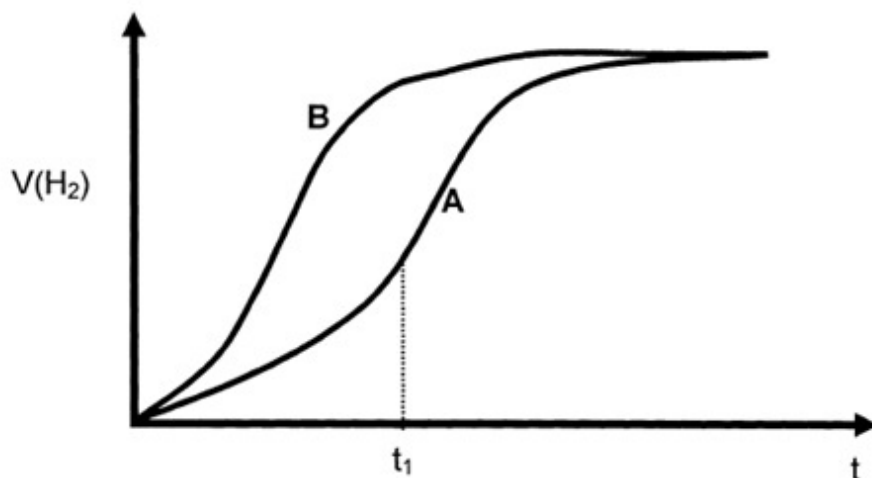
6.1 The sketch below represents the potential energy diagram for the reaction



- 6.1.1 What is the value of ΔH for the reaction? (2)
- 6.1.2 What is the value of the activation energy for the reaction? (1)
- 6.1.3 What is the value of the activation energy for the reaction $2\text{HI}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \text{I}_2(\text{g})$? (1)
- 6.1.4 What change was made to obtain the curve represented by the broken line? (1)
- 6.1.5 Is the reaction in QUESTION 6.1 exothermic or endothermic? (1)

- 6.2 A 2 g sample of zinc, the surface of which has been cleaned, is added to 30 cm³ hydrochloric acid solution with a concentration of 2 mol.dm⁻³.

Curve A below represents the volume of hydrogen gas formed versus time.



Give a possible reason for:

- 6.2.1 The increase in the reaction rate before t_1 (1)
- 6.2.2 The decrease in the reaction rate after t_1 (1)

A second experiment is performed using a different sample of zinc and a different sample of hydrochloric acid. The same mass of zinc and the same volume of hydrochloric acid are used. The result of this experiment is given by curve B.

- 6.2.3 State TWO factors that could possibly have contributed to the higher reaction rate represented by curve B.

(2)
[10]

QUESTION 7

- 7.1 A learner prepares a potassium hydroxide (KOH) solution to titrate against a sulphuric acid (H₂SO₄) solution at 25 °C.

The balanced equation for the reaction between potassium hydroxide and sulphuric acid is:



- 7.1.1 Calculate the mass of potassium hydroxide (KOH) needed to prepare 400 cm³ of a 0,15 mol.dm⁻³ KOH solution. (5)
- 7.1.2 25 cm³ of the solution prepared in QUESTION 7.1.1 is used to neutralise 30 cm³ of the sulphuric acid solution. Calculate the concentration of the H₂SO₄ solution. (5)
- 7.1.3 When only one drop of the sulphuric acid solution still had to be added to reach the equivalence point (end point) of the titration, the concentration of the OH⁻ in the mixture was 1,23 x 10⁻⁴ mol.dm⁻³. Calculate the pH of the solution at this specific point. (6)
- 7.2 **An aqueous solution of NH₄Cl is investigated.**
- 7.2.1 State whether the pH of this solution will be GREATER THAN 7, EQUAL TO 7 or LESS THAN 7. (1)
- 7.2.2 Give a reason for your answer to QUESTION 7.2.1. (1)
- 7.2.3 Write down a balanced equation to explain your answer to QUESTION 7.2.2. (3)
- 7.2.4 **A solution of acetic acid and sodium hydroxide are titrated together. State which indicator you would use to indicate the end point of the reaction.** (1)
- 7.2.5 Give a reason for your answer to Question 7.2.4 (2)

[24]

QUESTION 8

Grade 11 Physical Sciences learners in a school were asked to do investigations to find out which electro chemical cell(galvanic/voltaic cell) constructed by them produces better cell potential under standard conditions. The learners were divided into three groups and each group is provided with the necessary apparatus and chemicals. A salt bridge is also provided to each group. They have to prepare the required quantity of electrolytes of concentrations required for standard conditions to use in the anode and cathode compartments.

