higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE
(Second paper**)**
NQF LEVEL 4

(10021004)

24 November 2022 (X-paper)
09:00–12:00

A Non-programmable calculator may be used.

This question paper consists of 15 pages and 1 addendum of 4 pages containing a data sheet, periodic table and 2 information sheets.

575Q2N2224

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TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Write your EXAMINATION NUMBER and CENTRE NUMBER in the appropriate spaces on the ANSWER BOOK.
2. The question paper consists of 11 questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
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. You are advised to use the attached DATA SHEETS.
11. Write neatly and legibly.

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SECTION A

QUESTION 1

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The unit in which radioactive decay is measured

1.2 Hydrocarbons with multiple bonds between the carbon atoms

1.3 Radioactive emission that travels at the speed of light

1.4 Temperature at which the vapour pressure of a liquid equals the atmospheric pressure

1.5 The unit represented by $kg \cdot m^{-1} \cdot s^{-2}$

(5 × 1) **[5]**

QUESTION 2

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–L) next to the question number (2.1–2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Enhances the production of flowers and fruit	A	addition
2.2	Requirement for the bromination of alkanes	B	isomer
2.3	A carboxylic acid with two carbon atoms	C	redox
2.4	Type of reaction that produces plastic	D	substitution
2.5	Substance that can either accept or donate protons	E	nitrogen
		F	ultra violet light
		G	gamma rays
		H	vinegar
		I	ethanol
		J	amphiprotic
		K	potassium
		L	oxidising agent

(5 × 1) **[5]**

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QUESTION 3

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (3.1–3.5) in the ANSWER BOOK. If the statement is FALSE, write down the CORRECT statement.

3.1 Butanoic acid is a strong acid because it ionises partially.

3.2 In a nuclear reactor, moderators slow down the fast-moving neutrons.

3.3 An aerosol spray functions according to Bernoulli's principle.

3.4 The intermolecular forces in methanoic acid are weaker than the intermolecular forces in methanol.

3.5 Hot springs are a source of geothermal energy.

(5 × 2) **[10]**

QUESTION 4

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (4.1–4.5) in the ANSWER BOOK.

4.1 After 64 days, the activity of a radioactive nuclide has fallen to one sixteenth of its original value. The half-life of the radioactive nuclide is …

A 2 days.
B 4 days.
C 8 days.
D 16 days.

4.2 Alkenes may produce positional isomers when they undergo addition reactions.

Which of the following compounds will NOT produce positional isomers when reacted with hydrogen bromide?

(i) ethene
(ii) propene
(iii) but-2-ene

A (i) only
B (i) and (ii)
C (i) and (iii)
D (ii) and (iii)

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4.3 Some calcium carbonate is placed in a sealed container and allowed to reach chemical equilibrium as follows:

$$CaCO_3(s) \leftrightarrows CaO(s) + O_2(g)$$

How will the number of moles of oxygen and the K_c value be affected at equilibrium if more calcium carbonate is added to the container at constant temperature?

	NUMBER OF MOLES OF OXYGEN	K_c
A	Increases	Increases
B	Increases	Remains the same
C	Remains the same	Remains the same
D	Remains the same	Increases

4.4 One mole each of $SO_2(g)$ and $O_2(g)$ are placed in a sealed container and allowed to reach chemical equilibrium according to the following equation:

$$2SO_2(g) + O_2(g) \leftrightarrows 2SO_3(g)$$

Which ONE of the following is CORRECT concerning the equilibrium concentrations?

A $[O_2] = [SO_2]$
B $[SO_2] < [O_2]$
C $[SO_2] > [SO_3]$
D $[O_2] = [SO_3]$

4.5 Iron(ii) ions react with chlorine.

$$2Fe^{2+}(aq) + C\ell_2(g) \rightarrow 2Fe^{3+}(aq) + 2C\ell^-(aq)$$

Which ONE of the following statements about this reaction is CORRECT?

A Chlorine is reduced by iron(ii) ions.
B Iron(ii) ions are the oxidising agent.
C Iron(ii) ions are reduced by chlorine.
D Chlorine is the reducing agent.

