

GENERAL INSTRUCTIONS

1. Write your **examination number** (and **centre number** if applicable) in the appropriate spaces on the answer book.
2. Answer **ALL** the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. A data sheet is attached for your use.
6. **Marks may be forfeited if instructions are not followed.**

QUESTION 1**INSTRUCTIONS**

1. Answer this question on the specially printed **ANSWER SHEET**. *[NOTE: The answer sheet may be either a separate sheet provided as part of your question paper, or printed as part of the answer book.]*
Write your **EXAMINATION NUMBER** (and **centre number** if applicable) in the appropriate spaces if a separate answer sheet is used.
2. Four possible answers, indicated by A, B, C and D, are supplied with each question. Each question has only ONE correct answer. Choose only that answer, which in your opinion, is the correct or best one and mark the appropriate block on the answer sheet with a cross.
3. Do not make any other marks on the answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be deleted clearly by means of a diagonal line drawn across the page.
4. If more than one block is marked, no marks will be awarded for that answer.

PLACE THE COMPLETED ANSWER SHEET INSIDE THE FRONT COVER OF YOUR ANSWER BOOK, IF A SEPARATE ANSWER SHEET HAS BEEN USED.

EXAMPLE

QUESTION: The symbol for the SI unit of time is ...

- | | |
|---|---|
| A | t |
| B | h |
| C | s |
| D | m |

ANSWER:

A	B	C	D
---	---	--------------	---

1.1 Which one of the following is the best representation of the relationship known as Boyle's law?

A $\frac{pV}{T} = nR$

B $\frac{p_1}{p_2} = \frac{V_1}{V_2}$ (at constant temperature)

C $\frac{p_1}{p_2} = \frac{V_2}{V_1}$ (at constant temperature)

D $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (at constant pressure)

(4)

1.2 5 dm³ of a certain gas is enclosed in a container at a pressure p and a temperature T. Which one of the following sets of pressure and temperature will result in the volume of the gas changing to 15 dm³?

	Pressure	Temperature
A	2 x p	6 x T
B	6 x p	2 x T
C	3 x p	3 x T
D	$\frac{1}{3}$ x p	$\frac{1}{3}$ x T

(4)

1.3 Which one of the following is **NOT** a property of sulphur dioxide (SO₂)?

A It is denser than air.

B It can oxidise magnesium.

C It reacts with water to form sulphuric acid.

D It liquefies at a high pressure and a low temperature.

(4)

1.4 Which one of the following substances will produce a brown gas when heated?

A Sodium nitrate crystals

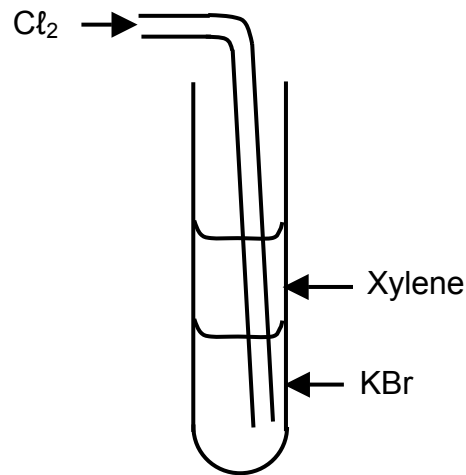
B Concentrated nitric acid

C Ammonium chloride crystals

D Nitrogen monoxide (nitrogen(II) oxide) gas

(4)

- 1.5 Cl_2 gas is bubbled through a test tube containing a layer of xylene and a layer of an aqueous solution of potassium bromide as shown in the diagram below. A reaction takes place.

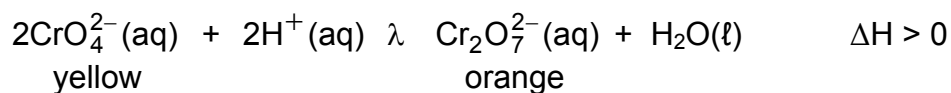


Thereafter a solution of silver nitrate is added and the test tube shaken. The possible product(s) respectively present in the top and bottom layer is/are ...

	Top layer	Bottom layer
A	Cl_2 solution	$\text{AgCl} + \text{KBr}$
B	Cl_2 solution	$\text{AgBr} + \text{KBr}$
C	Br_2 solution	$\text{AgBr} + \text{KNO}_3$
D	Br_2 solution	$\text{AgCl} + \text{KNO}_3$

(4)

- 1.6 Consider the following equation of a reversible reaction:

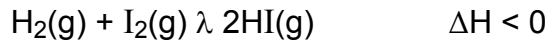


Which set of factors below would favour the formation of orange dichromate ions?

