GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

2018

10842

PHYSICAL SCIENCES

PAPER 2

TIME: 3 hours

MARKS: 150

16 pages + 4 data sheets

X05

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

PHYSICAL SCIENCES
(Paper 2)

TIME: 3 hours

MARKS: 150

INSTRUCTIONS AND INFORMATION

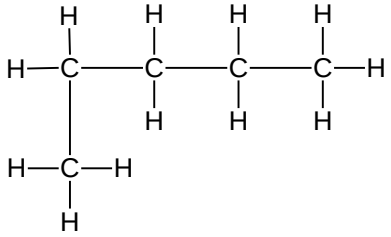
1. This question paper consists of 10 questions. Answer ALL the questions in the ANSWER BOOK.
2. Start the answer to each question on a NEW page.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line open between sub-questions, for example, between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round-off your final numerical answers to a minimum of TWO decimal places.
10. Give brief discussions, et cetera where required.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

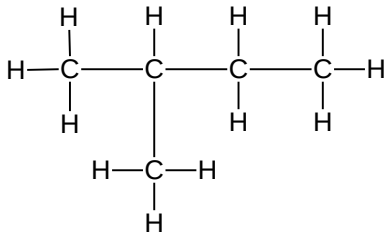
Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the answer book, e.g. 1.11 – D.

1.1 Consider the structural formulae of THREE organic compounds given below:

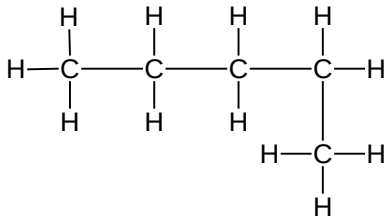
P



Q



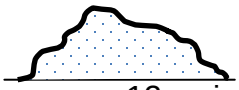
R



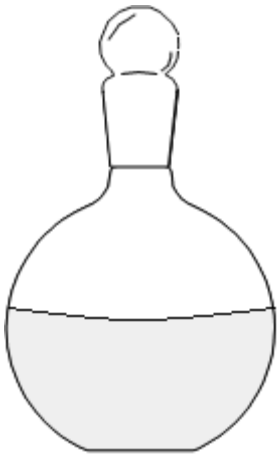
Which ONE of the following statements about the above compounds is CORRECT?

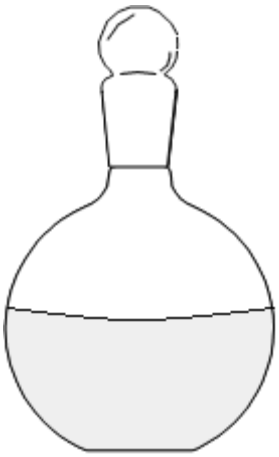
A P and R are the same compound.
B Q and R are the same compound.
C All three are different compounds.
D All three compounds are branched alkanes. (2)

1.2 Consider the four chemical samples below.

P 
12 g zinc powder

Q 
12 g zinc granules

R 
1 dm^3 of 1 $mol \cdot dm^{-3}$ HCℓ solution

S 
1 dm^3 of 2 $mol \cdot dm^{-3}$ HCℓ solution

A small balloon must be inflated with hydrogen gas. The balloon is attached to the top of one of the flasks into which zinc was added. To inflate the balloon as quickly as possible, which ONE of the combinations will be the most suitable?

A P and R
B P and S
C Q and P
D Q and S (2)

1.3 Diluted hydrochloric acid is gradually added to a flask of distilled water. What effect will this have on the value of the dissociation constant K_w of water at 25º C?

A Increase, until K_w reaches a maximum value.
B Decrease, until K_w is zero.
C No effect, no matter how much acid is added.
D A sharp increase in K_w and then a sudden decrease in K_w. (2)

1.4 Which ONE of the following factors does NOT affect a chemical system in equilibrium?

A Temperature
B Time
C Pressure
D Concentration (2)

1.5 Which ONE of the following species CANNOT act as an ampholyte?

A HSO_4^-
B H_2O
C CO_2
D HSO_3^- (2)

1.6 A standard copper-zinc electrochemical cell delivers a current. How do the concentrations of the two electrolytes change in time?

A $[Cu^{2+}]$ decreases and $[Zn^{2+}]$ increases at the same rate.
B $[Cu^{2+}]$ and $[Zn^{2+}]$ are unaffected as the reaction proceeds.
C $[Cu^{2+}]$ increases and $[Zn^{2+}]$ decreases in time.
D $[Cu^{2+}]$ and $[Zn^{2+}]$ both steadily decreases until both are zero. (2)

1.7 A spontaneous reaction occurs when chlorine gas comes into contact with hydrogen gas. The probable reason for this is that ...