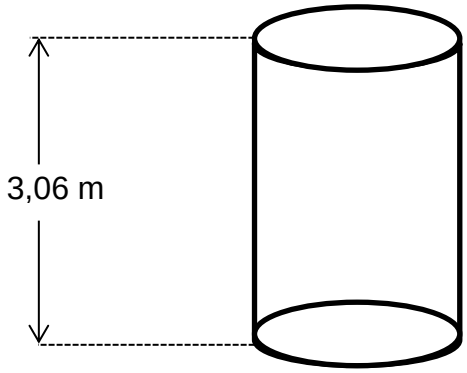
(5 × 3) **[15]**

TOTAL SECTION A: 35

SECTION B

QUESTION 5

5.1 A sealed steel cylinder, filled with paraffin, is placed on its circular base on a level surface. The area of the circular base is 14 m^2.



The pressure exerted by the paraffin on the circular base is 24 Pa.

Calculate the:

5.1.1 Force exerted by the paraffin on the circular base (3)

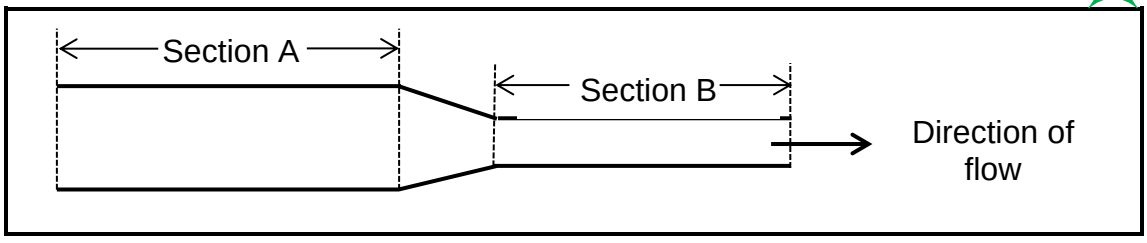
5.1.2 Density of paraffin (3)

5.2 The top of the steel cylinder was opened.

5.2.1 Will the pressure exerted on the circular base be greater than, equal to or less than 24 Pa? (1)

5.2.2 Give a reason for the answer to QUESTION 5.2.1 (1)

5.3 The pipe in a piping system narrows from a diameter of 25 mm to 15 mm.



The flow speed in Section A is 0,1 $m \cdot s^{-1}$, and the water pressure is P**.** Will the following INCREASE, DECREASE or REMAIN THE SAME in Section B?

5.3.1 Flow rate

5.3.2 Water pressure

(2 × 1) (2)

[10]

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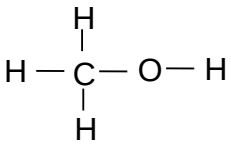
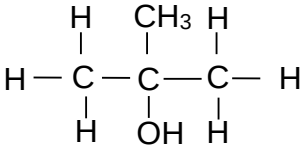
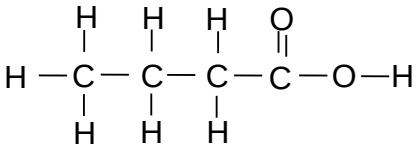
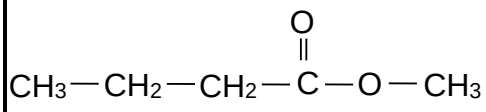
QUESTION 6

6.1 The letters A to F in the table below represent SIX organic compounds.

A		**D**	
B	ethyne	**E**	$CH_3CH_2CH_3$
C		**F**	

6.1.1 Write down the letter(s) that represent(s) the following:

(a) A compound with general formula C_nH_{2n-2} (1)

(b) The least reactive hydrocarbon (1)

6.1.2 For Compound D, write down the:

(a) Homologous series to which it belongs (1)

(b) Name of its functional group (1)

(c) IUPAC name (2)

6.1.3 For Compound F, write down the:

(a) Homologous series of the organic reactants required for its preparation (2)

(b) IUPAC name (2)

6.1.4 For Compound C, write down the:

(a) Structural formula of its chain isomer (2)

(b) IUPAC name of its chain isomer (2)

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6.2 A student investigated the relationship between vapour pressure and the chain length of alcohols at 20 °C.

