CAPE WINELANDS EDUCATION DISTRICT

CAPS

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

SEPTEMBER 2015

MARKS 150

TIME 3 hours

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

INSTRUCTIONS AND INFORMATION.

1. Write your name on the top of your ANSWER PAGE.

2. Answer ALL the questions on your ANSWER PAGE.

3. You may use a non-programmable calculator.

4. You may use appropriate mathematical instruments.

5. Number the answers correctly according to the numbering system used in this question paper.

6. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.

7. Give brief motivations, discussions, et cetera where required.

8. Round off your final numerical answers to a minimum of TWO decimal places.

QUESTION 1 [START ON A NEW PAGE]

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) on your ANSWER PAGE.

1.1 Which ONE of the following compounds belong to the same homologous series as propanoic acid?

A $CH_3CH_2CH_2COOH$

B $CH_3CH_2CH_2OH$

C CH_3COOCH_3

D CH_3CH_2CHO (2)

1.2 Which ONE of the following liquids will have the highest melting point?

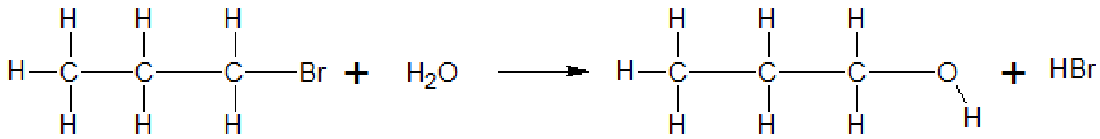
A ethanol

B propan-1-ol

C butan-1-ol

D pentan-1-ol (2)

1.3 Consider the reaction represented by the equation below:



This reaction is an example of:

A hydrogenation

B halogenation

C hydrolysis

D hydration (2)

1.4 Consider the reaction represented by the balanced equation below:

$$2SO_3(g) \rightarrow 2SO_2(g) + O_2(g) \qquad \Delta H = 198\ kJ \bullet mol^{-1}$$

Which ONE of the following is TRUE for this reaction?

When 2 moles of $SO_2(g)$ are formed ...

A 198 kJ of energy is absorbed.

B 198 kJ of energy is released.

C 396 kJ of energy is absorbed.

D 396 kJ of energy is released. (2)

1.5 The K_c value for a certain reaction is 0,0023. This small K_c value indicates that...

A equilibrium should be achieved at a slow rate.

B at equilibrium there will be a large yield of products.

C at equilibrium the rate of the forward reaction will be smaller than the rate of the reverse reaction.

D the concentration of the reactants at equilibrium is greater than the concentration of products. (2)

1.6 The following reaction has reached equilibrium in a closed container at a temperature of 359 K:

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) + energy$$

Which ONE of the following will increase the equilibrium concentration of NH_3?

A Add a catalyst.

B Remove NO(g) from the container.

C Increase the volume of the container.

D The temperature is increased to 400 K . (2)

1.7 In the titration of ethanoic acid (CH_3COOH) and sodium hydroxide (NaOH) the pH at the end point is 8,72. The most suitable indicator for this titration will be...

A methyl orange.

B phenolphthalein.

C bromothymol blue.

D universal indicator. (2)

1.8 Which one of the following is a conjugate acid-base pair in the following reaction?

$$CH_3COOH + NH_3 \rightarrow CH_3COO^- + NH_4^+$$

	Acid	Conjugate base
A	NH_3	NH_4^+
B	CH_3COO^-	NH_4^+
C	CH_3COOH	NH_3
D	CH_3COOH	CH_3COO^-

(2)

1.9 Which ONE of the following is an example of a galvanic cell?

A The cell that is used in a torch.

B The cell in which electroplating occurs.

C The cell in which copper is refined.

D The cell in which chlorine is prepared from brine (saltwater).

