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GRADE 10

NOVEMBER 2018

TECHNICAL SCIENCES P2

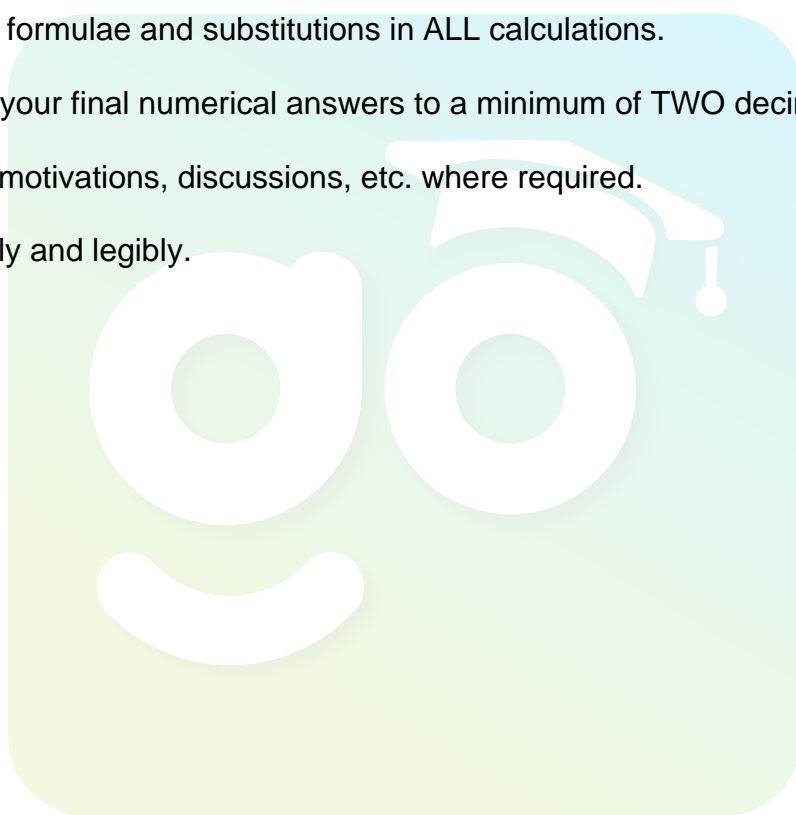
MARKS: 150

TIME: 3 hours

This question paper consists of pages 15, including 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. You may use a non-programmable calculator.
5. LEAVE a line open between subsections, i.e. QUESTION 2.1 and QUESTION 2.2.
6. You are advised to use the attached DATA SHEETS.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your final numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. Write neatly and legibly.



QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the correct answer and write only the letter (A–D) corresponding to the answer next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

- 1.1 Which ONE of the following regarding the thermal conductivity and electrical conductivity of metals is TRUE?

	Thermal conductivity	Electrical conductivity
A	Good	Good
B	Good	Poor
C	Poor	Good
D	Poor	Poor

(2)

- 1.2 Water can be classified as a(n) ...

- A element.
- B compound.
- C homogeneous mixture.
- D heterogeneous mixture.

(2)

- 1.3 The chemical name for Fe_2O_3 is ...

- A iron oxide.
- B iron (II) oxide.
- C iron (III) oxide.
- D iron (VI) oxide.

(2)

- 1.4 A sulphate has the following formula:

- A SO_2
- B SO_4^{2-}
- C SO_3^{2-}
- D S^{2-}

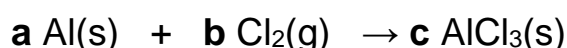
(2)

- 1.5 According to Technical Sciences the SI unit for temperature is ...

- A Joule.
- B Watt.
- C Degrees Celsius.
- D Kelvin.

(2)

- 1.6 What should the values of the quantities **a**, **b** and **c** be for the following reaction to be balanced?