A chlorine is a good oxidising agent.
B hydrogen is an oxidising agent.
C chlorine is a good reducing agent.
D hydrogen and chlorine are both non-metals. (2)

1.8 Consider the following hypothetical redox equation.

$$X(s) + 2Y^{3+}(aq) \rightleftharpoons X^{2+}(aq) + 2Y^{2+}(aq)$$

Which ONE of the following statements concerning the above equation is correct?

A X undergoes reduction by losing 1 electron.
B X undergoes reduction by losing 2 electrons.
C Y^{3+} undergoes reduction by gaining 1 electron.
D Y^{3+} undergoes reduction by gaining 2 electrons. (2)

1.9 Which ONE of the following is an industrial use of nitric acid?

A Refining of petrol and oil
B Dehydrating agent
C Recovery of metals from their ores
D Preparation of fertilisers (2)

1.10 The reaction $2SO_3 + O_2 \rightarrow 2SO_3$ in the contact process is ...

A reversible and does not take place in the presence of a catalyst.
B not reversible and only takes place in the presence of vanadium pentoxide.
C reversible and takes place in the heat exchanger of the factory.
D reversible and takes place in the presence of a catalyst. (2)

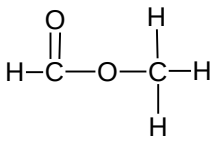
[20]

QUESTION 2

2.1 The molecular formula $C_2H_4O_2$ has two isomers.

2.1.1 Define an *isomer*. (2)

2.1.2 The structural formula of one of the isomers of $C_2H_4O_2$ is



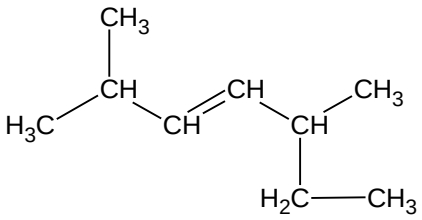
Write down the IUPAC name for this isomer. (2)

2.1.3 Draw the structural formula of the other isomer of the compound given above. (2)

2.1.4 Write down the IUPAC name for this isomer in QUESTION 2.1.3. (1)

2.1.5 To which **homologous series** does the isomer in QUESTION 2.1.3 belong? (1)

2.2 Consider the structural formula below.



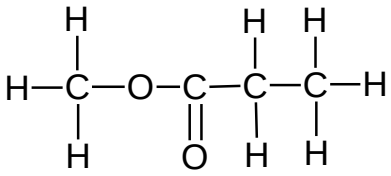
For this compound, write down the:

2.2.1 **General formula** of the homologous series to which it belongs (1)

2.2.2 IUPAC name (2)

2.3 Write down the structural formula of a tertiary alcohol consisting of 4 carbon atoms. (2)

2.4 Consider the following organic compound below. Write down the structural formula of the functional group of this compound.



(1)
[14]

QUESTION 3

Grade 12 learners investigate the effect of the molecular mass on the boiling point of the first 8 members of the homologous series of the primary alcohols.

3.1 Give ONE precaution that the learners need to take during this investigation. (1)

3.2 Structural isomers can influence the outcome of this investigation. Alcohols with more than two carbon atoms have more than one structural isomer.

3.2.1 Write down the TWO structural formulae and the IUPAC names of the isomers of the alcohols containing three carbon atoms. (4)

3.2.2 The learners used heptan-1-ol as one of the compounds during the investigation. Which ONE of the isomers named in QUESTION 3.2.1 must be used to make the results comparable and fair? (1)

3.2.3 Give the reason for the choice made in QUESTION 3.2.2. (1)

3.3 Butan-1-ol and butan-2-ol have different melting and boiling points. State, with reasons, which ONE of these two alcohols have the highest …

3.3.1 melting point. (3)

3.3.2 vapour pressure. (3)

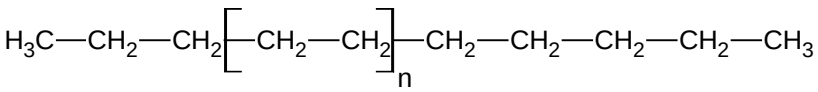
3.3.3 Will the boiling point of a primary alcohol INCREASE or DECREASE if the number of carbon atoms in the chain increases to eight? (1)

3.3.4 Give a reason for the answer to QUESTION 3.3.3. (2)

3.4 Polymers are used widely in our society to form a variety of plastic compounds.

3.4.1 Name the process where very large, high-molar mass molecules are formed from small molecules? (1)

3.4.2 Name the monomer in the following organic molecule:



(1)