The following results were tabulated:

	ALCOHOL	VAPOUR PRESSURE (kPa)
P	CH_3OH	11,9
Q	CH_3CH_2OH	5,95
R	$CH_3CH_2CH_2OH$	2,67
S	$CH_3CH_2CH_2CH_2OH$	0,56

6.2.1 For this investigation, write down:

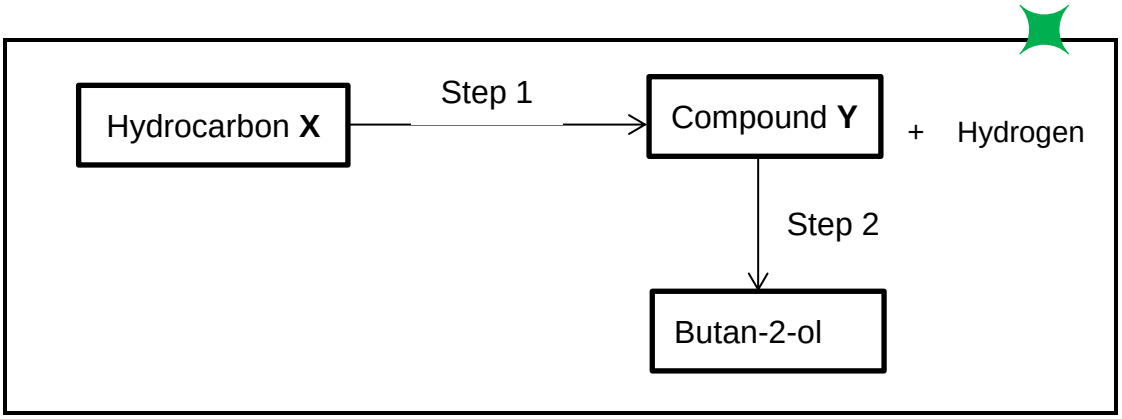
(a) One constant variable (1)

(b) The independent variable (1)

6.2.2 Write a suitable conclusion for this investigation. (2)

6.2.3 Give an explanation for the answer to QUESTION 6.2.2 in terms of the intermolecular forces and energy. (3)

6.3 The flow diagram below shows the conversion of a saturated hydrocarbon X into butan-2-ol.



6.3.1 What specific type of reaction is represented by Step 1? (1)

6.3.2 Write down the full structural formula for Compound Y**.** (2)

6.3.3 Name the inorganic reagent required for Step 2. (1)

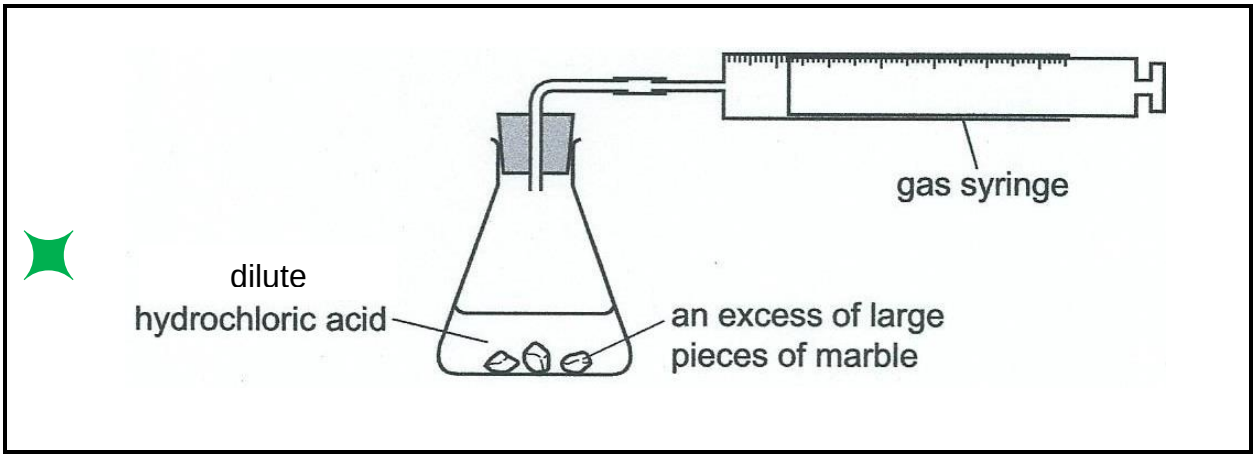
[25]

QUESTION 7

A student investigated the rate of the reaction between dilute hydrochloric acid (HCℓ) and excess marble ($CaCO_3$) under various conditions, using the apparatus illustrated below.