	Temperature	pH
A	Decrease	Increase
B	Decrease	Decrease
C	Increase	Increase
D	Increase	Decrease

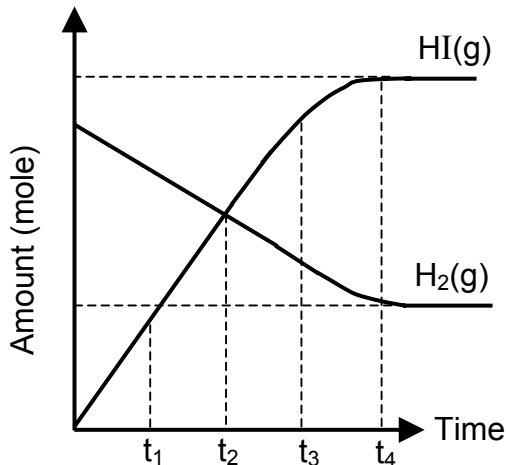
(4)

- 1.7 The following reversible reaction is used in the production of hydrogen iodide gas:

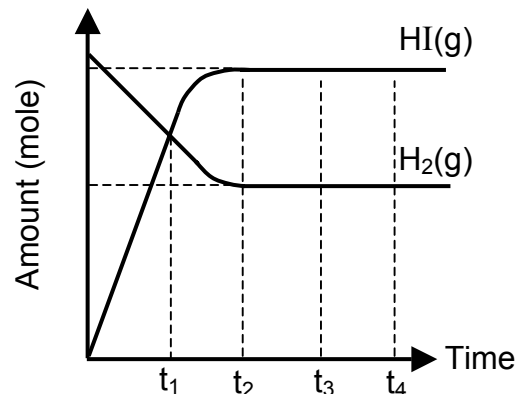


The graph X of amount of reagents against time was obtained when the reaction was carried out under certain conditions.

The graph Y was obtained for the same experiment using the same amount of $\text{H}_2(\text{g})$, but certain changes were made to the conditions affecting the system.



GRAPH X



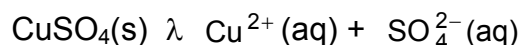
GRAPH Y

Which one of the following sets of changes could have been introduced to the system to obtain graph Y?

- A More $\text{I}_2(\text{g})$ was added and the temperature was decreased.
- B The temperature and pressure was decreased.
- C A catalyst was added and the temperature was increased.
- D A catalyst was added and the temperature was decreased.

(4)

- 1.8 Consider a saturated solution of copper sulphate in equilibrium with its ions at 25 °C.



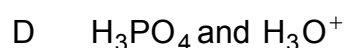
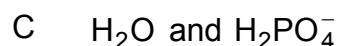
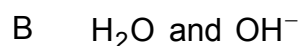
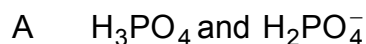
A few drops of concentrated sulphuric acid (H_2SO_4) is then added to this equilibrium mixture while the temperature remains constant, and after some time the equilibrium is **re-established**.

How will the rate of the reverse reaction and the product of the ion concentrations ($[\text{Cu}^{2+}][\text{SO}_4^{2-}]$) now compare to what they were originally?

	Rate of reverse reaction	$[\text{Cu}^{2+}][\text{SO}_4^{2-}]$
A	Remains the same	Remains the same
B	Increases	Increases
C	Remains the same	Increases
D	Increases	Remains the same

(4)

- 1.9 H_3PO_4 is dissolved in H_2O and after some time an equilibrium is established. The Lowry-Brønsted **bases** present in this reversible reaction are ...



(4)

- 1.10 The addition of which one of the following substances to water will increase the pH of the solution?

A Sodium ethanoate

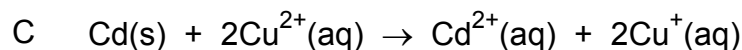
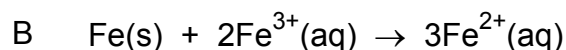
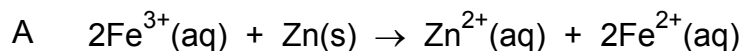
B Sodium sulphate

C Ammonium chloride

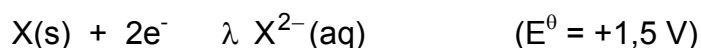
D Sodium chloride

(4)

1.11 Which one of the following reactions **CANNOT** occur spontaneously under standard conditions? (Refer to the table of Standard Electrode Potentials (Table 4).)



1.12 A hypothetical electrochemical cell is constructed by combining two half-cells of which the two half-reactions and electrode potentials are given below:



Which one of the following statements is true:

