KWAZULU-NATAL PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES

COMMON TEST

APRIL 2021

MARKS: 100

TIME: 2 hours

This question paper consists of 10 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.
2. Number the answers correctly according to the numbering system used in this question paper.
3. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
4. You may use a non-programmable calculator.
5. You may use appropriate mathematical instruments.
6. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEET.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum to TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. Write neatly and legibly.

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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 – 1.6) in the answer book, for example 1.7. D.

1.1 A glass rod is POSITIVELY charged by rubbing it with a silk cloth. Which ONE of the following statements is TRUE?

A Electrons are transferred from the glass rod to the silk cloth.

B Electrons are transferred from the silk cloth to the glass rod.

C Protons are transferred from the glass rod to the silk cloth.

D Protons are transferred from the silk cloth to the glass rod. (2)

1.2 Which one of the following terms best describes the ability of a metal to change shape on hammering

A Brittle

B Density

C Ductile

D Malleable (2)

1.3 The process when solids change directly into the gaseous phase is called…

A Condensation

B Sublimation

C Freezing

D Combustion (2)

1.4 The energy released when an electron is added to an atom or molecule is called…

A. Electron affinity

B. Electronegativity

C. Ionisation energy

D. 1st ionisation energy (2)

1.5 The bond between two nitrogen atoms in the N_2 molecule is known as a/an …

A. Ionic bond
B. Dative covalent bond
C. Metallic bond
D. Covalent bond

(2)

1.6 The N^{3-} ion is known as the … ion

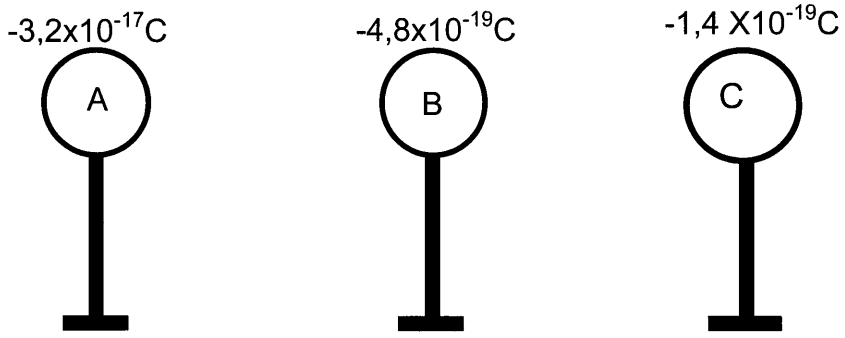
A. Nitrite
B. Nitride
C. Nitrate
D. Nitrogen

(2)
[12]

QUESTION 2

2.1 What is meant by *triboelectric charging*? (2)

2.2 Three metal spheres are placed on insulated stands and carry charges as shown below.



2.2.1 Determine the number of excess electrons found on sphere A. (3)

2.2.2 Is it possible for the charge indicated on sphere C to exist? State YES or NO. Give a reason for the answer. (2)

2.2.3 Name the principle used to explain your answer to question 2.2.2. (1)

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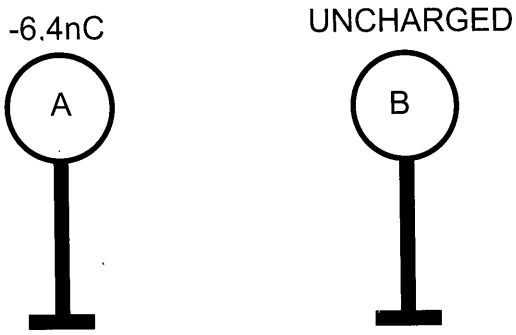
2.3 Two identical metal spheres are placed on insulated stands as shown below.



Sphere A carries a charge of -6,4 nC and sphere B is UNCHARGED.

2.3.1 What is meant by *sphere B is uncharged*? (2)

Sphere A is now brought CLOSE to sphere B. The spheres DO NOT touch.

2.3.2 Draw a sketch to show the charge distribution that takes place on sphere B. (2)

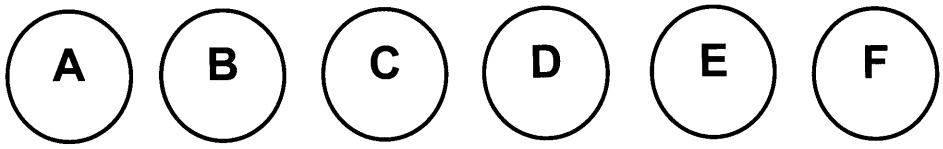
2.3.3 Name the phenomenon as described in question 2.3.2. (1)

The two spheres are now made to TOUCH each other and they are then separated.