(2)

1.10 Which ONE of the following is a primary nutrient in plants?

A C

B H

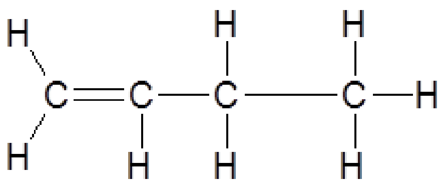
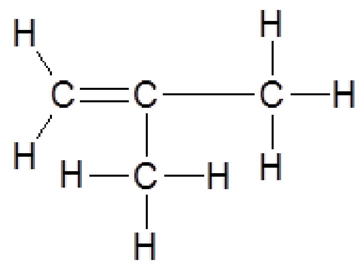
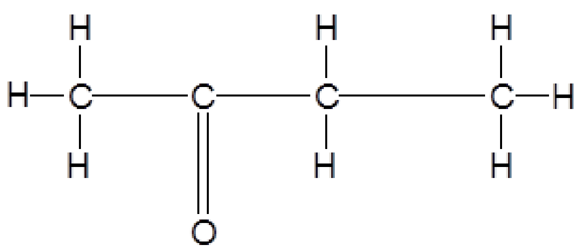
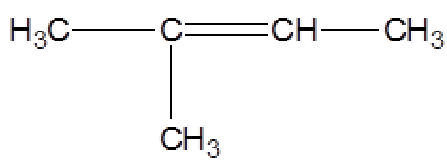
C O

D N (2)

[20]

QUESTION 2 [START ON A NEW PAGE]

Consider the organic compounds represented by the letters **A** to **G** in the table below:

A 	**B** 	
C But-2-ene	**D** $CH_3CH_2CH_2COOH$	**E** Methyl propanoate
F 	**G** 	

2.1 Define the term **hydrocarbon.** (2)

2.2 Write down the LETTER that represents...

2.2.1 a chain isomer of compound **A.** (1)

2.2.2 a positional isomer of compound **A**. (1)

2.2.3 a functional isomer of compound **D.** (1)

2.3 Define the term **structural isomer**. (2)

2.4 Write down the IUPAC name of compound **B.** (2)

2.5 Write down the molecular formula of compound **C.** (1)

2.6 Write down the structural formula of compound **E**. (2)

2.7 Write down the structural formula for the functional group of compound **C**. (1)

2.8 Write down the IUPAC name of the compound that contains a carboxyl group. (1)

2.9 Is compound **A** SATURATED or UNSATURATED? Give a reason for your answer. (2)

2.10 Write down the name of the homologous series to which compound **B** belongs. (1)

[17]

QUESTION 3 [START ON A NEW PAGE]

A learner conducts a scientific investigation to compare the boiling points of organic compounds belonging to different homologous series. Propan-1-ol, ethanoic acid and propanal are used for the investigation. His results are shown in the table below.

Compound	**Boiling Point (^{o}C)**
Compound A	48
Compound B	97
Compound C	118

3.1 For this investigation, name the …

3.1.1 independent variable. (1)

3.1.2 dependent variable. (1)

3.2 Will the vapour pressure of propanal be LOWER or HIGHER than the vapour pressure of propan-1-ol? Explain your answer by referring to the type of INTERMOLECULAR FORCES present and ENERGY. (4)

3.3 Identify:

3.3.1 Compound A (1)

3.3.2 Compound B (1)

3.3.3 Compound C (1)

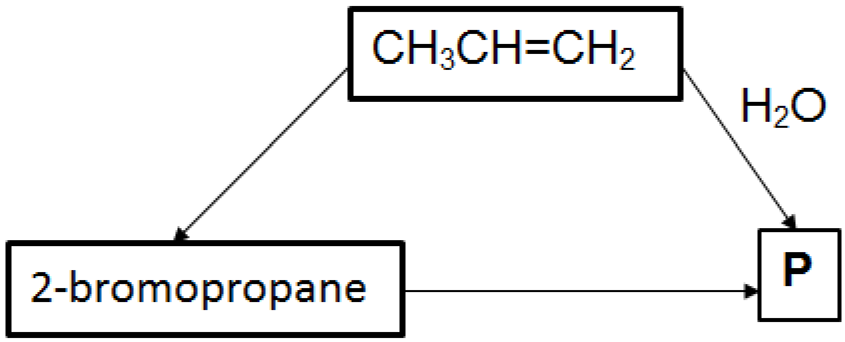
3.4 Will the boiling point of butan-1-ol be HIGHER or LOWER than the boiling point of propan-1-ol? Explain the answer referring to the INTERMOLECULAR FORCES. (2)

[11]

QUESTION 4 [START ON A NEW PAGE]

4.1 The flow diagram below shows the preparation of two organic compounds, using propene as one of the reactants.

4.1.1 Use structural formulae to write down a balanced chemical equation for the reaction between propene and water to produce compound **P.** (4)



