



Province of the  
**EASTERN CAPE**  
EDUCATION



# **NATIONAL SENIOR CERTIFICATE**

**GRADE 11**

**NOVEMBER 2023**

**PHYSICAL SCIENCES P2  
(CHEMISTRY)**

**MARKS: 150**

**TIME: 3 hours**



\* I P H S C E 2 \*

This question paper consists of 21 pages including  
4 data sheets and an answer sheet.

**INSTRUCTIONS AND INFORMATION**

1. Write your full NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. 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 motivations, discussions, et cetera where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 Consider the definition given below:

The high energy transition state between products and reactants.

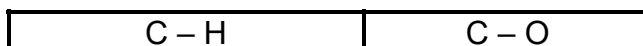
This is the definition of ...

- A a catalyst.
- B heat of reaction.
- C activation energy.
- D activated complex. (2)

1.2 Which ONE of the following ions can act as an ampholyte?

- A  $\text{HCO}_3^-$
- B  $\text{NH}_4^+$
- C  $\text{NO}_3^-$
- D  $\text{H}_3\text{O}^+$  (2)

1.3 Consider the interatomic bonds shown below:



Which ONE of the following combinations regarding the bond length and polarity of the bonds is CORRECT?

	Shortest bond length	Most polar bond
A	$\text{C} - \text{H}$	$\text{C} - \text{O}$
B	$\text{C} - \text{O}$	$\text{C} - \text{H}$
C	$\text{C} - \text{O}$	$\text{C} - \text{O}$
D	$\text{C} - \text{H}$	$\text{C} - \text{H}$

(2)

1.4 The conjugate base of the ion,  $\text{H}_2\text{PO}_4^-$  is ...

A  $\text{PO}_4^{3-}$ .

B  $\text{H}_2\text{O}$ .

C  $\text{HPO}_4^{2-}$ .

D  $\text{H}_3\text{PO}_4$ .

(2)

1.5 The table below shows the melting points of water ( $\text{H}_2\text{O}$ ) and hydrogen bromide ( $\text{HBr}$ ).

Compounds	Melting point (K)
$\text{H}_2\text{O}$	273
$\text{HBr}$	159

Which combination below CORRECTLY lists the strongest intermolecular forces in  $\text{H}_2\text{O}$  and  $\text{HBr}$  that explain the relatively high melting points of these compounds?

	In $\text{H}_2\text{O}$ there are:	In $\text{HBr}$ there are:
A	Hydrogen bonds	London forces
B	Hydrogen bonds	Dipole-dipole forces
C	Dipole-dipole forces	Hydrogen bonds
D	London forces	Hydrogen bonds

(2)

1.6 A pair of electrons that is shared between two atoms in a covalent bond is called ...

A lone pair.

B bond length.

C bonding pair.

D valence electrons.

(2)

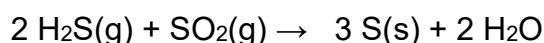
- 1.7 Air in a gas syringe is compressed to half its original volume while the temperature remains constant.

Which ONE of the following combinations are CORRECT regarding the gas pressure and the average speed of the gas particles?

	<b>Pressure</b>	<b>Average speed of gas particles</b>
A	Increases	Decreases
B	Decreases	Increases
C	Increases	Remain constant
D	Decreases	Remain constant

(2)

- 1.8 Consider the following reaction:



Which ONE of the combinations regarding the reducing agent and oxidising agent in this reaction is CORRECT?

	<b>Reducing agent</b>	<b>Oxidising agent</b>
A	H <sub>2</sub> S	SO <sub>2</sub>
B	SO <sub>2</sub>	H <sub>2</sub> S
C	S	H <sub>2</sub> O
D	SO <sub>2</sub>	S

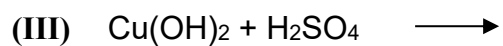
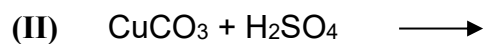
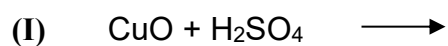
(2)

- 1.9 Which ONE of the following has polar covalent bonds but has only London dispersion forces between its molecules?

- A NH<sub>3</sub>
- B HBr
- C CO<sub>2</sub>
- D H<sub>2</sub>S

(2)

1.10 Consider the following incomplete reactions of sulphuric acid,  $\text{H}_2\text{SO}_4$ :



Which reaction(s) will produce  $\text{CuSO}_4$  and water as the only products of the reaction?