2.3.4 State the Law of Conservation of Charge (2)

2.3.5 Calculate the new charge on each sphere after touching. (3)

2.4 Refer to the six spheres A – F below. Sphere A is POSITIVELY charged. The charges on the other spheres are unknown.



A learner wishes to determine the nature of the charges on the other 5 spheres. She makes the following observations:

- F attracts both A and B
- D repels C
- E attracts D but repels F
- C attracts B

Use the above information to determine the nature of the charges on spheres B, C, D, E and F. (5)
[23]

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QUESTION 3

3.1 Use the following substances to answer the questions that follow.

A	Iron
B	Copper
C	Sulphur
D	Silicon
E	Air
F	Ammonium sulphate

3.1.1 Identify the ELEMENT that has a dull surface and cannot conduct electricity. (1)

3.1.2 Identify TWO substances that are brittle. (2)

3.1.3 Which element has magnetic properties? (1)

3.1.4 Identify the metalloid that is used in computers. (1)

3.1.5 Write down the chemical formula for F (ammonium sulphate) (2)

3.1.6 Identify the mixture in the table (1)

3.2 The base of a frying pan is made from aluminium while its handle is made from hard plastic.

3.2.1 Why is the base of the pan made from aluminium? (1)

3.2.2 Why is the handle made from hard plastic? (1)
[10]

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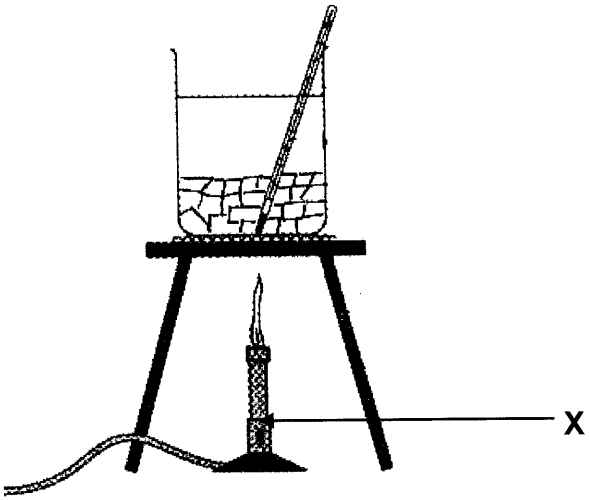
QUESTION 4

Grade 10 learners conducted an experiment to determine the heating curve of water by using crushed ice under standard pressure. The experiment was set up as shown below.

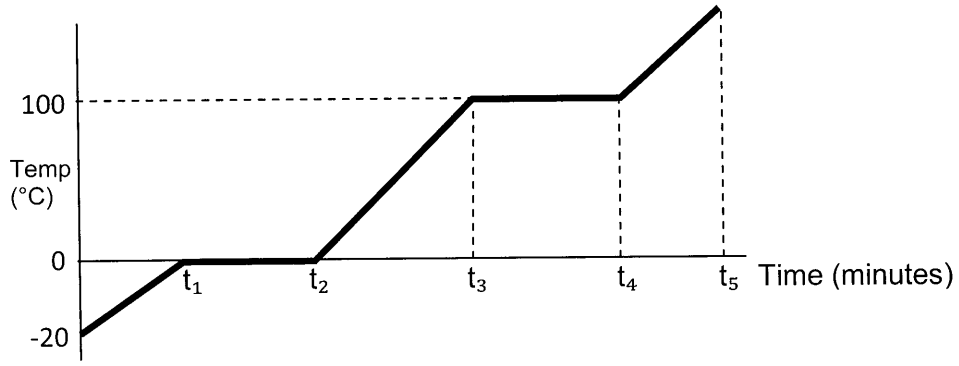


4.1 Define the term *temperature*. (2)

4.2 Name the apparatus labelled X. (1)

4.3 Why is it important to continuously stir the melting ice with a glass rod? (1)

4.4 The graph below shows the results obtained.



4.4.1 Name the process taking place between t_1 and t_2. (1)

4.4.2 Will the water particles move SLOWER or FASTER between t_2 and t_3 when compared to the movement of the particles between 0 and t_1? Explain the answer. (2)

4.4.3 Will the potential energy between t_3 and t_4 INCREASE, DECREASE or REMAIN THE SAME? (1)

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4.4.4 Can diffusion occur between t_4 and t_5? Answer YES or NO. Explain. (2)

4.4.5 Can the particles be compressed between t_4 and t_5?
Answer YES or NO. (1)

The forces between particles of ETHANOL are WEAKER than those in water.

