ALEXANDER ROAD HIGH SCHOOL

June 2022	**PHYSICAL SCIENCES JUNE PAPER 2**	3 HOURS
CO, JA, MH	**GRADE 12**	TOTAL = 150

Instructions:

- The question paper consists of 8 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two at least (2) decimal places where necessary.
- A periodic table has been provided on the back of the answer sheet.
- A formula sheet and Table 4A and 4B of Standard Reduction Potentials have been provided at the end of the question paper.

SECTION A

(answer on the answer sheet)

QUESTION 1:

Four possible options are provided as answers to the following questions. Each question has only one correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.10) on the answer sheet.

1.1 Which ONE of the following factors has NO EFFECT on the rate of a reaction?

A. Temperature of reaction vessel

B. Concentration of reactants

C. Volume of solution

D. State of division of reactants

1.2 The equilibrium constant for a particular reaction is 5×10^{-6}. At equilibrium…

A. there are relatively more products than reactants.

B. there are relatively more reactants than products.

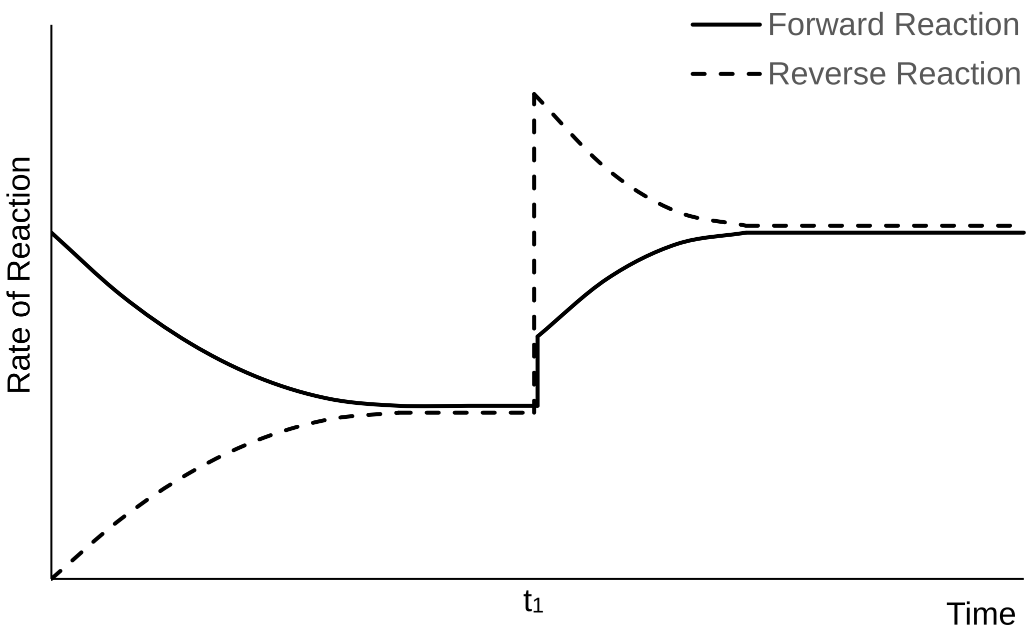
C. there are equal amounts of reactants and products.

D. the reverse reaction is happening at a faster rate than the forward reaction.

1.3 Iodine molecules are placed inside a closed container. The following equilibrium is established at 25°C

$$I_2\,(g) \rightleftarrows 2\,I^-\,(g)$$

At t_1, the pressure is changed. The reaction rate vs. time graph is shown below.



Which ONE of the following is correct regarding the pressure change made at t_1?

	Reaction That Is Favoured	Change in Pressure
A.	Forward	Increase
B.	Forward	Decrease
C.	Reverse	Decrease
D.	Reverse	Increase

1.4 Which one of the following factors that affect the chemical equilibrium of a closed system when changed will also cause the value of the equilibrium constant to change?

A. Concentration of reactants

B. Concentration of products

C. Pressure

D. Temperature

1.5 The following acid-base reactions occur spontaneously at the same temperature. All the solutions have the same concentration.

$$HPO_4^{2-}(aq) + CO_3^{2-}(aq) \rightarrow PO_4^{3-}(aq) + HCO_3^{-}(aq)$$

$$HPO_4^{2-}(aq) + HSO_4^{2-}(aq) \rightarrow H_2PO_4^{-}(aq) + SO_4^{2-}(aq)$$

The dissociation constants (K_b values) are as follows:

K_1 for HPO_4^{2-} ; K_2 for CO_3^{2-} ; K_3 for HSO_4^{-}

Which ONE of the following CORRECTLY shows the order of increasing K_b values?