4.1.2 Write down the IUPAC name of compound **P**. (1)

4.1.3 Compound **P** can also be obtained from 2-bromopropane.
Write down the:

(a) type of reaction that converts 2-bromopropane to **P**. (1)

(b) conditions under which the conversion can occur. (2)

4.2 A learner is preparing an ester using methanol (molecular formula: CH_4O) and ethanoic acid (molecular formula: $C_2H_4O_2$). The balanced chemical equation for this reaction is given below:

$$CH_4O + C_2H_4O_2 \rightarrow C_3H_6O_2 + H_2O$$

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

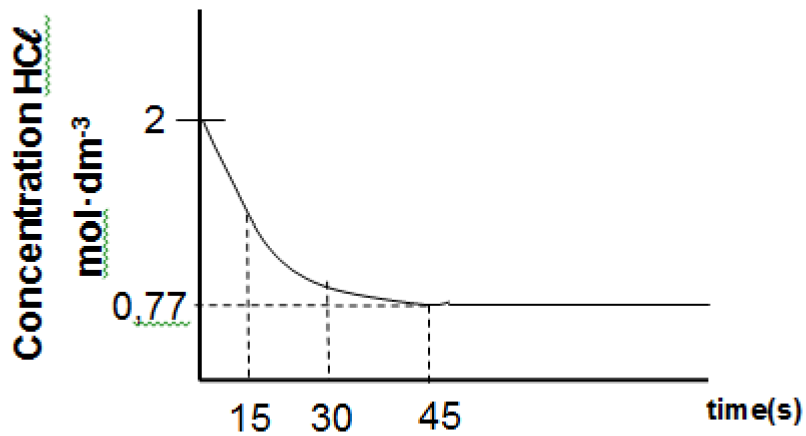
4.2.2 Write down the NAME or FORMULA of the catalyst needed in this reaction. (1)

4.2.3 When 50 g of methanol fully reacts with excess ethanoic acid, it produces 68,88 g $C_3H_6O_2$. Calculate the percentage purity of the methanol. (5)

[15]

QUESTION 5 [START ON A NEW PAGE]

A learners investigates the factors that influence the rate of reaction. He adds 50 g of Zn granules to 500 cm^3 hydrochloric acid ($HC\ell$) with a concentration of 2 $mol.dm^{-3}$. Assume that the zinc is completely covered by the hydrochloric acid. The hydrochloric acid has a temperature of 20 ^oC. The change in the concentration of $HC\ell$ during this reaction is shown in the graph below:



The balanced equation for this reaction is

$$Zn(s) + 2HC\ell(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

5.1 Write down TWO observations for this experiment. (2)

5.2 Define the term **reaction rate**. (2)

5.3 Calculate the average reaction rate for this reaction over 45 s. (4)

5.4 How does the initial rate of the reaction change if each of the following changes are made: Write only INCREASE, DECREASE or STAY THE SAME.

5.4.1 Increase the temperature of the hydrochloric acid to 30 ^oC. (1)

5.4.2 Use 600 cm^3 of the 2 $mol \cdot dm^{-3}$ hydrochloric solution instead of 500 cm^3. (1)

5.4.3 Add copper sulfate as a catalyst. (1)

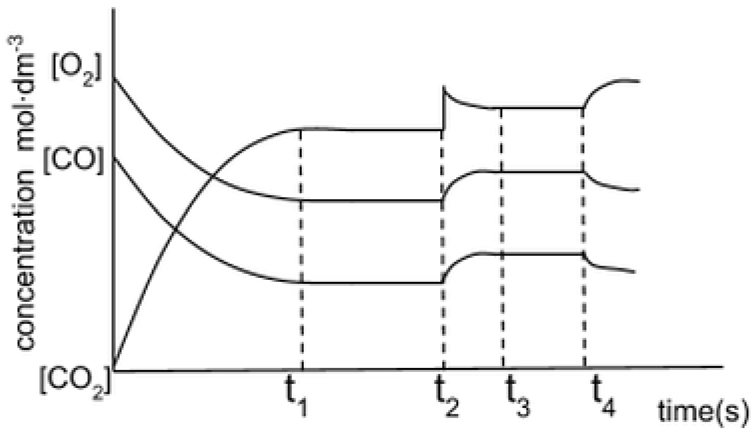
[11]

QUESTION 6 [START ON A NEW PAGE]

Carbon monoxide gas (CO) and oxygen gas (O_2) are placed in a closed container. They are allowed react to form carbon dioxide (CO_2). The balanced equation for this reaction is:

$$2CO(g) + O_2(g) \leftrightharpoons 2CO_2(g)$$

The graph below shows concentration changes of reactants and products for this reaction over time. Use this information to answer the following questions:



.

