basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2017

MARKS: 150

TIME: 3 hours

This question paper consists of 11 pages, 4 data sheets and 1 answer sheet.

* I P H S C E 2 *

EASTERN CAPE

INSTRUCTIONS AND INFORMATION

1. Write your name and class (for example 11A) in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK, except QUESTION 4.1, which must be answered on the attached ANSWER SHEET.

3. Hand in the ANSWER SHEET together with the ANSWER BOOK.

4. Start EACH question on a NEW page in the ANSWER BOOK.

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

6. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.

7. You may use a non-programmable calculator.

8. You may use appropriate mathematical instruments.

9. You are advised to use the attached DATA SHEETS.

10. Show ALL formulae and substitutions in ALL calculations.

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

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

13. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 Which ONE of the bonds between the atoms below has the highest polarity?

A H - C

B H - Cℓ

C H - O

D H - N (2)

1.2 Solid iodine sublimes easily. The intermolecular forces present in iodine are …

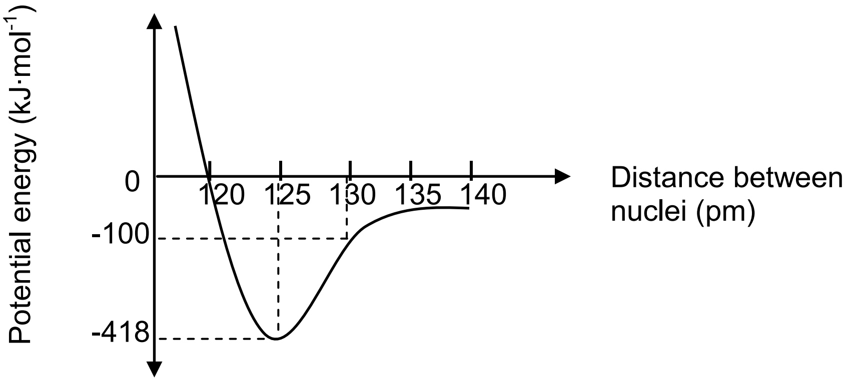
A London forces.

B hydrogen bonding.

C ion-dipole forces.

D dipole-dipole forces. (2)

1.3 The graph below shows how the potential energy varies with distance between the nuclei of two nitrogen atoms when a double bond between the nitrogen atoms (N = N) is formed.



Choose from the table the bond length and bond energy for N = N.

	BOND LENGTH (pm)	BOND ENERGY ($kJ \cdot mol^{-1}$)
A	120	0
B	125	518
C	125	418
D	130	-100

(2)

1.4 According to Boyle's law, …

A $p \; \alpha \; \frac{1}{V}$ if T is constant.

B $V \; \alpha \; T$ if p is constant.

C $V \; \alpha \; \frac{1}{T}$ if p is constant.

D $p \; \alpha \; V$ if n is constant. (2)

1.5 One mole of any gas occupies the same volume at the same temperature and pressure.

This statement is known as …

A Charles's law.

B Gay Lussac's law.

C Avogadro's law.

D the ideal gas LAW. (2)

1.6 One mole of a gas, SEALED in a container, has volume **V** at temperature **T** and pressure **p**. If the pressure is increased to **3p**, the ratio between the volume and temperature (V **:** T) is …

A 1 **:** ⅓

B 3 **:** 1

C ⅓ **:** 3

D 1 **:** 3

1.7 The chemical equation that represents an endothermic reaction:

A $NH_4NO_3(s) + H_2O(\ell) \rightarrow NH_4^+(aq) + NO_3^-(aq) \quad \Delta H > 0$

B $2Mg(s) + O_2(g) \rightarrow 2MgO(s) \quad \Delta H < 0$

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

D $H_2(g) + C\ell_2(g) \rightarrow 2HC\ell(g) \quad \Delta H = -131 \text{ kJ·mol}^{-1}$ (2)

1.8 The CORRECT formula for nitric acid:

A H_2SO_4

B CH_3COOH

C NH_3

D HNO_3 (2)

1.9 Consider the reaction below.

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

Which substance is the oxidising agent?

A Zn

B Cu^{2+}

C Zn^{2+}

D Cu (2)

1.10 Which ONE of the reactions below will produce the salt sodium ethanoate (sodium acetate)?

A $HC\ell(s) + CH_3COOH(aq) \rightarrow$

B $CH_3COOH(aq) + H_2O(\ell) \rightarrow$

C $CH_3COOH(aq) + NaOH(aq) \rightarrow$

D $H_2CO_3(aq) + NaOH(aq) \rightarrow$ (2)

[20]

QUESTION 2 (Start on a new page.)

Consider the following two reactions of methane (CH_4):

Reaction 1: $CH_4\,(g) + HC\ell\,(g) \rightarrow CH_3C\ell\,(g) + H_2\,(g)$

Reaction 2: $CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2H_2O\,(g)$

2.1 Define the term *covalent bond*. (2)

2.2 Draw Lewis structures for:

2.2.1 $CH_3C\ell$ (2)

2.2.2 CO_2 (2)

2.3 How many lone-pair electrons are on the central atom in the CO_2 molecule? (1)

2.4 Identify ONE of the substances in Reaction 2 that can form a dative covalent bond when reacting with an acid. (1)

2.5 Write down the shape of the:

2.5.1 H_2O molecule (1)

2.5.2 CO_2 molecule (1)

2.6 Although the molecules of CH_4 and $CH_3C\ell$ have the same shape, CH_4 is non-polar, while $CH_3C\ell$ is polar. Give a reason for the difference in molecular polarity. (1)

[11]

QUESTION 3 (Start on a new page.)

