GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

JUNE 2018

GRADE 11

PHYSICAL SCIENCES
PAPER 2

CHEMISTRY

MARKS: 150
TIME: 3 hours

13 pages and 2 data sheets

P.T.O.

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Paper 2 (CHEMISTRY)

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INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of EIGHT questions. Answer ALL 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 open 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. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round-off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief substantiations, discussions, et cetera where required.
12. Write neatly and legibly.

SECTION A

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given 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) in the ANSWER BOOK e.g. 1.11 D.

1.1 An ionic bond is formed when the electronegativity difference between atoms is …

A equal to zero.
B less than 1.
C greater than one but less than 2,1.
D greater than 2,1. (2)

1.2 According to the Kinetic Theory, molecules of different gases at the same temperature always have the same …

A average kinetic energy.
B pressure.
C volume.
D potential energy. (2)

1.3 Which of the following represents a mole?

A 18,02 g of water
B 22,4 g of nitrogen gas at STP
C 22,4 dm^3 of water at STP
D 3,2 g of oxygen gas (2)

1.4 The boiling point of CH_4 is much lower than that of H_2O. This is because of …

A dipole-dipole interactions in H_2O.
B hydrogen bonding in H_2O.
C dipole-dipole interactions in CO_2.
D ion-dipole interactions in CO_2. (2)

1.5 BF_3 will most probably have a / an … shape.

A linear
B angular
C trigonal planar
D tetrahedral (2)

1.6 2 g Hydrogen gas, 2 g Oxygen gas and 2 g Carbon dioxide gas are sealed in the same container with fixed walls. Which of the statements below is **correct** regarding the number of moles in the container?

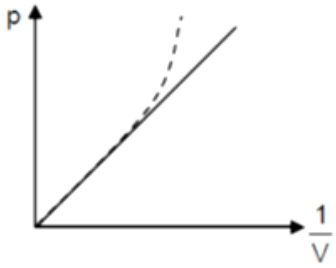
A Hydrogen gas is in excess in the container.
B Oxygen gas is in excess in the container.
C Carbon dioxide is in excess in the container.
D There are equal numbers of moles of each gas in the container. (2)

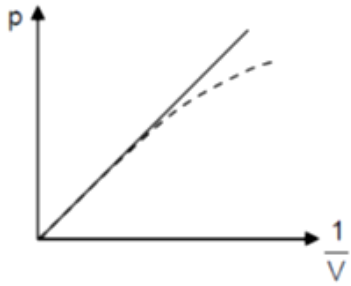
1.7 Which of the following relationships relating to bond length is generally correct?

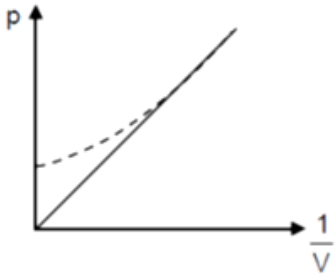
A The shorter the bond, the lesser the bond energy.
B The shorter the bond, the fewer the electrons in it.
C The shorter the bond length, the greater the bond energy.
D The shorter the bond, the lower the bond dissociation energy. (2)

1.8 In which ONE of the following graphs does the dotted line CORRECTLY represent the deviation of a real gas from ideal gas behaviour?

A


B


C


D


(2)

1.9 The temperature (in Kelvin) of a fixed mass of an enclosed gas is given as T. What will the new temperature be if both the pressure and the volume of the gas are doubled?

A ¼ T
B ½ T
C 2 T
D 4 T (2)

1.10 Ozone (O_3) decomposes spontaneously to form $O_2(g)$ according to the following balanced equation.

$$2\ O_3\ (g) \rightarrow 3\ O_2(g)$$

Which ONE of the following statements is correct?

A 96 grams of O_3 decomposes to form 96 grams of O_2.
B 2 grams of O_3 decomposes to form 3 grams of O_2.
C $6{,}02 \times 10^{23}$ molecules of O_3 decomposes to form $2{,}01 \times 10^{23}$ molecules of O_2.
D 3 moles of O_3 decomposes to form 2 moles of O_2. (2)

