Basic Education

KwaZulu-Natal Department of Basic Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCE P2
(CHEMISTRY)

COMMON TEST

MARCH 2016

NATIONAL SENIOR CERTIFICATE

GRADE 11

MARKS: 50

TIME: 1 Hour

This question paper consists of 5 pages, a graph sheet and a data sheet.

QUESTION 1: MULTIPLE CHOICE

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write down only the letter (A – D) next to the question number (1.1 – 1.3) in the answer book for example 1.1 D.

1.1 Which ONE of the following statements concerning Intermolecular forces is TRUE?

They:

A hold atoms together in a molecule
B hold molecules together in a solid, liquid or gas phase
C are formed by sharing electrons
D are formed by transferring electrons (2)

1.2 Which one of the following describes a bond in which one atom supplies both of the bond pair electrons?

A Polar covalent bond
B Ionic bond
C Dative (Co - ordinate) covalent bond
D Metallic bond (2)

1.3 Sodium chloride is dissolved in ethanol. What is /are the predominant type/s of intermolecular force/s between sodium chloride and ethanol?

A ion-dipole forces
B induced dipole and ion-induced dipole forces
C induced dipole and dipole-dipole forces
D Hydrogen bonding and induced dipole – induced dipole forces (2)

[6]

QUESTION 2

2.1 The electron configurations of three elements are given below:

P: $1s^2\ 2s^1$
Q: $1s^2\ 2s^2 2p^4$
R: $1s^2 2s^2 2p^6$

Q can form a diatomic molecule, and can also combine with P. Q cannot however combine with R.

2.1.1 What is a diatomic molecule? (1)

2.1.2 What type of bonding occurs when Q forms a diatomic molecule? (1)

2.1.3 Explain how the bonding process between two Q atoms takes place in terms of: orbital overlap, electrostatic forces and energy. (3)

2.1.4 Name the type of bond that forms between P and Q. (1)

2.1.5 Why is it not possible for Q to combine with R? (2)

2.2 Carbon dioxide, CO_2, is a gas at room temperature.

2.2.1 Draw the Lewis dot structure for the CO_2 molecule. (2)

2.2.2 What is the molecular shape of the CO_2 molecule? (1)

2.2.3 The C — O bond is a polar bond. The CO_2 molecule however is non-polar. Account for this observation. (2)

2.3 What are lone pairs of electrons? (2)

2.4 Define electronegativity. (2)

2.5 Calculate the energy needed to break up a mole of CH_4 into its atoms if 415 kJ mol^{-1} is needed to break one mole of C — H bonds. (2)
[19]

QUESTION 3

3.1 The boiling points of the hydrides of group 15 are given in the table below:

Hydride	Period	Boiling points (°C)
NH_3	2	-33
PH_3	3	-87,7
AsH_3	4	-55
SbH_3	5	-17,1

3.1.1 What is the phase of these hydrides at room temperature (25°C)? Give a reason. (2)

3.1.2 Define boiling point. (2)

3.1.3 Draw a line graph of the boiling points of the hydrides versus period. Use the attached graph paper provided. (4)

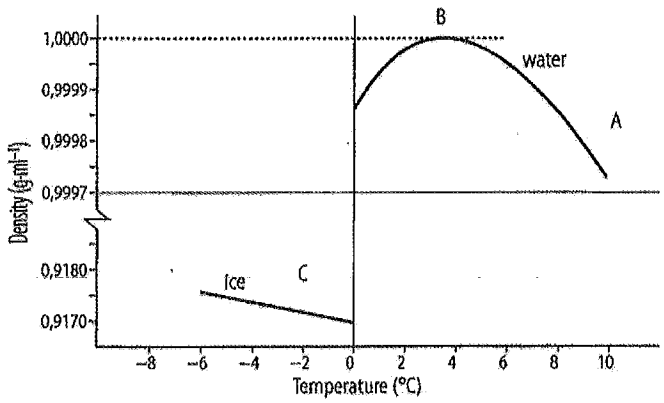
3.1.4 Describe the trend in the boiling points from PH_3 to SbH_3. (1)

3.1.5 Explain the trend described above in terms of intermolecular forces and energy. (3)

3.1.6 It is observed that the boiling point NH_3 does not follow the expected trend of the other hydrides in this group.
Explain this observation. (3)

3.2 Helium is a gas at room temperature. At very high pressures and very low temperatures helium gas becomes a liquid.
Explain this observation with reference to the type of intermolecular forces. (3)

3.3 The graph below shows the relationship between the density of water and temperature.



3.3.1 How does the density of water change from 0 °C to 4 °C? (1)

3.3.2 The trend described above is beneficial to aquatic life. Explain why this is so. (2)

3.4 Water has a high heat of vapourisation.

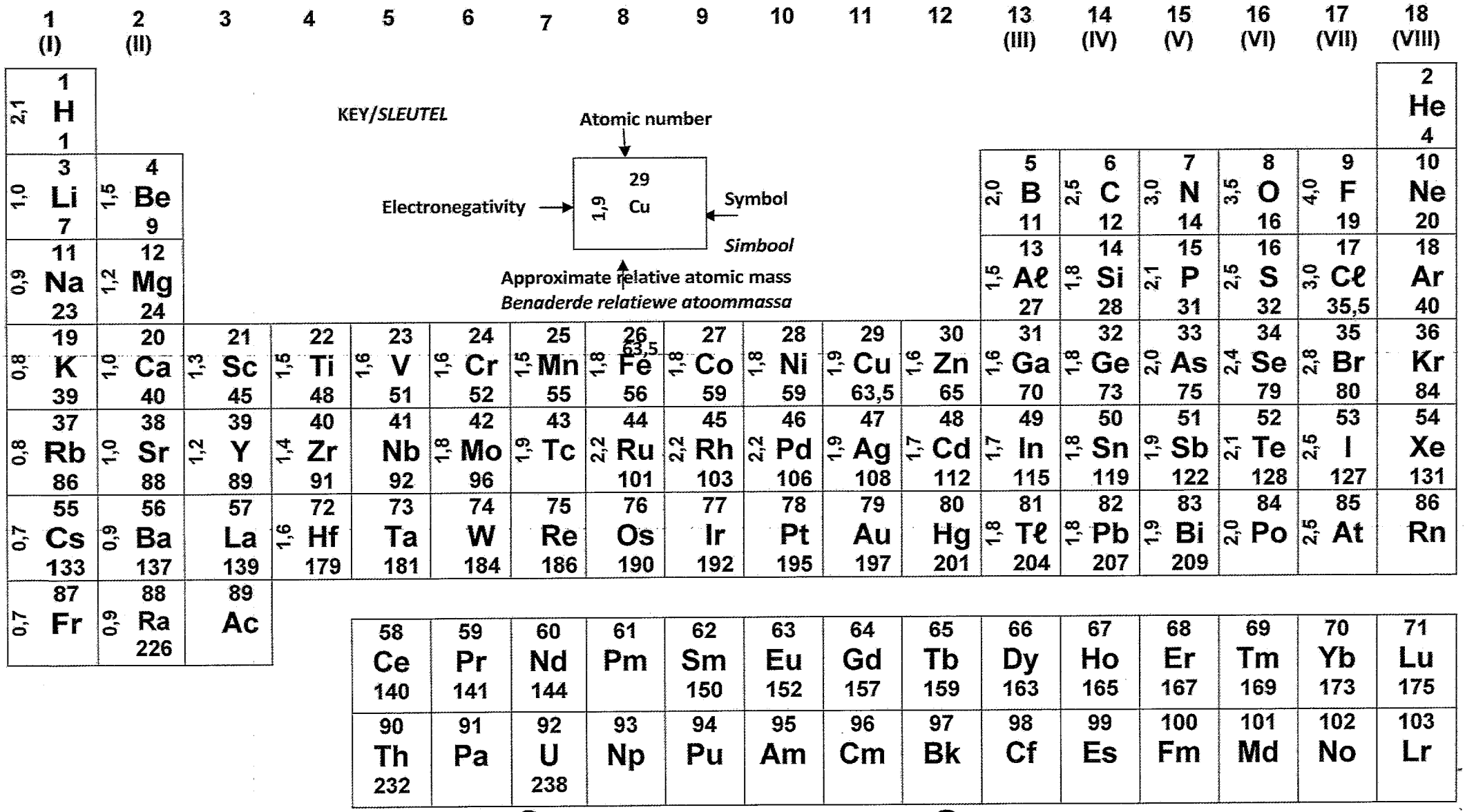
3.4.1 What is meant by this statement? (2)

3.4.2 Explain how this property of water is beneficial to life on Earth. (2)

[25]

TOTAL MARKS: [50]

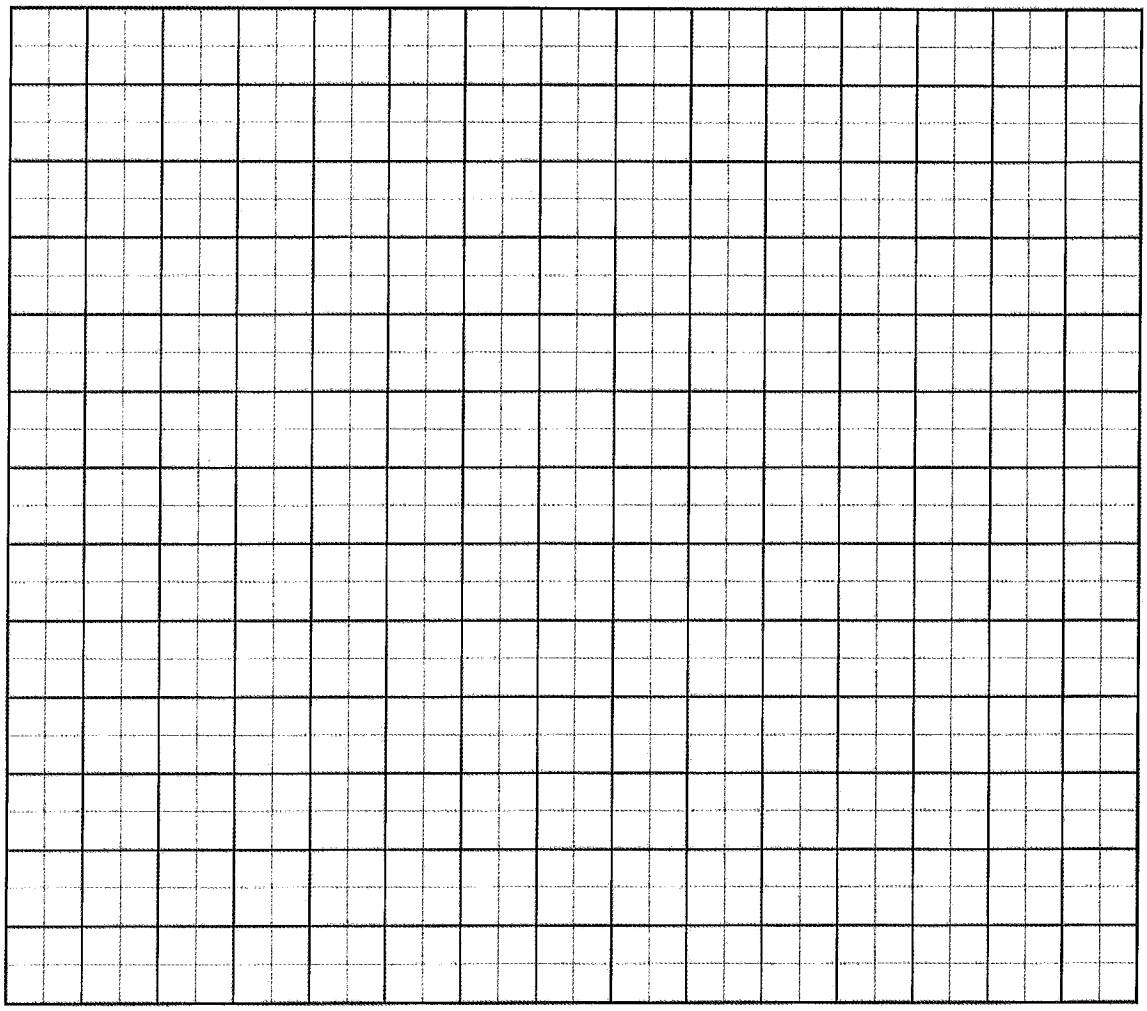
THE PERIODIC TABLE OF ELEMENTS



Answer Sheet : Question 3.1.3

Name: _____

Grade: _____



Tear-off page

Basic Education

KwaZulu-Natal Department of Basic Education

REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P2

COMMON TEST

MARCH 2016

MEMORANDUM

NATIONAL SENIOR CERTIFICATE

GRADE 11

MARKS : 50

TIME : 1 Hour

This memorandum consists of 4 pages.

QUESTION 1

1.1 B ✓✓ (2)

1.2 C✓✓ (2)

1.3 A✓✓ (2)

[6]

QUESTION 2

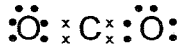
2.1.1 molecule made up of 2 same atoms.✓ (1)

2.1.2 covalent✓ (1)

2.1.3 As the two atoms approach each other their valence orbitals overlap. ✓
The unpaired valence electrons are shared and attracted to both nuclei holding ✓ the atoms together. When a bond is formed the molecule represents a state of lower energy. ✓ (3)

2.1.4 Ionic bond ✓ (1)

2.1.5 R has a complete outermost shell ✓with 8 electrons. This makes it a stable atom.✓ (2)

2.2.1  ✓✓ (2)

2.2.2 linear ✓ (1)

2.2.3 Symmetrical distribution ✓✓ of charge around the molecule / it is a symmetrical molecule with polar bonds✓✓ (2)

2.3 valence electrons that are not involved in bonding. ✓✓ (2)

2.4 measure of the attractive force a nucleus exerts on a shared electron pair in a molecule. ✓✓ (2)

2.5 energy = 4 x 415 ✓
= 1660 kJ.mol^{-1} ✓ (2)

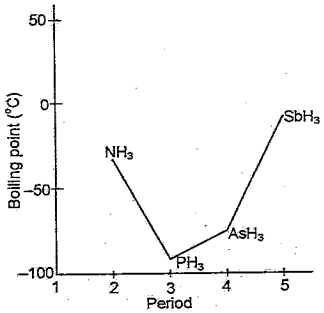
[19]

QUESTION 3

3.1.1 Gases✓
Their boiling points are all below 25°C✓ (2)

3.1.2 Boiling point is a temperature in which the vapour pressure of the liquid equals the atmospheric pressure. ✓✓ (2)

3.1.3



Criteria for marking	Marks
Correct shape	✓
Correct plotting of points	✓✓
Correct labels on axes	✓

(4)

3.1.4 As period increases boiling points increase ✓ (1)

3.1.5 As period increases molecular weight ✓of the hydrides increase. The strength of the Van der Waals forces increases.✓ More energy✓ needed to separate the molecules. (3)

3.1.6 The ammonia molecule has hydrogen bonding between its molecules. ✓
Hydrogen bonding is the stronger ✓ than Van der Waals forces. More energy is needed to boil ammonia compared to the other hydrides of group 15. ✓ (3)

3.2 Helium atoms come close to each other.✓
Dipoles are induced ✓ in neighbouring atoms. Forces of attraction between the atoms increase.✓ Gas becomes liquid. (3)

3.3.1 Increases ✓ (1)

3.3.2 When a deep body of water cools, the floating ice insulates the liquid below, preventing it from freezing. ✓ This allows life to exist under the frozen water. ✓

OR Ice has a lower density ✓ than water and can float on water ✓ in frozen rivers. (2)

3.4.1 Water requires a large amount of energy to change from liquid to vapour.✓✓ (2)

3.4.2 Water will remain as liquid over a greater temperature on Earth and will not evaporate easily.✓✓ (2)

[25]

TOTAL MARKS: [50]