A I only

B II only

C Both I and III

D Both II and III

(2)  
[20]

**QUESTION 2 (Start on a new page.)**

2.1 Consider the following compounds:

NH <sub>3</sub>	H <sub>3</sub> O <sup>+</sup>	BCl <sub>3</sub>	NaCl	HCN
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2.1.1 Define the term *molecule*. (2)

Write down the formula of the compound from the given list that has:

2.1.2 A dative covalent bond (1)

2.1.3 Ionic bonds (1)

2.1.4 Ion-dipole forces when dissolved in water (1)

2.2 Draw the Lewis structure for the following molecules:

2.2.1 NH<sub>3</sub> (2)

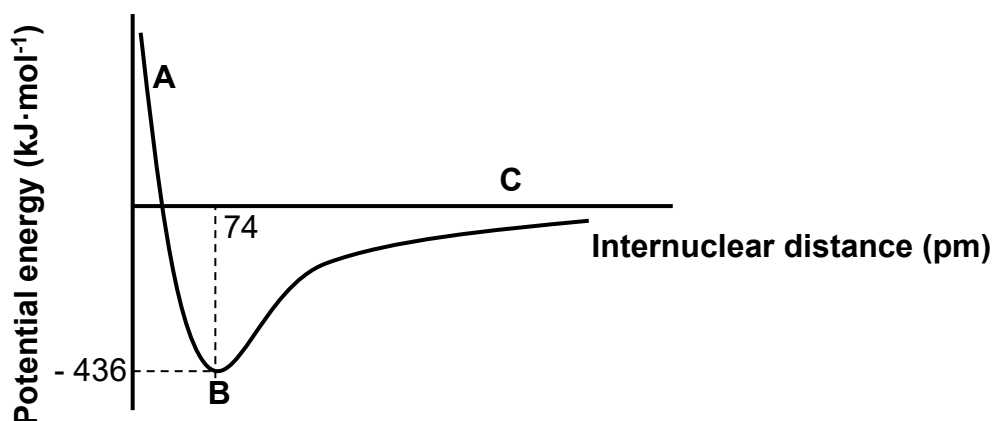
2.2.2 HCN (2)

2.3 How many lone pairs of electrons are in one molecule of NH<sub>3</sub>? (1)

2.4 Is BCl<sub>3</sub> a POLAR or NON-POLAR molecule?

Explain your answer by referring to molecular shape and polarity of the bonds in the molecule. (4)

- 2.5 The graph below shows the relationship between potential energy and the internuclear distance between two hydrogen atoms.



2.5.1 Define the term *bond energy*. (2)

2.5.2 Which point (**A**, **B** or **C**) on the graph represents the point of maximum force of attraction between the nuclei of the two hydrogen atoms? (1)

- 2.6 Consider the following table.

Bond	Bond energy (kJ·mol <sup>-1</sup> )
C – C	346
C = C	610
C ≡ C	835

2.6.1 Which ONE of the bonds shown in the table above will have the shortest bond length? (1)

2.6.2 Give a reason for your answer to QUESTION 2.6.1. (2)

[20]



**QUESTION 3 (Start on a new page.)**

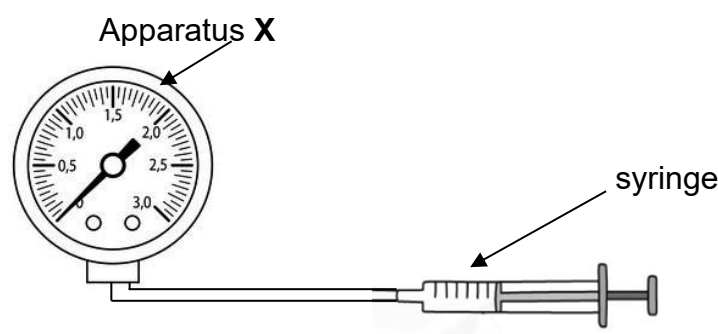
The table below shows the boiling points of group 4 compounds.

Compound		Boiling point (° C)
<b>A</b>	CH <sub>4</sub>	-161,6
<b>B</b>	SiH <sub>4</sub>	-112,0
<b>C</b>	GeH <sub>4</sub>	-88,5
<b>D</b>	SnH <sub>4</sub>	-52,0
<b>E</b>	HCl	<b>X</b>

- 3.1 Define *boiling point*. (2)
- 3.2 Write down the phase of compounds **A** to **D** at room temperature. (1)
- 3.3 Explain the trend in the boiling points of compounds **A** to **D**. (3)
- 3.4 Which compound in the table (**A** to **D**) will have the highest vapour pressure?  
Give a reason for your answer by referring to the data in the table. (2)
- 3.5 How will the value of **X** compare to the boiling point of CH<sub>4</sub>?  
Choose from HIGHER THAN, LOWER THAN or EQUAL to. (1)
- 3.6 Fully explain your answer to QUESTION 3.5. (3)
- [12]**

**QUESTION 4 (Start on a new page.)**

A group of learners investigate the relationship between the pressure and the volume of a gas. The gas syringe is connected to apparatus **X** as shown below.

