



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

**PHYSICAL SCIENCES P2
(CHEMISTRY)**

COMMON TEST

JUNE 2019

MARKS: 100

TIME : 2 Hours

This question paper consists of 9 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK**.
2. Answer **ALL** the questions in the answer book.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. Number the answers correctly according to the numbering system used in this question paper.
6. **YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.**
7. Give brief motivations, discussions, et cetera where required.
8. Show the formulae and substitutions in **ALL** calculations.
9. Round off answers to a minimum of **TWO** decimal places

QUESTION 1: MULTIPLE- CHOICE QUESTIONS

Four options are provided 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 – 1.7) in the ANSWER BOOK. Eg 1.8 A

1.1 The shape of the OF_2 molecule is :

- A Trigonal pyramidal
- B Linear
- C Bent
- D Tetrahedral

(2)

1.2 Which statement BEST explains the formation of the dative bond between ammonia (NH_3) and the hydrogen ion (H^+)?

- A Both NH_3 and H^+ are polar
- B The NH_3 molecule has a lone pair of electrons and the H^+ ion has an empty orbital.
- C H^+ ion is regarded as a proton and is attracted to the electrons on the nitrogen atom of the NH_3 molecule.
- D The electronegativity of the nitrogen atom is greater than the electronegativity of hydrogen.

(2)

1.3 Which ONE of the following statements concerning ideal gases is **INCORRECT**?

- A Ideal gases do not exert pressure
- B Ideal gas molecules do not occupy a volume
- C The collision between ideal gas molecules is elastic
- D There are no intermolecular forces between ideal gas molecules.

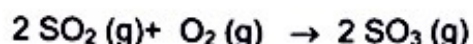
(2)

1.4 Which ONE of the following statements regarding the effect of intermolecular forces and some physical properties is **INCORRECT**?

- A The stronger the intermolecular force, the slower the rate of evaporation.
- B The weaker the intermolecular force, the lower the boiling point.
- C The stronger the intermolecular force, the higher the surface tension.
- D The stronger the intermolecular force, the lower the melting point..

(2)

- 1.5 2,50 mol of SO_2 and 1 mol of O_2 are sealed in a 1 dm^3 flask and allowed to react completely at STP according to the following balanced equation.



The TOTAL number of moles of gas in the flask at the END of the reaction is:

- A 2
B 3,50
C 2,50
D 0,50 (2)
- 1.6 The gas law that expresses the relationship between pressure and temperature of a gas is known as:
- A Charle's Law
B Gay- Lussac Law
C Boyle's Law
D Avogadro's Law (2)
- 1.7 The type of intermolecular force involved when CO_2 is added to water is :
- A Dipole- induced dipole forces
B London forces
C Covalent bonds
D Ion – induced dipole forces (2)

TOTAL : SECTION A [14]

QUESTION 2

Consider the substances in the table below. Select the correct answer for each of the questions that follow. Write down only the LETTER that corresponds to your choice

	SUBSTANCE		SUBSTANCE
A.	HCN	F	H ₂ O
B	MgCl ₂	G	CCl ₄
C	I ₂	H	CO ₂
D	NH ₄ ⁺	I	C ₂ H ₂
E	Cl ₂	J	H ₂ S

2.1 Identify

- 2.1.1 TWO molecules that have triple bonds. (2)
- 2.1.2 TWO substances that when mixed together will result in ion-dipole forces of attraction. (2)
- 2.1.3 A non-polar LIQUID at room temperature (1)
- 2.1.4 A MOLECULE having a tetrahedral shape. (1)
- 2.1.5 A SOLID that is insoluble in water. (1)
- 2.1.6 A GAS at room temperature with pure covalent bonds between its atoms. (1)

- 2.2 Compounds F (H₂O) and J (H₂S) are hydrides of group 6 elements. H₂O has a lower molar mass than H₂S, but a higher boiling point than H₂S.

