education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES P2 (CHEMISTRY)

COMMON TEST

MARCH 2019

MARKS : 50

TIME : 1 hour

This question paper consists of 6 pages and a data sheet.

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.

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, e.g. 1.5 D.

1.1. The shape of a molecule with four bonding electron pairs, and no lone pairs surrounding the central atom is:

A. Linear
B. Trigonal planar
C. Trigonal pyramidal
D. Tetrahedral (2)

1.2 A few Iodine (I_2) crystals are added to hexane (C_6H_{14}). After a while it is observed that the I_2 dissolves and the hexane has turned purple. The correct option to describe the molecules is:

	Hexane (C_6H_{14})	**Iodine (I_2)**
A	Polar	Polar
B	Polar	Non polar
C	Non polar	Non polar
D	Non polar	Polar

(2)

1.3 SiH_4 has a much lower boiling point than HF, even though it has a considerably larger molecular mass than HF. The reason that best explains this is that:

A There are dipole- dipole forces between the molecules of SiH_4
B There are hydrogen bonds between the molecules of HF
C There are hydrogen bonds between the molecules of SiH_4
D HF is a polar molecule and SiH_4 is not (2)

1.4. Dispersion forces (London forces) are present between the molecules of...

A PH_5
B SO_2
C NH_3
D BeO (2)

TOTAL SECTION A: [8]

SECTION B

INSTRUCTIONS AND INFORMATION

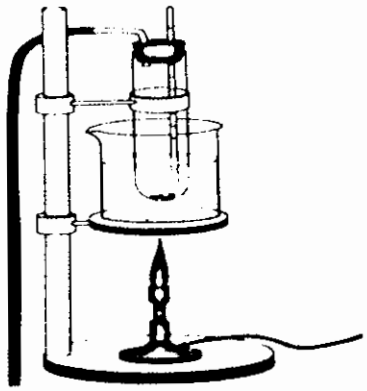
1. Answer all questions.
2. Show the formulae and substitutions in ALL calculations.
3. Round off your numerical answers to a minimum of **TWO** decimal places.

QUESTION 2

In an experiment to determine the relationship between boiling point and the strength of intermolecular forces, learners heated equal amounts of different liquids in a water bath over a Bunsen burner.

The following liquids were used:

- Methylated spirits
- Acetone
- Distilled Water
- Ethanol



It was found that the distilled water took the longest to boil.

2.1 Define boiling point. (2)

2.2 State the dependant variable in this investigation. (1)

2.3 Why are the liquids heated in a water bath? (1)

2.4 Which liquid has the lowest vapour pressure? (1)

2.5 Give a reason for your answer to question 2.4. (1)

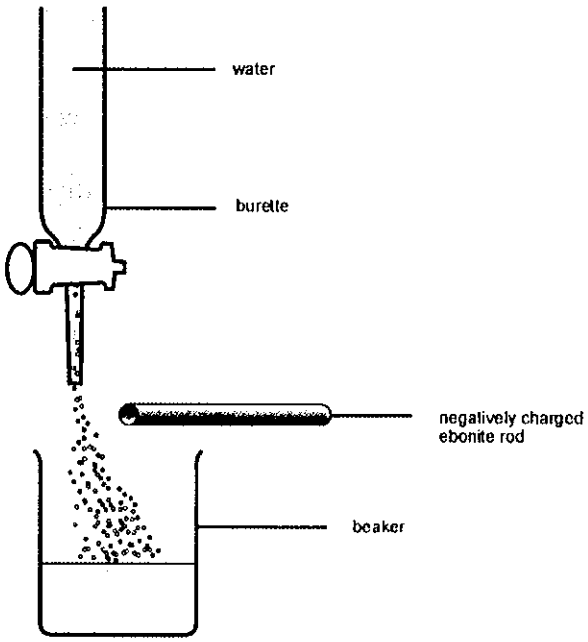
2.6 Explain the difference in the boiling points of acetone and water in terms of intermolecular forces and energy. (4)

2.7 What conclusion can be arrived at for the above investigation? (2)

[12]

QUESTION 3

John fills a burette with water. He opens the tap of the burette and brings a negatively charged ebonite rod close to the stream of water that runs from the burette. He finds that the water deflects from its vertical path towards the charged rod.



3.1 Describe what John's experiment proves about water molecules. (1)

3.2 Use the VSEPR theory to explain why water has a bent/angular shape. (2)

3.3 John now fills the burette with CCl_4 (tetra chloromethane) instead of water. Describe with a reason the effect the negatively charged ebonite rod will have on the CCl_4. (2)

3.4 Define a dative covalent bond. (2)

3.5 Water forms a dative covalent bond with the H^+ ion to form the hydronium ion (H_3O^+). Draw the Lewis structure to show the formation of the bond between water (H_2O) and the H^+ ion. (2)

[9]

