Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES P2 (CHEMISTRY)

COMMON TEST

MARCH 2018

MARKS: 50

TIME : 1 Hour

This question paper consists of 7 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK**.

4. Answer **ALL** the questions in the answer book.

5. You may use a non-programmable calculator.

6. You may use appropriate mathematical instruments.

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

8. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.

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

SECTION A

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 – 1.4) in the ANSWER BOOK. Eg 1.5 A

1.1 Which one of the following statements concerning bond energy is **NOT TRUE**?

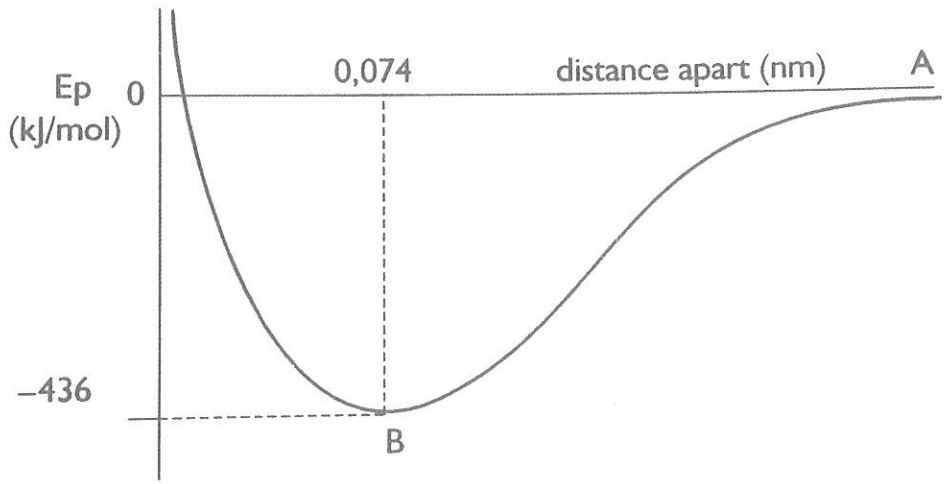
A. Bond energy increases as bond length decreases

B. Bond energy increases as atomic radius decreases

C. The higher the bond energy, the stronger the bond

D. Bond energy is smaller in multiple bonds than in single bonds (2)

1.2. The graph below shows the potential energy changes of a system of 2 hydrogen atoms as the distance between the 2 hydrogen nuclei changes.



Which of the following correctly represents the values for the bond energy and bond length respectively?

	Bond energy ($kJ.mol^{-1}$)	Bond length (nm)
A.	0.074	-436
B.	-436	0.074
C.	7.40×10^{-11}	-436
D.	-436	7.40×10^{-11}

(2)

1.3 The shape of the PCl_5 molecule as predicted by the VSEPR theory is:

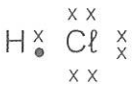
A. Trigonal Bi-pyramidal

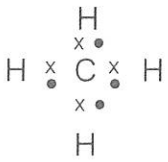
B. Octahedral

C. Trigonal planar

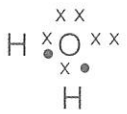
D. Trigonal pyramidal (2)

1.4. Which one of the following electron-dot structures represents a non-polar molecule?

A. 

B. 

C. 

D. 

(2)

TOTAL : SECTION A :[8]

SECTION B

INSTRUCTIONS AND INFORMATION

1. Answer all questions.
2. Show the formulae and substitutions in ALL calculations.
3. Round off your numerical answers to a minimum of TWO decimal places.

QUESTION 2

An experiment is carried out to determine whether potassium nitrate and iodine crystals are soluble in each of the three solvents, water, ethanol and xylene. The results recorded in the table below are incomplete.

Crystal	Water	Ethanol	Xylene
Potassium nitrate	A		B
Iodine		Soluble	C

2.1. Refer to the table above. Write down the letters A, B, and C and next to each letter indicate whether the crystals are **SOLUBLE or INSOLUBLE** in the solvents. (3)

2.2. By referring to types and the strength of intermolecular forces, explain why iodine crystals are soluble in ethanol. (3)

2.3 A learner wishes to prepare a solution of Iodine-water. Instead of adding iodine to water, he first adds the iodine to the ethanol and then adds this mixture to water. Fully explain the reasoning behind this approach. (3)
[9]

QUESTION 3

Consider the following molecules and answer the questions.

SO_2 ; CO_2 ; BF_3 ; NH_3

3.1. Draw the Lewis structure for the SO_2 molecule. (2)

3.2. BF_3 and NH_3 both contain 3 bonds around the central atom. The BF_3 molecule is non-polar while the NH_3 molecule is polar. Account for this difference between the two compounds using the VSEPR theory. (4)

3.3. Determine with the aid of a calculation, whether the C – O bond in the CO_2 molecule is POLAR or NON-POLAR. (2)

3.4 The boiling point of SO_2 is -10 °C and that of CO_2 is - 78 °C. Explain why the boiling point of SO_2 is higher than that of CO_2 by referring to the types of intermolecular forces and energy. (4)

3.5. NH_3 forms a dative covalent bond with the H^+ ion to form NH_4^+.

3.5.1. What is a dative covalent bond? (2)

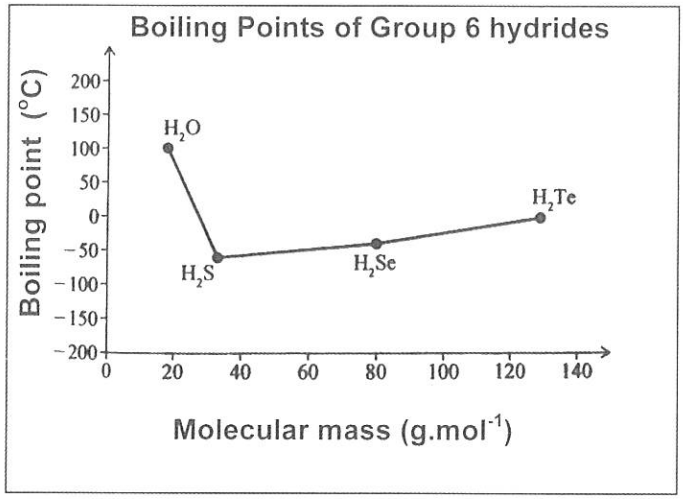
3.5.2. Use Lewis dot structures to show the bonding in the NH_4^+ ion. (2)

3.5.3 Write down the FORMULA of another compound that has a molecular shape similar to the NH_4^+ ion (1)

[17]

QUESTION 4

The graph below shows the boiling points and molar masses of the hydrides of group 6.