- A 2,2,3
- B 2,3,2
- C 1,3,1
- D 1,3,2

(2)

- 1.7 Why does pure water not conduct electricity well (if this is true)?
- A Huh? Water is an excellent conductor of electricity!
 - B Pure water contains very few ions.
 - C The intermolecular forces in water cause the molecules to move slowly from one place to another. (2)
 - D None of the above is correct.
- 1.8 The element Technetium is an artificially made element and does not occur freely in nature. The nuclear notation for an atom of this element is:
- $$\begin{array}{c} 99 \\ \text{Tc} \\ 43 \end{array}$$
- The nucleus of this atom contains ...
- A 43 neutrons and 56 protons.
 - B 43 neutrons and 99 protons.
 - C 43 protons and 99 neutrons. (2)
 - D 43 protons and 56 neutrons.
- 1.9 The sp notation for potassium is ...
- A $1s^2 2s^2 2p^6 3s^2 3p^5$.
 - B $1s^2 2s^2 2p^6 3s^2 3p^3$.
 - C $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$.
 - D $1s^2 2s^2 2p^6 3s^2 3p^1$. (2)
- 1.10 The class of substances that can be categorised by an increase in conductivity with an increase in temperature are ...
- A metalloids.
 - B non-metals.
 - C alkali metals.
 - D metals. (2)
- [20]

QUESTION 2 (Start on a new page)

2.1 Helium is used to fill party balloons.



Identify TWO properties below that make helium suitable for filling party balloons.

A. colourless	B. low density	C. small atoms	D. unreactive	(2)
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2.2 Helium is also formed on the sun through a process called nuclear fusion. In this process the nuclei of hydrogen atoms fuse to become a helium nucleus, releasing an enormous amount of energy. The nuclear reaction below illustrates one way in which it can occur.



2.2.1 What term can be used to describe the two different hydrogen atoms in the reaction? (2)

2.2.2. REDRAW the table below and fill in the missing information in relation to the nuclear fusion between two hydrogen atoms:

	Electrons e ⁻	Protons p ⁺	Neutrons n ⁰
${}^3_1\text{H}$	a	1	b
${}^2_1\text{H}$	c	1	d
${}^4_2\text{He}$	e	2	f

(6)

2.3 Argon and helium both appear in Group 8 (18) of the periodic table.



2.3.1 What name is given to the elements in this group? (2)

2.3.2 Write down the sp notation of an argon atom. (2)

[14]

QUESTION 3 (Start on a new page)

3.1 Study the list of chemical substances listed below.

A. Silver iodide	B. Barium nitrate	C. Salt water	D. Copper carbonate
E. Carbon dioxide	F. Carbon monoxide	G. Sodium chloride	H. Sugar water

Answer each of the following questions by choosing one of the substances from the list above. YOU MAY USE EACH SUBSTANCE ONLY ONCE:

Which of the substances is:

3.1.1 An insoluble salt? (1)

3.1.2 A solution that does not conduct electricity? (1)

3.1.3 Used to test for the presence of a sulphate anion? (1)

3.1.4 A gas that forms when nitric acid is added to a carbonate? (1)

3.1.5 A yellow precipitate? (1)

3.1.6 A solution with sodium chloride as the solute? (1)

3.2 Two Grade 10 Technical Sciences learners wanted to investigate the solubility of potassium chloride at various temperatures. Before they can proceed they have been asked by their teacher to do a background study on the two compounds and the dissolution process.

3.2.1 Choose the correct chemical formula for potassium chloride from the following:

KCl₂, K₂Cl, KCl (1)

3.2.2 Potassium chloride is a compound held together by ionic bonding. Briefly explain how this type of bond forms. (3)

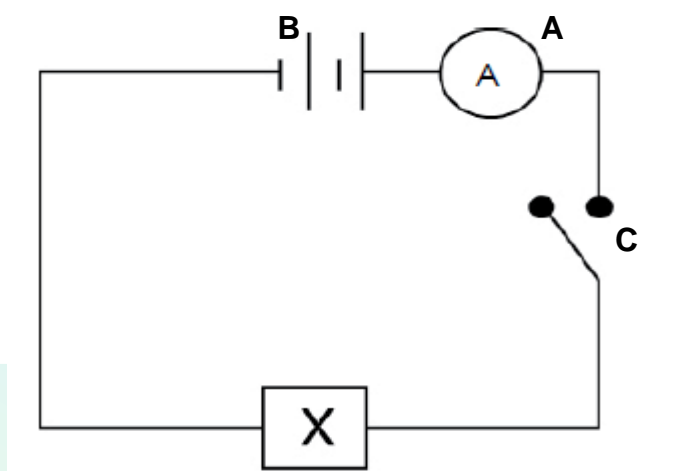
3.2.3 What name is given to the process by means of which a salt dissolves in water? (1)

3.2.4 Write an equation to illustrate how the process in QUESTION 3.2.3 happens with potassium chloride. (3)

[14]

QUESTION 4 (Start on a new page)

The experiment for the electrical conductivity of certain substances is tested with the help of the following circuit configuration:



X represents the substance that is tested and the substances below are placed in the position of **X** consecutively.