The investigative project given to the learners involved a planning and designing stage. During planning and designing stage, they have to answer certain questions based on the construction and processes involved. Each group of learners constructed their electrochemical cells using the different electrodes and electrolytes and the salt bridge. The electrodes and electrolytes of anode and cathode compartments and the standard cell potential of the electrochemical cell of each group are tabulated as shown below.

	Anode compartment	Cathode compartment	E°_{cell}
Electrochemical cell-1	Pb _(s) metal rod in Pb ²⁺ _(aq) solution	Mg _(s) metal strip in Mg ²⁺ _(aq) solution	2,23 V
Electrochemical cell-2	Al _(s) metal rod in Al ³⁺ _(aq) solution	Fe _(s) metal rod in Fe ²⁺ _(aq) solution	1,22 V
Electrochemical cell-3	Cu _(s) metal rod in Cu ²⁺ _(aq) solution	Ag _(s) metal rod in Ag ⁺ _(aq) solution	0,46 V

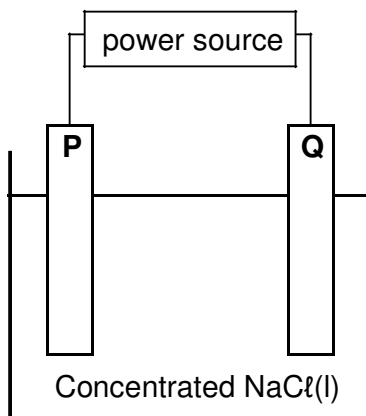
- 8.1 What are the TWO standard conditions necessary for a voltaic cell to operate? (2)
- 8.2 Name TWO functions of a salt bridge. (2)
- 8.3 Using the reduction potential table 4A or 4B write down the strongest oxidizing agent among the electrolytes given in the anode and cathode compartment columns. (Choose from Pb²⁺, Al³⁺, Cu²⁺, Mg²⁺, Fe²⁺, Ag⁺) (1)
- 8.4 In the tabular column given above the particulars for anode and cathode compartment for one of the electrochemical cells is entered **incorrectly** by the group of learners. Is it electrochemical cell-1, electrochemical cell-2 or electrochemical cell-3? (2)

- 8.5 Write down the half cell reaction taking place at the anode of electrochemical cell-2. (2)
- 8.6 Which electrode Cu or Ag in electrochemical cell-3 undergoes a decrease in mass when the cell is in operation? Give a reason for your answer. (3)
- 8.7 Do the necessary calculations to show that the emf of the electrochemical cell-2 is 1,22 V. (3)
- 8.8 Write down the nett cell reaction for electrochemical cell-3. (3)

[18]

QUESTION 9

The simplified diagram below represents an electrochemical cell used for the electrolysis of a concentrated sodium chloride solution.

