Province of the EASTERN CAPE EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2022

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKS: 100

TIME: 2 hours

This question paper consists of 16 pages, including 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of SEVEN 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 1.7) in the ANSWER BOOK, for example 1.8 D.

1.1 Which ONE of the following is the NAME given to the reaction in which electrons are transferred from one substance to another substance?

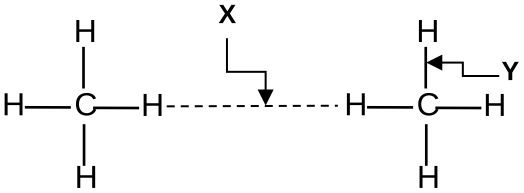
A Redox

B Precipitation

C Neutralisation

D Decomposition (2)

1.2 The diagram below is used to demonstrate the differences between interatomic bonds (chemical bonds) and intermolecular forces.



Which ONE of the following statements is CORRECT?

A **X** is stronger than **Y**

B **X** is an interatomic bond

C **X** is an intermolecular force

D **Y** is an intermolecular force (2)

1.3 The minimum amount of energy needed for a chemical reaction to start is called …

A activation energy.

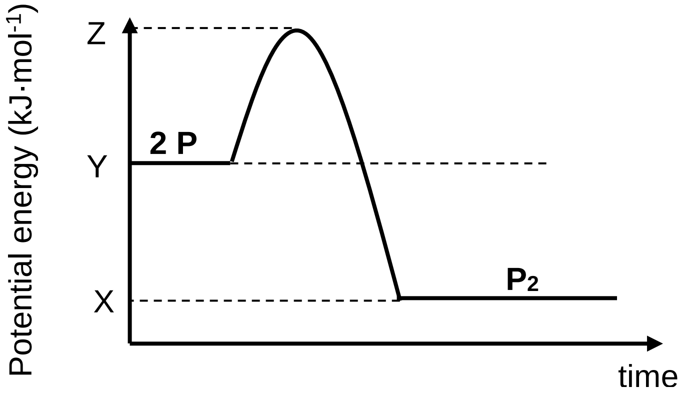
B catalyst.

C heat of reaction.

D bond energy. (2)

1.4 Consider the potential energy graph for the hypothetical reaction:

$$2\,\mathbf{P} \rightarrow \mathbf{P_2}$$



The heat of the reaction (ΔH) is represented by …

A Z – Y.

B X – Y.

C Y – X.

D Y – Z. (2)

1.5 Consider the INCOMPLETE reaction below:

$$\mathbf{X} + HC\ell \rightarrow \text{Salt} + H_2O$$

Which ONE of the following is CORRECT regarding compound **X**?

Compound **X** is a(n) …

A carbonate.

B metal.

C metal oxide.

D acid. (2)

1.6 Consider the substances **P**, **Q** and **R**.

P dissolves in **Q** but not in **R**.

The MOST LIKELY bonds or intermolecular forces in substances **P**, **Q** and **R** are:

	P	**Q**	**R**
A	Ionic bonds	Dipole-dipole forces	London forces
B	London forces	Dipole-dipole forces	Ionic bonds
C	Dipole-dipole forces	London forces	Ionic bonds
D	Ionic bonds	London forces	Dipole-dipole forces

(2)

1.7 According to the kinetic molecular theory, molecules of gases at the **same temperature** always have the same …

A mass.

B volume.

C pressure.

D average kinetic energy. (2)

[14]

QUESTION 2 (Start on a new page.)

Consider the following compounds.

O_2 ; H_2O ; H_3O^+

2.1 Define the term *molecule.* (2)

2.2 Draw the Lewis structures for:

2.2.1 O_2 (2)

2.2.2 H_2O (2)

2.3 The H_3O^+- ions forms when the oxygen atom in H_2O <u>donates its lone pair of electrons into the vacant orbital of H^+</u>.

2.3.1 Write down the NAME of the type of bond described by the underlined phrase. (1)

2.3.2 Draw the Lewis structure for the H_3O^+-ion. (2)

2.4 Which molecule is polar, H_2O or O_2?

Explain your answer. (4)
[13]

QUESTION 3 (Start on a new page.)

The table below shows the relationship between the melting points of three molecules:

Molecule	Melting point (˚C)
CH_4	-182,5
CF_4	-150
$CCℓ_4$	-23

3.1 Define the term *melting point.* (2)

3.2 Explain the trend in melting points of the molecules in the above table by referring to the intermolecular forces and energy involved. (4)

3.3 Which molecule in the table will have the highest vapour pressure at a given temperature?

Explain the answer by referring to the data in the table. (2)

3.4 Water (H_2O) is a smaller molecule than $CCℓ_4$, but water has a higher melting point than $CCℓ_4$.

Explain this observation by referring to the type of intermolecular forces involved. (2)

3.5 Write down the name of intermolecular force that will exist in a mixture of H_2O and $CCℓ_4$. (2)

[12]

QUESTION 4 (Start on a new page.)

A group of learners investigate the relationship between pressure and the volume of an enclosed gas at room temperature.

They recorded their results in the table below:

Pressure (kPa)	**Volume (cm^3)**
100,33	7,34
102,2	7,21
103,93	7,09
X	6,97

4.1 For this investigation, write down the:

4.1.1 Name of the gas law that is being investigated (1)

4.1.2 Controlled variable (1)

4.1.3 Relationship between pressure and volume of the gas as described by the first 3 data sets in the table (2)

4.2 Calculate the value of **X**. (4)

4.3 Write down the TWO conditions under which real gases behave more like an ideal gas. (2)

4.4. Write down the NAME of a gas whose behaviour is close to that of an ideal gas, under the conditions mentioned in QUESTION 4.3 above. (1)

[11]

QUESTION 5 (Start on a new page.)

5.1 An organic compound has the following composition by mass.

Element	Percentage (%)
C	54,55
H	9,09
O	36,36

The molar mass of the compound is TWICE the empirical molar mass.

5.1.1 Define the term *empirical formula.* (2)

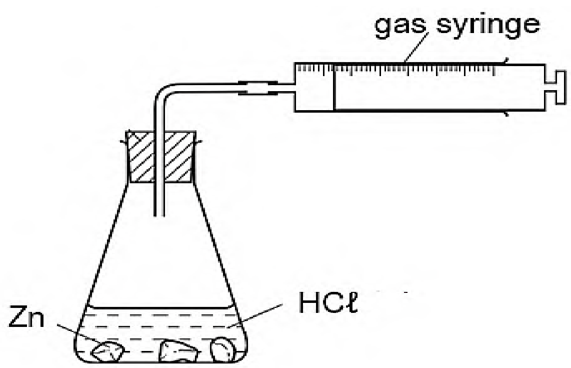
5.1.2 Determine, by calculation, the molecular formula of the compound. (5)

5.2 A teacher demonstrates to a group of learners the impact that the limiting reagent have on the amount of product formed during a chemical reaction.

The teacher uses the following chemical equation:

$$Zn\ (s) + 2\ HC\ell\ (aq) \rightarrow ZnC\ell_2\ (aq) + H_2\ (g)$$

The teacher uses the following set-up for this investigation:



Experiment 1	Experiment 2
7 g of Zn	3,27 g of Zn
1 mol of HCℓ	1 mol of HCℓ

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

5.2.2 Determine, by calculation, the limiting reagent in **experiment 1**. (5)

5.2.3 How will the amount of zinc chloride ($ZnC\ell_2$) produced in **experiment 2,** compare to that of **experiment 1**?

Write down only HIGHER THAN, LOWER THAN or EQUAL TO.

Explain your answer. (4)

5.2.4 **Experiment 2** was carried out at 40 °C. The molar volume of hydrogen gas at this temperature is 25,7 $dm^3 \cdot mol^{-1}$.

Calculate the volume of hydrogen gas produced once the reaction reaches completion in **experiment 2**. (5)

[23]

QUESTION 6 (Start on a new page.)

6.1 Consider the following ionisation reaction of HCℓ:

$$HC\ell\,(g) \;+\; H_2O\,(\ell) \;\rightleftharpoons\; C\ell^-\,(aq) + H_3O^+$$

6.1.1 Define an *acid* in terms of the Lowry-Brønsted model. (2)

6.1.2 Write down ONE conjugate acid-base pair. (2)

6.1.3 Write down the formula of the substance in the reaction that can act as an ampholyte in some reactions. (1)

6.2 A certain volume of a hydrochloric acid solution of concentration 0,5 mol.dm^{-3} is added to a sample of seashells of mass 8 g in a container. The hydrochloric acid solution (HCℓ) COMPLETELY reacts with the calcium carbonate ($CaCO_3$) in the sample according to the balanced equation:

$$CaCO_3\,(s) \;+\; 2\,HC\ell\,(aq) \;\rightarrow\; CaC\ell_2\,(aq) + 2\,H_2O\,(\ell) + CO_2\,(g) \quad \Delta H < 0$$

The seashell contains 95% $CaCO_3$.

6.2.1 Is the reaction ENDOTHERMIC or EXOTHERMIC?

Give a reason for the answer. (2)

6.2.2 Calculate the volume, in cm^3, of the hydrochloric acid (HCℓ) that was added to the sample inside the container. (7)

[14]

QUESTION 7 (Start on a new page.)

7.1 Consider the balanced redox reaction:

$$Cu(s) + 2\,Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag\,(s)$$

7.1.1 Define *oxidation.* (2)

From the balanced equation above, write down the:

7.1.2 Reduction half reaction (2)

7.1.3 Formula of the reducing agent (1)

7.1.4 Explanation for the answer in QUESTION 7.1.3 by referring to the oxidation numbers (2)

7.2 The following INCOMPLETE chemical equation represents a redox reaction:

$$Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) \rightarrow Cr^{3+}(aq) + Fe^{3+}(aq)$$

7.2.1 Determine the oxidation number of Cr in $Cr_2O_7^{2-}$. (2)

7.2.2 Using information from the table of standard reduction potentials write down the BALANCED net ionic reaction.

Clearly indicate the following:

- Reduction half reaction
- Oxidation half reaction
- Balanced net ionic equation (4)

[13]

TOTAL: 100

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

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*

NAAM/*NAME*	SIMBOOL/*SYMBOL*	WAARDE/*VALUE*
Standard pressure *Standaarddruk*	p^θ	$1,013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume teen 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	$6,02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at /by 298K

$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ / $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$

$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ / $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$

$E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{reducing\ agent}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$

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

KEY/ *SLEUTEL*

Atoomgetal
Atomic number: 29

Elektronegatiwiteit
Electronegativity: 1,9

Simbool
Symbol: Cu

Benaderde relatiewe atoommassa
Approximate relative atomic mass: 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
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

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
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 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 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* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

Half-reactions/*Halfreaksies*			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

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NATIONAL SENIOR CERTIFICATE/*NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 11

NOVEMBER 2022

PHYSICAL SCIENCES P2
FISIESE WETENSKAPPE V2
MARKING GUIDELINE/*NASIENRIGLYN*

MARKS/*PUNTE*: 100

This marking guideline consists of 8 pages./
Hierdie nasienriglyn bestaan uit 8 bladsye.

QUESTION/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 C ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

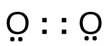
1.5 C ✓✓ (2)

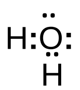
1.6 A ✓✓ (2)

1.7 D ✓✓ (2)
[14]

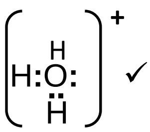
QUESTION/*VRAAG 2*

2.1 A group of two or more covalently bonded atoms that function as a unit. ✓✓
ʼn Groep van twee of meer atome wat kovalent verbind is en as ʼn eenheid funksioneer. (2)

2.2 2.2.1

✓✓ (2)

2.2.2

✓✓ (2)

2.3 2.3.1 Dative covalent bond/Co-ordinate covalent bond ✓
Datiewe kovalentebinding/Gekoördineerde kovalentebinding (1)

2.3.2

✓✓ (2)

2.4 H_2O ✓

<u>O_2</u>
The difference in electronegativity is 0. ✓
Die verskil in elektronegatiwiteit is 0.

<u>H_2O</u>
O-atom is more electronegative than the H-atom /
The O – H bond is polar ✓
O-atoom is meer elektronegatief as die H-atoom/ Die O – H binding is polêr.

The molecular geometry is asymmetrical/bent/angular. ✓
Die molekulêre geometrie is asimmetries/gebuig/hoekig. (4)

[13]

QUESTION/*VRAAG* 3

3.1 The temperature at which the solid and liquid phases (of a substance are) in equilibrium. ✓✓
Die temperatuur waarteen vastestof en vloeistof fases (van 'n stof) in ewewig is. (2)

3.2 The molecular size/mass increases from CH_4 to $CCℓ_4$. ✓
All three molecules have London forces/induced-dipole forces/ dispersion ✓
The strength of London forces/induced-dipole forces/dispersion forces increases with an increase in molecular size/mass. ✓
More energy will be required to overcome the London forces with the molecules with the higher melting point ✓

Die molekulêre grootte/massa vergroot van CH_4 na $CCℓ_4$
Al drie molekules het Londonkragte./geïnduseerde dipoolkragte/dispersie
Die sterkte van die Londonkragte geïnduseerde dipoolkragte/dispersie vergroot met 'n toename in molekulêre grootte/massa
Meer energie word benodig om die Londonkragte te oorkom in die molekules wat hoër smeltpunte het. (4)

3.3 CH_4 ✓
Lowest melting point / *Laagste smeltpunt* ✓ (2)

3.4 $CCℓ_4$ have only London forces ✓/induced-dipole forces/dispersion / *het slegs Londonkragte geïnduseerde dipoolkragte/dispersie*
H_2O has both hydrogen bonds (and London forces/induced-dipole forces/dispersion /) *het beide waterstofbindings (en Londonkragte geïnduseerde dipoolkragte/dispersie)* ✓
The hydrogen bonds are stronger than the London forces ✓
Die waterstofbinding is sterker as die Londonkragte (2)

3.5 Dipole-induced dipole forces / *Dipool-geïnduseerde dipoolkragte* ✓ (2)

[12]

QUESTION/*VRAAG 4*

4.1 4.1.1 Boyle's law/*Boyle se wet* ✓ (1)

4.1.2 Temperature/*Temperatuur* **OR/*OF*** the amount of gas/*die hoeveelheid gas* ✓ (1)

4.1.3 The pressure of the gas is inversely proportional to the volume of the gas. ✓✓
Die druk van die gas is omgekeerd eweredig aan die volume van die gas. (2)

4.2 $p_1V_1 = p_2V_2$ ✓

(100,33) (7,34) ✓ = X (6,97) ✓ **OR/*OF*** 102,2 x 7,21 = X. 6,97

X = 105,66 (kPa) ✓ X = 105,66 (kPa) ✓

OR/OF 103,93. 7,09 = X. 6,97
X = 105,66 (kPa)

(Any two point (co-ordinates) can be used / *enige twee punte (koördinate) kan gebruik word.*) (4)

4.3 High temperature / *Hoër temperatuur* ✓ and/*en* low pressure/ *lae druk* ✓ (2)

4.4 Helium ✓ or / *of* Hydrogen / *Waterstof* (1)
[11]

QUESTION/*VRAAG* 5

5.1 5.1.1 The simplest whole number ratio between the elements/atoms of a compound. ✓✓
Die eenvoudigste heelgetal verhouding tussen die elemente/atome van 'n verbinding. (2)

5.1.2

Element	**Mass/*Massa***	**Mole/Mol**	**Simplest mol ratio *Eenvoudigste mol-verhouding***
C	54,55	= 54,55 / 12 ✓ = 4,55	= 4,55 / 2,27 = 2
H	9,09	= 9,09 / 1 ✓ = 9,09	= 9,09 / 2,27 = 3
O	36,36	= 36,36 / 16 ✓ = 2,27	= 2,27 / 2,27 = 1

(Dividing by 2,27 in last column / *Deel die laaste kolom deur 2,27*) ✓

Empirical formula/*Empiriese formule*: C_2H_3O

Molecular formula/*Molekulêre formule*: $C_4H_6O_2$ ✓ (5)

5.2 5.2.1 The substance that is completely used up during a chemical reaction. ✓✓
Die stof wat volledig tydens 'n chemiese reaksie reageer/opgebruik word. (2)

5.2.2 $n = \frac{m}{M}$ ✓

$n = \frac{7}{65}$ ✓

n = 0,11 mol of Zn

mole ratio / *mol verhouding* Zn : HCℓ
1 : 2

Actual / *Werklik* 0,11 : 1 ✓✓

The actual ratio of Zn to HCℓ is too small.
Die werklike verhouding van Zn tot HCℓ is te klein.

Therefore Zn is the limiting reagent ✓
Daarom is Zn die beperkende reagens (5)

5.2.3 Lower than/*Laer as* ✓

Zn is the limiting reagent / *Zn is die beperkende reagens* ✓
Smaller amount of zinc is used in experiment 2 ✓✓
Kleiner hoeveelheid sink word in eksperiment 2 gebruik (4)

5.2.4 $n = \frac{m}{M}$ ✓

$n = \frac{3,27}{65}$ ✓

n = 0,05 mol of Zn

n (Zn) = n (H_2) = 0,05 mol ✓

$V = nV_m$

V = (0,05)(25,7) ✓

V = 1,285 dm^3 ✓ (5)
[23]

QUESTION/*VRAAG* 6

6.1 6.1.1 It is a substance that donates protons (H^+ ions) ✓✓
Dit is die stof wat protone (H^+-ione) skenk. (2)

6.1.2 H_3O^+ and/*en* H_2O ✓✓ **OR/OF** HCℓ and $Cℓ^-$ (2)

6.1.3 H_2O ✓ (1)

6.2.1 EXOTHERMIC / *EKSOTERMIES* ✓

$\Delta H < 0$ **OR / *OF*** Net energy is released / *Netto energie vrygestel* ✓ (2)

6.2.2 **<u>$CaCO_3$</u>**

m ($CaCO_3$) = 8 × 0,95 ✓

m ($CaCO_3$) = 7,6 g

$n = \frac{m}{M}$ ✓

$n = \frac{7,6}{100}$ ✓

n = 0,076 mol

<u>Mole ratio/*Molverhouding*</u>

n (HCℓ) = 2 n ($CaCO_3$)

n (HCℓ) = 2 (0,076) ✓

n (HCℓ) = 0,152 mol

<u>HCℓ</u>

$c = \frac{n}{V}$ ✓

$(0,5) = \frac{(0,152)}{V}$ ✓

V = 0,304 dm^3

V = 304 cm^3 ✓ (7)

[14]

QUESTION/*VRAAG* 7

7.1 7.1.1 Loss of electrons ✓✓ / *Verlies aan elektrone*
The reaction wherein the electrons is donated to./Die reaksie waarin elektrone geskenk word. (2)

7.1.2 $Ag^+ + e^- \rightarrow Ag$ ✓✓ (2)

7.1.3 Cu ✓ (1)

7.1.4 The <u>oxidation number increases</u> ✓ from <u>0 to + 2</u> ✓
Die <u>oksidasiegetal neem toe</u> vanaf <u>0 tot + 2</u> (2)

7.2 7.2.1 $2x + 7(-2) = -2$

$x = +6$ ✓✓ (2)

7.2.2 Oxidation half reaction: $Fe^{2+} \rightarrow Fe^{3+} + e^-$ ✓
Oksidasie halfreaksie:

Reduction half reaction: $Cr_2O_7^{2-} + 14\ H^+ + 6e^- \rightarrow 2\ Cr^{3+} + 7\ H_2O$ ✓
Reduksie-halfreaksie:

Net ionic equation: $6\ Fe^{2+} + Cr_2O_7^{2-} + 14\ H^+ \rightarrow 6\ Fe^{3+} + 2\ Cr^{3+} + 7\ H_2O$ ✓✓
Netto ioniese reaksie:

<u>Marking criteria/*Nasienkriteria*</u>
Correct oxidation half reaction / *Korrek oksidasie halfreaksie 1/4*
Correct reduction half reaction / *Korrek reduksie halfreaksie 1/4*
Reactants and products correct in net ionic equation 2/4
Reaktante en produkte korrek volgens netto ioniese vergelyking
Balancing/*Balansering*

(4)
[13]

TOTAL/*TOTAAL:* 100