Explain fully why H₂O has a higher boiling point than H₂S, by referring to the types and strengths of the intermolecular forces in each and the energy involved. (4)

- 2.3 Draw the Lewis structure for compound G (CH₄) (2)

- 2.4 Compound H (CO₂) has polar covalent bonds in the molecule.

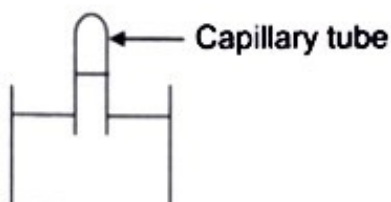
2.4.1 Is the compound CO₂ polar or non-polar? Explain fully. (3)

2.4.2 Name the type of intermolecular forces found in this compound. (1)

[18]

QUESTION 3

Grade 11 learners investigated the effect of intermolecular force on capillarity. They pour 100ml each of **water; glycerine and nail polish remover** in separate beakers. A capillary tube is inserted into each liquid and after a while, the level of liquid in the capillary tube is measured.



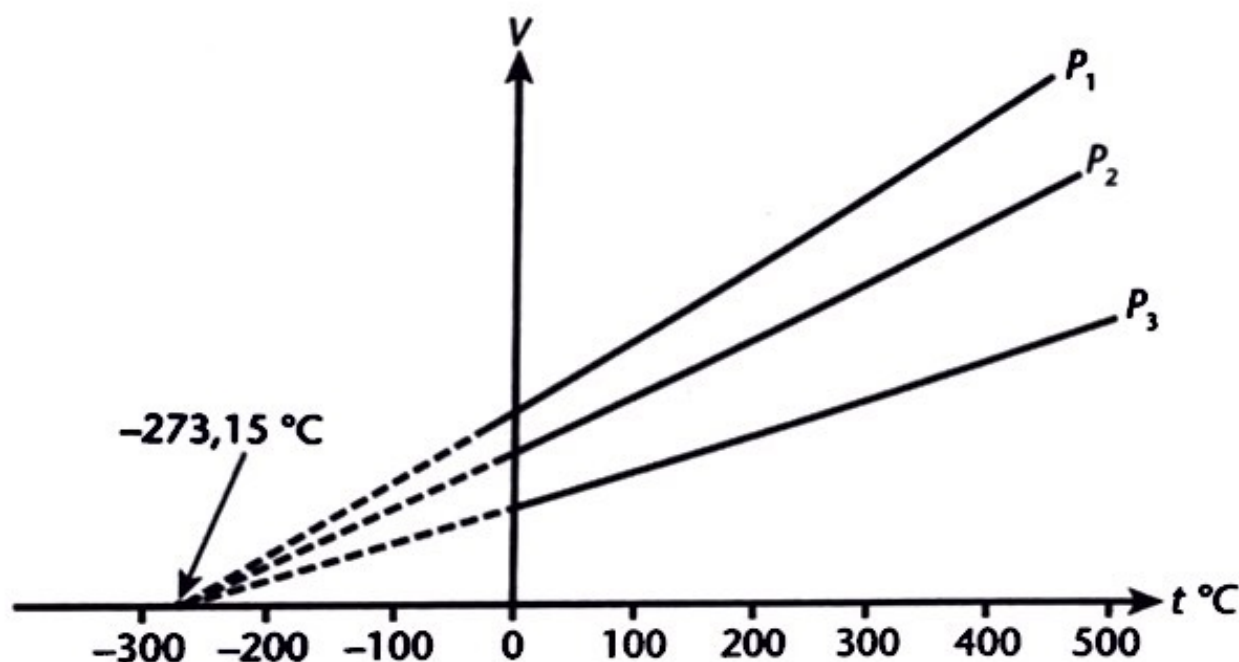
They recorded their results in a table as follows:

Liquid	Height (mm)
Water	19
Glycerine	5
Nail polish remover	26

- 3.1 State the dependent variable in the above investigation. (1)
- 3.2 Which liquid displayed the greatest degree of capillarity? (1)
- 3.3 Explain the answer to question 3.2 above. (3)
- 3.4 Use the results in the table and arrange the liquids in order of **INCREASING STRENGTH** of intermolecular force that is, from the weakest intermolecular force to the strongest intermolecular force. (2)
- 3.5 Identify the liquid with the highest boiling point. (1)
- [8]**

QUESTION 4

- 4.1 The graph below shows the relationship between the volume and Celsius temperature of an enclosed gas maintained at a constant pressure, P_1 . The experiment is repeated for different constant pressures P_2 and P_3 .