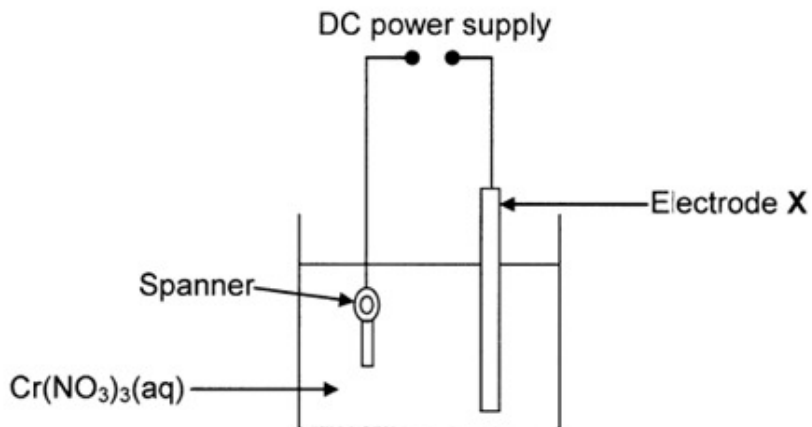


- 9.1 Is the above cell a GALVANIC or an ELECTROLYTIC cell? (1)
- 9.2 Chlorine gas is released at electrode **Q**. Write down the:
- 9.2.1 Electrode (**P** or **Q**) at which reduction takes place (1)
- 9.2.2 Half-reaction that takes place at electrode **P** (2)
- 9.2.3 Direction (**P TO Q** or **Q TO P**) in which electrons flow in the external circuit (1)
- 9.2.4 NAME of the species that acts as reducing agent (1)
- 9.3 Write down the balanced net (overall) cell reaction taking place in this cell. (3)

[9]

Question 10

The diagram below represents a simplified electrolytic cell used to electroplate a spanner with chromium. The spanner is continuously rotated during the process of electroplating.



A constant current passes through the solution and the concentration of $\text{Cr}(\text{NO}_3)_3(\text{aq})$ remains constant during the process. In the process, a total of 0,03 moles of electrons is transferred in the electrolytic cell.

- 10.1** Define the term *electrolysis*. (2)
- 10.2** Write down the:
- 10.2.1** Half-reaction that occurs at the spanner (2)
- 10.2.2** NAME or FORMULA of the metal of which electrode X is made (1)
- 10.2.3** NAME or FORMULA of the oxidising agent (1)
- 10.3** Calculate the gain in mass of the spanner. (4)
- [10]**

[150 marks]

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

Half-reactions/Halfreaksies	E^{\ominus} (V)
$F_2(g) + 2e^- = 2F^-$	+ 2,87
$Co^{3+} + e^- = Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- = 2H_2O$	+ 1,77
$MnO_4^- + 8H^+ + 5e^- = Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^- = 2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- = 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- = 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- = Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- = Pt$	+ 1,20
$Br_2(l) + 2e^- = 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- = NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- = Hg(l)$	+ 0,85
$Ag^+ + e^- = Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- = NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- = Fe^{2+}$	+ 0,77
$O_2(g) + 2H^+ + 2e^- = H_2O_2$	+ 0,68
$I_2 + 2e^- = 2I^-$	+ 0,54
$Cu^+ + e^- = Cu$	+ 0,52
$SO_2 + 4H^+ + 4e^- = S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- = 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- = Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- = SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^- = Cu^+$	+ 0,16
$Sn^{4+} + 2e^- = Sn^{2+}$	+ 0,15
$S + 2H^+ + 2e^- = H_2S(g)$	+ 0,14
$2H^+ + 2e^- = H_2(g)$	0,00
$Fe^{3+} + 3e^- = Fe$	- 0,06
$Pb^{2+} + 2e^- = Pb$	- 0,13
$Sn^{2+} + 2e^- = Sn$	- 0,14
$Ni^{2+} + 2e^- = Ni$	- 0,27
$Co^{2+} + 2e^- = Co$	- 0,28
$Cd^{2+} + 2e^- = Cd$	- 0,40
$Cr^{3+} + e^- = Cr^{2+}$	- 0,41
$Fe^{2+} + 2e^- = Fe$	- 0,44
$Cr^{3+} + 3e^- = Cr$	- 0,74
$Zn^{2+} + 2e^- = Zn$	- 0,76
$2H_2O + 2e^- = H_2(g) + 2OH^-$	- 0,83
$Cr^{2+} + 2e^- = Cr$	- 0,91
$Mn^{2+} + 2e^- = Mn$	- 1,18
$Al^{3+} + 3e^- = Al$	- 1,66
$Mg^{2+} + 2e^- = Mg$	- 2,36
$Na^+ + e^- = Na$	- 2,71
$Ca^{2+} + 2e^- = Ca$	- 2,87
$Sr^{2+} + 2e^- = Sr$	- 2,89
$Ba^{2+} + 2e^- = Ba$	- 2,90
$Cs^+ + e^- = Cs$	- 2,92
$K^+ + e^- = K$	- 2,93
$Li^+ + e^- = Li$	- 3,05