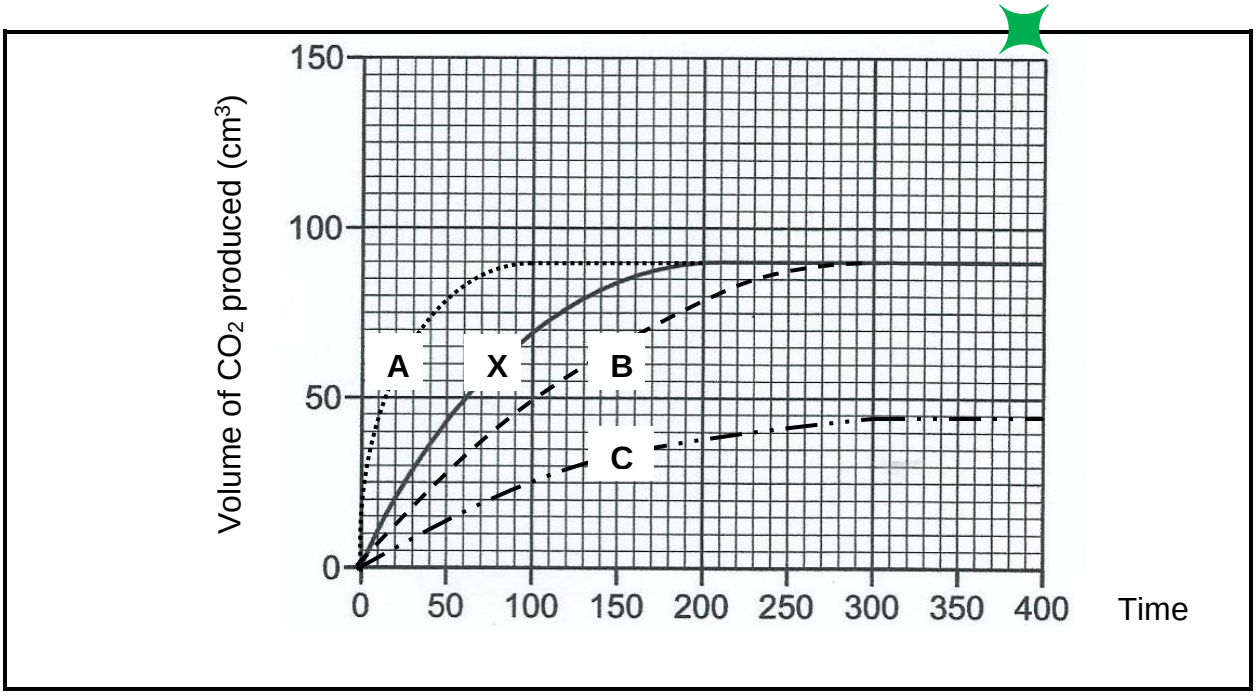
The following reaction occurred:

$$2HC\ell(aq) + CaCO_3(s) \rightarrow CaC\ell_2(aq) + CO_2(g) + H_2O(\ell)$$



Various graphs of volume of $CO_2(g)$ produced against time were plotted as shown.

Graph X was obtained using 200 cm^3 of 0,1 $mol \cdot dm^{-3}$ hydrochloric acid and large pieces of excess marble at 25 °C.



7.1 The volume of HCℓ(aq) placed in the flask was 200 cm^3. Reaction **X** takes 180 seconds to reach completion.

7.1.1 What maximum volume of $CO_2(g)$ is produced by Reaction **X?** (1)

7.1.2 Calculate the average rate of Reaction X in $mol \cdot s^{-1}$. Assume the molar volume to be 24,5 $dm^3 \cdot mol^{-1}$. (4)

7.1.3 Determine the initial concentration of $HC\ell(aq)$ that was used in Reaction X. (4)

7.2 Which graph was obtained by the addition of a catalyst, while keeping all other conditions constant? Select from A, B or C. (1)

7.3 Give an explanation for the answer to QUESTION 7.2 in terms of the Kinetic Molecular Theory. (3)

[13]

QUESTION 8

8.1 When chloride ions are added to a solution containing $Co(H_2O)_6^{2+}$, the following equilibrium is established:

$$Co(H_2O)_6^{2+} + 4C\ell^- \leftrightarrows CoC\ell_4^{2-} + 6H_2O$$

Pink Blue

A few drops of concentrated hydrochloric acid are added to the equilibrium mixture.

8.1.1 What will be the resulting colour of the mixture? (1)

8.1.2 Give an explanation for the answer to QUESTION 8.1.1 (3)

8.2 The following reaction can be used to remove hydrogen sulphide from natural gas:

$$2H_2S(g) + SO_2(g) \leftrightarrows 3S(s) + 2H_2O(g) \quad \Delta H = -145\ kJ \cdot mol^{-1}$$

In an experiment, 3,6 mol $H_2S(g)$ and 2,8 mol $SO_2(g)$ was sealed in a 10 dm^3 reaction flask. At equilibrium, the flask contained 76,8 g solid sulphur.

