education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCE: CHEMISTRY (P2)

COMMON TEST

MARCH 2020

MARKS: 50

TIME: 1 hour

This question paper consists of 5 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name on the **ANSWER BOOK**.
2. Answer **ALL** the questions in the ANSWER BOOK.
3. This question paper consists of FOUR questions.
4. You may use a non-programmable calculator.
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.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A-D) next to the question number (1.1 - 1.10) in the ANSWER BOOK, for example 1.5 D.

1.1 Which ONE of the following is a molecule with a multiple bond?

A N_2
B NH_3
C OF_2
D $HOC\ell$ (2)

1.2 The molecular formula of ethyne is C_2H_2.

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

A Trigonal planar.
B Octahedral.
C Llinear.
D Bent. (2)

1.3 The table below indicates the boiling points of four liquids.

SUBSTANCE	BOILING POINT (°C)
Water	100
Methylated spirits	78,5
Ethanol	78,37
Acetone	56

Which ONE of the above liquids has the lowest surface tension?

A Water.
B Methylated spirits.
C Ethanol.
D Acetone. (2)

1.4 The predominant forces between the molecules in an ice crystal are called . . .

A London forces.
B Hydrogen bonding.
C Induced dipole forces.
D Polar covalent bonding. (2)
[8]

QUESTION 2 (Start on a new page.)

The water molecule has the formula: H_2O.

2.1 Water forms a dative covalent bond with the hydrogen ion.

2.1.1 What is a dative covalent bond? (2)

2.1.2 State ONE requirement for the formation of a dative covalent bond. (1)

2.1.3 Draw the Lewis structure to show the bonding that takes place when the above dative covalent bond is formed. (2)

2.1.4 Name the ion that is formed from the above dative covalent bond. (1)

2.2 The water molecular is angular in shape. Explain this shape in terms of the VSEPR theory. (3)

2.3 The density of ice is less than the density of the liquid.

2.3.1 Explain the significance of the above for life on EARTH. (3)

2.3.2 Calculate the number of water molecules present in 1 dm^3 of water if the mass of 1 cm^3 of water is 1 g. (3)
[15]

QUESTION 3 (Start on a new page.)

The bond length of the H – Br bond is 60 pm.
350 kJ.mol-1 of energy is required to break the H – Br bond.

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

3.2 Draw a sketch graph (not to scale) in your answer book to show how potential energy changes as the distance between the nuclei changes when a hydrogen (H) atom approaches a bromine (Br) atom.

Indicate the following values on the graph:

(i) Bond length.

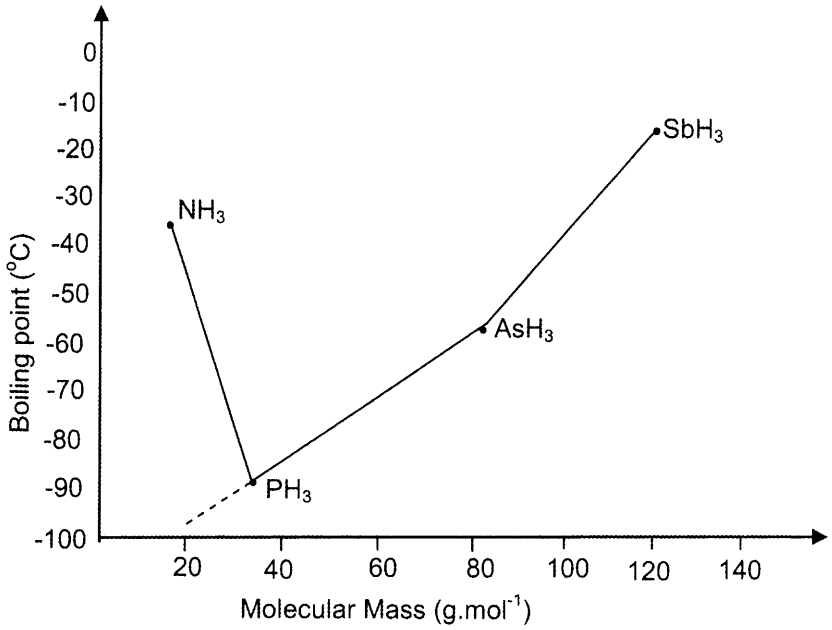
(ii) Bond energy. (5)

3.3 How will the bond length of an H - Cℓ bond compare to that of the H – Br bond? Write down LONGER THAN, EQUAL TO or SHORTER THAN. (1)

3.4 Give a reason for the answer to question 3.3. (1)
[9]

QUESTION 4 (Start on a new page.)

The graph below shows the results obtained during an investigation to determine the boiling points of substances formed when hydrogen is bonded to atoms from group V of the periodic table.