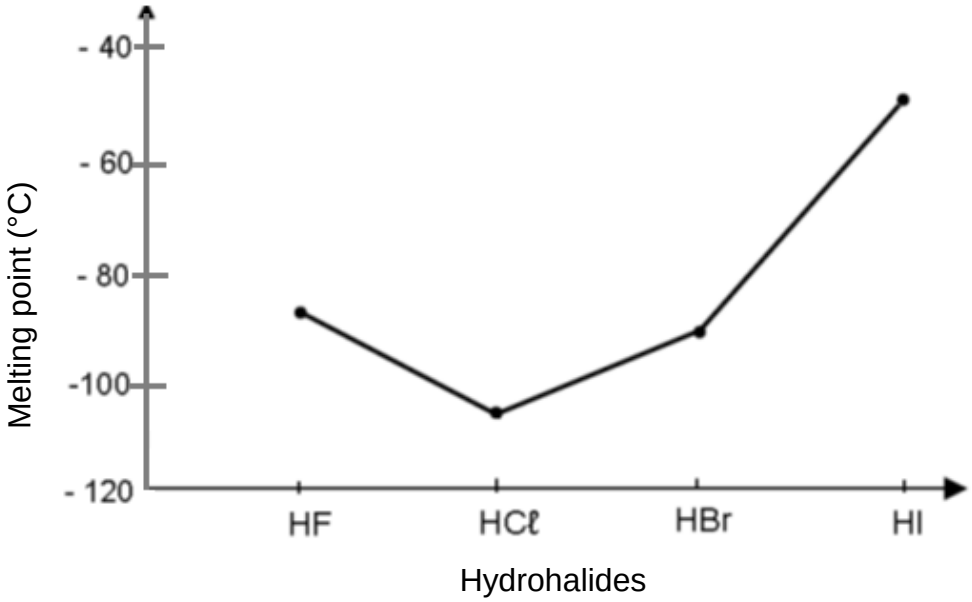
TOTAL SECTION A: [20]

SECTION B

QUESTION 2 (Start on a new page)

2.1. Define the term *Intermolecular forces*. (2)

2.2 Study the following graph and answer the questions.



Identify the intermolecular forces present in the following solids:

2.2.1 HF (1)

2.2.2 HCℓ (1)

2.2.3 Explain the difference in the melting points between the molecules of HCℓ and HI. (6)

2.2.4 Give the name of the Hydrohalide that will require the most energy to undergo the phase change. (2)

2.3 The boiling point of methanol CH_3OH is much higher than the boiling point of methane CH_4.

2.3.1 Define the term *boiling point*. (2)

2.3.2 Explain the difference in boiling points between these two above-mentioned molecules in terms of the intermolecular forces. (3)

[17]

QUESTION 3 (Start on a new page)

3.1 Explain *Lewis diagrams*. (2)

3.2 Study the following compounds and answer the questions that follow.

$NaC\ell$; H_2O ; NH_3 ; H_2

3.2.1 Name the type of chemical bond that exists in each of the above-mentioned molecules / compounds. (3)

3.2.2 Identify the shape of each of the molecules above. (3)

3.2.3 Which of the molecules listed above could form a dative covalent bond? (2)

3.2.4 Use Lewis diagrams to show the formation of the bond in your answer to 3.2.3. (3)

[13]

QUESTION 4 (Start on a new page)

When compared to other liquids, water has some unique physical properties. It has a high specific heat capacity and a high heat of vaporisation, but it has a low viscosity. Water acts as a solvent for many other substances.

4.1 Name the intermolecular forces in H_2O that are responsible for the high heat of vaporisation of water. (2)

4.2 Define the term *heat of vaporisation*. (2)

4.3 Are water molecules polar or non-polar? Explain your answer. (4)

4.4 Explain the term *dipole*. (2)

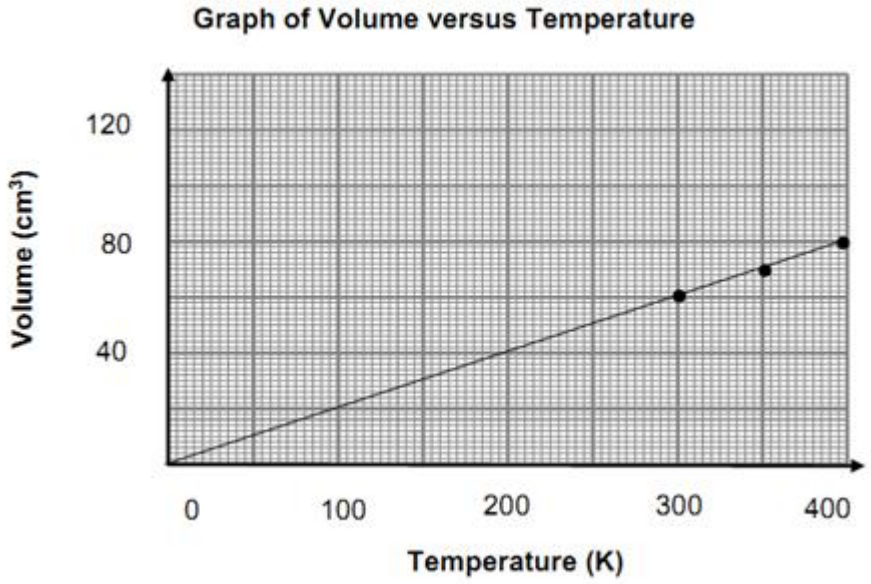
4.5 You are given two substances, KCℓ and I_2. Which one will be able to dissociate in water? (1)

4.6 Give a reason for your answer in question 4.5. (2)

4.7 Water is able to move up in narrow glass tubes. Name and explain this phenomenon. (3)
[16]

QUESTION 5 (Start on a new page)

A group of learners conducted an investigation to verify the relationship between the volume and temperature of a gas. They filled a syringe with helium gas and placed the syringe in water baths at different temperatures. They recorded the results which they used to plot the graph below.



5.1 Define an *ideal gas*. (2)

5.2 Name ONE example of a real gas that behaves the most like an ideal gas. (2)

5.3 What property is defined as a measure of the average kinetic energy of gas molecules? (2)

5.4 Use the information from the graph to answer the following questions:

5.4.1 Identify the dependent and the independent variable for this experiment. (2)

5.4.2 What is the name of the gas law that these learners investigate? (2)

5.4.3 Which TWO variables must be kept constant during the experiment? (2)

5.4.4 Determine the volume (in cm^3) of the gas when the temperature is 25˚ C. (2)

5.4.5 Calculate the pressure of 12 mol He gas held in a 750 cm^3 container at 25 ˚C. (4)

5.5 In the diagram below, a syringe is filled with gas A while the other syringe contains gas B. The volume, temperature and mass of the contents of the two syringes are the same. The pressure of gas A is a half of that of gas B.

5.5.1 How does the amount of moles of gas A compare to that of gas B? Write only HIGHER, LOWER or REMAINS THE SAME. (1)

5.5.2 Explain your answer in 5.5.1. (2)
[21]

QUESTION 6 (Start on a new page)

6.1 In an experiment 45.5 g of Zn and 50g of HCℓ are reacted together and it produces the products as illustrated in the unbalanced reaction below:

$$\mathbf{Zn + HC\ell \rightarrow ZnC\ell_2 + H_2}$$

6.1.1 Re-write and balance the above reaction. (2)

6.1.2 Determine by means of a calculation which one of the two reactants is the limiting reactant. (4)

6.1.3 Determine the mass of the reactant in excess at the end of the reaction. (3)

6.1.4 Calculate the volume of the $H_2(g)$ formed at the end of the reaction. (3)

6.2 The complete combustion of methane gas produces carbon dioxide and water. Assume that 3 moles of methane are burned in the presence of excess O_2 according to the following balanced equation:

$$\mathbf{CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O}$$

6.2.1 Calculate the mass of the carbon dioxide that can be produced from this reaction. (4)

6.2.2 Calculate the percentage yield if the actual yield of carbon dioxide in this reaction is 87g. (3)

6.3 Diluted acetic acid (vinegar) has the following percentage composition:

39,9 % carbon
6,7 % hydrogen
53,4 % oxygen

Determine the molecular formula of acetic acid if the molar mass of acetic acid is 60 $g{\cdot}mol^{-1}$. (6)
[25]

QUESTION 7 (Start on a new page)

Most modern cars are equipped with airbags for both the driver and the passenger. The following is the unbalanced reaction of sodium azide (a compound found in airbags) which is activated by an electrical signal:

$$\mathbf{NaN_3\ (s) \rightarrow Na(s) + N_2(g)}$$

7.1 How many Nitrogen atoms are present in 12g of sodium azide? (5)

7.2 Balance the given equation above. (3)

7.3 Calculate the mass of NaN_3 needed to inflate a sample airbag with a volume of 85 dm^3 at STP. Assume the temperature of the gas remains constant during the reaction. (5)

7.4 Define the term *Empirical formula*. (2)

7.5 Prove that the empirical formula of sodium azide is NaN_3 using the following information:

35,39 % of sodium azide by mass is made up of sodium. (3)

7.6 In reality the above reaction is very exothermic.

7.6.1 Will the pressure in the sample airbag INCREASE, DECREASE or REMAIN THE SAME, as the gas temperature, returns from very high, to 25°C? (2)

7.6.2 Explain your answer in 7.6.1 in terms of the kinetic molecular theory. (3)

[23]

QUESTION 8 (Start on a new page)

Potassium chlorate decomposes completely to form potassium chloride and a certain gas. A learner can verify the gas as it promotes combustion.