8.2.1 Calculate the equilibrium concentration of $H_2O(g)$. (4)

8.2.2 Calculate the equilibrium constant for this reaction. (5)

8.2.3 The temperature of the equilibrium system is lowered. Will the quantity of S(s) INCREASE, REMAIN CONSTANT or DECREASE? (1)

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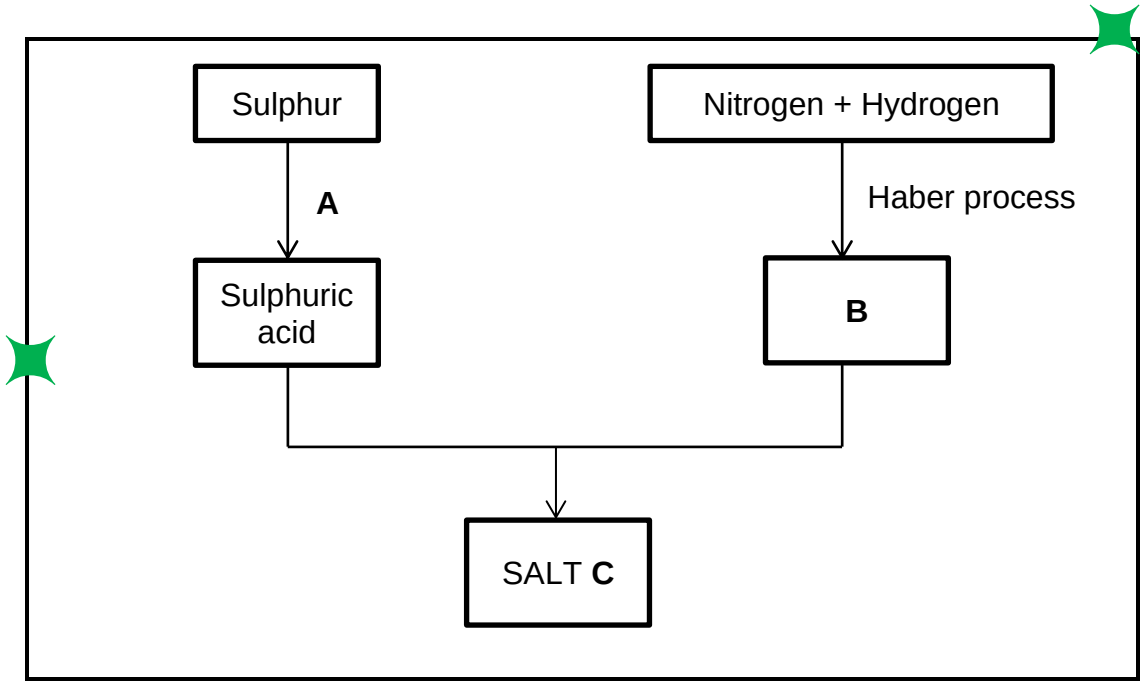
8.3 The flow diagram below illustrates the formation of a salt used in fertilisers.



8.3.1 Name the industrial Process A. (1)

8.3.2 Name Product B. (1)

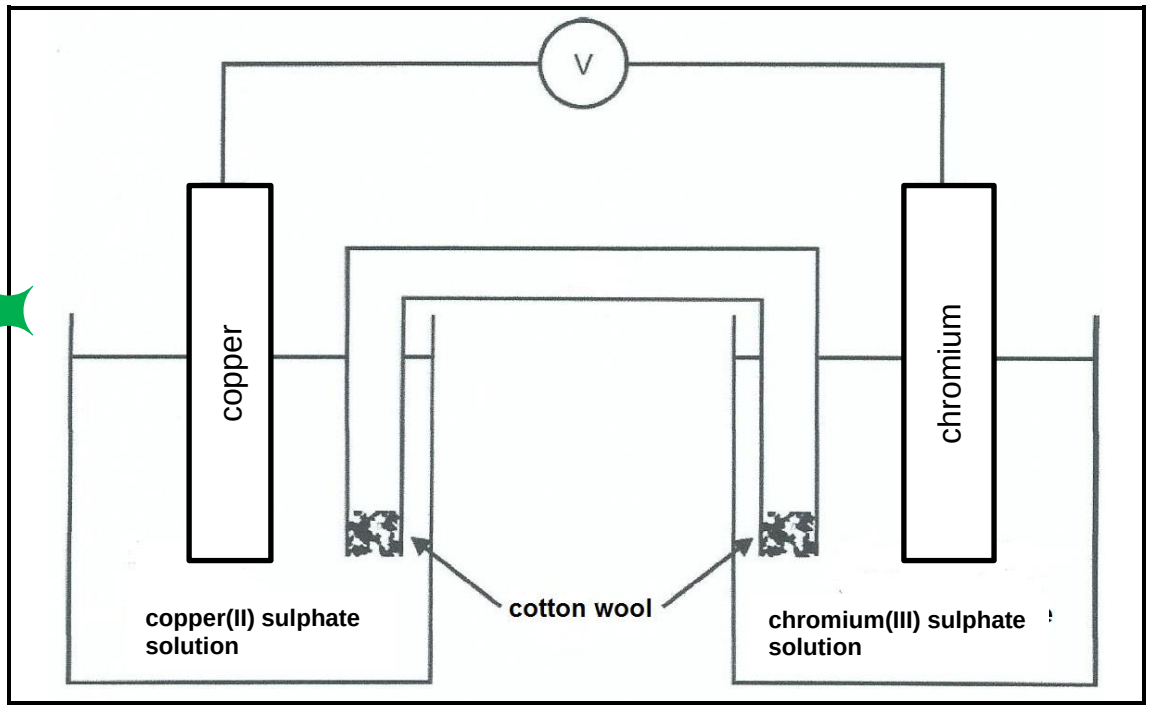
8.3.3 Write down the FORMULA of Salt C. (1)

[17]

QUESTION 9

9.1 A voltaic cell is constructed using copper and chromium half-cells as shown below. The copper half-cell contains copper(II) sulphate solution, and the chromium half-cell contains chromium(III) sulphate solution.

The cell reaction is spontaneous.



9.1.1 Define *reduction*. (2)

9.1.2 State ONE difference between a *galvanic cell* and an *electrolytic cell*. (2)

9.1.3 Calculate the initial reading on the voltmeter under standard conditions. (4)

9.1.4 While the cell is in use, will the following INCREASE, DECREASE or REMAIN CONSTANT?

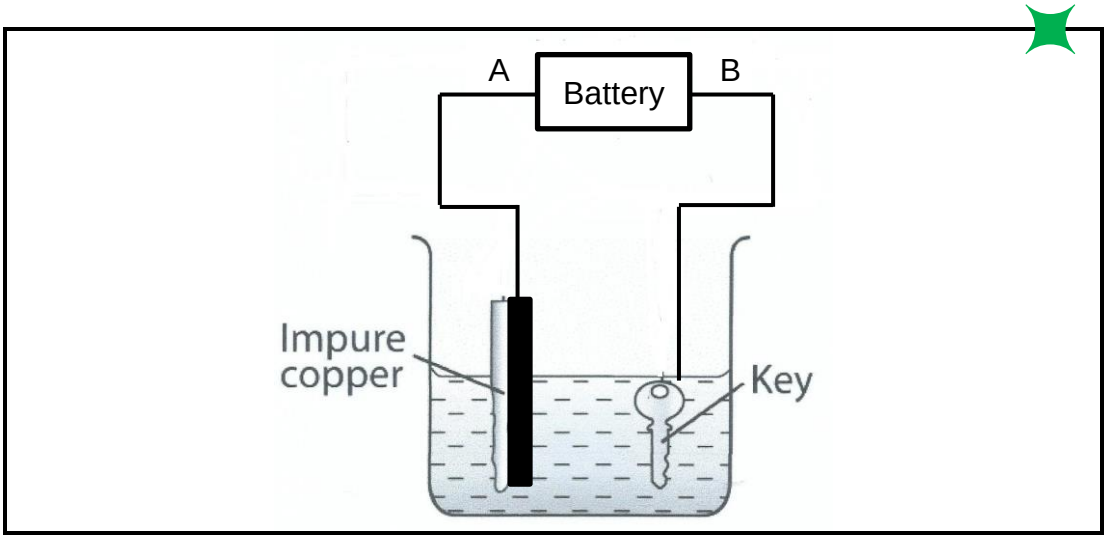
(a) Concentration of $Cr^{3+}(aq)$ (1)

(b) Concentration of $Cu^{2+}(aq)$ (1)