Consider the list of six substances with their formulae and boiling points in the table below.

NAME OF SUBSTANCE	FORMULA	BOILING POINT (°C)
Water	H_2O	100
Ethanol	CH_3CH_2OH	78
Bromine	Br_2	58,8
Iodine	I_2	184,3
Ammonia	NH_3	-33,3
Phosphine	PH_3	-87,7

3.1 Explain why ethanol is soluble in water. Refer to the relative strength of the intermolecular forces in ethanol and water. (3)

3.2 Explain why the boiling point of iodine is higher than that of bromine. Refer to the intermolecular forces present in EACH substance in the explanation. (3)

3.3 Explain why phosphine will evaporate faster than ammonia by referring to the types of intermolecular forces present in EACH substance. (4)

3.4 Water, ethanol and bromine are all liquids at room temperature.

Which ONE will have the highest vapour pressure? (1)

3.5 Give a reason for the answer to QUESTION 3.4 by referring to the relative strength of the intermolecular forces and boiling points. (2)
[13]

QUESTION 4 (Start on a new page.)

In an experiment to investigate the relationship between pressure and temperature of an enclosed gas, 48 g of oxygen gas was sealed in a container. The results obtained are recorded in the table below.

PRESSURE (kPa)	TEMPERATURE (K)
155,8	250
187,0	300
218,1	350
249,3	400
280,5	450

4.1 Draw a graph of pressure versus temperature on the attached ANSWER SHEET. Extrapolate the graph so that it intersects the y-axis. (4)

4.2 What conclusion can be made from the final graph? (2)

4.3 Explain why it will not be possible to obtain accurate values at very low temperatures. (2)

4.4 Use the kinetic molecular theory to explain the effect of an increase in temperature on the pressure of a gas. (4)

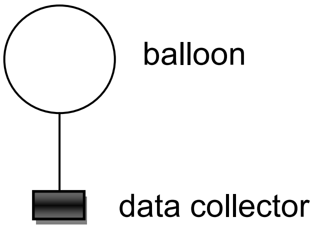
4.5 Under which conditions of temperature and pressure will a real gas act as an ideal gas? (2)

4.6 Calculate the gradient of the graph. (3)

4.7 Use the answer to QUESTION 4.6 to determine the volume of the container. (5)
[22]

QUESTION 5 (Start on a new page.)

Weather balloons are sent into space to gather data. The balloons usually burst at a pressure of 27 640 Pa and a volume of 36,3 m^3. The data collector then falls back to Earth.



The gas in a certain weather balloon has an initial volume of 12,6 m^3 and pressure of 105 000 Pa at a temperature of 25 °C when it is released into space.

Calculate the:

5.1 Temperature of the gas, in °C, in the balloon when it bursts (4)

5.2 Initial amount of gas (in moles) in the balloon (4)
[8]

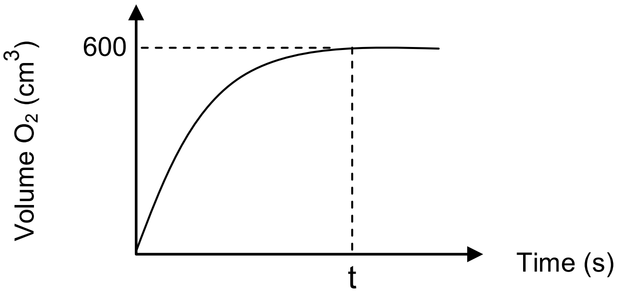
QUESTION 6 (Start on a new page.)

6.1 The decomposition of hydrogen peroxide in the presence of a catalyst at standard pressure and room temperature is given by the unbalanced chemical equation below.

$$H_2O_2(aq) \rightarrow H_2O(\ell) + O_2(g)$$

The oxygen gas is collected and the volume is recorded over a period of time. The reaction is completed at time **t**.

The results are plotted on a graph of volume O_2 versus time, as shown below.



Take the molar gas volume (V_m) as 24,45 dm^3 at room temperature and standard pressure.

6.1.1 Balance the equation. (2)

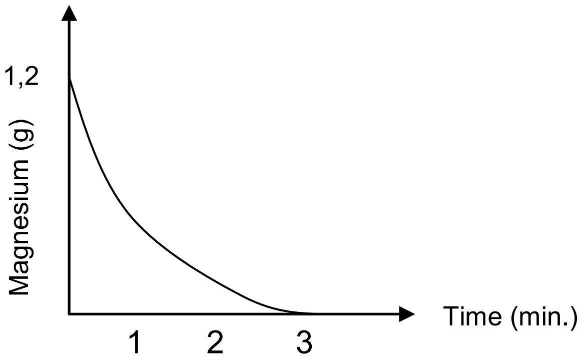
6.1.2 How would a catalyst affect the reaction? (2)

6.1.3 Use the information on the graph to calculate the mass of hydrogen peroxide that decomposed. (6)

6.2 In an experiment, a learner adds 500 cm^3 hydrochloric acid ($HC\ell$), with a concentration of 0,36 $mol\cdot dm^{-3}$, to 1,2 g of magnesium in a test tube. She records the change in the mass of magnesium as the reaction proceeds at regular intervals. The balanced chemical equation for the reaction is:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

The change in the mass of magnesium during the reaction is shown on the graph below.



