Province of the
EASTERN CAPE
EDUCATION

NATIONAL
SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2022

TECHNICAL SCIENCES P2

MARKS: 75

TIME: 1½ hours

This question paper consists of 11 pages, including 2 data sheets.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1.   Answer ALL the questions in the ANSWER BOOK.

2.   Start EACH question on a NEW page.

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 ONE line between two sub-questions for example between 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, et cetera 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   A temperature change of t °C is equal to a temperature change of …

    A $(t + 273)$ K.

    B $(273 - t)$ K.

    C t K.

    D   273 K.   (2)

1.2   The amount of heat energy needed to raise the temperature of 3 kg of water by 3 °C is …

    A $3{,}78 \times 10^4$ N.

    B   9 J.

    C   1,26 kJ.

    D   37,8 kJ.   (2)

1.3   An electrochemical cell is set up to plate a nickel object with silver.

    Which ONE of the combinations below CORRECTLY shows the metal used for the positive electrode and the electrolytic solution in the electrochemical cell?

|	METAL USED FOR POSITIVE ELECTRODE	ELECTROLYTE SOLUTION
A	Silver	Silver nitrate
B	Silver	Nickel sulphate
C	Nickel	Silver nitrate
D	Nickel	Nickel sulphate

(2)

1.4 The hull (casing) of a ship contains large quantities of iron (Fe) and the seawater acts as a very good 'salt bridge'. To protect the hull from rusting, metal blocks are attached to the hull.

Which ONE of the following metals will protect the hull the BEST against rusting?

A Mg

B Pb

C Ni

D Cu (2)

1.5 In the following reaction

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$
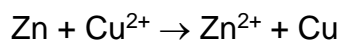
the …

A zinc ion is the reducing agent.

B copper ion is the reducing agent.

C copper ion is the oxidising agent.

D zinc ion is the oxidising agent. (2)

[10]

QUESTION 2 (Start on a NEW page.)

Give ONE word for each of the following statements.

2.1 The amount of heat lost equals the amount of heat gained, when no heat is lost (1)

2.2 The amount of heat required to increase the temperature of 1 kg of the substance by 1 °C or 1 K (1)

2.3 The decomposition of a substance when an electric current is passed through it (1)

2.4 Anything outside the system which has some bearing on the behaviour of the system (1)

[4]

QUESTION 3 (Start on a NEW page.)

Thermodynamics is a branch of Technical Sciences that is built upon the fundamental laws which Heat and Work obey. In our study we saw that these laws place additional restrictions on the use of energy in the form of heat and work, restrictions that the law of conservation of energy does not imply.

3.1	State the First law of Thermodynamics in words.	(2)
3.2	Differentiate between an *isolated system* and a *closed system*.	(4)
3.3	Name THREE thermodynamic variables in Technical Sciences.	(3)
3.4	Define the term *heat capacity* in words.	(2)
3.5	250 g of water at 80 °C is added to a certain unknown mass of water at 10 °C. If the final temperature of the mixture is 27 °C.	
	Calculate the unknown mass of water.	(4)
3.6	A block of warm glass, mass 120 g at a temperature of 77 °C is added to 250 g of water at a temperature of 23 °C. The highest final temperature is 27 °C.	
	Calculate the specific heat capacity of glass.	(6)
		[21]

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QUESTION 4 (Start on a NEW page.)

In thermodynamics we deal with the processes involving heat, work and energy.

4.1 Define *internal energy* of a thermodynamic system in words. (2)

4.2 650 kJ of heat energy is supplied to a certain machine. 440 kJ of this energy is converted into mechanical work.

Calculate the change in internal energy of this machine. (3)

4.3 Define a *working substance* in thermodynamics. (2)

4.4 Give TWO types of working substances in technology. (2)

[9]

QUESTION 5 (Start on a NEW page.)

Chemical change deals with a variety of chemical reactions including electrochemistry which is a branch that deals with energy conversions due to chemical reactions.
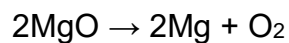
5.1 Distinguish between an *oxidising agent* and a *reducing agent*. (4)

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

    5.2.1 Ca**C**O$_3$ (2)

    5.2.2 K**Mn**O$_4$ (2)

5.3 Consider the following balanced chemical reaction:

$$2MgO \rightarrow 2Mg + O_2$$

Identify the substance which is:

    5.3.1 Oxidised (2)

    5.3.2 Reduced (2)

[12]

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QUESTION 6 (Start on a NEW page.)

The diagram below is a representation of a practical conducted by Technical Sciences learners. It is an electrochemical cell used to decompose a concentrated copper(II) chloride solution using inactive electrodes.