9.1.5 Give a reason for the answer to QUESTION 9.1.4 (b) by writing a suitable half-reaction. (2)

9.1.6 Write down a balanced net ionic equation for the cell reaction. (3)

9.2 The following apparatus was used to electroplate a metal key with copper:



9.2.1 Which is the negative pole of the battery, A or B? (1)

9.2.2 Write down the half-reaction that occurs at the impure copper electrode. (2)

9.2.3 List TWO changes that must be made to this cell if the key is to be electroplated with silver. (2)

[20]

QUESTION 10

10.1 The following solutions are found on a laboratory bench:

SOLUTION	DESCRIPTION
P	0,1 mol·dm^{-3} acetic acid
Q	0,1 mol·dm^{-3} sodium hydrogen carbonate
R	0,1 mol·dm^{-3} nitric acid
T	0,1 mol·dm^{-3} potassium hydroxide

10.1.1 Select TWO solutions that will produce an acidic end point in a titration. (2)

10.1.2 Which ONE of the solutions has a pH closest to 14? (1)

10.2 In a laboratory experiment, a student added 200 cm^3 of 0,8 mol·dm^{-3} sodium hydroxide to an unknown volume of 1,6 mol·dm^{-3} sulphuric acid.

$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O$$

The concentration of the excess sulphuric acid in the resulting mixture was 0,8 mol·dm^{-3}

10.2.1 Is sulphuric acid a STRONG or WEAK electrolyte? (1)

10.2.2 Give a reason for the answer to QUESTION 10.2.1. (2)

10.2.3 State the Lowry-Bronsted definition of a *base*. (2)

10.2.4 How many moles of sodium hydroxide were added to the sulphuric acid? (3)

10.2.5 Determine the quantity of sulphuric acid that reacted with the sodium hydroxide. (2)

10.2.6 Calculate the unknown volume of sulphuric acid. (5)
[18]

QUESTION 11

11.1 $^{238}_{92}U$ and $^{235}_{92}U$ are two different forms of uranium.

11.1.1 Give the term used to describe these different forms of uranium. (1)

11.1.2 Describe how their nuclei differ from each other. (2)

11.2 The table below shows the change in the mass and atomic number of types of radioactive decay.

	CHANGE IN ATOMIC NUMBER	CHANGE IN MASS NUMBER
P	+1	0
Q	-2	-4
R	-1	0
T	0	0

Write down the CAPITAL LETTER which shows the change in the atomic mass number and the atomic number for the following types of emissions:

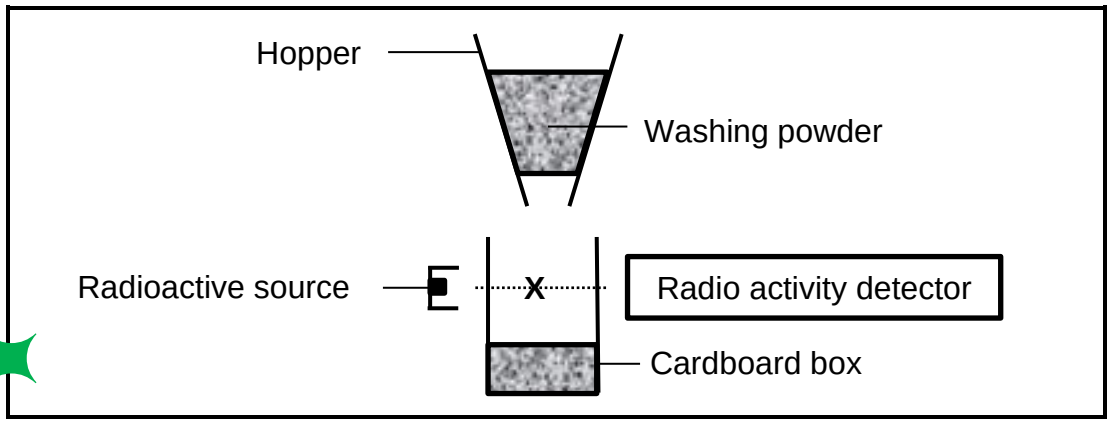
11.2.1 Gamma radiation

11.2.2 Alpha particle

11.2.3 Beta-positive emission

(3 × 1) (3)

11.3 A radioactive source is used in a factory to monitor the level of washing powder in cardboard boxes as they move along a conveyor belt.