QUESTION 4

4.1 Define electronegativity. (2)

4.2 Carbon dioxide (CO_2) forms when two oxygen atoms bond to a carbon atom.

4.2.1 Draw the Lewis diagram for CO_2. (2)

4.2.2 By using a calculation, determine whether the bond between the carbon and the oxygen is polar or non-polar. (2)

4.2.3 Is the CO_2 molecule polar or non-polar? Explain fully. (2)

4.2.4 Explain why solid CO_2 sublimes at room temperature. (3)

4.3 NaCl dissolves in water.

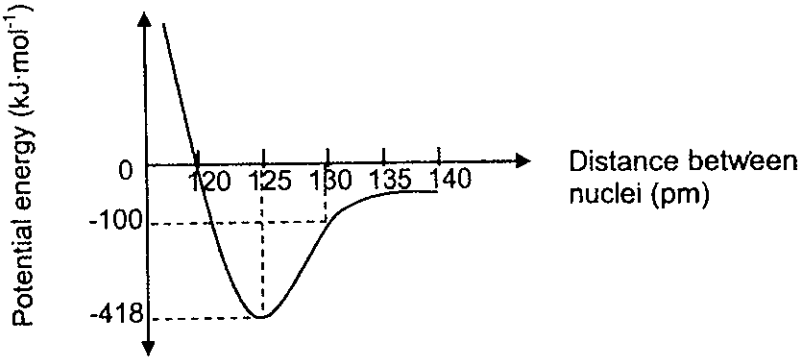
4.3.1 What type of intermolecular force will be found in the solution of NaCl in water? (1)

4.3.2 Explain using types and strength of intermolecular forces, why NaCl forms a solution in water. (3)

[15]

QUESTION 5

The graph below shows how the potential energy varies with distance between the nuclei of 2 nitrogen atoms when a double bond between the nitrogen atoms (N=N) is formed.



5.1 Define bond length. (2)

5.2 What is the bond length (in pm) of the N=N bond? (1)

5.3 The bond energy of the N≡N bond is 946 kJ.mol^{-1}. Will the bond length of the N≡N bond be **GREATER THAN, LESS THAN OR EQUAL TO** your answer in 5.2? (1)

5.4. What is the relationship between bond energy and bond length? (2)

[6]

TOTAL MARKS: [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 He 4
2,1 1 H 1																	
1,0 3 Li 7	1,5 4 Be 9											2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1,5 13 Aℓ 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 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 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 88 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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

29
1,9 Cu
63,5

education

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MARKING GUIDELINE

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This marking guideline consists of 4 pages.

QUESTION 1

1.1. D ✓✓

1.2. C ✓✓

1.3. B ✓✓

1.4. A ✓✓ 4 x 2 = (8)

QUESTION 2

2.1. The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓ (2)

2.2. Boiling point. ✓ (1)

2.3. (Some) Liquids are flammable ✓ (1)

2.4. H_2O/water ✓ (1)

2.5. It has the highest boiling point. ✓ (1)

2.6. Acetone has dipole –dipole forces ✓ and water has hydrogen bonding. ✓ The intermolecular forces in water are stronger✓. More energy is required to break the intermolecular forces in water ✓ for a phase change to take place. (4)

2.7. The stronger the intermolecular force, the higher the boiling point. ✓✓ (2)

[12]

QUESTION 3

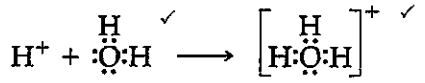
3.1. Water molecules are polar.✓ (1)

3.2. Water has lone pairs of electrons on the central atom. ✓
The force of repulsion between lone pairs is greater than that between bonding pairs, ✓decreasing the bond angle. (2)

3.3 There will be less or no deflection ✓ - CCl_4 is a non-polar molecule. ✓ (2)

3.4 A bond between an atom with an empty orbital and a lone pair of electrons from an atom in another molecule. ✓✓ (2)

3.5



(2)

[9]

QUESTION 4

4.1 The measure of the tendency of an atom in a molecule to attract bonding electrons. ✓✓ (2)

4.2

4.2.1 :Ö:: C ::Ö: ✓✓ (2)

4.2.2 3.5 – 2.5 = 1✓ bond is polar (covalent) ✓ (2)

4.2.3 Non-polar✓ - molecule is symmetrical with even distribution of electrons. No net dipole moment.✓ OR both ends of the molecule have the same polarity. ✓ (2)

4.2.5 CO_2 is a non -polar molecule with very weak London forces✓ between the molecules. The intermolecular forces can be easily overcome at low temperatures ✓ with high vapour pressures, resulting in the attainment of the boiling point. ✓Hence it becomes a gas from a solid. (3)

4.3

4.3.1 Ion-dipole✓ (1)

4.3.2 The forces holding the ions in the NaCl lattice together are strong electrostatic forces of attraction. ✓Water has strong hydrogen bonding. ✓ Since the forces are of the same order of strength, ✓ NaCl dissolves in the water forming a solution. (3)

[15]

QUESTION 5

5.1. The average distance between the nuclei of 2 bonded atoms. ✓✓ (2)

5.2. 125 pm✓ (1)

5.3. Less than ✓ (1)

5.4. The shorter the bond length, ✓the greater the bond energy. ✓ (2)

[6]

TOTAL MARKS: [50]

$F_{NET} = m \cdot a$
$-F_T + W = m \cdot a$
$-F_T + (3 \cdot 9.8) = 3a$ ✓
$F_T = -3a + 29.4$. .....(2)

$5a + 4.5 = -3a + 29.4$
$a = 3.11\ ms^{-2}$✓

(4)

4.3 Velocity decreases✓, until it comes to a stop. ✓ (2)

[8]

QUESTION FIVE

5.1 Everybody in the universe attracts every other body with a gravitational force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres. ✓ (2)

5.2.1 W/Fg $= m \cdot g$ ✓
$= 90 \cdot 9.8$ ✓
$= 882$ N ✓ (3)

Positive marking from Q 5.2.

5.2.2 $F = \frac{G \cdot m_1 \cdot m_2}{r^2}$ ✓

882✓ $= \frac{6,67 \times 10^{-11} \times 90 \times m_2}{(6,38 \times 10^6)^2}$ ✓

$m_2 = 5.98 \times 10^{24}$ kg✓ (4)

[9]

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