Electrode **A** →

← Electrode **B**

Concentrated copper(II) chloride solution
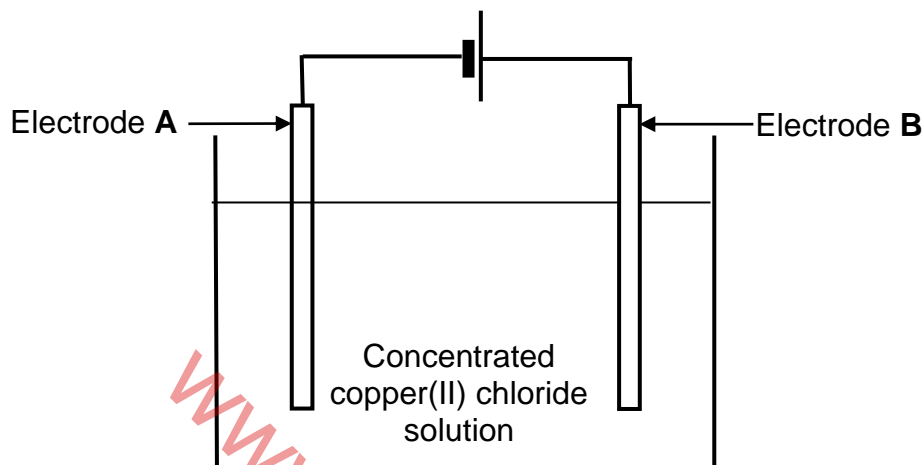
6.1   Give the name of the type of electrochemical cell represented by the diagram above.   (1)

6.2   Explain your answer in QUESTION 6.1 above.   (2)

6.3   State the main difference between a ca*thode* and an *anode*.   (2)

6.4   Give the name of the inactive electrodes used in the practical.   (1)

6.5   Write down the observation that will take place at electrode:

    6.5.1   **A**   (2)

    6.5.2   **B**   (2)

6.6   Which ONE, electrode **A** or **B**, is the …

    6.6.1   anode?   (1)

    6.6.2   cathode?   (1)

6.7   Write down the half reaction that will take place at the:

    6.7.1   Cathode   (2)

    6.7.2   Anode   (2)

6.8   State THREE industrial uses of electrolysis in technology.   (3)
                                                                                                                            [19]

                                                                                                TOTAL: 75

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INFORMATION FOR TECHNICAL SCIENCES
GRADE 11 PAPER 2

TABLE 1: SPECIFIC HEAT CAPACITIES

NAME	VALUES ($J.kg^{-1}.K^{-1}$)
Water	4 200
Copper	400
Aluminium	900
Glass	700
Ethyl alcohol	2 460
Iron	460
Zinc	380
Lead	130
Ice	2 100
Brass	380
Mercury	140
Methylated spirits	2 400

TABLE 2: FORMULAE

HEAT AND THERMODYNAMICS

$C = c\, m$	$Q = c\, m\, \Delta T$	$\Delta Q = \Delta U + \Delta W$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 **1** H 1					**KEY/SLEUTEL**		Atomic number *Atoomgetal*										**2** He 4
1,0 **3** Li 7	1,5 **4** Be 9			Electronegativity *Elektronegatiwiteit* →			1,9 **29** **Cu** 63,5		← Symbol *Simbool*			2.0 **5** B 11	2,5 **6** C 12	3,0 **7** N 14	3,5 **8** O 16	4,0 **9** F 19	**10** Ne 20
0,9 **11** Na 23	1,2 **12** Mg 24			Approximate relative atomic mass *Benaderde relatiewe atoommassa*								1,5 **13** Aℓ 27	1,8 **14** Si 28	2,1 **15** P 31	2,5 **16** S 32	3,0 **17** Cℓ 35,5	**18** Ar 40
0,8 **19** K 39	1,0 **20** Ca 40	1,3 **21** Sc 45	1,5 **22** Ti 48	1,6 **23** V 51	1,6 **24** Cr 52	1,5 **25** Mn 55	1,8 **26** Fe 56	1,8 **27** Co 59	1,8 **28** Ni 59	1,9 **29** Cu 63,5	1,6 **30** Zn 65	1,6 **31** Ga 70	1,8 **32** Ge 73	2,0 **33** As 75	2,4 **34** Se 79	2,8 **35** Br 80	**36** Kr 84
0,8 **37** Rb 86	1,0 **38** Sr 88	1,2 **39** Y 89	1,4 **40** Zr 91	**41** Nb 92	1,8 **42** Mo 96	1,9 **43** Tc	2,2 **44** Ru 101	2,2 **45** Rh 103	2,2 **46** Pd 106	1,9 **47** Ag 108	1,7 **48** Cd 112	1,7 **49** In 115	1,8 **50** Sn 119	1,9 **51** Sb 122	2,1 **52** Te 128	2,5 **53** I 127	**54** Xe 131
0,7 **55** Cs 133	0,9 **56** Ba 137	**57** La 139	1,6 **72** Hf 179	**73** Ta 181	**74** W 184	**75** Re 186	**76** Os 190	**77** Ir 192	**78** Pt 195	**79** Au 197	**80** Hg 201	1,8 **81** Tℓ 204	1,8 **82** Pb 207	1,9 **83** Bi 209	2,0 **84** Po	2,5 **85** At	**86** Rn
0,7 **87** Fr	0,9 **88** Ra 226	**89** Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr