GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

JUNE 2016

GRADE 11

PHYSICAL SCIENCES
CHEMISTRY
(PAPER 2)

NAME OF LEARNER: ____

GRADE 11 __________

TIME: 180 minutes (3 hours)

MARKS: 150

13 pages + 2 data sheets and 1 answer sheet

P.T.O.

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PHYSICAL SCIENCES
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(Paper 2)

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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 NINE questions. Answer ALL questions in the ANSWER BOOK, except for Question 6.5 which has to be answered on the ANSWER SHEET attached to this question paper. Write your name in the appropriate space on the ANSWER SHEET. Detach the ANSWER SHEET and submit it together with your ANSWER BOOK.
3. Start the answer to each question on a NEW page in the ANSWER BOOK.
4. Number the answers 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 strongly 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 explanations, discussions, et cetera where required.

12 Write neatly and legibly.

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 E.

1.1 Which of the following molecules is a polar molecule?

A CH_4
B Cl_2
C CO_2
D HCl (2)

1.2 *Bond length* is the distance between …

A the orbitals of two attached atoms.
B the nuclei of two attached atoms.
C the electrons in two attached atoms.
D the molecules of the same substance. (2)

1.3 Hydrogen bonding is a special case of …

A London-dispersion forces.
B ion-dipole attraction.
C dipole-dipole attractions.
D ion-ion interactions. (2)

1.4 When NaCl dissolves in water, aqueous Na^+ and $C\ell^-$ ions result. The force of attraction that exists between Na^+ and H_2O is called a(n) … interaction.

A dipole-dipole
B ion-ion
C hydrogen bonding
D ion-dipole (2)

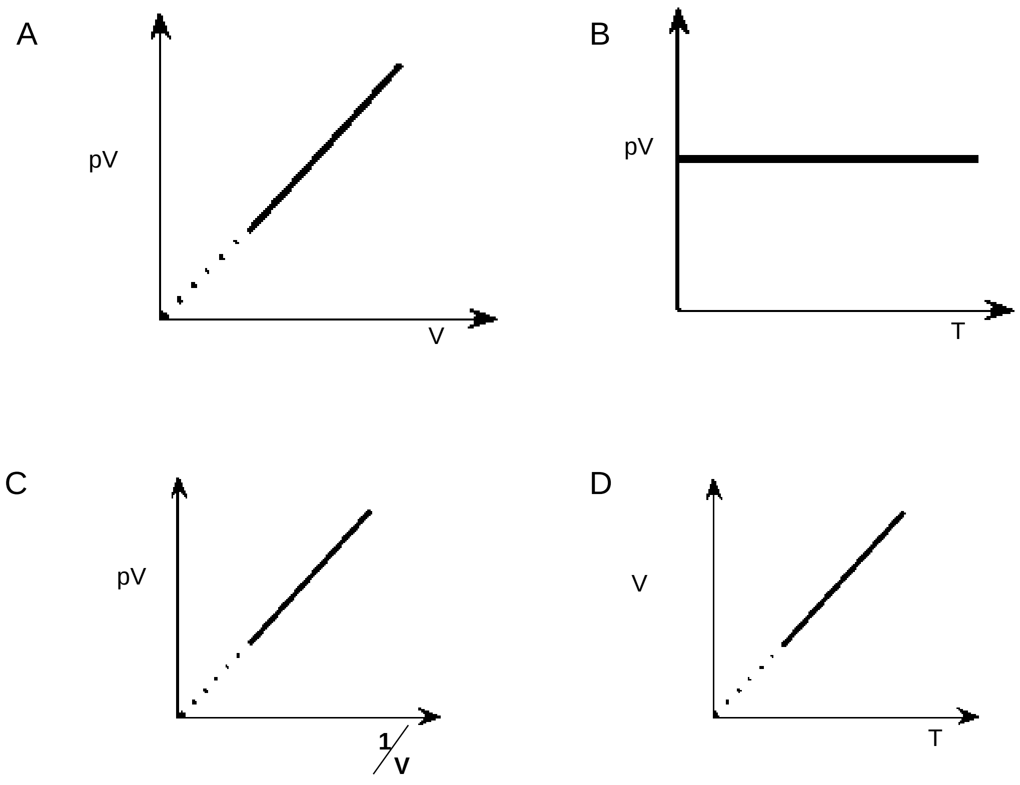
1.5 A fixed mass of oxygen gas is sealed in a syringe at a certain temperature and pressure. The gas has a volume V. If both the pressure and the Kelvin temperature are now doubled, the volume of the gas will be ...

A V
B ½ V
C 2 V
D 4 V (2)

1.6 The temperature of a gas is ...

A directly proportional to the volume, if the pressure is kept constant.
B proportional to the pressure of the gas.
C determined by the amount of the gas molecules present in the sample.
D an indication of the average kinetic energy of the gas molecules. (2)

1.7 The relationship between p, V and T, for 1 mol of an enclosed gas was investigated and the results are plotted below. In which ONE of the graphs does the gradient of the line represent the universal gas constant (R)?



(2)

1.8 How many mole of copper (I) oxide are there in 52,8 g of the substance?

A 0,369 mole
B 0,664 mole
C 1,51 mole
D 2,71 mole (2)

1.9 8 mole of zinc is mixed with 7 mole of hydrochloric acid and allowed to react to form zinc chloride and hydrogen gas, according to the following balanced equation:

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

If 2 mole of H_2(g) is formed during the reaction, the number of mole of Zn(s) and HCℓ(aq) that remain in the container are respectively:

	Mole of Zn	**Mole of HCℓ**
A	6	5
B	6	3
C	0	0
D	0	5

(2)

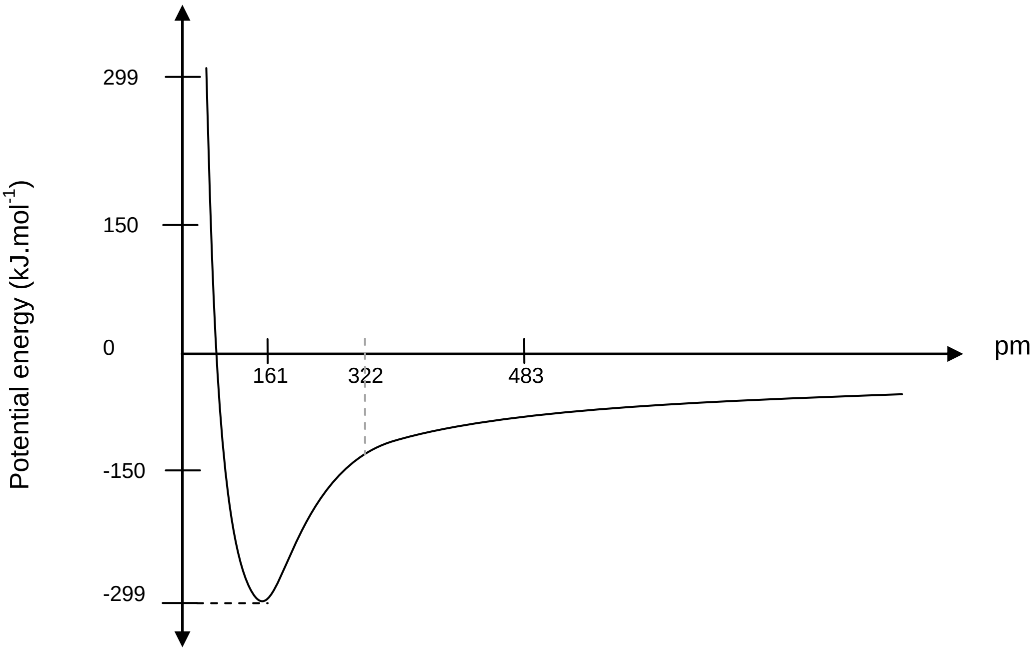
1.10 13,93 g of zinc has the same number of particles as …

A 3,2 g of calcium.
B 12 g of iron.
C 3 g of nitrogen.
D 5 g of sulphur. (2)

[20]

QUESTION 2: (Start on a new page.)

The graph below shows how the potential energy changes as two atoms (H and I) approach each other (pm = picometre = 1 x 10^{-12} m)



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

2.2 From the graph, write down the value of the bond length (in pm). (2)

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

2.4 From the graph, write down the value of the bond energy. (2)

2.5 How will the bond length of the H-Cl bond compare to that of the H-I bond? Write down **SHORTER THAN, EQUAL TO** or **LONGER THAN**. Explain your answer. (3)

[11]

QUESTION 3: (Start on a new page.)

3.1 Define the term *electronegativity*. (2)

3.2 On your periodic table the electronegativity of oxygen is 3,5 and that of nitrogen is 3,0. Why is oxygen more electronegative than nitrogen? (3)

3.3 Consider the following compounds and answer the questions that follow:

$$\mathbf{C\ell_2 \quad H_2O \quad PC\ell_3}$$

3.3.1 Use the difference in electronegativity to identify the intra-molecular bonds in each of the compounds above. Show all calculations. (3)

3.3.2 Draw the Lewis diagram for $PC\ell_3$. Identify the shape of the $PC\ell_3$ molecule and explain whether it will be a polar or non-polar molecule, with reference to the bonds and molecular shape. (3)

3.3.3 Explain the difference between a polar bond and a polar molecule, using the compounds $CHC\ell_3$ and $CC\ell_4$ as examples. (4)
[15]

QUESTION 4: (Start on a new page.)

Carbon dioxide, sulphur dioxide and ammonia are some of the substances we encounter in our daily lives and through the household products we use on a daily basis.

Complete the table below by providing only the answer next to the question number.

Chemical Substance	**Lewis structure**	**Shape of the molecule using VSEPR theory**	**Intermolecular forces between the molecules**
4.1 SO_2	4.1.1	4.1.2	4.1.3
4.2 CO_2	4.2.1	4.2.2	4.2.3
4.3 NH_3	4.3.1	4.3.2	4.3.3
4.4 NH_4^+	4.4.1	4.4.2	4.4.3

(12)

4.5 Name and explain the bond formed between NH_3 and H^+ to form ammonium in 4.4 (4)

[16]

QUESTION 5: (Start on a new page.)