A. $K_1 < K_2 < K_3$

B. $K_3 < K_2 < K_1$

C. $K_2 < K_1 < K_3$

D. $K_3 < K_1 < K_2$

1.6 Consider the chemical equation below:

$$OH^{-}(aq) + HCO_3^{-}(aq) \rightleftarrows CO_3^{2-}(aq) + H_2O(\ell)$$

The Lowry-Brønsted acids in the above reaction are…

A. HCO_3^{-} and OH^{-}

B. H_2O and HCO_3^{-}

C. H_2O and OH^{-}

D. OH^{-} and CO_3^{2-}

1.7 Which ONE of the following half reactions occurs at the anode during the electrolysis of an aqueous AgCℓ solution?

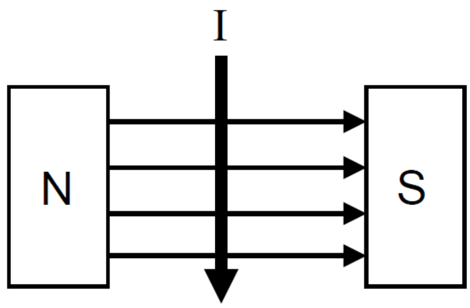
A. $C\ell_2 + 2e^- \rightarrow 2C\ell^-$

B. $Ag^+ + e^- \rightarrow Ag$

C. $2C\ell^- \rightarrow C\ell_2 + 2e^-$

D. $Ag \rightarrow Ag^+ + e^-$

1.8 In the sketch below, a conductor carrying conventional current, I, is placed in a magnetic field.



Which ONE of the following best describes the direction of the magnetic force experienced by the conductor?

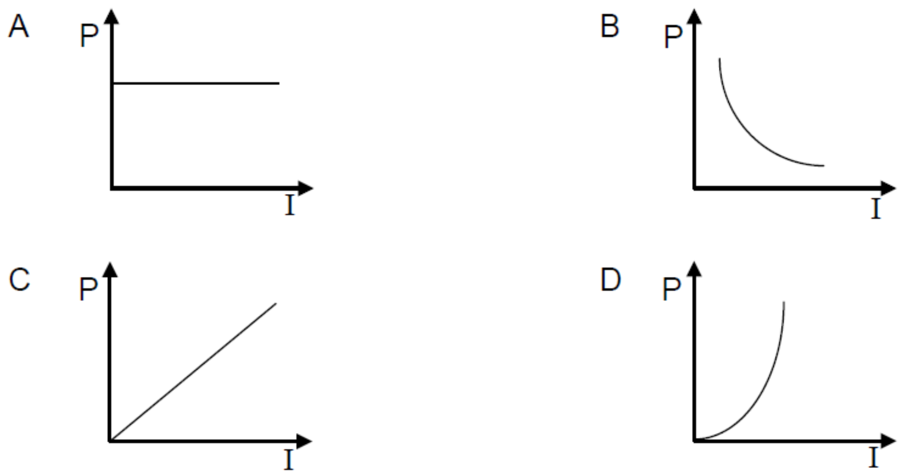
A. Parallel to the direction of the magnetic field

B. Opposite to the direction of the magnetic field

C. Into the page perpendicular to the direction of the magnetic field

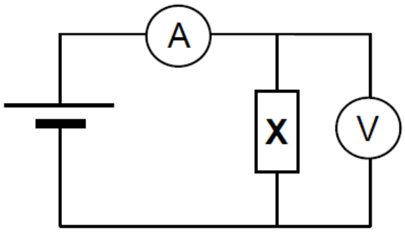
D. Out of the page perpendicular to the direction of the magnetic field

1.9 Which ONE of the following graphs best represents the relationship between the electrical power and the current in an ohmic conductor?

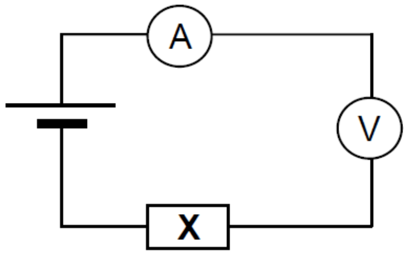


1.10 Which ONE of the circuits below can be used to measure the current in a conductor **X** and the potential difference across its ends?

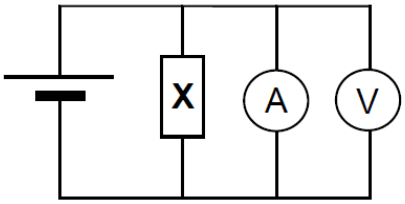
A



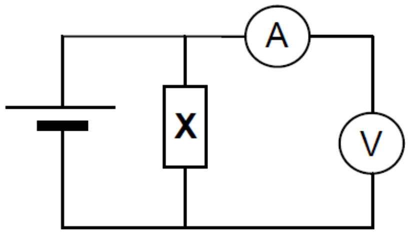
B



C



D



TOTAL SECTION A = [20]

<u>SECTION B</u>

(answer on folio paper)

<u>QUESTION 2:</u>

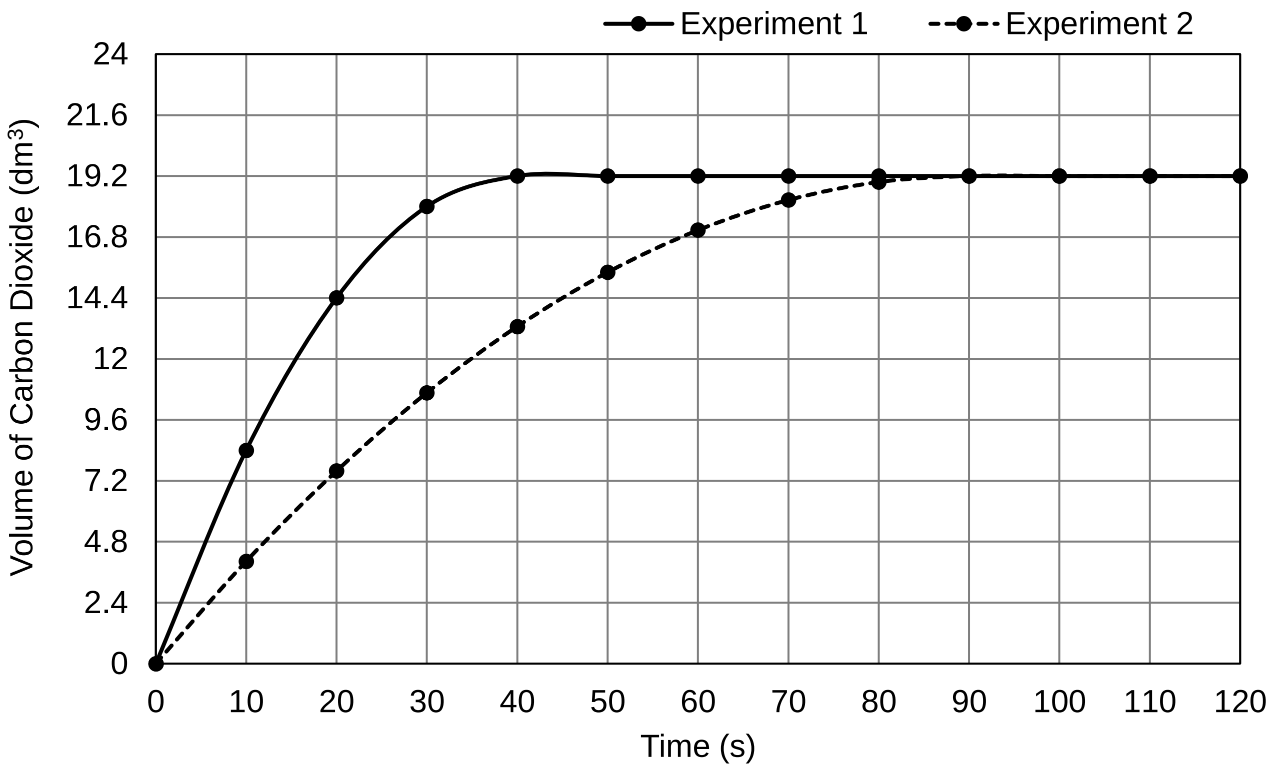
The reaction between washing soda (Na_2CO_3) and hydrochloric acid (HCℓ) is studied to determine the factors that affect the rate of reaction. The balanced chemical equation is given below:

$$Na_2CO_3\,(s) + 2\,HC\ell\,(aq) \rightarrow 2\,NaC\ell + H_2O\,(\ell) + CO_2\,(g)$$

The reaction is repeated a number of times with the following reaction conditions:

Experiment	**1**	**2**	**3**	**4**
Mass of Na_2CO_3 (g)	102,82	102,82	102,82	102,82
State of division of Na_2CO_3	Granules	Granules	Granules	Powder
Concentration of HCℓ ($mol.dm^{-3}$)	0,75	0,75	1,25	1,25
Volume of solution (dm^3)	1,6	1,6	1,6	1,6
Temperature	35°C	25°C	25°C	25°C

The volume of CO_2 produced was measured every 10 seconds for experiment 1 and 2 respectively. The results are shown on the volume vs. time graph below.



2.1 Define *reaction rate* in terms of the quantities shown on the graph. (2)

2.2 Experiment 1 and 2 are compared.

2.2.1 Write down the independent variable. (1)

2.2.2 In which experiment did the reaction occur faster? Write only **1** or **2**.
Explain your answer using collision theory. (3)

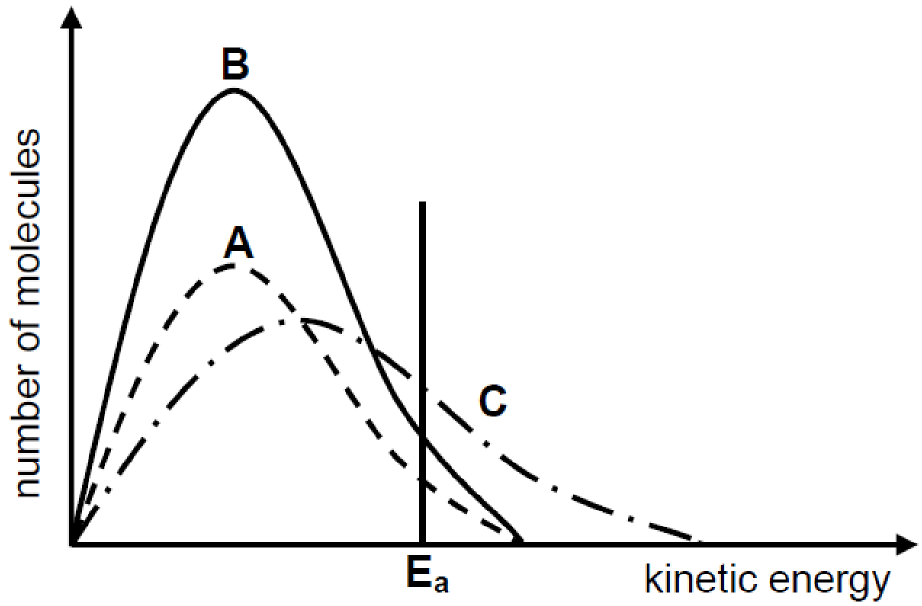
2.2 Use your graph to determine:

2.3.1 The time the reaction takes to reach completion in experiment 1. (1)

2.3.2 The average reaction rate in experiment 2. (2)

2.4 Calculate the volume of carbon dioxide produced in experiment 3 if the molar volume of a gas at 25°C is 24 $dm^3.mol^{-1}$. (5)

2.5 The Maxwell-Boltzmann distribution curves for each experiment are given below.



2.5.1 There are four experiments but only three curves. Which curve represents two different experiments? (1)

2.5.2 Which curve represents experiment 2? **Give a reason for your answer**. (3)

[18]

QUESTION 3:

When cobalt chloride is dissolved in water the following reversible reaction takes place:

$$[CoC\ell_4]_2^{-} (aq) \quad + \quad 6\ H_2O\ (\ell) \quad \rightleftarrows \quad [Co(H_2O)_6]^{2+} (aq) \quad + \quad 4\ C\ell^{-} (aq)$$

dark blue light pink

The cobalt chloride ion, $[CoC\ell_4]_2^{-}$, has a dark blue colour whereas the cobalt hexahydrate ion, $[Co(H_2O)_6]^{2+}$, has a light pink colour.
The system reaches equilibrium with the solution a light pink colour.

3.1 Define the term *chemical equilibrium*. (2)

3.2 Does the equilibrium lie TO THE LEFT or TO THE RIGHT? (1)

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

3.4 Write an expression for calculating the equilibrium constant K_c for the reaction. (1)

3.5 Which reaction will be favoured by the following changes?
Write only FORWARD or REVERSE or NEITHER.

3.5.1 $[CoC\ell_4]_2^{-}$ is removed. (1)

3.5.2 Water is added. (1)

3.5.3 Table salt is added. (1)

3.6 Use Le Chatelier's principle to explain your answer to question 3.5.3. (1)

3.7 The temperature of the system is decreased resulting in the solution turning a dark blue colour. Is the forward reaction EXOTHERMIC or ENDOTHERMIC? Use Le Chatelier's principle to explain your answer. (3)

3.8 A chemical engineer mixes 0,6 mol nitrogen gas with hydrogen gas in a closed 2 dm^3 container at **T**°C. The nitrogen and hydrogen react to form ammonia (NH_3) according to the balanced chemical equation:

$$N_2\ (g) \quad + \quad 3\ H_2\ (g) \quad \rightleftarrows \quad 2\ NH_3\ (g)$$

At equilibrium, there are 4,42 g NH_3. Determine the INITIAL mass of hydrogen in the container if the equilibrium constant is 3,864 at **T**°C. (9)

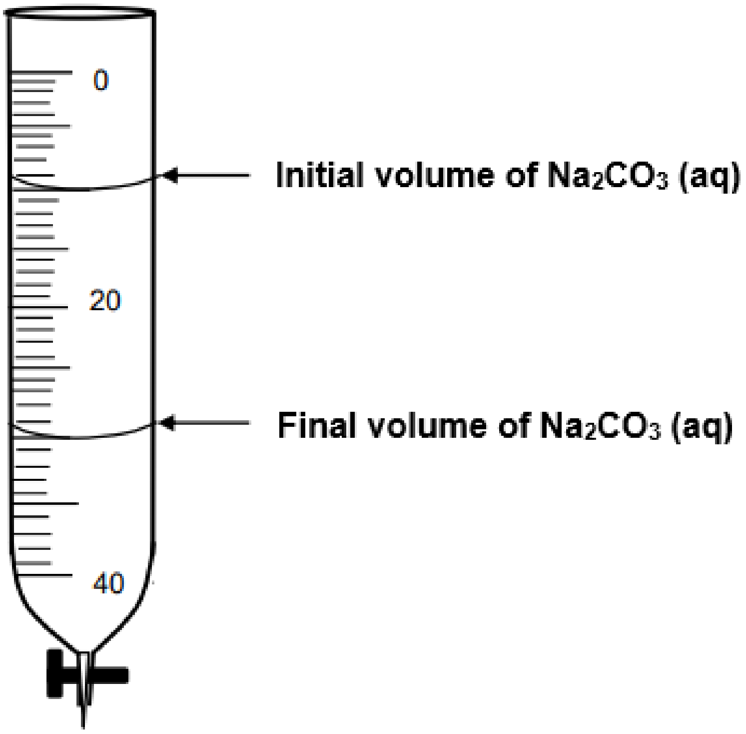
[22]

QUESTION 4:

In a titration exactly 40 cm^3 of sulphuric acid (H_2SO_4) of unknown concentration is neutralised by a sodium carbonate solution (Na_2CO_3) of concentration 1 $mol.dm^{-3}$.
The reaction is represented by the balanced reaction below:

$$H_2SO_4\ (aq) + Na_2CO_3\ (aq) \longrightarrow Na_2SO_4\ (aq) + H_2O\ (\ell) + CO_2\ (g)$$

The sodium carbonate is placed in a burette and the measurements of the initial and final volume used during the titration is given in the diagram below.



4.1 Calculate the volume of sodium carbonate used in the calculation. (1)

4.2 Calculate the pH of the original sample of sulphuric acid used in the titration. (8)

4.3 Is the solution at the endpoint ACIDIC, ALKALINE or NEUTRAL? (1)

4.4 Suggest a suitable indicator for the titration. (1)

4.5 Give the *colour change* that will happen during the titration. (1)

4.6 Is the diluted sulphuric acid used in the titration a STRONG or a WEAK acid? (1)

4.7 Give a reason for your answer in question 4.6. (1)

4.8 Vinegar is a solution of ethanoic acid, CH_3COOH. A certain manufacturer claims that their product contains a minimum of 5,8 g of ethanoic acid per 100 ml of vinegar solution. To test this claim, learners take a 10 cm^3 sample of the vinegar and add water to make a 100 cm^3 dilute vinegar solution. They then neutralise 20 cm^3 of the dilute vinegar solution with 18 cm^3 of sodium hydroxide solution of concentration 0,1 $mol.dm^{-3}$.

The balanced equation for the reaction is:

$$CH_3COOH\ (aq) + NaOH\ (aq) \longrightarrow CH_3COONa\ (aq) + H_2O\ (\ell)$$

4.8.1 Calculate the concentration of the vinegar sold by the manufacturer. (8)

4.8.2 Determine by calculation whether the manufacturer's claim is TRUE or NOT. (4)

[26]

QUESTION 5:

5.1 Define *oxidation* in terms of oxidation numbers. (2)

5.2 An experiment is conducted to confirm the relative positions of metals on Table 4A and 4B. Three test tubes are filled with a copper(II)sulphate solution. Each of the metals below are placed into the solution in separate test tubes. For **each metal** state whether the metal is REDUCED or OXIDISED or has NO REACTION. If a reaction takes place, give the half reaction that will demonstrate the change in the **metal**.

5.2.1 Copper(II) (2)

5.2.2 Manganese (2)

5.3. The reaction between most metals and an acid produces a salt and hydrogen gas. Copper, when reacting with nitric acid, is an exception producing another gas. Identify the gas by only writing down the half reaction for the formation of the gas. (2)

5.4.1 NAME one of the products of the chloro-alkali industry that is very explosive. (1)

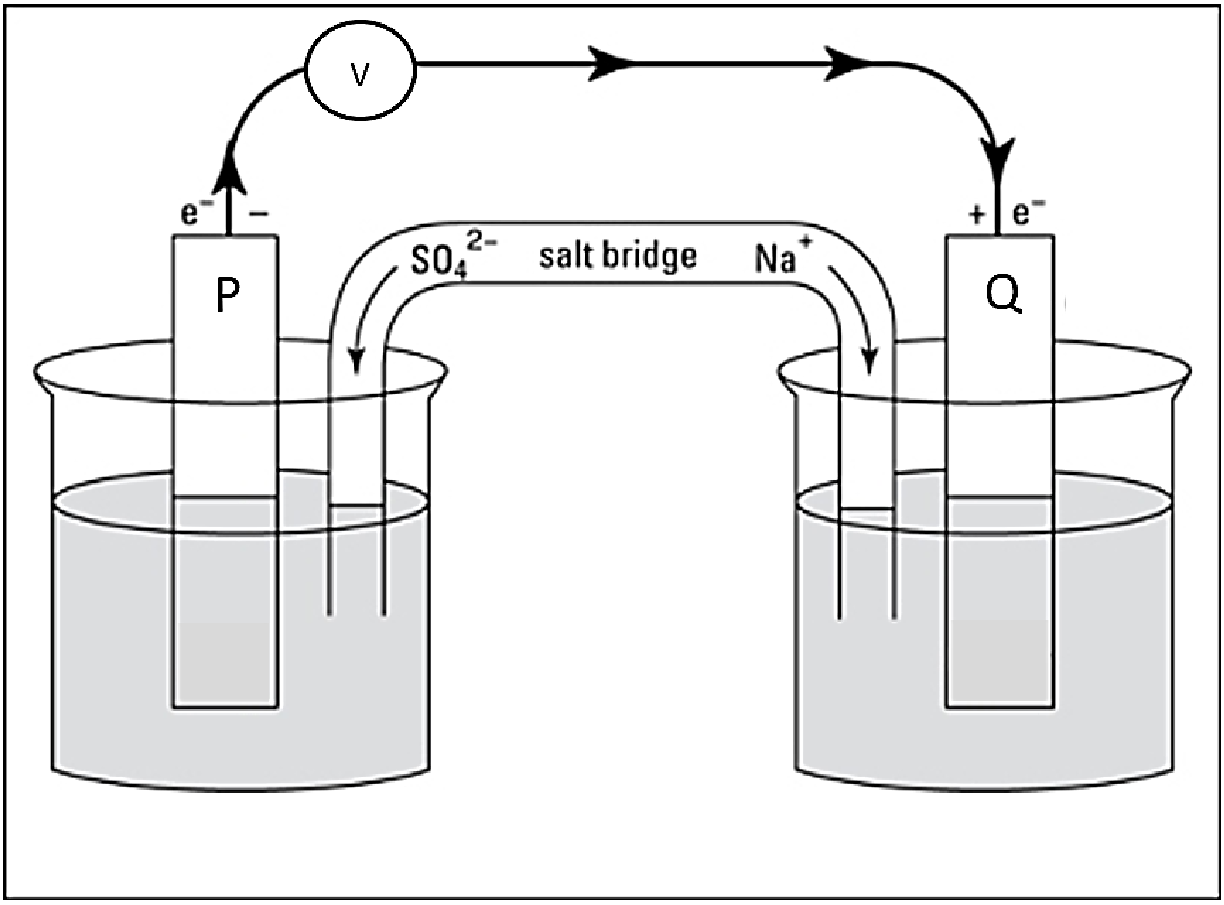
5.4.2 Give the reduction half-reaction of the industry. (2)

5.4.3 Explain one negative effect that this industry has on the environment. (2)

[13]

QUESTION 6:

An incomplete electrochemical cell is shown below with electrodes P and Q. The electron current direction and some ionic movement is indicated.



6.1	Identify the type of cell.	(1)
6.2	The salt bridge is incomplete. What is needed to complete it? **Motivate your answer**.	(2)
6.3	Give one function of the salt bridge.	(1)
6.4	You are given nickel and magnesium to use as electrodes.	
6.4.1	Which one of the metals will be used as electrode P?	(1)
6.4.2	Give the oxidation half reaction.	(1)
6.4.3	What will be a suitable solution to use in the beaker with electrode P?	(1)
6.4.4	Calculate the emf of the cell.	(3)

6.5 Electrode Q is now replaced with a hydrogen gas electrode and electrode P is replaced with a zinc electrode.

6.5.1 Give the cell notation for the cell. (3)

6.5.2 When this cell is in operation, what will happen to the pH of the solution around electrode Q? Only write INCREASE, DECREASE or REMAINS THE SAME. (1)

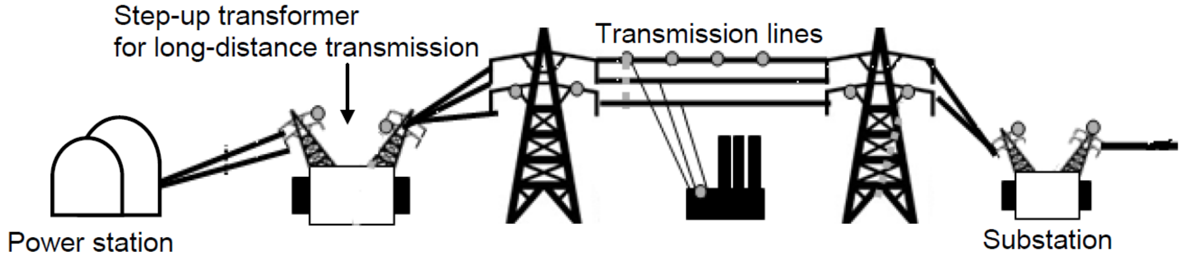
6.5.3 Give a reason for your answer in 6.5.2 by referring to the relative reducing abilities of the substances involved. (3)

6.5.4 Is electrode Q the cathode or anode? (1)

[18]

QUESTION 7:

7.1 The diagram below illustrates how electricity generated at a power station is transmitted to a substation.



7.1.1 Does the power station use an AC or a DC generator? (1)

7.1.2 Sketch a labelled graph of the potential difference generated at the power station versus time. (2)

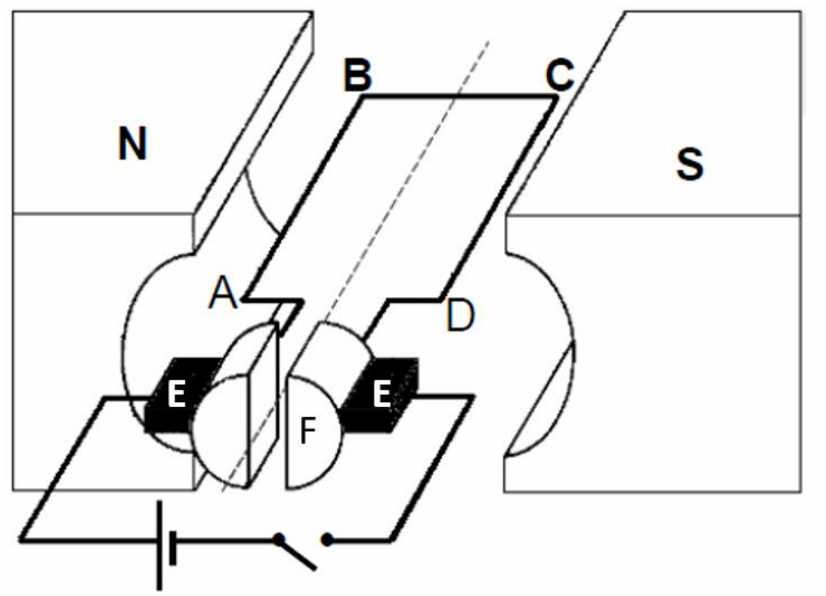
7.1.3 The average power produced at the power station is 4,45 x 10^9 W. Calculate the rms current in the transmission lines if the power is transmitted at a maximum voltage of 30 000 V. (4)

7.2 Diesel-electric trains make use of electric motors as well as generators. The table below compares a motor and a generator in terms of the type of energy conversion and the underlying principle on which each operates. Complete the table by writing down only the question number (7.2.1–7.2.3) and next to each number the answer.

	TYPE OF ENERGY CONVERSION	**PRINCIPLE OF OPERATION**
Motor	7.2.1	7.2.2
Generator		7.2.3

(3)

7.3 The simplified diagram below represents an electrodynamic device.



7.3.1 Is this a motor or a generator? (1)

7.3.2 What is the function of the parts labelled E? (1)

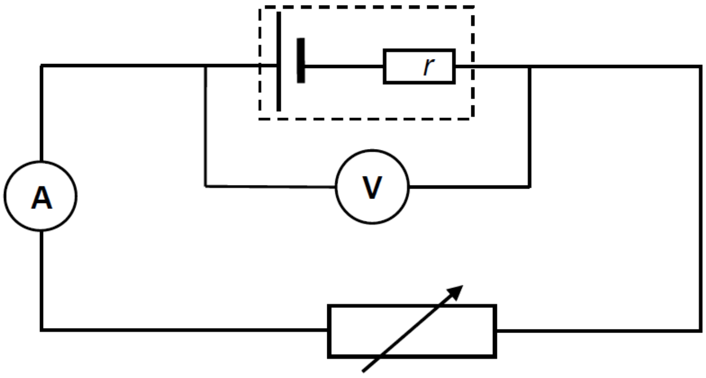
7.3.3 When the switch is closed, current flows in the circuit.
Will part ABCD turn CLOCKWISE or ANTI-CLOCKWISE? (1)

7.3.4 Describe one change that can be made to this device in order to make it more effective. (1)

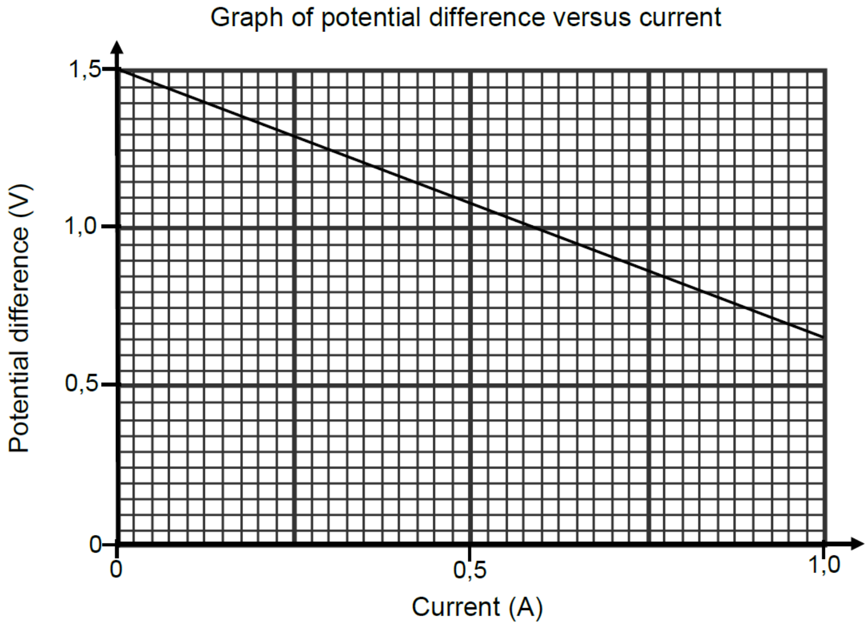
[14]

QUESTION 8:

8.1 Learners conduct an investigation to determine the emf and internal resistance (r) of a battery. They set up a circuit as shown in the diagram below and measure the potential difference using the voltmeter for different currents in the circuit.



The results obtained are shown in the graph below.



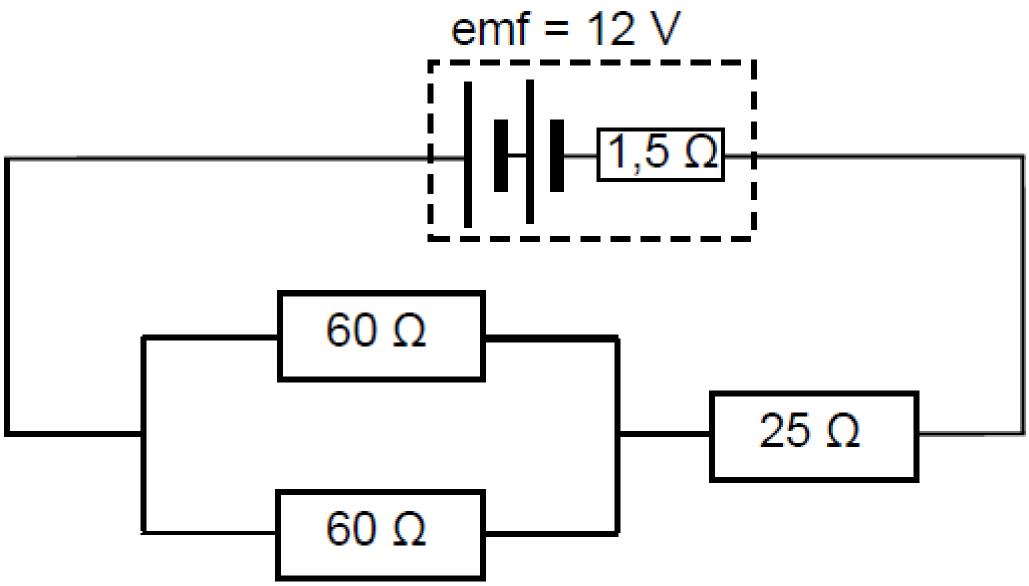
8.1.1 Calculate the gradient of the graph. (3)

8.1.2 Name the physical quantity represented by the gradient and give its unit of measurement. (2)

8.1.3 Use the graph to determine the emf of the battery. (1)

8.1.4 How does the voltmeter reading change as the ammeter reading increases? Write down INCREASES, DECREASES or REMAINS THE SAME.
(Use the formula emf = IR + Ir to explain the answer.) (3)

8.2 In the circuit represented below, the two 60 Ω resistors connected in parallel are connected in series with a 25 Ω resistor. The battery has an emf of 12 V and an internal resistance of 1,5 Ω.



Calculate the:

8.2.1 Equivalent external resistance of the circuit. (3)

8.2.2 Total current in the circuit. (4)

8.2.3 Potential difference across the parallel resistors. (3)

[19]

TOTAL SECTION B = [130]

Formula Sheet

Physical Constants:

Name	Symbol	Value
Charge on electron	e	$-1,6 \times 10^{-19}$ C
Electron mass	m_e	$9,11 \times 10^{-31}$ kg
Avogadro's constant	N_A	$6,02 \times 10^{23}$ mol^{-1}
Standard pressure	p^{θ}	$1,013 \times 10^{5}$ Pa
Molar gas volume at STP	V_m	22,4 dm^{3}.mol^{-1}
Standard temperature	T^{θ}	273 K

Formulae:

ELECTRIC CIRCUITS

$R = \frac{V}{I}$	$Q = I\Delta t$
$V = \frac{W}{q}$	$\text{emf}\ (\varepsilon) = I(R + r)$
$R_s = R_1 + R_2 + \cdots$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$ or $R_p = \frac{R_1 \times R_2}{R_1 + R_2}$
$W = Vq$ $W = VI\Delta t$ $W = I^2 R\Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ $P_{ave} = I_{rms}^2 R$ $P_{ave} = \frac{V_{rms}^2}{R}$

CHEMISTRY

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or $c = \frac{m}{MV}$
$p_1V_1 = p_2V_2$	$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$
$pH = -\log[H_3O^+]$	$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at 298 K
$E_{cell}^{\theta} = E_{cathode}^{\theta} - E_{anode}^{\theta}$ or $E_{cell}^{\theta} = E_{reduction}^{\theta} - E_{oxidation}^{\theta}$ or $E_{cell}^{\theta} = E_{oxidising\ agent}^{\theta} - E_{reducing\ agent}^{\theta}$	

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			E^θ (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
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 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 reducing ability/*Toenemende reduserende vermoë* ↓

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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↓)

Increasing reducing ability/*Toenemende reduserende vermoë* (↑)