- 4.1 Identify and label the apparatus **A**, **B** and **C** in the diagram above. (6)
- 4.2. Explain which properties substance **X**, in the diagram above, must possess in order to act as an electrical conductor when it is placed in a closed circuit. (2)
- 4.3. REDRAW the table and complete it to show conduction of the substances. Use the symbols as indicated, i.e. ✓ or ✗

Name of the substance	Conducts or not: ✓ or ✗
A. Potassium chloride crystal	
B. Distilled water	
C. Potassium chloride solution	

(3)

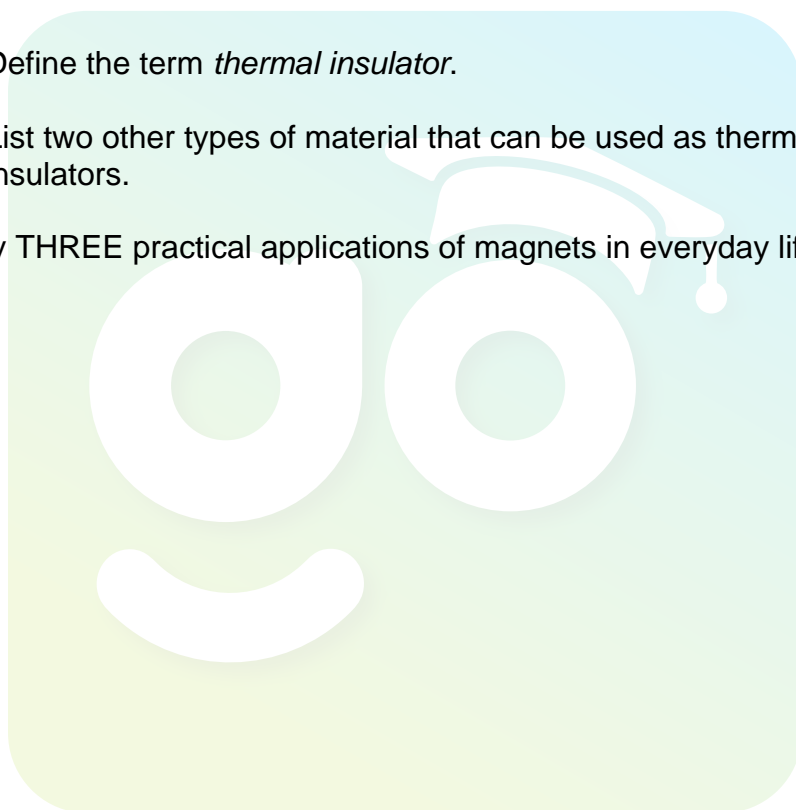
- 4.4 How would the reading of apparatus **A** in the circuit change if the concentration of the potassium chloride solution increases? (2)
- 4.5 In order for the above experiment to take place effectively the variables must be taken into consideration; i.e. the dependent variable, the independent variable and the control variable. REDRAW the table and label these variables.

Dependent variable	a
Independent variable	b
Control variable	c

(3)

- 4.6 What other apparatus can be used as a replacement for the apparatus labelled **A** to carry out the same investigation? Explain what will be the observation regarding conduction when using this replacement apparatus. (3)

- 4.7 Classify the following materials as magnetic or non-magnetic:
- 4.7.1 Aluminium (1)
 - 4.7.2 Iron (1)
 - 4.7.3 Plastic ruler (1)
- 4.8 Many South Africans live in informal housing because of the prevailing high rate of unemployment. These informal houses are mainly made of corrugated iron sheets, making them very cold in winter. Because of technological developments, expanded polystyrene (Styrofoam) can be used as a building material for these impoverished communities. The material can be used to line the inside of the informal houses because of its property as a thermal insulator.
- 4.8.1 Define the term *thermal insulator*. (2)
 - 4.8.2 List two other types of material that can be used as thermal insulators. (2)
- 4.9 State any THREE practical applications of magnets in everyday life. (3)
- [29]**