3.4.3 Give ONE use of the polymer in QUESTION 3.4.2. (1)

[19]

QUESTION 4

4.1 The following equation represents an organic chemical reaction.

$$C_3H_6\ (g) + HBr\ (g) \rightarrow \text{compound } \mathbf{X} + H_2O \rightarrow \text{secondary alcohol}$$

4.1.1 Write down the molecular formula of compound **X**. (1)

4.1.2 Name the type of reaction that takes place when C_3H_6 is converted to compound **X**. (1)

4.1.3 Give the IUPAC name of the secondary alcohol that is formed. (1)

4.1.4 Define a *secondary alcohol*. (1)

4.1.5 Instead of adding water to compound **X**, concentrated sodium hydroxide and ethanol is added, and the mixture is heated under reflux.

Write down the IUPAC name of the organic product that is formed. (1)

4.1.6 Name the type of elimination reaction that takes place. (1)

4.2 Most organic compounds can undergo substitution, addition or elimination reactions to produce a variety of compounds. Some incomplete organic reactions are represented below.

Reaction I: $CH_3 – CH_2 – CH = CH_2 + H_2O \rightarrow$
Reaction II: $CH_3 – CH_2 – CH_2 – C(CH_3) = CH_2 + HBr \rightarrow$
Reaction III: $CH_3 – CH(OH) – CH_2 – CH_3 + H_2SO_4 \xrightarrow{\text{heat}}$

4.2.1 Name the type of reaction represented by **Reaction III**. (1)

Both **Reactions I and II** are examples of addition reactions. Name the type of addition reaction that is represented by:

4.2.2 **Reaction I** (1)

4.2.3 **Reaction II** (1)

4.2.4 **Reaction I** takes place in the presence of a catalyst. Write down the FORMULA of the inorganic catalyst used in **Reaction I**. (1)

4.2.5 Write down the IUPAC name of the major product formed in **Reaction II**. (2)
[12]

QUESTION 5

5.1 The following equation represents a reaction used to prepare $CO_2(g)$ in the school laboratory. Pieces of calcium carbonate are added to a 0,1 mol·dm^{-3} hydrochloric acid solution in a glass beaker.

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

5.1.1 Mention THREE ways to increase the rate of CO_2 production in the above reaction. (3)

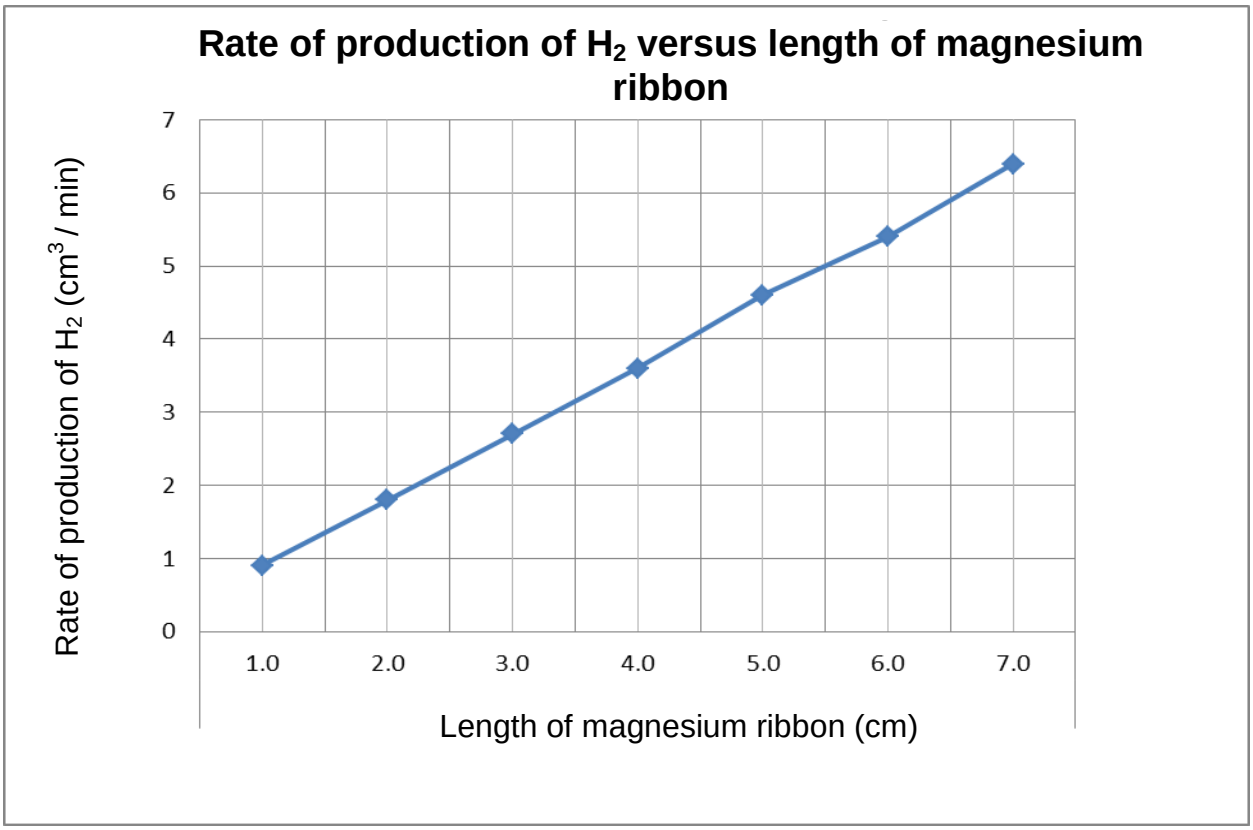
5.1.2 Discuss TWO methods to measure the rate of this reaction. (4)