4.1 Define *boiling point*. (2)

4.2 Write down an investigative question for this investigation. (2)

4.3 Consider PH_3, AsH_3 and SbH_3.

4.3.1 Name the type of van der Waals forces that exist between molecules of PH_3. Explain the answer by referring to the shape and polarity of the molecule. (3)

4.3.2 Which of the three substances has the highest vapour pressure? Give a reason for the answer. (2)

4.3.3. Fully explain why SbH_3 has a higher boiling point than AsH_3. (3)

4.4 It is expected that from the trend shown in the above graph, the boiling point of NH_3 should fall along the dotted line.
Explain, with reference to the TYPE OF INTERMOLECULAR FORCES AND ENERGY, why the boiling point of NH_3 does not fall along the dotted line. (4)

4.5 The SAME INVESTIGATION is now conducted when the atmospheric pressure is LOWERED. What effect will this have on:

4.5.1 The vapour pressure of NH_3? (1)

4.5.2 The boiling point of NH_3? (1)

(Choose from INCREASES, DECREASES or REMAINS THE SAME in each case):

[18]

TOTAL MARKS: 50

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

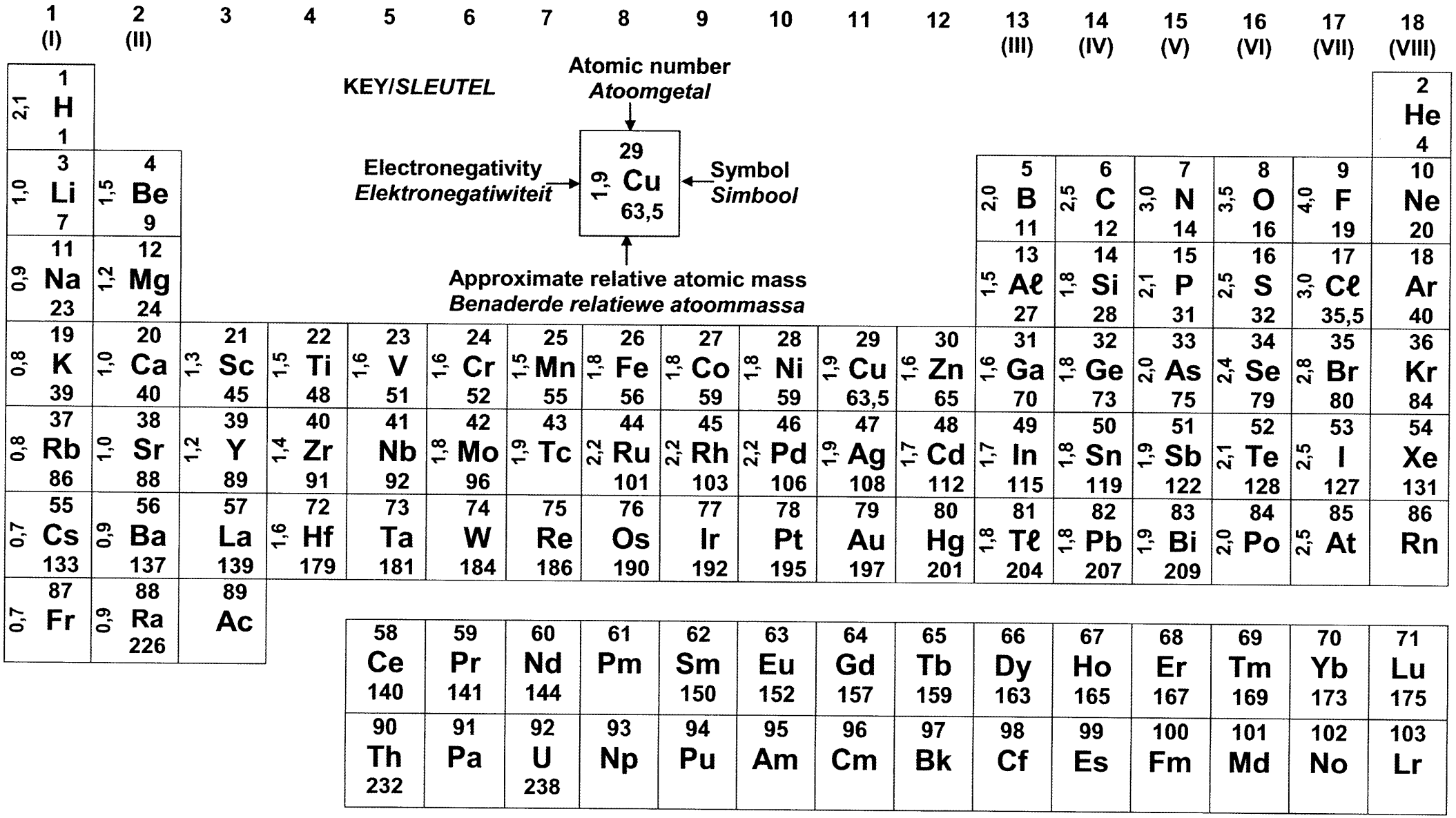
TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

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	$8{,}31\ J{\cdot}K^{-1}{\cdot}mol^{-1}$
Standard pressure Standaarddruk	p^{θ}	$1{,}013 \times 10^{5}\ Pa$
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3{\cdot}mol^{-1}$
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



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PROVINCE OF KWAZULU-NATAL

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKING GUIDELINE

COMMON TEST

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N.B: This marking guideline consists of 3 pages.