QUESTION 5 (Start on a new page)

5.1 Distinguish between a *cation* and an *anion*. (2)

5.2 Write down the NAME and the CHARGE of EACH of the underlined ions:

5.2.1 KNO₃ (2)

5.2.2 Al₂(SO₄)₃ (2)

5.2.3 Ca(OH)₂ (2)

5.3 In Stock notation, the number of charge on the metal ion in a compound is indicated by Roman numerals whenever the metal exhibits multiple valences. Using Stock notation, write down the chemical name of the following compounds:

5.3.1 FeO (2)

5.3.2 CaCl₂ (2)

5.4 Write down the CHEMICAL FORMULAE of the binary compounds:

5.4.1 Hydrogen bromide (2)

5.4.2 Copper oxide (2)

5.4.3 Magnesium chloride (2)

5.5 The following equations are not balanced properly. Identify the error in each case and explain why it is incorrect.

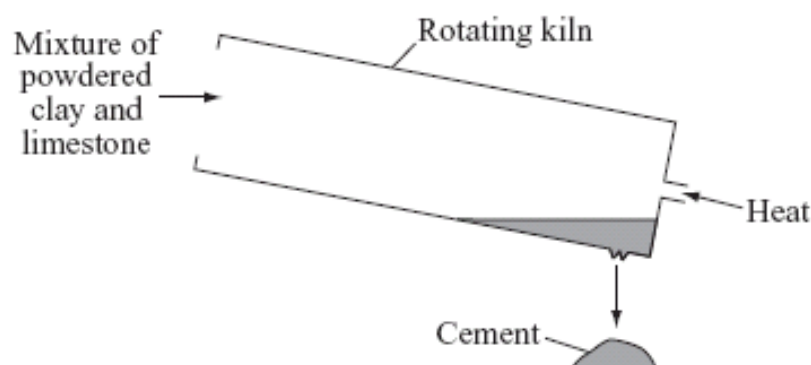
5.5.1 $\text{Na}_2 + 2\text{H}_2\text{O} \rightarrow (\text{NaOH})_2 + \text{H}_2$ (4)

5.5.2 $2\text{Mg} + \text{Cl}_2 \rightarrow \text{Mg}_2\text{Cl}_2$ (3)

[25]

QUESTION 6 (Start on a new page)

Limestone (calcium carbonate or CaCO_3) is an important raw material in the manufacture of cement.



In this process:

- powdered limestone and clay are mixed in a rotating kiln;
- *thermal decomposition* of the limestone takes place to produce **calcium oxide (CaO)** and **carbon dioxide (CO₂)**.
- the calcium oxide then reacts with the clay to make cement.

6.1 Balance the following chemical equation to show the decomposition of calcium carbonate.



6.2 Prove that the law of conservation of mass applies in the reaction in QUESTION 6.1. (4)

6.3 The reaction in QUESTION 6.1 will be referred to as *thermal decomposition* because it happens in the presence of heat. Choose the correct statement that qualifies the decomposition reaction: (2)

- A Heat is released
- B Heat is needed
- C Heat does not play a role

6.4 One of the products of the thermal decomposition reaction in QUESTION 6.1.1 is carbon dioxide. Describe the laboratory test that is used to test for the presence of this gas. (3)

6.5 Is a rotating kiln used to make the cement? Answer YES or NO, and give a reason for your answer. (2)

[14]

QUESTION 7 (Start on a new page)

- 7.1. Two isotopes of the element chlorine are ^{35}Cl (75,78%) and ^{37}Cl (24,22%). The percentages indicate how abundant the isotopes are in comparison with each other.

7.1.1 Provide a term for the group of elements in which chlorine belongs. (2)

7.1.2 Complete the following table, showing the isotopes, by writing the letter and the relevant answer.

	^{35}Cl	^{37}Cl
Number of protons	17	17
Number of electrons	A	B
Number of neutrons	C	D
Number of nucleons	35	37

(4)

- 7.2 An element is in group 5, period 2 and has 8 neutrons. Give the name and the nuclear notation of this element. (3)

- 7.3 Read the statements below and state whether they are **TRUE** or **FALSE**.

