



**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2023

TECHNICAL SCIENCES P2

MARKS: 75

TIME: 1½ hours

This question paper consists of 10 pages, including 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of FIVE questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. You are advised to use the attached PERIODIC TABLE.
6. Number the answers according to the numbering system used in this question paper.
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

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 numbers (1.1 to 1.5) in the ANSWER BOOK, for example 1.6 D.

1.1 The SI unit for specific heat capacity is the ...

- A Kelvin.
- B Joules per Kilogram Kelvin.
- C Joules.
- D Joules per Kilogram. (2)

1.2 The formula that gives the relationship between heat capacity and specific heat capacity correctly, is ...

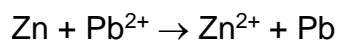
- A $Q = mc\Delta t$.
- B $C = \frac{m}{c}$.
- C $C = \frac{Q}{\Delta t}$.
- D $C = mc$. (2)

1.3 A learner left a solution of copper sulphate in a zinc container overnight. The next morning a brown insoluble substance coated the sides and bottom of the zinc container. The container was corroded and some of the solution had leaked to the floor.

Which ONE of the following reactions took place inside the zinc container?

- A $\text{Cu(s)} + \text{ZnSO}_4(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{Zn(s)}$
- B $\text{Cu}^{2+}(\text{aq}) + \text{ZnSO}_4(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{Zn(s)}$
- C $\text{Zn}^{2+}(\text{aq}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}^{2+}(\text{aq})$
- D $\text{Zn(s)} + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu(s)}$ (2)

1.4 In the reaction:



- A The zinc ion is the reducing agent
- B The lead ion is the reducing agent
- C The lead ion is the oxidising agent
- D The zinc ion is the oxidising agent (2)

1.5 An oxidising agent is a substance that undergoes ...

- A oxidation and loses electrons in the process.
 - B oxidation and gains electrons in the process.
 - C reduction and loses electrons in the process.
 - D reduction and gains electrons in the process. (2)
- [10]**

QUESTION 2 (Start on a new page.)

Thermodynamics is the branch of science that is built upon the fundamental laws that Heat and Work obey when acting on different objects.

- 2.1 State the *law of conservation of heat*. (2)
- 2.2 520 kJ of heat energy is supplied to a certain machine. 310 kJ of this energy is converted to mechanical work.
- Calculate the change in internal energy of this machine. (3)
- 2.3 Define a *working substance* in Technical Sciences in words. (2)
- 2.4 Give TWO examples of a working substance. (2)
- [9]**

QUESTION 3 (Start on a new page.)

- 3.1 Define *specific heat capacity*. (2)
- 3.2 Distinguish between a *surrounding* and *thermodynamic system*.
- 3.3 Suppose you are given 1 ℓ of water in one container and in another container 1 ℓ of ethyl alcohol. (4)
- 3.3.1 Which ONE of the 1 ℓ liquids can be used as an excellent coolant? (1)
- 3.3.2 Explain your answer in QUESTION 3.3.1 using the specific heat capacities of the two liquids. (2)
- 3.4 220 g of water at 90 °C is added to a certain unknown mass of water at 10 °C. The final temperature of the mixture is 33 °C. (4)
- Calculate the unknown mass of water.
- 3.5 The state of the system in thermodynamics is the physical condition of the system as described by values for physical parameters, such as volume, pressure and temperature.
- 3.5.1 Distinguish between a *closed system* and an *isolated system*. (4)
- 3.5.2 Pieces of warm copper, with a mass of 100 g at a temperature of 81 °C is added to 200 g of water at a temperature of 15 °C. The highest final temperature is 18 °C. Calculate the specific heat capacity of copper. (7)

[24]

QUESTION 4 (Start on a new page.)

Chemical change deals with a variety of chemical reactions including Electrochemistry which is the branch that deals with energy conversions due to chemical reactions.

4.1 Differentiate between *oxidation* and *reduction* reactions. (4)

4.2 Determine the oxidation numbers of each of the underlined elements. Write down every step to show how you arrived at the answer.

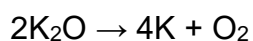
4.2.1 MnO₂ (2)

4.2.2 K₂Cr₂O₇ (2)

4.2.3 NH₄⁺ (2)

4.3 Define the term *electrolysis* in words. (2)

4.4 Consider the following balanced chemical reaction:



Identify the substance which is:

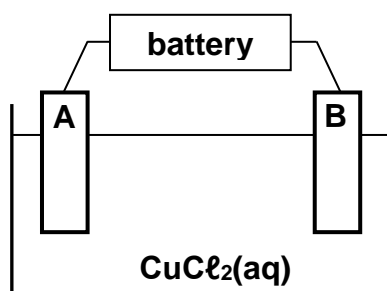
4.4.1 Oxidised (2)

4.4.2 Reduced (2)

[16]

QUESTION 5 (Start on a new page.)

The experimental set up below was used by Grade 11 learners of Technical Sciences to investigate the electrolysis of a copper chloride solution ($\text{CuCl}_2(\text{aq})$).



- 5.1 Define the term *electrolyte* in words. (2)
- 5.2 Why is carbon preferred as an electrode? (2)
- 5.3 What observation will be made at electrodes **A** and **B**? (4)
- 5.4 Which electrode **A** or **B**, represents the:
- 5.4.1 Anode (1)
- 5.4.2 Cathode (1)
- 5.5 Write down the half reaction that will take place at the cathode. (2)
- 5.6 Write down the half-reaction that will take place at the anode. (2)
- 5.7 State TWO uses of electrolysis in technology. (2)

[16]**TOTAL: 75**

**DATA FOR TECHNICAL SCIENCES GRADE 11
PAPER 2**

**GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 11
VRAESTEL 2**

TABLE 1: SPECIFIC HEAT CAPACITIES/TABEL 1: SPESIFIEKE HITTEKAPASITEITE

Name/ <i>Naam</i>	Values/ <i>Waardes</i> (J.kg ⁻¹ .K ⁻¹)
Water	4 200
Copper / <i>Koper</i>	400
Aluminium	900
Glass / <i>Glas</i>	700
Ethyl alcohol / <i>Etielalkohol</i>	2 460
Iron / <i>Yster</i>	460
Zinc / <i>Sink</i>	380
Lead / <i>Lood</i>	130
Ice / <i>Ys</i>	2 100
Brass	380
Mercury / <i>Kwik</i>	140
Methylated spirits / <i>Brandspiritus</i>	2 400

TABLE 2: FORMULAE/TABEL 2: FORMULES

HEAT AND THERMODYNAMICS/HITTE EN TERMODINAMIKA

$C = c m$	$Q = c m \Delta T$	$\Delta Q = \Delta U + \Delta W$
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WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$f = \frac{1}{T}$	$\Delta v = \frac{\Delta x}{\Delta t}$
$T = \frac{1}{f}$	$v = f \lambda$

1 (I)	2 (II)	3	4	5	6	7	8 <i>Atoomgetal</i>	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
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