6.2.1 Identify the limiting agent in this reaction. Give a reason for the answer. (2)

6.2.2 Calculate the number of moles of **unreacted** hydrochloric acid in the test tube after 3 minutes. (7)
[19]

QUESTION 7 (Start on a new page.)

The equation for the combustion of butane gas is given below.

$$\text{butane}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g) \qquad \Delta H < 0$$

7.1 Define the term *activation energy.* (2)

7.2 Is the combustion reaction of butane *exothermic* or *endothermic*? Give a reason for the answer. (2)

7.3 Draw a sketch graph of potential energy versus course of reaction for the reaction above.

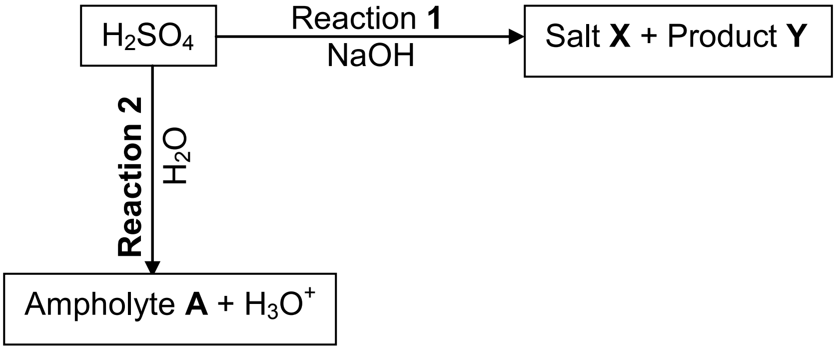
Clearly indicate the following on the graph:

- Activation energy
- Heat of reaction (ΔH)
- Reactants and products (3)

7.4 Determine the empirical formula of butane gas if it consists of 82,76% carbon and 17,24% hydrogen. (4)
[11]

QUESTION 8 (Start on a new page.)

8.1 Two reactions of sulphuric acid are shown in the diagram below.



8.1.1 Define a *Lowry-Brønsted base*. (2)

8.1.2 Write down a balanced equation for Reaction **1**. (3)

8.1.3 Write down the NAME of the salt represented by **X**. (2)

8.1.4 Write down the FORMULA of ampholyte **A**. (2)

8.1.5 Write down the formulae of the TWO conjugate acid-base pairs in Reaction **2**. (4)

8.2 A solution of sodium hydroxide (NaOH) is prepared by dissolving 6 g solid NaOH in 500 cm^3 water.

This solution reacts completely with 10 g impure ammonium chloride ($NH_4C\ell$) according to the equation below.

$$NaOH(aq) + NH_4C\ell(s) \rightarrow NaC\ell(aq) + H_2O(\ell) + NH_3(aq)$$

8.2.1 Calculate the concentration of the NaOH solution. (4)

8.2.2 Calculate the percentage **impurities** in the $NH_4C\ell$. (6)
[23]

QUESTION 9 (Start on a new page.)

The reaction between dichromate ions ($Cr_2O_7^{-2}$) and iron(II) ions (Fe^{2+}) in an acidic medium is given below.

$$Cr_2O_7^{-2}(aq) + Fe^{2+}(aq) + H^+(aq) \rightarrow Cr^{3+}(aq) + Fe^{3+}(aq) + H_2O(\ell)$$

9.1 Determine the oxidation number of CHROMIUM in $Cr_2O_7^{-2}$(aq). (2)

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

9.3 Write down the FORMULA of the substance that undergoes oxidation. Explain the answer in terms of oxidation numbers. (2)

9.4 Write down the FORMULA of the oxidising agent. (2)

9.5 Write down the reduction half-reaction. (2)

9.6 Write down the net balanced ionic equation for the reaction, using the ion-electron method. (3)
[13]

QUESTION 10 (Start on a new page.)

Gold and iron are two of many minerals mined in South Africa. Iron is mined in open-cast mines, while gold is usually found in deep-shaft (underground) mines. During the process of refining, the following chemical reactions take place to extract the metal from the ore:

Gold is dissolved in a solution containing cyanide ions (CN^-) to extract it from the ore. The balanced chemical equation for the reaction is:

$$4Au(s) + 8NaCN(aq) + 2H_2O(\ell) + O_2(g) \rightarrow 4NaAu(CN)_2(aq) + NaOH(aq)$$

Iron(VI) oxide and carbon are heated in a furnace to extract iron from the ore. The balanced chemical equation for the reaction is:

$$2Fe_2O_3(s) +3C(s) \rightarrow 4Fe(\ell) + 3CO_2(g)$$

10.1 State TWO advantages of open-cast mining when compared to deep-shaft (underground) mining. (2)

Consider the iron extraction reaction.

10.2 Is iron oxidised or reduced during the reaction? Give a reason for the answer. (2)

10.3 State TWO disadvantages of using carbon in this reaction. (2)

Consider the gold extraction reaction.

10.4 Give ONE reason why gold is present as an element in the ore. (2)

10.5 What role does oxygen gas (O_2) play in the reaction? (2)
[10]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6,02 \times 10^{23}\ mol^{-1}$
Molar gas constant *Molêre gaskonstante*	R	$8,31\ J\cdot K^{-1}\cdot mol^{-1}$
Standard pressure Standaarddruk	p^{θ}	$1,013 \times 10^{5}$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22,4\ dm^{3}\cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$\frac{p_1V_1}{T_1}=\frac{p_2V_2}{T_2}$	$pV=nRT$
$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$n=\frac{V}{V_m}$	$c=\frac{n}{V}$ OR/*OF* $c=\frac{m}{MV}$

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

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
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

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

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

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

Half-reactions/*Halfreaksies*			**E^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
$\mathbf{2H^+ + 2e^-}$	$\rightleftharpoons$	$\mathbf{H_2(g)}$	**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* ↓

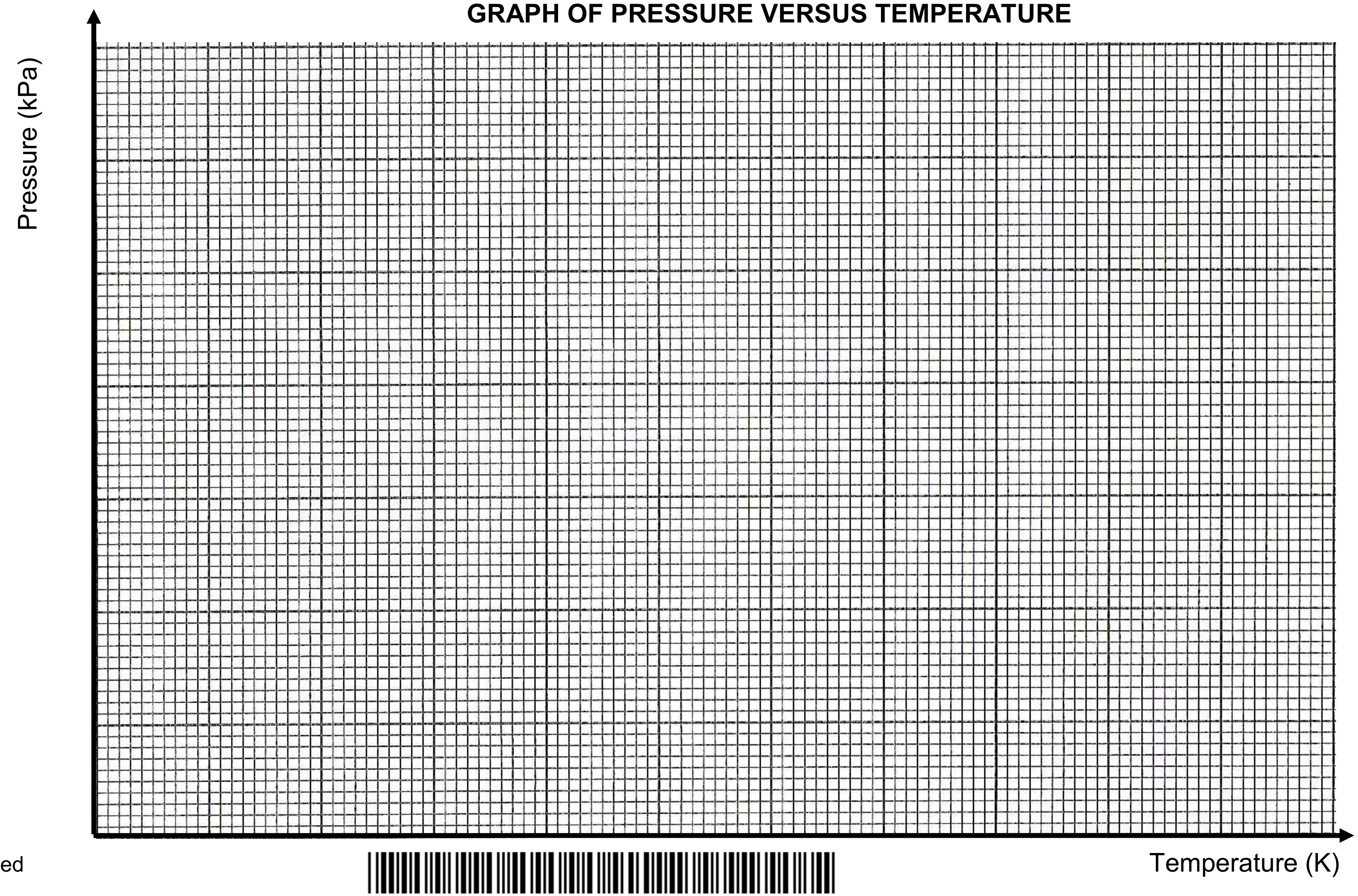
Increasing reducing ability/*Toenemende reduserende vermoë* ↑

ANSWER SHEET

Hand in this ANSWER SHEET together with the ANSWER BOOK.

NAME: ______________________________________ **CLASS:**_____

QUESTION 4.1


GRAPH OF PRESSURE VERSUS TEMPERATURE

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 11

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

NOVEMBER 2017

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2017 -11- 07
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

These marking guidelines consist of 13 pages.
Hierdie nasienriglyne bestaan uit 13 bladsye.

Approved
DBE: Int. Mod
2017:11:07

Approved.
7/11/2017
Chief Examiner

QUESTION/*VRAAG 1*

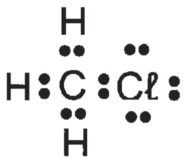
1.1	C ✓✓	(2)
1.2	A ✓✓	(2)
1.3	C ✓✓	(2)
1.4	A ✓✓	(2)
1.5	C ✓✓	(2)
1.6	D ✓✓	(2)
1.7	A ✓✓	(2)
1.8	D ✓✓	(2)
1.9	B ✓✓	(2)
1.10	C ✓✓	(2) **[20]**

Mc

QUESTION/*VRAAG* 2

2.1 A covalent bond is the sharing of electrons between two atoms to form a molecule. ✓✓
'n Kovalente binding is die deel van elektrone tussen twee atome van 'n molekuul. ✓✓ (2)

2.2 2.2.1



✓✓ (2)

2.2.2

✓✓ (2)

2.3 None/zero ✓/*Geen/nul* ✓ (1)

2.4 H_2O/water ✓ (1)

2.5.1 H_2O is angular/bent/*hoekig* ✓ (1)

2.5.2 CO_2 is linear/*lineêr* ✓ (1)

2.6 (The charge distribution in) $CH_3C\ell$ is asymmetrical and CH_4 is symmetrical. ✓
(Die verspreiding van lading in) $CH_3C\ell$ is asimmetries en CH_4 is simmetries.

OR/*OF*

The chlorine has a higher electronegativity than the hydrogen. ✓
Die chloor het 'n hoër elektronegatiwiteit as waterstof. (1)
[11]

QUESTION/*VRAAG* 3

3.1
- Both water and ethanol have hydrogen bonds ✓
- which are the same in relative strength. ✓
- Substances with comparable (same) relative strength in intermolecular forces will dissolve. ✓

- *Beide water en etanol het waterstofbindings*
- *wat dieselfde relatiewe sterkte is.*
  Stowwe wat vergelykbare (dieselfde) relatiewe sterkte in intermolekulêre kragte het, sal in mekaar oplos (3)

3.2
- The intermolecular forces between the molecules of iodine and bromine are both London forces (Van der Waals forces/Induced dipole forces). ✓
- Iodine molecules have a bigger molecular mass than the molecules of bromine **OR** iodine molecules have a larger surface area than molecules of bromine **OR** iodine molecules have more electrons than that of bromine and thus have a larger polarity (any option) ✓
- The bigger the molecules/larger the surface are of the molecules, the stronger the intermolecular forces. ✓

- *Die intermolekulêre kragte tussen molekules van jodium en broom is beide London kragte (van der Waalskragte/Geïnduseerde kragte).*
- *Jodiummolekules het 'n groter molekulêre massa as die molekules van broom **OF** jodiummolekules het 'n groter oppervlak as broommolekules **OF** jodiummolekules het meer elektrone as die van broom en het daarom 'n groter polariteit (enige opsie)*
- *Hoe groter die molekule/oppervlakte van die molekule, hoe sterker is die intermolekulêre kragte.* (3)

3.3
- The intermolecular forces between phosphine molecules are dipole-dipole forces/Van der Waals forces. ✓
- The intermolecular forces between ammonia molecules are hydrogen bonds. ✓
- The dipole-dipole forces are weaker than the hydrogen bonds. ✓
- Weaker forces will cause the molecules to evaporate faster/stronger forces will evaporate slower ✓

- *Die intermolekulêre kragte tussen fosfien se molekules is dipool-dipoolkragte/Van der Waalskragte*
- *Die intermolekulêre kragte tussen die molekules van ammoniak is waterstofbindings*
- *Die dipool-dipoolkragte is swakker as die waterstofbindings*
- *Swakker kragte sal veroorsaak dat molekules vinniger verdamp/sterker kragte sal veroorsaak dat molekules stadiger verdamp* (4)

3.4 Bromine ✓/*Broom* ✓ (1)

3.5 **NEGATIVE MARKING FROM 3.4/*NEGATIEWE NASIEN VANAF 3.4***
- The boiling point of bromine is lower than the other two liquids therefore it has weaker intermolecular forces. ✓
- If intermolecular forces are weaker, the vapour pressure will be higher. ✓

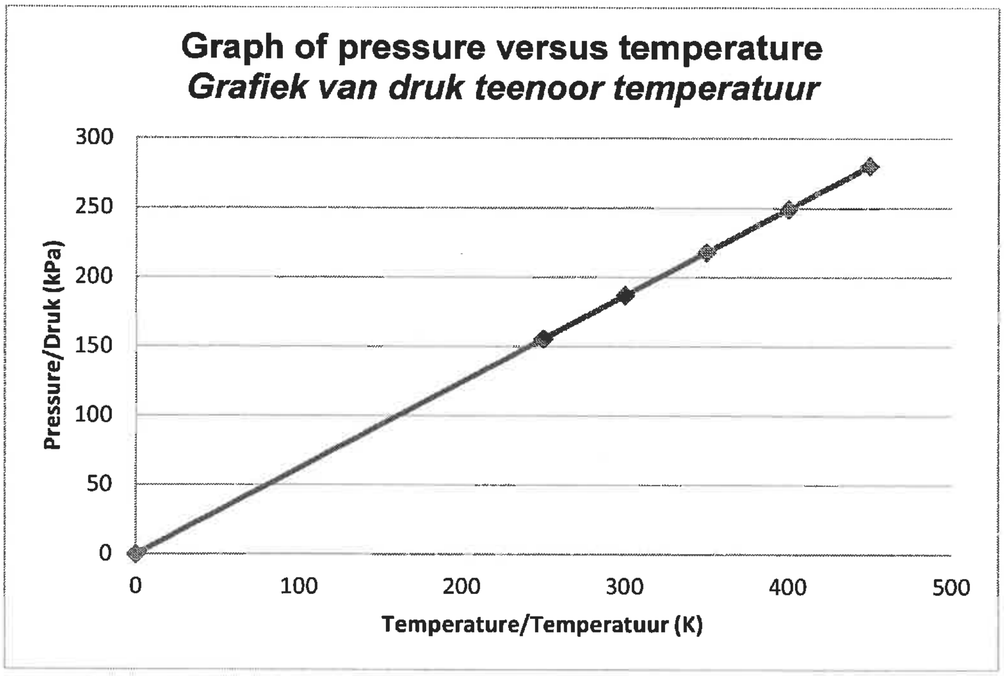
- *Die kookpunt van broom is laer as die ander twee vloeistowwe en het daarom swakker intermolekulêre kragte.*
- *Indien die intermolekulêre kragte swakker is, sal die dampdruk van die vloeistof hoër wees.*

OR/*OF*
- The boiling point of water and ethanol are higher than bromine, therefore it has stronger intermolecular forces.
- If the intermolecular forces are stronger, the vapour pressure will be lower.
Die kookpunt van water en etanol is hoër as broom en het daarom sterker intermolekulêre kragte.
Indien die intermolekulêre kragte sterker is, sal die dampdruk laer wees. (2)

[13]

QUESTION/*VRAAG* 4

4.1



Refer to the last page of the marking guidelines for the graph drawn to scale.
Verwys na die laaste bladsy van die nasienriglyne vir die skaalgrafiek.

Criteria for marking the graph	
Use of correct scale on both axis *Korrekte skaal op die asse*	✓
At least three (3) points plotted correctly *Ten minste drie (3) punte korrek gestip*	✓
Line of best fit drawn *Beste passing lyn getrek*	✓
Graph drawn to the origin *Grafiek getrek deur die oorsprong*	✓

(4)

4.2 Pressure of an enclosed gas is directly proportional to the (absolute) temperature ✓ if the volume stays constant. ✓
OR p α T ✓ when V is constant ✓
OR As the pressure of an enclosed gas increases, the temperature increases proportionately ✓ if the volume stays constant✓

Druk van 'n ingeslote gas is direk eweredig aan die temperatuur ✓ indien die volume konstant bly. ✓
OF *p α T ✓indien V konstant is* ✓
OF *Indien die druk van 'n ingeslote gas verhoog, sal die temperatuur eweredig verhoog ✓indien die volume konstant bly*✓ (2)

4.3 At very low temperature values, the gas will liquify, (not acting like a gas anymore) ✓✓

OR

At low temperature the particles come close together/intermolecular forces become significant ✓ therefor the gas liquify ✓

Teen baie lae tempertuurwaardes sal die gas vervloei en nie soos 'n gas optree nie. ✓✓

OF

Teen baie lae temperature sal die deeltjies baie nader aan mekaar wees/die intermolekulêre kragte word beduidend ✓ en die gas sal vervloei. ✓ (2)

4.4

- If the temperature increases, the average kinetic energy of the particles increases. ✓
- The particles move faster. ✓
- The number of collisions between the particles increase (and force per unit area). ✓
- If the number of collisions increases, the pressure increases. ✓

- *Indien die temperatuur verhoog, neem die gemiddelde kinetiese energie van die deeltjies toe*
- *Die deeltjies beweeg vinniger.*
- *Die aantal botsings tussen die deeltjies neem toe (en die krag per eenheid oppervlak neem toe)*
- *Indien die aantal botsings toeneem sal die druk toeneem.* (4)

4.5 High temperature ✓/*Hoë temperatuur*
Low pressure ✓/*Lae druk* (2)

4.6 Accept any combination of coordinates from the graph for example:
Aanvaar enige kombinasie van koördinate vanaf die grafiek byvoorbeeld:

$$\text{Gradient} = \frac{280{,}5 - 155{,}8 \ ✓}{450 - 250 \ ✓} = 0{,}62 \ ✓$$

OR/OF

$$\text{Gradient} = \frac{280{,}5 - 0 \ ✓}{450 - 0 \ ✓} = 0{,}62 \ ✓$$

OR/OF

$$\text{Gradient} = \frac{249{,}3 - 0 \ ✓}{400 - 0 \ ✓} = 0{,}62 \ ✓$$

OR/OF

$$\text{Gradient} = \frac{218{,}1 - 0 \ ✓}{350 - 0 \ ✓} = 0{,}62 \ ✓$$

(3)

4.7 **POSITIVE MARKING FROM 4.6/*POSITIEWE NASIEN VANAF 4.6***

$$n = \frac{m}{M}$$

$$n = \frac{48}{32} \checkmark$$

n = 1,5 mole/*mol* ✓

From/*Vanaf* $pV = nRT$

$$\text{Gradient} = \frac{nR}{V} \checkmark$$

(**NOTE:** Pressure is in kPa on graph – to use equation it should be in Pa)
*(**LET WEL:** Druk vanaf die grafiek is in kPa en moet eers omgeskakel word na Pa om die formule te gebruik)*

$$620 = \frac{1{,}5(8{,}31)}{V} \checkmark$$

$V = 0{,}\ 02\ m^3$ ✓
($20{,}1\ dm^3$) (5)

[22]

QUESTION/*VRAAG* 5

5.1

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2} \checkmark$$

$$\overset{\checkmark}{\frac{105\ 000(12{,}6)}{298}} = \frac{27\ 640(36{,}3)}{T_2} \checkmark$$

$T_2 = 226$ K
$T_2 = -47$ °C ✓ (4)

5.2 $pV = nRT$ ✓
$(105\ 000)(12{,}6)$ ✓$= n(8{,}31)(298)$ ✓
n = 534,25 mole/*mol* ✓ (4)

[8]

QUESTION/*VRAAG* 6

6.1.1 $2H_2O_2\ (aq)$ ✓ $\rightarrow 2H_2O\ (\ell) + O_2\ (g)$ ✓ (2)

6.1.2 The catalyst lowers the activation energy of the reaction ✓✓
Accept: catalyst speeds up the reaction
'n Katalisator verlaag die aktiveringsenergie van die reaksie ✓✓
Aanvaar: katalisator laat die reaksie vinniger plaasvind (2)

6.1.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n = \frac{V}{V_m}$ ✓ $n = \frac{0,6}{24,45}$ ✓ n = 0,0245 mole/*mol* O_2 produced/*gevorm* $H_2O_2 : O_2$ 2 : 1 ✓ n = 0,049 mole/*mol* H_2O_2 reacted/*reageer* $n = \frac{m}{M}$ ✓ $0,049 = \frac{m}{34}$ ✓ m = 1,67 g ✓ (Accept range 1,36 – 1,67 g) *(Aanvaar 1,36 – 1,67 g)*	From the balanced equation: *Vanaf gebalanseerde vergelyking*: 68g $H_2O_2 \rightarrow 24,45\ dm^3\ O_2$ ✓✓ X g $H_2O_2 \rightarrow 600 \times 10^{-3}\ dm^3$ ✓ $X = \frac{68 \times 0,6}{24,45}$ ✓ ✓ X = 1,67 g ✓

(6)

6.2.1 Magnesium ✓,
the mass of magnesium after 3 minutes/at the end of the reaction was zero ✓
OR the magnesium is used up

Magnesium ✓,
die massa magnesium na 3 minute/aan die einde van die reaksie was nul ✓
OF die magnesium is opgebruik (2)

6.2.2

$$c = \frac{n}{V} \checkmark$$

$$0{,}36 = \frac{n}{0{,}5} \checkmark$$

n = 0,18 mole/*mol*/HCℓ used/*gebruik*

$$n = \frac{m}{M}$$

$$n = \frac{1{,}2}{24} \checkmark$$

n = 0,05 mole/*mol* Mg reacted/*reageer*

Mg : HCℓ
1 : 2 ✓
0,1 mole/*mol* ✓ HCℓ reacted/*reageer*

Moles of HCℓ left in the test tube = $0{,}18 \overset{\checkmark}{-} 0{,}1 = 0{,}08$ mole ✓/*Mol HCℓ ongereageer in die proefbuis = 0,18 – 0,1 = 0,08 mol* (7)

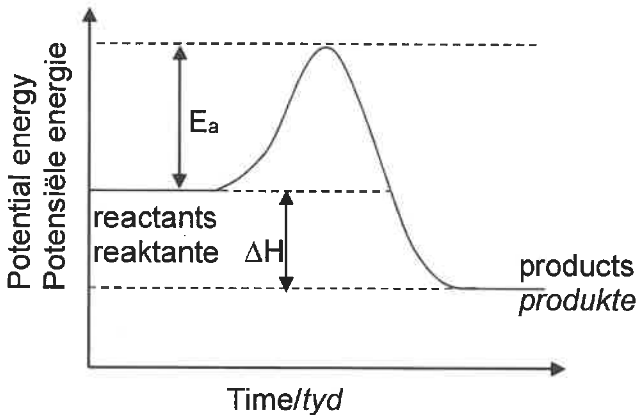
[19]

QUESTION/VRAAG 7

7.1 The minimum energy needed for a reaction to take place. ✓✓
Die minimum energie benodig vir die reaksie om plaas te vind. ✓✓ (2)

7.2 An exothermic reaction ✓ releases energy **OR** $\Delta H < 0$ ✓
'n Eksotermiese reaksie ✓ *stel energie vry* ***OF*** $\Delta H < 0$ ✓ (2)

7.3



MARKING CRITERIA/*NASIENKRITERIA*	
Activation energy E_a correct position and labelled *Aktiveringsenergie E_a korrekte posisie en benoem*	✓
Heat of reaction ΔH correct position and labelled *Reaksiewarmte ΔH korrekte posisie en benoem*	✓
Products have lower energy than reactants *Produkte het laer energie as reaktanse*	✓