4.4.6 Will the boiling point for ethanol be GREATER THAN or LESS than 100° C under the same standard conditions? (1)
[12]

QUESTION 5

An element **X** has the following electron configuration: $1s^2 2s^2 2p^4$

5.1 In which group in the periodic table will this element be found?
Give a reason for the answer by referring to the above electron configuration. (2)

5.2 In which period in the periodic table will this element be found?
Give a reason for the answer by referring to the above electron configuration. (2)

5.3. For element **X**, write down:

5.3.1 Its chemical name. (1)

5.3.2 Its normal valency. (1)

5.4 An atom of element **X** forms an ion

5.4.1 Write down the name of the ION that forms when an atom gains electrons.
(Choose from ANION or CATION) (1)

5.4.2 What will be the charge on the ion formed from atom X? (1)

5.4.3 From the periodic table, identify an element with the same electron configuration as the ion formed from atom X (2)

5.4.4 Write down the chemical NAME for the ion that is formed from atom X (2)
[12]

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QUESTION 6

6.1 The table below shows the first ionisation energies of some group one elements

Element	1st Ionization energies ($kJ \cdot mol^{-1}$)
Lithium	520
Sodium	496
Potassium	419

6.1.1 Define the term *first ionization energy*. (2)

6.1.2 Write down the name of the group 1 elements. (1)

6.1.3 Explain the trend of 1st ionization energies on going down the group. (4)

6.2. Potassium naturally exists as isotopes, ^{39}K and ^{41}K.

Isotope	% abundance	Atomic Mass number
^{39}K	93.258	38.964
^{41}K.	6.742	**X**

6.2.1 Define the term *isotope*. (2)

6.2.2 The relative atomic mass of potassium is 39. Determine the atomic mass number (**X**) of Potassium 41 isotope. (4)
[13]

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QUESTION 7

7.1 Define the term *chemical bond.* (2)

7.2 Draw Lewis dot diagrams for the following:

7.2.1 Aluminium (1)

7.2.2 Oxygen (1)

7.3 Define the term *ionic bond*. (2)

7.4 Draw the Lewis structure of KBr. (2)

7.5 Draw the Lewis dot diagrams for the formation of $CaC\ell_2$. (4)

7.6 Write down the relative atomic mass of potassium. (1)

7.7 Calculate the relative molecular mass for NH_3. (2)

7.8 Calculate the relative formula mass for magnesium bromide. (3)
[18]

TOTAL MARKS: [100]

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DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Speed of light in a vacuum *Spoed van lig in 'n vacuum*	c	$3,0 \times 10^{8}\ m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}\ J \cdot s$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$
Electron charge	q_e	$-1,6 \times 10^{-19}\ C$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$ **or** $c = f\lambda$	$T = \frac{1}{f}$	$E = hf$

ELECTROSTATICS

$n = \frac{Q}{Q_e}$	$Q = \frac{Q_1 + Q_2}{2}$

ELECTRIC CIRCUIT

$Q = I\ \Delta t$	$\frac{1}{Rp} = \frac{1}{R_1} + \frac{1}{R_2} + ...$
$R_s = R_1 + R_2 + ...$	$V = \frac{W}{Q}$

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TABLE 3: THE PERODIC TABLE OF ELEMENTS

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APRIL 2021

MARKING GUIDELINE

MARKS: 100

TIME: 2 hours

This marking guideline consists of 6 pages.

QUESTION 1: MULTIPLE- CHOICE

1.1 A ✓✓ (2)

1.2 D ✓✓ (2)

1.3 B ✓✓ (2)

1.4 A ✓✓ (2)

1.5 D ✓✓ (2)

1.6 B ✓✓ (2)
[12]

QUESTION 2

2.1 Process by which objects are charged by contact/rubbing ✓✓ (2)

2.2.1 $n = \frac{Q}{Q_e}$ ✓
$= \frac{-3,2\times10^{-17}}{-1,6\times10^{-19}}$ ✓
$= 200$ ✓ (3)

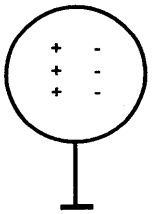
2.2.2 No. Smallest charge that can exist is $1,6 \times 10^{-19}$ C (2)

2.2.3 Principle of Charge Quantization ✓ (1)

2.3.1 number of electrons equals number of protons ✓✓ (if neutral, 1 mark) (2)