6.1 Explain the term **chemical equilibrium**. (2)

6.2 At which times interval(s) is/(are) the reaction at equilibrium? (2)

6.3 Does the FORWARD or the REVERSE reaction have the faster reaction rate during the interval t_2 to t_3 ? (1)

6.4 The temperature is decreased at t_4. Is the reaction EXOTHERMIC or ENDOTHERMIC? (1)

6.5 Explain the answer to QUESTION 6.4 (3)

6.6 What change is made to at t_2? (1)

6.7 How will the change made at t_2 influence the value of K_c for this reaction? Write only INCREASE, DECREASE or REMAIN THE SAME. (1)

6.8 Initially 63 g of CO and 9,11 g of O_2 is placed in a 2 dm^3 container. At equilibrium the concentration of CO_2 is 0,15 mol•dm^{-3}. Calculate the value of K_c for this reaction. (10)

[21]

QUESTION 7 [START ON A NEW PAGE]

7.1 In an acid-base titration 50,0 cm^3 of a 0,20 $mol \cdot dm^{-3}$ sodium hydroxide (NaOH) solution was placed in a conical flask and a few drops of indicator was added. The burette was filled with sulfuric acid (H_2SO_4) of unknown concentration. The experiment was repeated three times and the following results were obtained:

Experiment	**Volume of H_2SO_4 (cm^3)**
1	20,2
2	19,8
3	20,0

The balanced equation for the reaction is:

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(\ell)$$

7.1.1 Define the term **endpoint** of a titration. (2)

7.1.2 Sulfuric acid is a diprotic acid. Explain the term **diprotic acid**. (1)

7.1.3 Explain why sulfuric acid is a strong acid. (2)

7.1.4 Calculate the average volume of sulfuric acid used for the titration. (1)

7.1.5 Calculate the concentration of the sulfuric acid solution. (5)

7.2 The balanced chemical equation for the self-ionisation of water is:

$$2H_2O(\ell) \rightarrow H_3O^+(aq) + OH^-(aq) \qquad \Delta H > 0$$

At 25 °C the dissociation constant, $K_{c,}$ (also known as Kw) for this reaction is 10^{-14} and the pH = 7.

7.2.1 Explain why water is classified as an **ampholyte**. (2)

7.2.2 Write down the concentration of the hydroxide ions (OH^-) at 25 °C. (1)

7.2.3 Write down an equation for the dissociation constant (K_w) for the above reaction. (2)

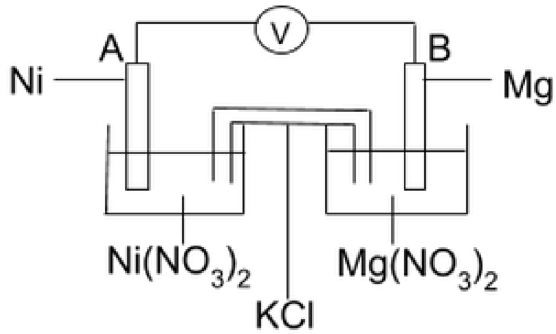
7.3 If water is heated to a temperature of 75 °C, the value of K_w changes to $10^{-12,7}$.

7.3.1 What effect will this change in temperature have on the pH of the water? Write down INCREASE ABOVE 7, DECREASE BELOW 7 or REMAIN 7. (1)

7.3.2 Explain your answer in QUESTION 7.3.1 using Le Chatelier's Principle. (2)
[19]

QUESTION 8 [START ON A NEW PAGE]

8.1 In the cell below a nickel electrode is connected to a magnesium electrode. The cell is set up under standard conditions. Both electrodes are placed in electrolytes, connected with a salt bridge.



8.1.1 Write down the energy conversion that occurs in this cell. (2)

8.1.2 Define the term **electrolyte**. (2)

8.1.3 Which electrode, **A** or **B**, is the anode? (1)

8.1.4 Write down the reduction half-reaction that occurs in this cell. (2)

8.1.5 Calculate the reading on the voltmeter for this cell. (4)

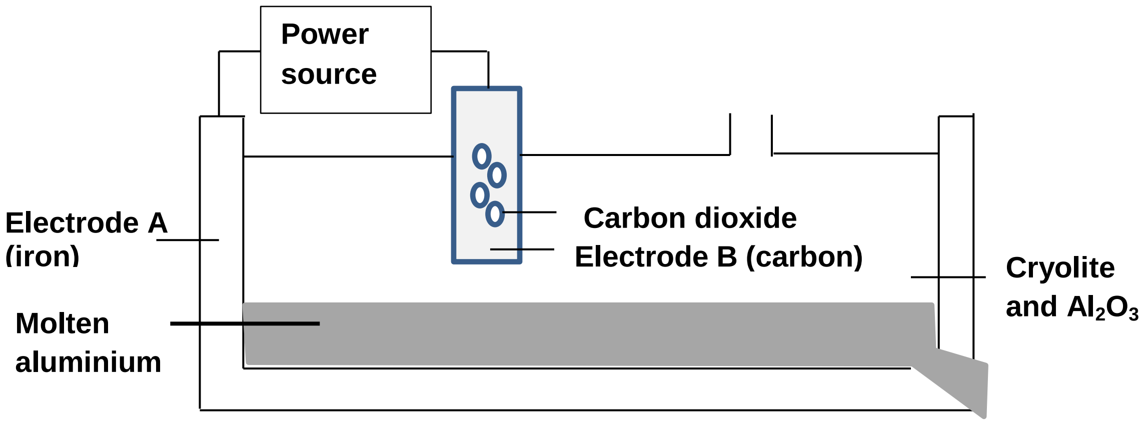
The voltmeter is now replaced with an ammeter.

8.1.6 In which direction do the electrons flow in the external circuit? Write down ONLY from **A to B** or from **B to A**? (1)

8.1.7 Explain the function of the salt bridge in this cell by referring to the movement of electrons and ions. (3)

8.1.8 Write down the cell notation for this cell. (3)

8.2 Bauxite ore is dissolved in molten cryolite and purified to Al_2O_3. From the bauxite, pure molten aluminium is obtained. The cell used for the extraction of aluminium is shown in the sketch below.



The net cell reaction for this cell is given as:

$$2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$$

8.2.1 Write down the reduction half reaction for this cell. (2)

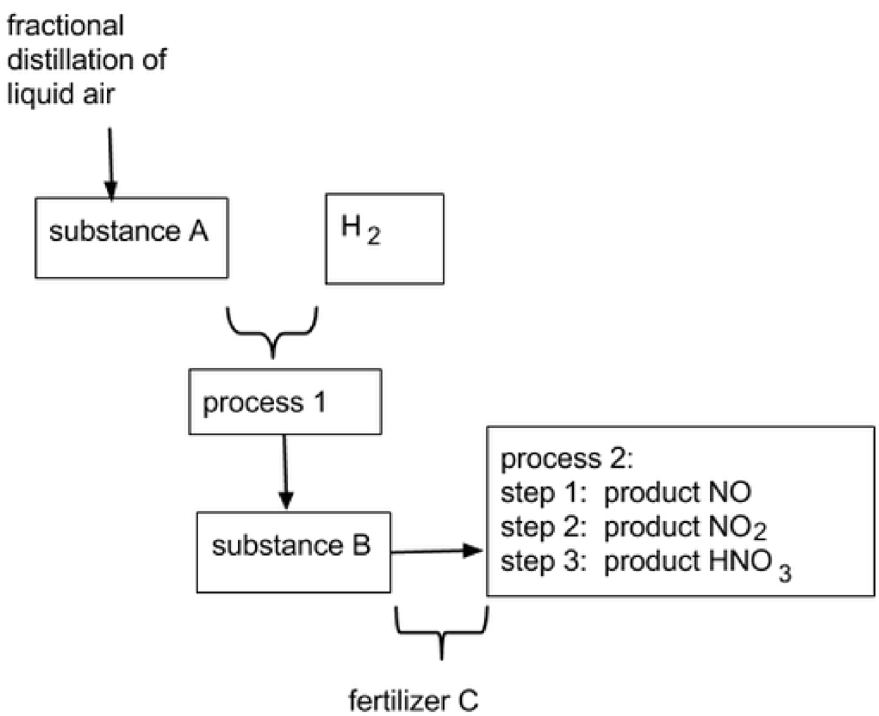
8.2.2 Which one of electrode A or electrode B should be connected to the positive terminal of the power source? (1)

8.2.3 Write down the formula of the oxidising agent in this reaction. (1)

[22]

QUESTION 9 [START ON A NEW PAGE]

9.1 The diagram below illustrates the processes used to manufacture a certain fertiliser. Study the diagram and answer the questions that follow:



9.1 Write down the NAME or FORMULA of substance A that is obtained by the fractional distillation of liquid air. (1)

9.2 Write down the balanced chemical equation for the reaction that occurs in process 1. (3)

9.3 Write down the name of substance B that forms as a result of process 1. (1)

9.4 Write down the balanced equation for the catalytic oxidation of ammonia, which is represented by step 1 of process 2. (3)

9.5 Write down the name of fertiliser C that forms when substance B reacts with HNO_3. (1)

9.6 What process occurs when fertiliser C runs into rivers? (1)

9.7 The NPK ratio for a 1,5 kg bag of fertiliser C is 1:0:0(40). Calculate the mass of nitrogen in the bag of fertiliser. (4)

[14]

TOTAL 150

INFORMATION FOR PHYSICAL SCIENCES GR 12
PAPER 2 (CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^{θ}	$1,013 \times 10^{5}$ Pa
Molar gas volume at STP	V_m	$22,4\ dm^{3} \cdot mol^{-1}$
Standard temperature	T^{θ}	273 K
Charge on electron	e	$-1,6 \times 10^{-19}$ C

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*	29
Electronegativity / *Elektronegatiwiteit*	1,9
Symbol / *Simbool*	Cu
Approximate relative atomic mass / *Benaderde relatiewe atoommassa*	63,5

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 2,1 **H** 1																	2 **He** 4
3 1,0 **Li** 7	4 1,5 **Be** 9											5 2,0 **B** 11	6 2,5 **C** 12	7 3,0 **N** 14	8 3,5 **O** 16	9 4,0 **F** 19	10 **Ne** 20
11 0,9 **Na** 23	12 1,2 **Mg** 24											13 1,5 **Aℓ** 27	14 1,8 **Si** 28	15 2,1 **P** 31	16 2,5 **S** 32	17 3,0 **Cℓ** 35,5	18 **Ar** 40
19 0,8 **K** 39	20 1,0 **Ca** 40	21 1,3 **Sc** 45	22 1,5 **Ti** 48	23 1,6 **V** 51	24 1,6 **Cr** 52	25 1,5 **Mn** 55	26 1,8 **Fe** 56	27 1,8 **Co** 59	28 1,8 **Ni** 59	29 1,9 **Cu** 63,5	30 1,6 **Zn** 65	31 1,6 **Ga** 70	32 1,8 **Ge** 73	33 2,0 **As** 75	34 2,4 **Se** 79	35 2,8 **Br** 80	36 **Kr** 84
37 0,8 **Rb** 86	38 1,0 **Sr** 88	39 1,2 **Y** 89	40 1,4 **Zr** 91	41 **Nb** 92	42 1,8 **Mo** 96	43 1,9 **Tc**	44 2,2 **Ru** 101	45 2,2 **Rh** 103	46 2,2 **Pd** 106	47 1,9 **Ag** 108	48 1,7 **Cd** 112	49 1,7 **In** 115	50 1,8 **Sn** 119	51 1,9 **Sb** 122	52 2,1 **Te** 128	53 2,5 **I** 127	54 **Xe** 131
55 0,7 **Cs** 133	56 0,9 **Ba** 137	57 **La** 139	72 1,6 **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 1,8 **Tℓ** 204	82 1,8 **Pb** 207	83 1,9 **Bi** 209	84 2,0 **Po**	85 2,5 **At**	86 **Rn**
87 0,7 **Fr**	88 0,9 **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** 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**

TABLE 4A: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↑

Half-reactions			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
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 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
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 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/ ↓

TABLE 4B: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↓

Increasing reducing ability ↑

Half-reactions			E^{θ} (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