QUESTION 1

1.1 A ✓✓ (2)

1.2 C ✓✓ (2)

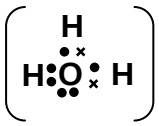
1.3 D ✓✓ (2)

1.4 B ✓✓ (2)
[8]

QUESTION 2

2.1 2.1.1 the bond formed when an empty valence shell shares a lone pair of electrons from another atom.✓ (2)

2.1.2 one atom must have a lone pair of electrons while the other atom must have an empty valence shell. (1)

2.1.3 

- 2 lone pairs and 2 shared pairs ✓
- positively charged ✓

(2)

2.1.4 hydronium ion/oxonium ion ✓ (1)

2.2 the central atom has 2 lone pairs and 2 bonded pairs✓
lone pairs repel each other and the bonded pairs more strongly than the bond pairs repel each other✓
decreasing the bond angle✓ (3)

2.3 2.3.1 Ice will float on water. ✓
Bottom layer will not freeze. ✓
Thus sustaining the aquatic life. ✓ (3)

2.3.2 1000 g = 1 dm^3

$$n = \frac{m}{RM}$$

$$= \frac{1000g}{18}$$

= 55,55 mol.

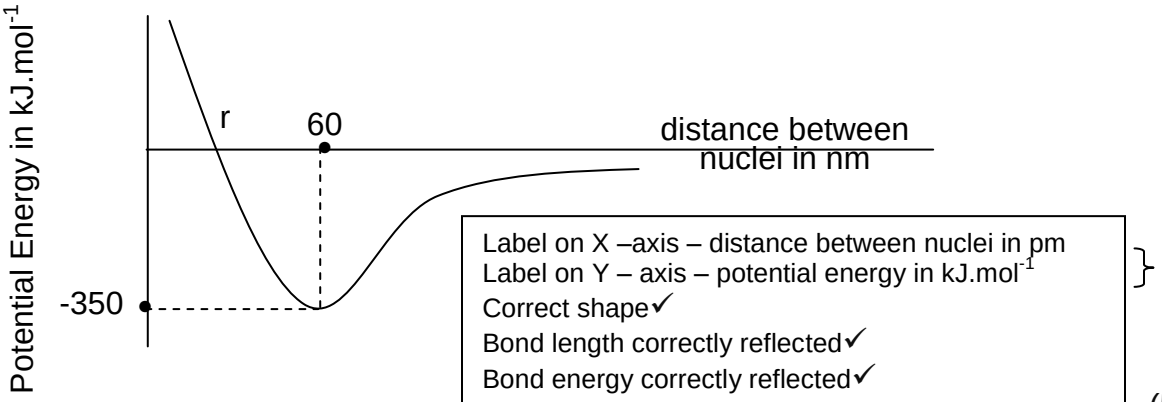
No. of molecules = 55,55 x N_A ✓

= 3,34 x 10^{25} ✓ (3)
[15]

QUESTION 3

3.1 the average distance between the nuclei of two bonded atoms. ✓✓ (2 or 0) (2)

3.2



(5)

3.3 SHORTER THAN✓ (1)

3.4 chlorine atoms are smaller than bromine atoms. ✓ (1)
[9]

QUESTION 4

4.1 the temperature at which the vapour pressure of a substance equals the atmospheric pressure. ✓✓ (2 or 0) (2)

4.2 What is the relationship between molecular mass and boiling point? ✓✓
(of the hydrides of the group V elements) (2)

4.3.1 Dipole-dipole forces. ✓
Molecular shape is trigonal pyramidal✓ (one lone pair).
Molecule is polar.✓ (3)

4.3.2 PH_3✓ has the lowest boiling point✓ (2)

4.3.3 As the relative molecular mass increases, the size of the atom increases forming stronger dipoles.✓
Strength of the intermolecular forces increases.✓
More energy required to overcome the intermolecular forces✓ (3)

4.4 Hydrogen bonding between molecules of NH_3.✓
Dipole-dipole forces between molecules of PH_3, ASH_3 and SbH_3. ✓
Intermolecular forces therefore unusually stronger between NH_3 molecules. ✓
More energy required to overcome the intermolecular forces in NH_3. ✓ (4)

4.5.1 Remains the same✓ (1)

4.5.2 Increases✓ (1)
[18]

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