2.3.2

Must show positive charges on the right



✓✓ (2)

2.3.3 Charge Polarisation ✓ (1)

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2.3.4 The total/ net charge in an isolated system ✓remains constant during any physical process ✓ (2)

2.3.5 $Q_{new} = \frac{Q_1 + Q_2}{2}$ ✓

$= \frac{-6,4 + 0}{2}$ ✓

$= -3,2$ nC ✓ (3)

2.4 B: neutral ✓
C: positive ✓
D: positive ✓
E: negative ✓
F: negative ✓ (5)
[23]

QUESTION 3

3.1.1 C /Sulphur ✓ (1)

3.1.2 C and F✓✓ (2)

3.1.3 A / Iron ✓ (1)

3.1.4 Silicon/ D ✓ (1)

3.1.5 $(NH_4)_2SO_4$ ✓✓ (2)

3.1.6 Air ✓ (1)

3.2.1 It is a good thermal conductor ✓ (1)

3.2.2 It is a good thermal insulator ✓ (1)
[10]

QUESTION 4

4.1 Measure of the average kinetic energy of the particles ✓✓ (2)

4.2 Bunsen burner ✓ (1)

4.3 To distribute the heat evenly in the beaker ✓ (1)

4.4.1 Melting ✓ (1)

4.4.2 Faster ✓
The temperature has increased **OR**
the water now exists in the liquid phase **OR** particles have more kinetic energy ✓ (2)

4.4.3 Increase ✓ (1)

4.4.4 Yes ✓
The water is in the gaseous phase ✓ (2)

4.4.5 Yes ✓ (1)

4.4.6 Less than ✓ (1)
[12]

QUESTION 5

5.1. Group 6 ✓

X has 6 valence electrons ✓
Accept
the number of electrons in the outermost orbital is 6 (2)

5.2 Period 2✓
Highest energy level is 2 ✓ (2)

5.3.1 Oxygen ✓ (1)
5.3.2 Two ✓ (1)

5.4.1 Anion ✓ (1)
5.4.2 -2 ✓ (1)
5.4.3 Neon/Ne ✓✓ (2)
5.4.4 oxide ✓✓ (2)
[12]

QUESTION 6

6.1.1 First ionisation energy is the energy needed per mole to remove the first electron from an atom in the gaseous phase. ✓✓ (2)

6.1.2 Alkali metals ✓ (1)

6.1.3 Ionization energy decreases ✓
The **distance** between valence orbitals and the nucleus increases✓, therefore the **force of attraction** between nucleus and outermost electrons decrease✓. Thus, less energy is required to remove the outermost electron. ✓ (4)

6.2.1 Isotopes are atoms of the same element having the same number of proton but different numbers of neutrons. ✓✓ (2)

6.2.2

$$\text{R.A.M} = \frac{\mathbf{M}^{39}\text{K} \times \%\text{ abundance}}{100\%} + \frac{\mathbf{M}^{41}\text{K} \times \%\text{ abundance}}{100\%}$$

$$39.00\checkmark = \frac{38.964 \times 93.258\%\checkmark}{100\%} + \frac{\mathbf{M}^{41}\text{K} \times 6.742\%\checkmark}{100\%}$$

$$\mathbf{M}^{41}\text{K} = 39.544\ \text{g.mol}^{-1}\checkmark$$

(4)

[13]

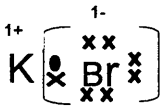
QUESTION 7

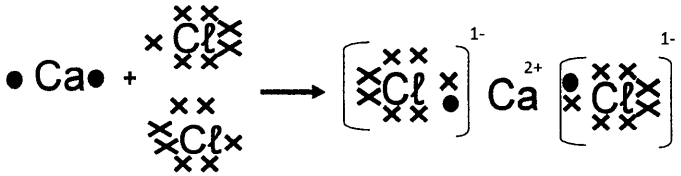
7.1 Chemical bond is a mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons. ✓✓ (2)

7.2.1  ✓ (1)

7.2.2  ✓ (1)

7.3 Ionic bond is the transfer of electrons to form cations (positive ions) and anions (negative ions) that attract each other to form a formula-unit. ✓✓ (2)

7.4  ✓✓ (2)

7.5  (4)

7.6 39 g.mol^{-1}✓ (1)

7.7 $M_{r\,(NH3)} = \underline{14 + 3x1}$ ✓ = 17✓ (2)

7.8 $M_{r(MgBr2)} = 24 +$ ✓ $\underline{2x80}$ ✓ = 184✓ (3)

[18]