4.1 Define *boiling point.* (2)

4.2 Explain why the boiling points increase from H_2S to H_2Te. (2)

4.3 The boiling point of water is much higher than that of the other hydrides. Explain fully why this is so. (3)

4.4 Which hydride will have the highest vapour pressure at -100°C? Give a reason. (2)

4.5. The density of ice is different to that of water. Explain how this is beneficial to life on earth. (3)

4.6 The density of water is 1g.mol^{-1} at 25 °C. Calculate the number of water molecules in 0,5 dm^3 of water. (4)

[16]

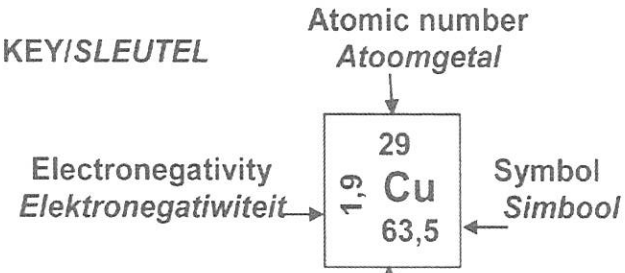
TOTAL : 50

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

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	10 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	18 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	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 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	54 Xe 131
0,7 Cs 133	0,9 Ba 137	57 La 139	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	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	86 Rn
0,7 Fr	0,9 Ra 226	89 Ac															

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce 140	Pr 141	Nd 144	Pm	Sm 150	Eu 152	Gd 157	Tb 159	Dy 163	Ho 165	Er 167	Tm 169	Yb 173	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

KEY/*SLEUTEL*



CONSTANTS

AVOGADRO CONSTANT 6.02×10^{23}

EQUATIONS

$n = m/M$

$D = m/V$

$n = N/N_A$

Education
KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P2 (CHEMISTRY)

COMMON TEST

MARCH 2018

MARKING GUIDELINE

NATIONAL SENIOR CERTIFICATE

GRADE 11

This marking guideline consists of 3 pages.

QUESTION 1

1.1. D ✓✓
1.2. B ✓✓
1.3. A ✓✓
1.4. B ✓✓

4x2 = (8)

QUESTION 2

2.1. A- Soluble ✓

B- Insoluble✓

C- Soluble ✓ (3)

2.2. Ethanol has both dipole –dipole forces and London forces. ✓ Iodine has London forces. ✓ Since the intermolecular forces are of similar order of strength, √the intermolecular forces can be overcome and dissolution takes place. (3)

2.3 - Iodine is insoluble in water ✓
- iodine is soluble in ethanol ✓
- ethanol is soluble in water √ hence iodine water can be prepared (3)

[9]

QUESTION 3

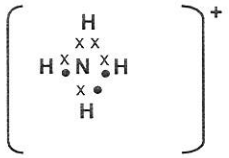
3.1.  ✓✓ (2)

3.2. BF_3 has no lone pairs. ✓ 3 bonds are evenly spaced out✓
NH_3 has one lone pair. ✓
Repulsion of bonded pair of electrons by lone pair makes molecule polar✓ (4)

3.3. END = 3.5-2.5 = 1 ✓ Since the difference in electronegativity is greater than 0, the bond is polar ✓ (2)

3.4. SO_2 **has** a higher molar mass✓ and is also a polar molecule with dipole- dipole forces ✓ between SO_2 molecules. The intermolecular force between CO_2 molecules is London forces. ✓
Dipole-dipole forces are stronger than London forces and more energy ✓ is needed to separate SO_2 molecules. (4)

3.5.1 The bond formed when an empty valence shell of an atom shares a lone pair of electrons from another atom ✓✓ (2)

3.5.2  ✓✓ (2)

3.5.3 CH_4 or $CC\ell_4$ ✓ (1)

[17]

QUESTION 4

4.1. The temperature at which the vapour pressure of a liquid is equal to atmospheric pressure. ✓✓ (2)

4.2. From H_2S to H_2Te, the molar mass increases, ✓causing an increase in strength of Van der Waals forces ✓ More energy is needed to separate the molecules. (2)

4.3. Water has hydrogen bonding ✓between molecules. The other hydrides have dipole- dipole forces ✓ between molecules. Hydrogen bonding is stronger than dipole-dipole forces. ✓More energy needed to separate water molecules. (3)

4.4 H_2S ✓ Lowest B.P. ✓ (2)

4.5. Density of ice is less than density of water. ✓ Ice floats on water providing an insulating layer √for aquatic life to exist. ✓ OR Water freezes from top down✓ and captures heat✓ allowing aquatic organisms to survive (3)

4.6 D =m/V
1 = m/0.5
m = 500g

n = m/M ✓
= 500/18 ✓
= 27.78 mol

$N = n \times N_A$
$= 27.78 \times 6.02 \times 10^{23}$ ✓
$= 1.67 \times 10^{23}$ molecules ✓ (4)

[16]
TOTAL: 50