5.1.3 Give TWO reasons why this reaction will NOT reach equilibrium in the beaker. (2)

5.2 In an investigation, different lengths of magnesium ribbon of the same width react with diluted hydrochloric acid of the same concentration. The rate at which hydrogen gas is produced in each reaction is measured and the data obtained is recorded in the table below.

Length of magnesium ribbon (cm)	1,0	2,0	3,0	4,0	5,0	6,0	7,0
Rate of production of H_2 $\left(\frac{cm^3}{min}\right)$ at 25 °C	0,9	1,8	2,7	3,6	4,6	5,4	6,4

A graph of the results appears below.



5.2.1 Use the graph to give the rate at which hydrogen gas is produced from a 5,5 cm length of magnesium ribbon. (1)

5.2.2 The experiment is repeated under the same conditions, except that the hydrochloric acid is heated to 60 °C before the magnesium ribbon is added. How will the gradient of the new graph differ from that of the original gradient?
Write only STEEPER GRADIENT or LOWER GRADIENT. (1)

5.2.3 Explain your answer to QUESTION 5.2.2 in terms of the collision theory. (2)

5.2.4 What conclusion can be made from the graph? (2)
[15]

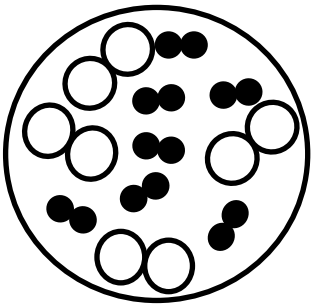
QUESTION 6

6.1 State *Le Chatelier's principle*. (2)

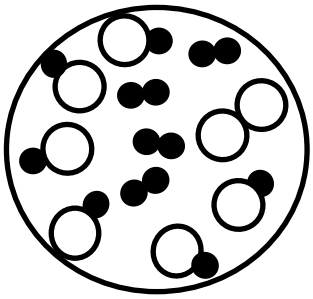
6.2 Iodine reacts with excess hydrogen in a sealed container of constant volume. Hydrogen iodide is formed.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \qquad \Delta H > 0$$

Samples of the initial reaction mixture and the equilibrium reaction mixture's molecular compositions are shown below. An iodine atom is represented by (O) and hydrogen atom by (●).



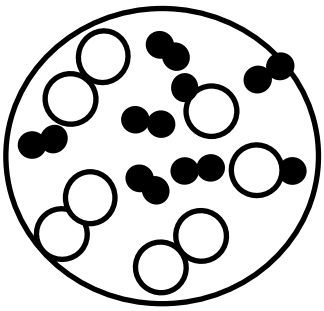
Initial reaction mixture



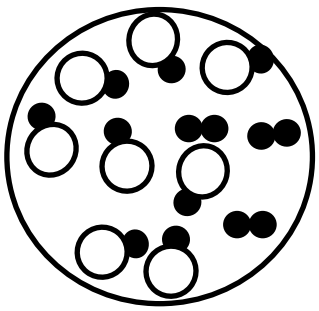
Reaction mixture at equilibrium

6.2.1 The temperature of the equilibrium mixture is decreased, and a new equilibrium is established. Choose between **A** and **B** to identify the new molecular composition of the reaction mixture. (1)

A



B



6.2.2 Explain the answer to QUESTION 6.2.1 (3)

6.3 Consider the equilibrium established in an aqueous 0,10 mol·dm^{-3} ethanoic acid (acetic acid) solution at 25 ^{o}C.

$$CH_3COOH(\ell) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + CH_3COO^-(aq)$$

The pH of this solution is 2,87.
This pH corresponds to a $[H_3O^+] = 1{,}34 \times 10^{-3}$ mol·dm^{-3}

6.3.1 Calculate the equilibrium constant of an aqueous solution of ethanoic acid at 25 ^{o}C. (3)

6.3.2 Concentrated sodium ethanoate (CH_3COONa), was dissolved in an ethanoic acid solution. How will the pH of the ethanoic acid solution change?