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reduserende vermoë

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

Half-reactions/Halfreaksies	E° (V)
$\text{Li}^+ + e^- = \text{Li}$	-3,05
$\text{K}^+ + e^- = \text{K}$	-2,93
$\text{Cs}^+ + e^- = \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2e^- = \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2e^- = \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2e^- = \text{Ca}$	-2,87
$\text{Na}^+ + e^- = \text{Na}$	-2,71
$\text{Mg}^{2+} + 2e^- = \text{Mg}$	-2,36
$\text{Al}^{3+} + 3e^- = \text{Al}$	-1,66
$\text{Mn}^{2+} + 2e^- = \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2e^- = \text{Cr}$	0,91
$2\text{H}_2\text{O} + 2e^- = \text{H}_2(\text{g}) + 2\text{OH}^-$	-0,83
$\text{Zn}^{2+} + 2e^- = \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3e^- = \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2e^- = \text{Fe}$	-0,44
$\text{Cr}^{2+} + e^- = \text{Cr}^+$	-0,41
$\text{Cd}^{2+} + 2e^- = \text{Cd}$	-0,40
$\text{Co}^{2+} + 2e^- = \text{Co}$	-0,28
$\text{Ni}^{2+} + 2e^- = \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2e^- = \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2e^- = \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3e^- = \text{Fe}$	-0,06
$2\text{H}^+ + 2e^- = \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2e^- = \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2e^- = \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + e^- = \text{Cu}^+$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2e^- = \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2e^- = \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4e^- = 4\text{OH}^-$	+0,40
$\text{SO}_2 + 4\text{H}^+ + 4e^- = \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^+ + e^- = \text{Cu}$	+0,52
$\text{I}_2 + 2e^- = 2\text{I}^-$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2e^- = \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + e^- = \text{Fe}^{2+}$	+0,77
$\text{NO}_3^- + 2\text{H}^+ + e^- = \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^+ + e^- = \text{Ag}$	+0,80
$\text{Hg}_2^{2+} + 2e^- = 2\text{Hg}(\ell)$	+0,85
$\text{NO}_3^- + 4\text{H}^+ + 3e^- = \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2e^- = 2\text{Br}^-$	+1,07
$\text{Pt}^{2+} + 2e^- = \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^+ + 2e^- = \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4e^- = 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6e^- = 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2e^- = 2\text{Cl}^-$	+1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5e^- = \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2e^- = 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + e^- = \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2e^- = 2\text{F}^-$	+2,87

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reduserende vermoë

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESTE WETENSAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

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

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ at/by 298 K	
$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta / E_{\text{sel}}^\theta = E_{\text{katode}}^\theta - E_{\text{anode}}^\theta$	
or/of $E_{\text{cell}}^\theta = E_{\text{reduction}}^\theta - E_{\text{oxidation}}^\theta / E_{\text{sel}}^\theta = E_{\text{reduksie}}^\theta - E_{\text{oksidasie}}^\theta$	
or/of $E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta / E_{\text{sel}}^\theta = E_{\text{oksideermiddel}}^\theta - E_{\text{reduseermiddel}}^\theta$	

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)
1 H 1																	2 He 4
3 Li 7	4 Be 9											5 B 11	6 C 12	7 N 14	8 O 16	9 F 19	10 Ne 20
11 Na 23	12 Mg 24											13 Al 27	14 Si 28	15 P 31	16 S 32	17 Cl 35,5	18 Ar 40
19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 59	29 Cu 63,5	30 Zn 65	31 Ga 70	32 Ge 73	33 As 75	34 Se 79	35 Br 80	36 Kr 84
37 Rb 86	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 92	42 Mo 96	43 Tc	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	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	81 Tl 204	82 Pb 207	83 Bi 209	84 Po	85 At	86 Rn
87 Fr	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	91 Pa	92 U	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

29
1,9 Cu
63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

232		238												
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