(3)

7.4 $C : \frac{82,76}{12} = 6,896$ ✓

$H : \frac{17,24}{1} = 17,24$ ✓

Divide by the smallest answer
Deel deur die kleinste antwoord

$\frac{6,896}{6,896} : \frac{17,24}{6,896}$ ✓

1 : 2,5

2 : 5

C_2H_5 ✓ (4)

[11]

QUESTION/*VRAAG* 8

8.1.1 A base is proton acceptor ✓✓
'n Basis is 'n protonontvanger ✓✓ (2)

8.1.2 $H_2SO_4(aq) + 2NaOH\ (aq)$ ✓ → $Na_2SO_4\ (aq) + 2H_2O\ (\ell)$ ✓ balance/*balans* ✓ (3)

8.1.3 Sodium sulphate ✓✓/*Natriumsulfaat* ✓✓ (2)

8.1.4 HSO_4^- ✓✓ (2)

8.1.5 HSO_4^- and/*en* H_2SO_4 ✓✓
H_2O and/*en* H_3O^+ ✓✓ (4)

8.2.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$c = \frac{m}{MV}$ ✓ $c = \frac{6}{(40)(0,5)}$ ✓ ✓ $c = 0,3\ mol.dm^{-3}$ ✓	$n = \frac{m}{M}$ $n = \frac{6}{40}$ ✓ n = 0,15 mole / *mol* $c = \frac{n}{V}$ ✓ $c = \frac{0,15}{0,5}$ ✓ $c = 0,3\ mol.dm^{-3}$ ✓

(4)

8.2.2

$n = \frac{m}{M}$

$n = \frac{6}{40}$ ✓

n = 0,15 mole/*mol* NaOH

NaOH : $NH_4C\ell$

1 : 1 ✓

$n = \frac{m}{M}$

$0,15 = \frac{m}{53,5}$ ✓

m = 8,025 g $NH_4C\ell$

$\frac{8,025}{10} \times 100 = 80,25\ \%$ pure/*suiwer* ✓

100 – 80,25 ✓ = 19,75 % impurities/*onsuiwerhede* ✓

OR/*OF*

10 – 8,025 = 1,975

$\frac{1,975}{10} \times 100 = 19,75\%$ impurities/*onsuiwerhede*

(6)
[23]

QUESTION/*VRAAG* 9

9.1 Cr^{6+} OR/*OF* (+6) ✓✓ (2)

9.2 Gain of electrons ✓✓
Opneem van elektrone (2)

9.3 Fe^{2+}, ✓ the oxidation number increases from +2 to +3 ✓
Accept Fe if the oxidation numbers explained correctly
Fe^{2+}, ✓ die oksidasiegetal neem toe van +2 na +3 ✓
Aanvaar Fe indien die verduideliking van die oksidasiegetalle korrek is (2)

9.4 Cr^{6+} **OR/*OF*** $Cr_2O_7^{2-}$ ✓✓ (2)

9.5 $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ ✓✓ (2)

9.6 $6Fe^{2+} \rightarrow 6Fe^{3+} + 6e^-$ ✓

$\underline{Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O}$

$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$ ✓✓

NOTE: If Fe-reaction was not shown and only net equation:
marks for reactants, products and balancing
***NOTA**: Indien die Fe-reaksie nie getoon word nie en slegs netto reaksie:*
Punte vir reaktante, produkte en balansering (3)
[13]

QUESTION/*VRAAG10*

10.1 Miners don't risk their lives going deep or being trapped underground. ✓
No risk of sink holes ✓
Mynwerkers het nie 'n lewensgevaarlike risiko om ondergronds vas te val nie.
Daar ontstaan nie sinkgate nie
OR/*OF*
Any other relevant answer/*Enige ander relevante antwoord* (2)

10.2 Reduced, ✓ oxidation number of iron decreases (from 3+ to 0) ✓
Gereduseer, ✓ die oksidasiegetal van yster neem af (van 3+ na 0) ✓ (2)

10.3 Carbon is a non-renewable resource ✓
Carbon dioxide as product can increase global warming ✓
Koolstof is 'n nie-hernubare bron
Koolstofdioksied as produk kan aardverwarming vererger
OR/*OF*
Any other relevant answer/*Enige ander relevante antwoord* (2)

10.4 The gold does not oxidize easily like iron. ✓✓
OR The gold is non-reactive / does not react easily
Die goud oksideer nie so maklik soos yster nie. ✓✓
OF *Goud reageer nie maklik nie / goud is nie reaktiewe metaal nie* (2)

10.5 It acts as oxidising agent. ✓✓/*Dit tree op as oksideermiddel. ✓✓* (2)
[10]

TOTAL/*TOTAAL*: 150

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APPROVED MARKING GUIDELINE
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ANSWER SHEET/ANTWOORDBLAD

Hand in this ANSWER SHEET with the ANSWER BOOK./Lewer hierdie ANTWOORDBLAD saam met die ANTWOORDEBOEK in.

NAME/NAAM: ________________________ **CLASS/KLAS:**_____

QUESTION/VRAAG 4.1

GRAPH OF PRESSURE VERSUS TEMPERATURE/*GRAFIEK VAN DRUK TEENOOR TEMPERATUUR*