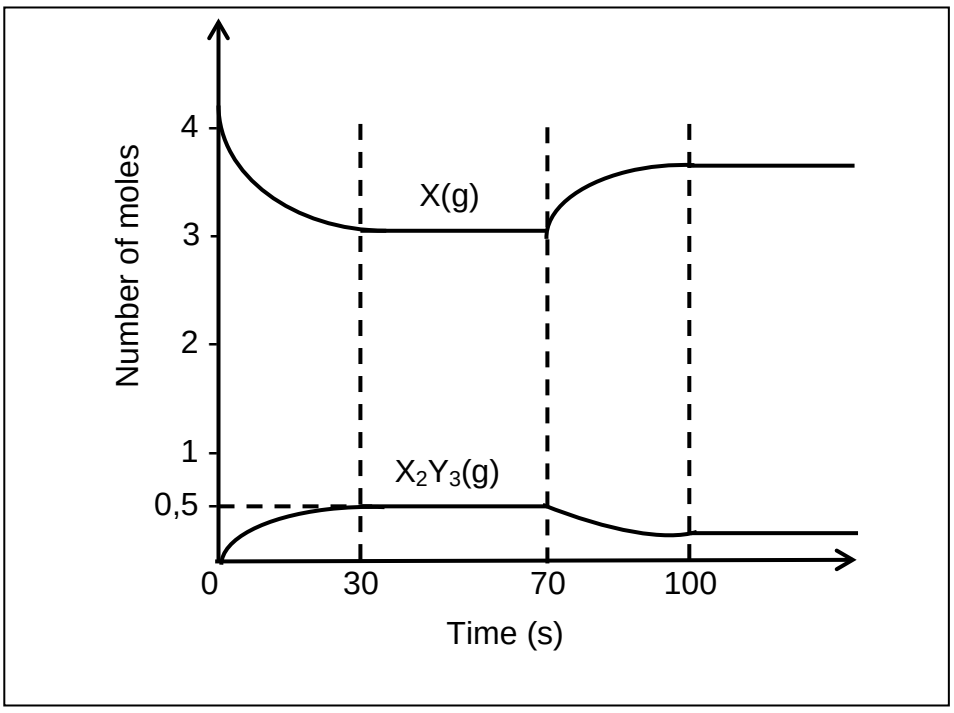
Write only INCREASES, DECREASES, or STAYS THE SAME. (1)

6.3.3 Explain the answer to QUESTION 6.3.2 (3)

6.4 4 mol of gas **X** and 4 mol of gas **Y** are added and sealed in a 2 dm^3 container at a certain temperature. The following equilibrium is established at a certain temperature.

$$2X(g) + 3Y(g) \rightleftharpoons X_2Y_3(g)$$

The graph below shows the number of moles of gas **X** and gas **X_2Y_3** present from the time the container is sealed.



6.4.1 How many moles of gas X_2Y_3 are formed by the time the reaction reaches equilibrium at 30 s? (1)

6.4.2 Calculate the value of the equilibrium constant at t = 50 s. (6)
[20]

QUESTION 7

7.1 The dissociation constant of some substances is given below.

Name of substance	Formula	Ka (298 K)
Hydrogen sulphate ion	HSO_4^-	$1,2 \times 10^{-2}$
Ammonium ion	NH_4^+	$5,6 \times 10^{-10}$
Phosphoric acid	H_3PO_4	$7,5 \times 10^{-3}$
Hydrocyanic acid	HCN	$4,9 \times 10^{-10}$

7.1.1 Write down the FORMULA of the substance that has the highest tendency to dissociate. (1)

7.1.2 Write down the FORMULA of the conjugate base of hydrocyanic acid. (1)

7.2 7,6 g of impure commercial washing soda ($Na_2CO_3.10H_2O$) is dissolved in water. The solution is diluted to 500 cm^3 in a measuring flask. 25 cm^3 of this solution is titrated with a standard HCℓ solution of concentration 0,1 $mol \cdot dm^{-3}$.

$$Na_2CO_3.10H_2O + HC\ell \rightarrow NaC\ell + H_2O + CO_2$$

7.2.1 Rewrite and balance the chemical equation for the above reaction. (2)

7.2.2 Three indicators are available to indicate the equivalence point of this titration.

- Methyl orange
- Bromothymol blue
- Phenolphthalein

Choose from the list of indicators, the ONE which will be the most suitable for this titration. (1)

7.2.3 Give a reason for the answer to QUESTION 7.2.2 (2)

7.2.4 What colour change will be observed during the titration of the base with the acid. (1)

7.2.5 Calculate the mass of pure Na_2CO_3 in commercial washing soda, if 24,8 cm^3 of the HCℓ solution was needed to reach the equivalence point in the titration. (5)

7.2.6 Calculate the percentage purity of the Na_2CO_3 in the original mass of commercial washing soda. (3)

[16]

QUESTION 8

8.1 A standard electrochemical cell is set up according to the equation below.

$$Mg(s) + 2AgNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + 2Ag(s)$$

8.1.1 Write down the cell notation of this cell. (3)

8.1.2 Write down the NAME of the oxidising agent. (1)

8.1.3 Calculate the initial emf of this cell. (3)

8.1.4 At what temperature is the emf of a standard cell measured? (1)

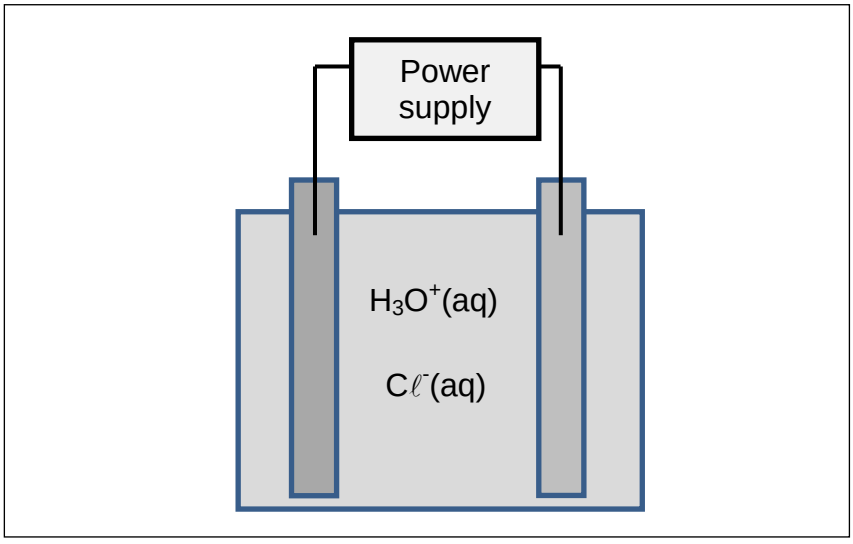
8.1.5 At what half-cell concentration will the cell give the emf obtained in QUESTION 8.1.3? (1)

8.1.6 This cell is connected to a light bulb marked 3V;6W. In theory the bulb should light up, but in practice it does not. ($I = \frac{P}{V}$). Give a possible reason for this observation. (3)

[12]

QUESTION 9

9.1 A cell consists of a source of direct current (a battery) connected to two electrodes that are immersed in an aqueous solution of hydrochloric acid as indicated below. The electrical circuit is complete.



9.1.1 To which electrode (anode or cathode) do the hydronium ions migrate? (1)

9.1.2 Write down the half-reaction taking place at the electrode in QUESTION 9.1.1. (2)

9.1.3 Give the NAME or FORMULA of the product that is formed at the <u>other</u> electrode. (1)

9.2 The electroplating of metals is a very important industrial electrochemical application.

9.2.1 Define *electroplating*. (2)

9.2.2 Name ONE use of electroplating. (1)

9.2.3 To which electrode must the object that is to be electroplated be connected? (1)
[8]

QUESTION 10

10.1 The table below shows the ideal soil conditions for growing three types of crops.

Crop	**Soil pH**	**Soil nitrogen**	**Soil phosphorous**	**Soil potassium**
Wheat	6	Medium	High	Low
Potatoes	9	Medium	Medium	High
Sugar beet	7	Medium	Medium	High

10.1.1 Which crop grows best in acidic soil? (1)

A farmer bought the fertilisers listed in the table below:

Common name	**Chemical formula**
Sulphate of potash	K_2SO_4
Triple superphosphate	$Ca(H_2PO_4)$
Ammonium nitrate	NH_4NO_3
Ammonium sulphate	$(NH_4)_2SO_4$

Samples of soil from two fields, A and B were analysed. The results are in the following table:

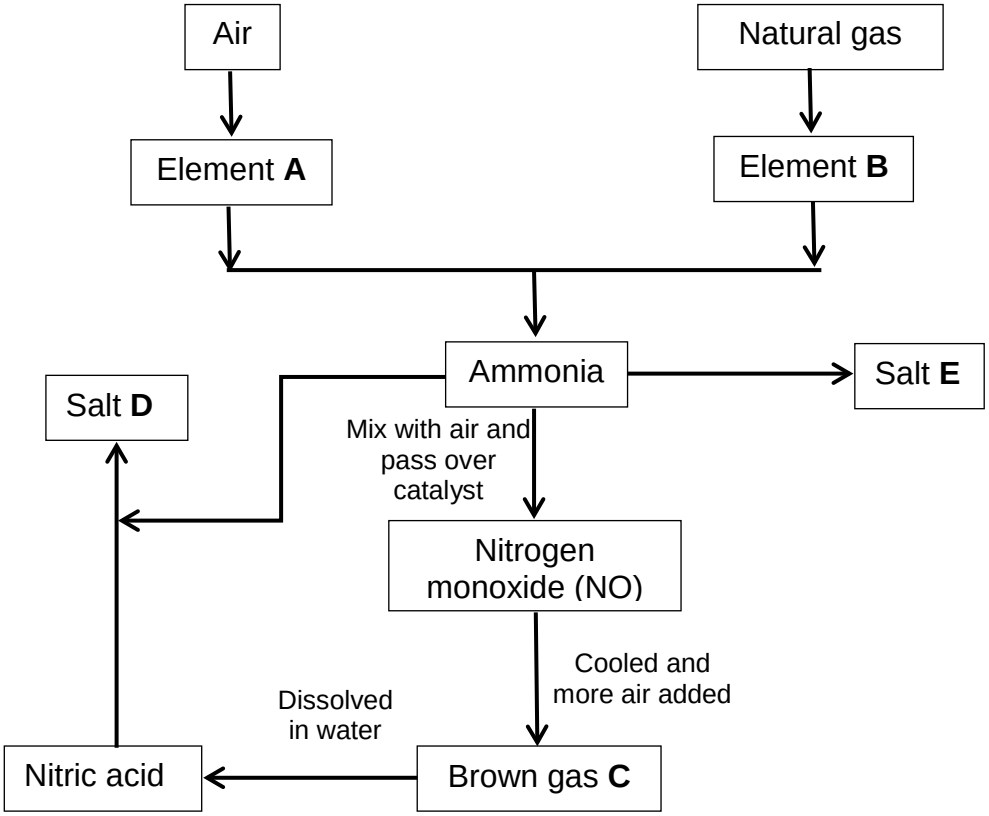
Field	**Nitrogen**	**Phosphorous**	**Potassium**
A	Low	High	Low
B	Medium	Medium	Medium

10.1.2 Which ONE of the fertilisers should the farmer add to the soil in field A to make it more suitable for growing wheat? (1)

10.1.3 Give a reason for the answer to QUESTION 10.1.2. (3)

10.1.4 Calculate the % nitrogen in the ammonium nitrate. (4)

10.1.5 Some of the processes used in the manufacturing of fertilizers are indicated in the flow diagram below. Complete the flow diagram below by writing down the NAME or FORMULA of substances A to E. Write only the letter and the answer in your ANSWER BOOK.



(5)
[14]

TOTAL: 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}	$1{,}013 \times 10^5$ 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	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro se konstante*	N_A	$6{,}02 \times 10^{23}$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR / *OF* $c = \frac{m}{MV}$	$n = \frac{V}{V_M}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	pH = - log$[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at / *by* 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ Or / *of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ Or / *of* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS / *TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

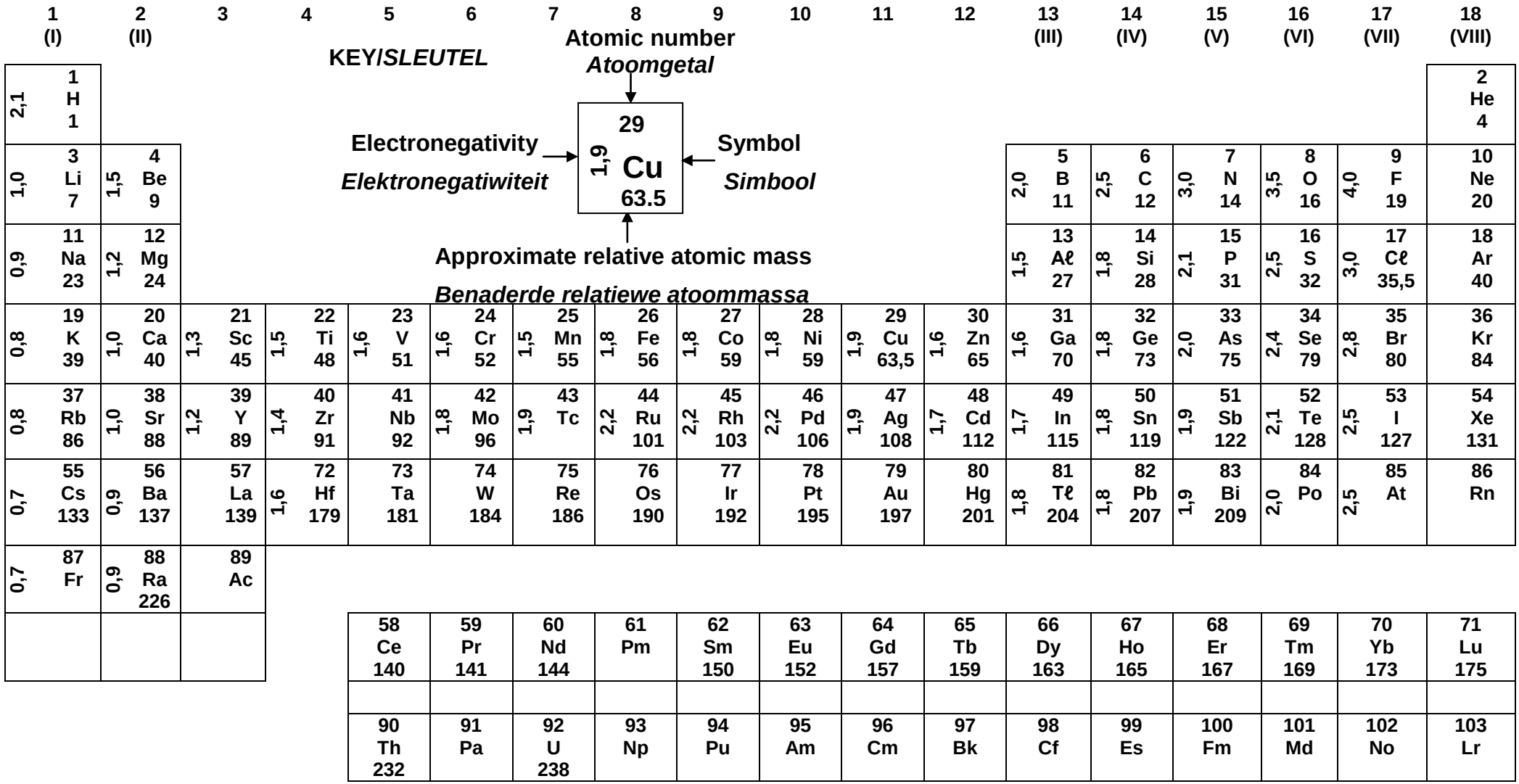


TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability / *Toenemende oksiderende vermoë* ↑

Half-reactions / *Halfreaksies*	$E^{\ominus}$ (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+ 1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^- \rightleftharpoons 2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$Br_2(\ell) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(\ell)$	+ 0,85
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 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
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 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**
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	– 0,06
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	– 0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	– 0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	– 0,27
$Co^{2+} + 2e^- \rightleftharpoons Co$	– 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
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	– 0,76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	– 0,83
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	– 0,91
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	– 1,18
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	– 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	– 2,36
$Na^+ + e^- \rightleftharpoons Na$	– 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 reduserende vermoë* ↓

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

Half-reactions / *Halfreaksies*			$E^{\ominus}$ (V)
$Li^+ + e^-$	⇌	Li	– 3,05
$K^+ + e^-$	⇌	K	– 2,93
$Cs^+ + e^-$	⇌	Cs	– 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	– 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	– 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	– 2,87
$Na^+ + e^-$	⇌	Na	– 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	– 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	– 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	– 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	– 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	– 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	– 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	– 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	– 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	– 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	– 0,40
$Co^{2+} + 2e^-$	⇌	Co	– 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	– 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	– 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	– 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	– 0,06
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+ 1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

Increasing oxidising ability / Toenemende oksiderende vermoë ↓

Increasing reducing ability / Toenemende reduserende vermoë ↑

END