In the table below the melting points and boiling points of different substances at standard pressure are given. Use this information to answer the following questions.

Substance	Melting point °C	Boiling point °C
He	-272	-269
HBr	−86.9	−66.8
CCl_4	-23	77
CO_2	Sublimes at -79	
CH_4	-184	-162
H_2O	0	100

5.1 In which ONE of the substances will the weakest intermolecular forces exist in the solid phase? (2)

5.2 Name the type of intermolecular forces that exists between the following:

5.2.1 The molecules of CO_2 (2)

5.2.2 The molecules of H_2O (2)

5.3 Which one of the substances is a liquid at -10 °C? (2)

5.4 Explain the difference between the melting and boiling points of HBr and H_2O. (4)

5.5 Describe what happens to CO_2 at -79° C. (2)

[14]

QUESTION 6: (Start on a new page.)

A learner investigates the relationship between the pressure and volume of a given amount of gas at a constant temperature. The following readings are obtained:

Pressure (kPa)	Volume (cm^3)	$\frac{1}{\text{pressure}}$ (kPa^{-1})
62	103	
70	88	
80	73	
90	62	
110	42	
180	25	
250	18	
360	10	

Complete the table on the ANSWER SHEET and then answer the following questions.

6.1 Name and state the law that is being investigated in this experiment. (3)

6.2 Identify the following variables for this experiment:

6.2.1 Independent variable (2)

6.2.2 Dependent variable (2)

6.3 Name TWO variables that must be kept constant in this experiment. (2)

6.4 Write an investigative question for this experiment. (2)

6.5 Sketch a graph of volume (on y-axis) against $\frac{1}{\text{pressure}}$ (on x-axis) using the graph paper provided on the ANSWER SHEET. (4)

[15]

QUESTION 7: (Start on a new page.)

7.1 Name THREE properties of an ideal gas. (3)

7.2 Under which circumstances do real gases behave like an ideal gas? (2)

7.3 Name the model that describes the movement of particles in the three states of matter. (2)

7.4 A diver dives down into the sea, to where the temperature is 10°C and the pressure is 150 kPa. He releases a bubble of air from his lungs. The volume of the bubble, when released is 5 cm^3.
Calculate the volume of the bubble when it reaches the surface of the sea, where the temperature is 25°C. (4)

7.5 When 35 g of an unknown gas is pumped into a closed, empty 12 dm^3 container at a constant temperature of 55°C, the pressure inside the container is 285 x 10^3 Pa.

7.5.1 Calculate the number of mole of gas in the container. (4)

7.5.2 What is the molar mass of the gas? (3)

7.5.3 Identify the gas. (2)

7.6 For what does STP stand? (2)

7.7 At STP, what volume will 3 mole of any gas occupy? (3)

7.8 5,4 mole of carbon dioxide is at STP. What volume does the CO_2 have? (3)
[28]

QUESTION 8: (Start on a new page.)

8.1 A laboratory analysis of a compound shows that it has the following chemical composition:

Carbon: 76 % **Hydrogen: 12,5%** **Oxygen: 11,5%**

8.1.1 Determine the empirical formula for the compound. (5)

8.1.2 Determine the molecular formula if the molar mass of the compound is 282 $g.mol^{-1}$ (4)

8.2 14,5 g of iron reacts with 12 g of water during a corrosion reaction to form Fe_3O_4 and H_2, according to the following equation.

$$Fe + H_2O \rightarrow Fe_3O_4 + H_2$$

8.2.1 Balance the equation. (3)

8.2.2 Find the substance which is the limiting reactant? Show your calculations. (6)

8.2.3 Using the calculations in your answer to Question 8.2.2, determine the mass of Fe_3O_4 that will be formed. (3)

8.3 Chalk is almost pure calcium carbonate. If 10 g of chalk was reacted with an excess of dilute hydrochloric acid, 2.128 litres of carbon dioxide gas is collected at STP.

$$CaCO_3\ (s) + 2HCl\ (aq) \rightarrow CaCl_2\ (aq) + H_2O\ (l) + CO_2\ (g)$$

Determine the purity of calcium carbonate. (Tip: Start by measuring how much carbon dioxide is given off.) (5)

[26]

QUESTION 9: (Start on a new page.)

A learner pours herself a glass of Coke and adds some ice cubes to it. She sees that the ice cubes drift up and float in the Coke.

9.1 Which characteristic of ice allows it to float at the top of the Coke? (1)

9.2 Which property of water allows it to remain in the liquid phase over a wider temperature range? Why is this feature important for life on earth? (2)

9.3 Name and describe another characteristic of water that is NOT discussed in Questions 9.1 and 9.2. (2)
[5]

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* $c = \frac{m}{MV}$

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**

ANSWER SHEET

QUESTION 6

NAME OF LEARNER:_________________________

Pressure (kPa)	Volume (cm^3)	$\frac{1}{\text{pressure}}$ (kPa^{-1})
62	103	
70	88	
80	73	
90	62	
110	42	
180	25	
250	18	
360	10	