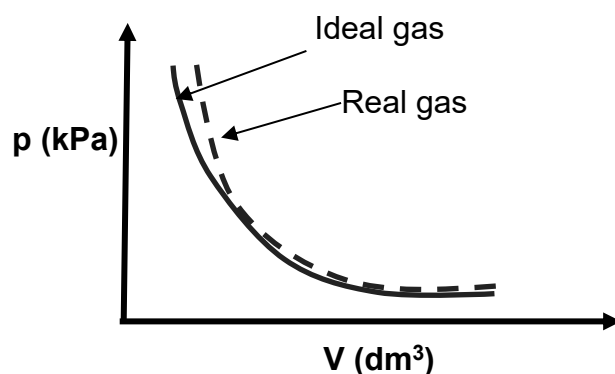


The learners vary the volume and record the pressure and volume. They calculated the inverse of the volume and recorded it with the pressure readings in table shown below.

	Pressure (kPa)	1/volume (cm <sup>-3</sup> )
1	92,5	0,05
2	111	0,06
3	129,5	0,07
4	148	0,08

- 4.1 Write down the name of the gas law that is being investigated. (1)
- 4.2 For this investigation, write down ONE controlled variable. (1)
- 4.3 Give the name of apparatus **X**. (1)
- 4.4 Use the data in the table and draw a pressure against 1/ volume graph on the attached ANSWER SHEET marked ANNEXURE A. (4)
- 4.5 Using information from the graph write down the learners' conclusion. (2)
- 4.6 Calculate the volume of the gas at a pressure of 184 kPa. (4)

- 4.7 The graph of pressure versus volume of an enclosed gas at constant temperature for a real gas and an ideal gas is shown below.



Explain the deviation of a real gas from ideal gas behaviour as shown in the graph above.

(2)

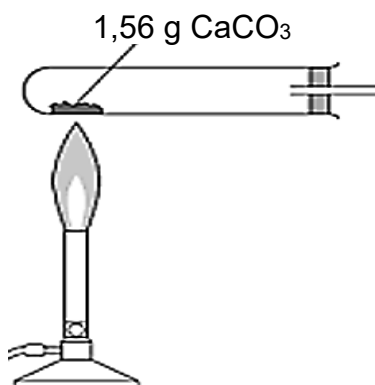
- 4.8 Give ONE reason in terms of the TYPE and STRENGTH of intermolecular forces why ammonia gas,  $\text{NH}_3$  will deviate from ideal gas at low temperatures.

(2)

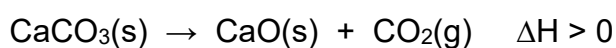
[17]

**QUESTION 5 (Start on a new page.)**

5.1 1,56 g of calcium carbonate is heated as shown in diagram below.



The calcium carbonate decomposes according to the balanced equation:



0,163 g of CO<sub>2</sub> is produced during this decomposition.

5.1.1 Is this reaction ENDOTHERMIC or EXOTHERMIC? (1)

5.1.2 Give a reason for your answer in QUESTION 5.1.1. (2)

5.1.3 Describe *Avogadro's number*. (1)

5.1.4 Calculate the:

(a) Number of CO<sub>2</sub> molecules produced (4)

(b) Mass of CaCO<sub>3</sub> that remains unreacted in the flask at the completion of the reaction (5)

5.2 A compound with a molar mass of 162 g·mol<sup>-1</sup> has the following mass composition:

44,4% C	6,21% H	39,5% S	9,86% O
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Determine the molecular formula of the compound. (7)  
[20]

**QUESTION 6 (Start on a new page.)**

**x** grams sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) reacts with 0,028 mol of hydrochloric acid ( $\text{HCl}$ ) at 25 °C. The balanced equation for the reaction is:



448  $\text{cm}^3$  of  $\text{CO}_2$  gas is produced during this reaction. The molar volume at 25 °C is 24,47  $\text{dm}^3 \cdot \text{mol}^{-1}$ .

6.1 Define the term *limiting reagent*. (2)

6.2 Name the law that states that:

*ONE mole of any gas occupies the same volume at the same temperature and pressure.* (1)

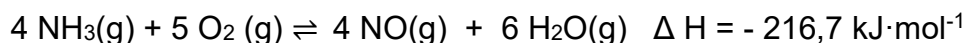
6.3 Determine by calculation which substance is the limiting reagent,  $\text{Na}_2\text{CO}_3$  or  $\text{HCl}$ . (5)

6.4 Calculate the value of **x**. (4)

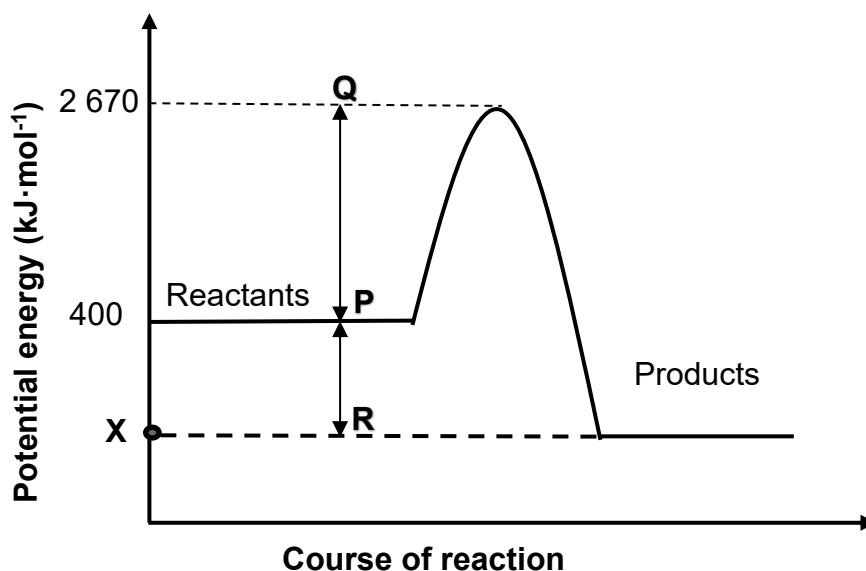
**[12]**

**QUESTION 7 (Start on a new page.)**

Consider the following reaction:



The graph below shows the potential energy against the course of this reaction.

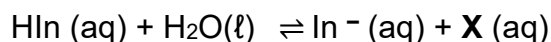


- 7.1 Define *activation energy*. (2)
- 7.2 What do the following sections of the graph represent?
- 7.2.1 **RP** (1)
- 7.2.2 **QP** (1)
- 7.3 Determine by calculation the value of **X**. (3)
- 7.4 What effect will the addition of suitable catalyst to the reaction mixture have on the activation energy of the reaction?
- Choose from INCREASES, DECREASES or NO EFFECT. (1)
- 7.5 60 cm<sup>3</sup> of NH<sub>3</sub> reacts completely with 90 cm<sup>3</sup> of O<sub>2</sub> at the same temperature and pressure in a container that can expand.
- Calculate the TOTAL THEORETICAL VOLUME (in dm<sup>3</sup>) of the gases present in the container at the completion of the reaction. (5)
- 7.6 Will the measured TOTAL volume of the gases at the completion of the reaction be HIGHER or LOWER than the value calculated in QUESTION 7.5? (1)

**[14]**

**QUESTION 8 (Start on a new page.)**

8.1 Consider the following acid-base reaction that occurs in an indicator, HIn:



8.1.1 Define an *acid* according to the Lowry-Brønsted theory. (2)

8.1.2 Is the indicator (HIn) an acid or a base in the reaction?

Give a reason for your answer. (2)

8.1.3 Write down the formula of **X**. (1)

The indicator has the following colours in different solutions:

Acid	Neutral	Base
Yellow	Green	Blue

8.1.4 What will the colour of the indicator be when it is added to a sodium hydroxide (NaOH) solution?

Choose from YELLOW, GREEN or BLUE. (1)

8.2 A school laboratory has 100 cm<sup>3</sup> of hydrochloric acid (HCl) solution with a concentration of 0,9 mol·dm<sup>-3</sup> available.

8.2.1 Define *concentration* in words. (2)

8.2.2 Calculate the number of moles of hydrochloric acid (HCl) present in 100 cm<sup>3</sup> of this solution. (3)

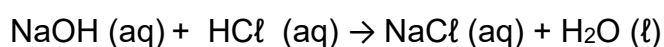
All of the 100 cm<sup>3</sup> hydrochloric acid solution is allowed to react with 3,5 g of an unknown metal carbonate (MCO<sub>3</sub>) according to the balanced equation:



The hydrochloric acid solution is found to be in EXCESS.

The EXCESS hydrochloric acid (HCl) is neutralised by 25 cm<sup>3</sup> of a sodium hydroxide (NaOH) solution with a concentration 0,8 mol·dm<sup>-3</sup>.