Graph of volume against temperature

- 4.1.1 Give the name, and state in words, the Law that is illustrated in the graph. (3)
- 4.1.2 Apart from pressure, state ONE other variable that must be kept constant for each experiment (1)
- 4.1.3 What is the relationship between the volume and temperature of the gas? (1)
- 4.1.4 Which one of the 3 pressures, P_1 ; P_2 or P_3 is the HIGHEST? (1)
- 4.1.5 Fully explain the answer to question 4.1.4 above. Use a relevant equation to support your explanation. (3)
- 4.2 A 10 dm^3 steel vessel that holds a sample of oxygen gas at 25°C and 100 kPa develops a leak. Some of the oxygen gas escapes before the leak is repaired. The pressure of the O_2 in the vessel after the leak is repaired is 55 kPa . The temperature remains at 25°C .

Calculate the mass of oxygen gas that leaked.

(8)

[17]

QUESTION 5

A compound contains the elements carbon, hydrogen and oxygen only. It consists of 54.56% carbon and 36.36% hydrogen. The molar mass of the compound is 132 g.mol^{-1} .

- 5.1 State the definition of *empirical formula*. (2)
- 5.2 Calculate the empirical formula of the compound. (6)
- 5.3 Determine the molecular formula of the compound. (2)
- [10]**

QUESTION 6

Iron is recovered from iron ore (Fe_2O_3) in a blast furnace. The following reaction takes place.



In one such reaction, 160g of **impure** iron ore was reacted and 63 dm^3 of CO_2 was produced at STP.

- 6.1 Write down the definition of the *mole*. (2)
- 6.2 Calculate the number of CO_2 molecules that formed at STP (4)
- 6.3 Calculate the maximum no of moles of iron that will be formed in the above reaction. (2)
- 6.4 Calculate the percentage purity of the iron ore sample used. (4)
- [12]**

QUESTION 7

Industrially, vanadium metal, (V) which is used in steel alloys can be obtained by reacting vanadium pentoxide(V_2O_5) with calcium at high temperatures. The balanced equation for the reaction is:



During an industrial process 31850 g of V_2O_5 reacts with $2 \times 10^4 \text{ g}$ of Ca.

- 7.1 State the definition of a *limiting reagent*. (2)
- 7.2 Calculate the theoretical yield of vanadium. (6)
- 7.3 Calculate the percentage yield if $8,67 \times 10^3 \text{ g}$ of vanadium is obtained. (2)

[10]

QUESTION 8

4.14 g of solid LiNO_3 is first dissolved in a small amount of water and then made up to a certain final volume so that the concentration of the solution is $0,05 \text{ mol.dm}^{-3}$

- 8.1 Write down the definition of *concentration*. (2)
- 8.2 Calculate the number of moles of LiNO_3 used. (2)
- 8.3 Calculate the final volume of the solution. (3)
- 8.4 An additional 250 cm^3 of water is now added to this solution. Calculate the new concentration of the solution (4)

[11]**TOTAL MARKS: 100**

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(i)	(ii)											(iii)	(iv)	(v)	(vi)	(vii)	(viii)
1 H	2 He																
3 Li	4 Be																
5 Na	6 Mg																
7 Li	8 Be																
9 Na	10 Mg																
11 Na	12 Mg																
13 Al	14 Si																
15 P	16 S																
17 Cl	18 Ar																
19 K	20 Ca																
21 Sc	22 Ti																
23 V	24 Cr																
25 Mn	26 Fe																
27 Co	28 Ni																
29 Cu	30 Zn																
31 Ga	32 Ge																
33 As	34 Se																
35 Br	36 Kr																
37 Rb	38 Sr																
39 Y	40 Zr																
41 Nb	42 Mo																
43 Tc	44 Ru																
45 Rh	46 Pd																
47 Ag	48 Cd																
49 In	50 Sn																
51 Sb	52 Te																
53 I	54 Xe																
55 Cs	56 Ba																
57 La	58 Ce																
59 Pr	60 Nd																
61 Pm	62 Sm																
63 Eu	64 Gd																
65 Tb	66 Dy																
67 Ho	68 Er																
69 Tm	70 Yb																
71 Lu	72 Hf																
73 Ta	74 W																
75 Re	76 Os																
77 Ir	78 Pt																
79 Au	80 Hg																
81 Tl	82 Pb																
83 Bi	84 Po																
85 At	86 Rn																
87 Fr	88 Ra																
89 Ac	90 Th																
91 Pa	92 U																
93 Np	94 Pu																
95 Am	96 Cm																
97 Bk	98 Cf																
99 Es	100 Fm																
101 Md	102 No																
103 Lr	104 Th																
105 Pa	106 U																
107 Fr	108 Ra																
109 Ac	110 Th																
111 Pa	112 U																
113 Np	114 Pu																
115 Am	116 Cm																
117 Bk	118 Cf																
119 Es	120 Fm																
121 Md	122 No																
123 Lr	124 Th																
125 Pa	126 U																
127 Fr	128 Ra																
129 Ac	130 Th																
131 Np	132 Pu																
133 Am	134 Cm																
135 Bk	136 Cf																
137 Es	138 Fm																
139 Md	140 No																
141 Lr	142 Th																
143 Pa	144 U																
145 Np	146 Pu																
147 Am	148 Cm																
149 Bk	150 Cf																
151 Es	152 Fm																
153 Md	154 No																
155 Lr	156 Th																
157 Pa	158 U																
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165 Es	166 Fm																
167 Md	168 No																
169 Lr	170 Th																
171 Pa	172 U																
173 Np	174 Pu																
175 Am	176 Cm																
177 Bk	178 Cf																
179 Es	180 Fm																
181 Md	182 No																
183 Lr	184 Th																
185 Pa	186 U																
187 Np	188 Pu																
189 Am	190 Cm																
191 Bk	192 Cf																
193 Es	194 Fm																
195 Md	196 No																
197 Lr	198 Th																
199 Pa	200 U																
201 Np	202 Pu																
203 Am	204 Cm																
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207 Es	208 Fm																
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213 Pa	214 U																
215 Np	216 Pu																
217 Am	218 Cm																
219 Bk	220 Cf																
221 Es	222 Fm																
223 Md	224 No																
225 Lr	226 Th																
227 Pa	228 U																
229 Np	230 Pu																
231 Am	232 Cm																
233 Bk	234 Cf																
235 Es	236 Fm																
237 Md	238 No																
239 Lr	240 Th																
241 Pa	242 U																
243 Np	244 Pu																
245 Am	246 Cm																
247 Bk	248 Cf																
249 Es	250 Fm																
251 Md	252 No																
253 Lr	254 Th																
255 Pa	256 U																
257 Np	258 Pu																
259 Am	260 Cm																
261 Bk	262 Cf																
263 Es	264 Fm																
265 Md	266 No																
267 Lr	268 Th																
269 Pa	270 U																
271 Np	272 Pu																

KEY/SLEUTEL

Atomic number
Atoomgetal/Electronegativity
ElektronegativiteitSymbol
SimboolApproximate relative atomic mass
Benaderde relatieve atoommassa

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p°	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \text{ mol}^{-1}$
Molêre gaskonstante Molar gas constant	R	$8,31 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T°	273 K
Avogadro's Constant	N of/or N_A	$6,022 \times 10^{23} \text{ mol}^{-1}$
Charge on Electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$C = \frac{n}{V}$ or/of $C = \frac{m}{MV}$	$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$ $pV = nRT$
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