7.3.1 Valence electrons are electrons in the outer energy levels. (1)

7.3.2 Core electrons are bonding electrons. (1)

- 7.4 Draw an energy level diagram to represent the electron structure for the following:

7.4.1 Phosphorus (3)

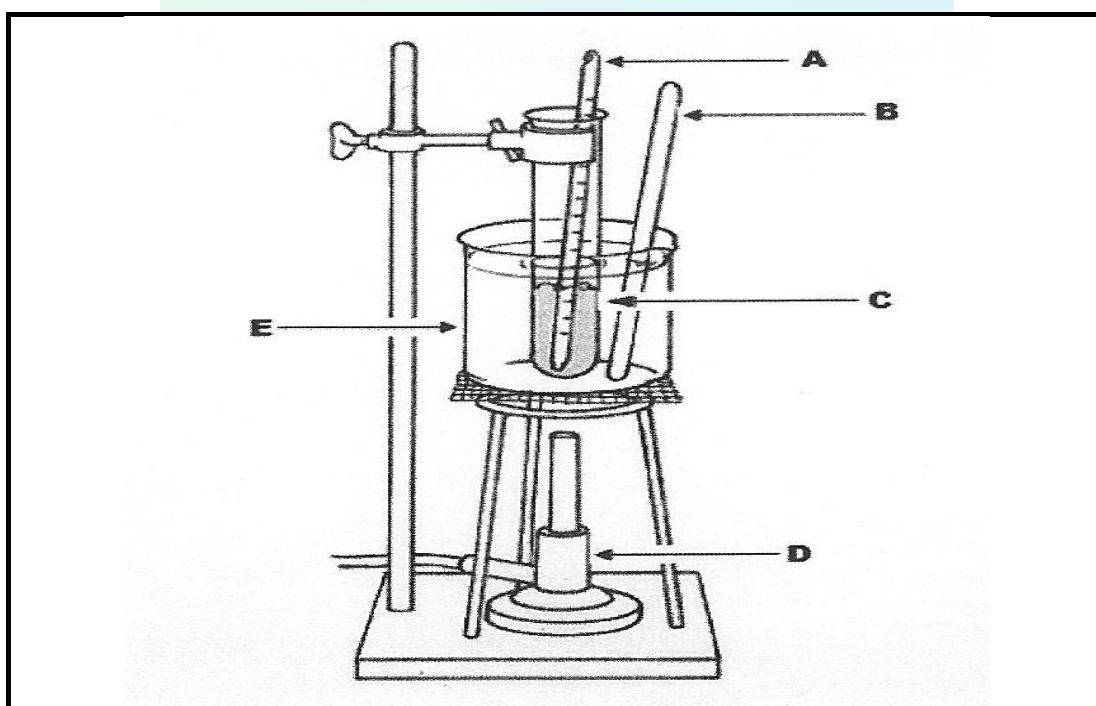
7.4.2 Mg^{2+} (Magnesium ion) (2)

[16]

QUESTION 8 (Start on a new page)

Heat plays a vital role in our lives. The purpose of clothing, as well as heating and air conditioning systems, is to regulate the transfer of heat into and out of our bodies. This regulation is necessary because the human body must be maintained at a temperature of or near 98,6 °F.

- 8.1 Distinguish between *heat* and *temperature*. (4)
- 8.2 Name THREE types of thermometers studied in Technical Sciences. (3)
- 8.3 Give THREE practical applications of thermometers in the universal developing technology. (3)
- 8.4 The pieces of apparatus below were assembled to conduct an experiment to determine the melting point of paraffin wax in a Technical Sciences Grade 10 laboratory. They were labelled **A–E** as shown in the diagram.



- 8.4.1 Name the pieces of apparatus labelled **A–E**. (5)
- 8.4.2 What is the function of the apparatus labelled **B** in the diagram? (2)
- 8.4.3 What property of paraffin wax does not allow it to be heated directly on an open flame? (1)

[18]**TOTAL: 150**

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**DATA FOR TECHNICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 10
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES

NAAM/NAME	SIMBOOL/SYMBOL	WAARDE/VALUE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume teen STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro se konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V} \text{ OR } c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$	$pV = nRT$

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TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMEMENTE

1 (I)	2 (II)	3	4	5 KEY/ SLEUTEL	6	7	8	9 Atoomgetal	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 1 H	3 1,0 7 Li	4 1,5 9 Be															2 He 4