8.1 Write down the chemical NAME of the gas that forms. (2)

8.2 Write a balanced equation of this reaction. (4)

8.3 Calculate the number of K^+ ions obtained when 16,2 g potassium chlorate decomposes. (4)

8.4 During the actual reaction it was found that only 7,2 g of potassium chloride was formed, when 16,2 g potassium chlorate decomposed. Calculate the percentage purity of the reactant. (5)

TOTAL SECTION B: [15]

TOTAL 150

END

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

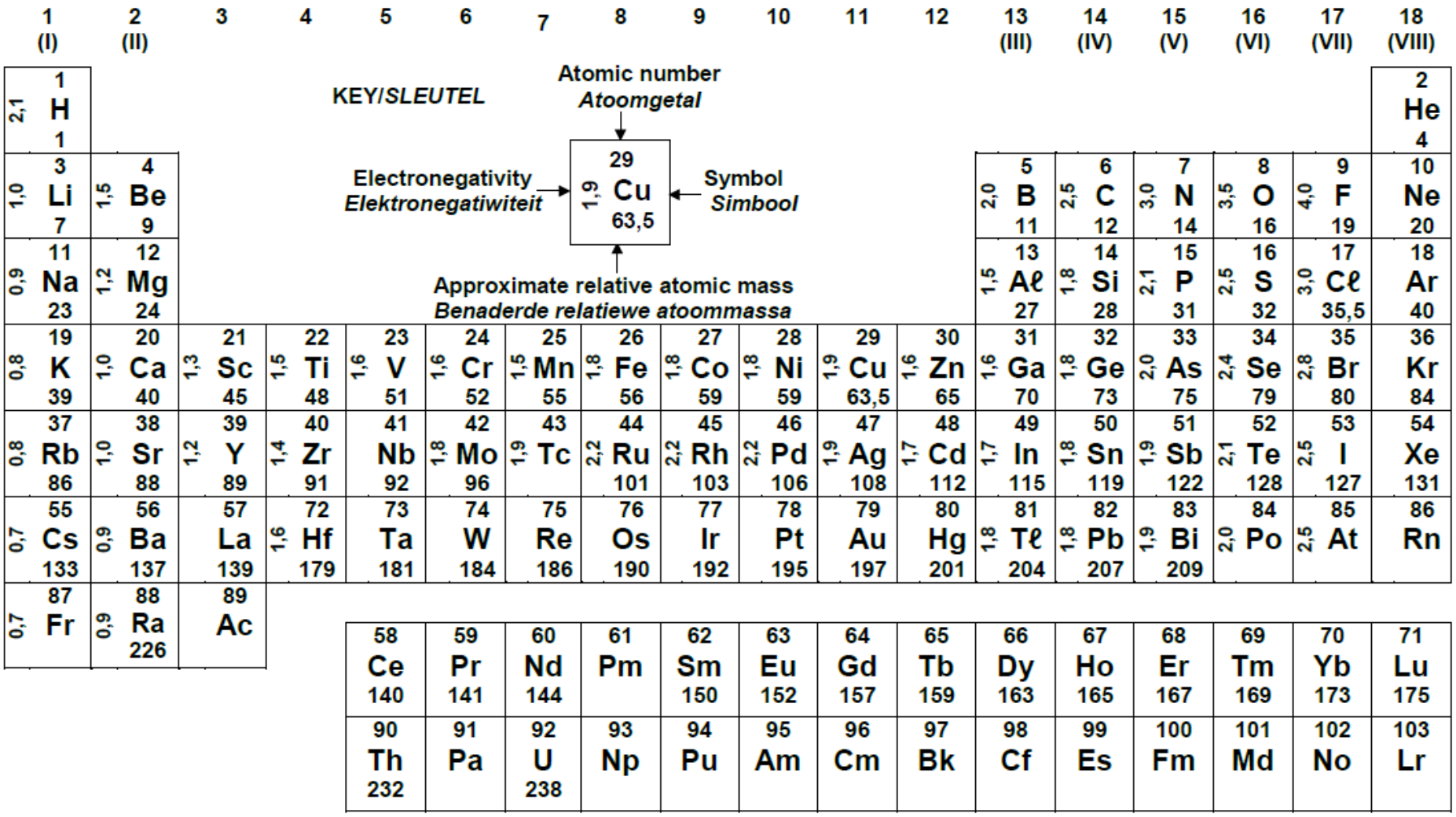
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

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·K^{-1}·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·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* $c=\frac{m}{MV}$



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)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	Xe 131
0,7 Cs 133	0,9 Ba 137	La 139	1,6 Hf 179	Ta 181	W 184	Re 186	Os 190	Ir 192	Pt 195	Au 197	Hg 201	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	Rn
0,7 Fr	0,9 Ra 226	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