11.3.1 A beta emitter is used as a radioactive source in this application.

Give a REASON why the following sources are unsuitable:

(a) Alpha source (1)

(b) Gamma source (1)

11.3.2 Explain what happens when the level of powder in the cardboard box reaches X. (4)

[12]

TOTAL SECTION B: 115
GRAND TOTAL: 150

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ADDENDUM

DATA FOR PHYSICAL SCIENCES L4
PAPER 2 (CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature	T^{θ}	273 K

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$c = \frac{n}{V}$ or $c = \frac{m}{MV}$
$q = I \Delta t$ $W = Vq$	$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ or $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ or $E^{\theta}_{cell} = E^{\theta}_{oxidisingagent} - E^{\theta}_{reducingagent}$

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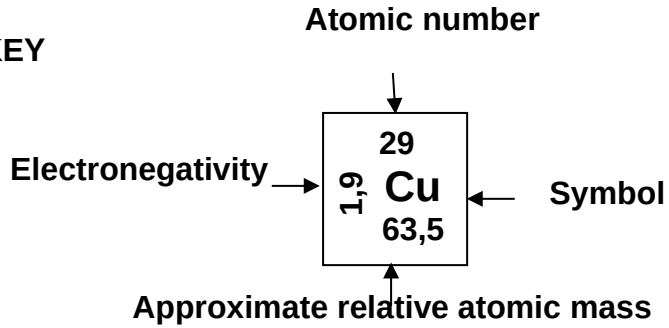
TABLE 3: THE PERIODIC TABLE OF ELEMENTS

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																	**2** **He** 4
1,0 **3** **Li** 7	1,5 **4** **Be** 9											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											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**

KEY



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TABEL 4A: STANDAARDREDUKSIEPOTENSIALE

***Halfreaksies*/Half-reactions**			E^{θ} **(V)**
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,77
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	$\rightleftharpoons$	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O_2	+ 0,68
$I_2 + 2e^-$	$\rightleftharpoons$	$2I^-$	+ 0,54
$Cu^+ + e^-$	$\rightleftharpoons$	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	$\rightleftharpoons$	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	$\rightleftharpoons$	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	$\rightleftharpoons$	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	**$\rightleftharpoons$**	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	– 0,06
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	– 0,13
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	– 0,14
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	– 0,27
$Co^{2+} + 2e^-$	$\rightleftharpoons$	Co	– 0,28
$Cd^{2+} + 2e^-$	$\rightleftharpoons$	Cd	– 0,40
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	– 0,41
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	– 0,44
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	– 0,74
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	– 0,76
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	– 0,83
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	– 0,91
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	– 1,18
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 1,66
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	– 2,36
$Na^+ + e^-$	$\rightleftharpoons$	Na	– 2,71
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	– 2,87
$Sr^{2+} + 2e^-$	$\rightleftharpoons$	Sr	– 2,89
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	– 2,90
$Cs^+ + e^-$	$\rightleftharpoons$	Cs	– 2,92
$K^+ + e^-$	$\rightleftharpoons$	K	– 2,93
$Li^+ + e^-$	$\rightleftharpoons$	Li	– 3,05

***Toenemende oksiderende vermoë*/Increasing oxidising ability** ↑

***Toenemende reduserende vermoë*/Increasing reducing ability** ↓

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TABLE 4B: STANDARD REDUCTION POTENTIALS

Half-reactions/*Halfreaksies*			E^{θ} (V)
$Li^+ + e^-$	$\rightleftharpoons$	Li	– 3,05
$K^+ + e^-$	$\rightleftharpoons$	K	– 2,93
$Cs^+ + e^-$	$\rightleftharpoons$	Cs	– 2,92
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	– 2,90
$Sr^{2+} + 2e^-$	$\rightleftharpoons$	Sr	– 2,89
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	– 2,87
$Na^+ + e^-$	$\rightleftharpoons$	Na	– 2,71
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	– 2,37
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 1,66
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	– 1,18
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	– 0,91
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	– 0,83
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	– 0,76
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	– 0,74
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	– 0,44
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	– 0,41
$Cd^{2+} + 2e^-$	$\rightleftharpoons$	Cd	– 0,40
$Co^{2+} + 2e^-$	$\rightleftharpoons$	Co	– 0,28
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	– 0,27
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	– 0,14
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	– 0,13
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	– 0,06
$2H^+ + 2e^-$	**$\rightleftharpoons$**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	$\rightleftharpoons$	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	$\rightleftharpoons$	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	$\rightleftharpoons$	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	$\rightleftharpoons$	Cu	+ 0,52
$I_2 + 2e^-$	$\rightleftharpoons$	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	$\rightleftharpoons$	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,77
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

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