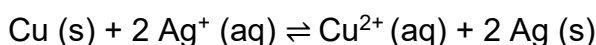
The neutralisation reaction of the excess HCl solution is shown below:



8.2.3 Determine by calculation the symbol of the unknown metal, M. (7)  
[18]

**QUESTION 9 (Start on a new page.)**

- 9.1 A clean piece of copper (Cu) is placed in a solution of silver nitrate (AgNO<sub>3</sub>). The balanced net ionic equation is:



- 9.1.1 Define *reduction* in terms of electron transfer. (2)

- 9.1.2 What type of reaction does copper, Cu undergo in this equation?

Choose from OXIDATION or REDUCTION.

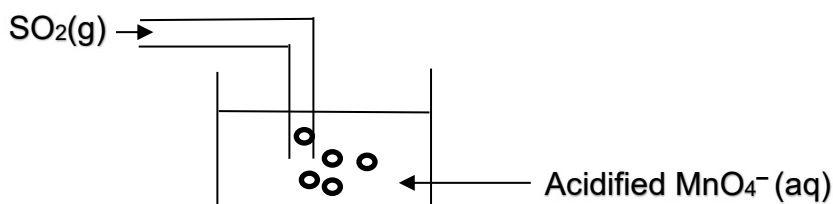
Explain your answer by referring to oxidation numbers. (3)

Write down the:

- 9.1.3 Formula or name of the spectator ions in the reaction (1)

- 9.1.4 Reduction half reaction (2)

- 9.2 Sulphur dioxide gas (SO<sub>2</sub>) is bubbled into an acidified solution of potassium permanganate as shown in the diagram below.



It is observed that the solution turns from purple to colourless due to the reduction of MnO<sub>4</sub><sup>-</sup> ions to Mn<sup>2+</sup> ions. During the reaction SO<sub>2</sub> is oxidised to sulphate ions, SO<sub>4</sub><sup>2-</sup>.

- 9.2.1 Determine the oxidation number of sulphur, S in SO<sub>4</sub><sup>2-</sup>. (2)

Write down the:

- 9.2.2 Oxidation half reaction (2)

- 9.2.3 Balanced net ionic equation using the half reaction method (5)

**[17]**

**TOTAL: 150**



**NATIONAL SENIOR CERTIFICATE  
NASIONALE SENIOR SERTIFIKAAT**

**DATA FOR PHYSICAL SCIENCES GRADE 11  
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 11  
VRAESTEL 2 (CHEMIE)**

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

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

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

$n = \frac{m}{M}$ <b>OR/OF</b> $n = \frac{N}{N_A}$ <b>OR/OF</b> $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ <b>OR/OF</b> $c = \frac{m}{MV}$	$p_1V_1 = p_2V_2$
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TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

KEY/ SLEUTEL																	
		Atomgetal Atomic number															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(I)	(II)																
1 H 1																	2 He 4
3 Li 7	4 Be 9																
11 Na 23	12 Mg 24																
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 98	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 210	85 At 210	86 Rn 222
87 Fr 227	88 Ra 226	89 Ac															

29

Cu

63,5

Elektronegativiteit  
Electronegativity

Simbool  
Symbol

Benaderde relatieve atoommassa  
Approximate relative atomic mass

29

71 Lu 175	70 Yb 173	69 Tm 169	68 Er 167	67 Ho 165	66 Dy 163	65 Tb 159	64 Gd 157	63 Eu 152	62 Sm 150	61 Pm	60 Nd 144	59 Pr 141	58 Ce 140
103 Lr	102 No	101 Md	100 Fm	99 Es	98 Cf	97 Bk	96 Cm	95 Am	94 Pu	93 Np	92 U 238	91 Pa	90 Th 232

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

Half-reactions/Halfreaksies		$E^{\circ}$ (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
$Cl_2(g) + 2e^-$	$\rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^-$	$\rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	$\rightleftharpoons Hg(l)$	+ 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
<b><math>2H^+ + 2e^-</math></b>	<b><math>\rightleftharpoons H_2(g)</math></b>	<b>0,00</b>
$Fe^{3+} + 3e^-$	$\rightleftharpoons Fe$	- 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
$Al^{3+} + 3e^-$	$\rightleftharpoons Al$	- 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 oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reduserende vermoë

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

Increasing oxidising ability/Toenemende oksiderende vermoë

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

Increasing reducing ability/Toenemende reduserende vermoë

## ANNEXURE A:

NAME AND SURNAME: \_\_\_\_\_

## QUESTION 4.4