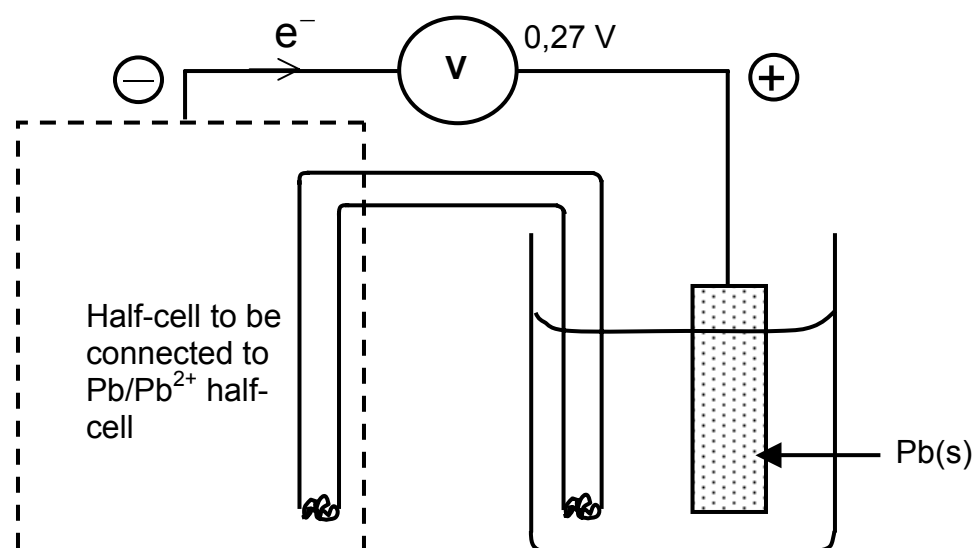
A $\text{X}^{2-}(\text{aq})$ will be oxidised more readily than $\text{Y}(\text{s})$.

B $\text{Y}^{+}(\text{aq})$ will be one of the products formed in the cell reaction.

C The mass of X will increase when the cell is delivering current.

D Electrons will flow from X(s) to Y(s) in the external circuit when the cell is delivering current. (4)

- 1.13 Which one of the following half-cells would have to be connected to a Pb/Pb²⁺ half-cell to obtain a voltmeter reading of 0,27 V in the following standard electrochemical cell?



- A Pt, H₂S/S
 B Cd/Cd²⁺
 C Cr/Cr³⁺
 D Sn/Sn²⁺ (4)
- 1.14 The formula of the organic product formed when ethanol reacts with methanoic acid is:
- A C₂H₄O₂
 B C₃H₅O₂
 C C₃H₆O₂
 D C₄H₈O₂ (4)
- 1.15 Which one of the following properties is associated with propane?
- A Addition reactions
 B Exothermic reactions with oxygen
 C Hydrogenation
 D Higher boiling point than C₄H₁₀ (4)

[60]

ANSWER QUESTIONS 2 - 9 IN YOUR ANSWER BOOK.**INSTRUCTIONS**

1. Start each question on a new page in your answer book.
2. Leave one line between sub-sections, for example between QUESTIONS 2.1 and 2.2.
3. Give all formulae used and show your working (this includes substitutions).
4. Number your answers in the same way that the questions are numbered.

QUESTION 2

2.1 Consider the following substances in the solid phase:

- A Carbon
- B Sulphur
- C Sodium
- D Sodium chloride
- E Water

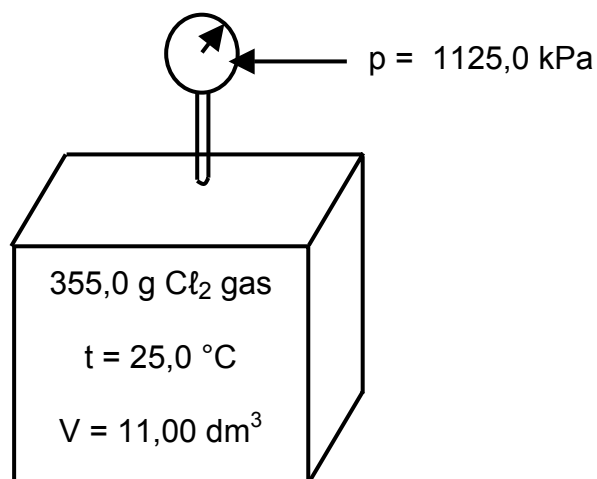
Which one is an example of ...

(Write down only the letter A, B, C, D or E.)

- 2.1.1 a solid that is a good conductor of electricity and forms a basic oxide when it reacts with oxygen? (2)
- 2.1.2 a substance having an allotrope that is a network solid with an extremely high melting point? (2)
- 2.1.3 a non-conductor of electricity that becomes a good conductor when it melts? (2)
- 2.1.4 a solid in which hydrogen bonding exists? (2)
- 2.2 2,0 g of **oxygen gas** at a certain temperature and pressure has a volume of 4,0 dm³. 2,0 g of **hydrogen gas** is at the same temperature and pressure.
- 2.2.1 Calculate the volume of the hydrogen gas. (6)
- 2.2.2 Is the average kinetic energy of the molecules of the hydrogen gas **SMALLER THAN, GREATER THAN** or **EQUAL TO** that of the oxygen gas? (2)

- 2.3 A learner saw the following detailed sketch of an experiment and a table containing information about $\text{Cl}_2(\text{g})$ in a textbook.

He decides to verify the correctness of the information in the book by calculating R , and comparing it to the value of $8,31 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$ on the data sheet.



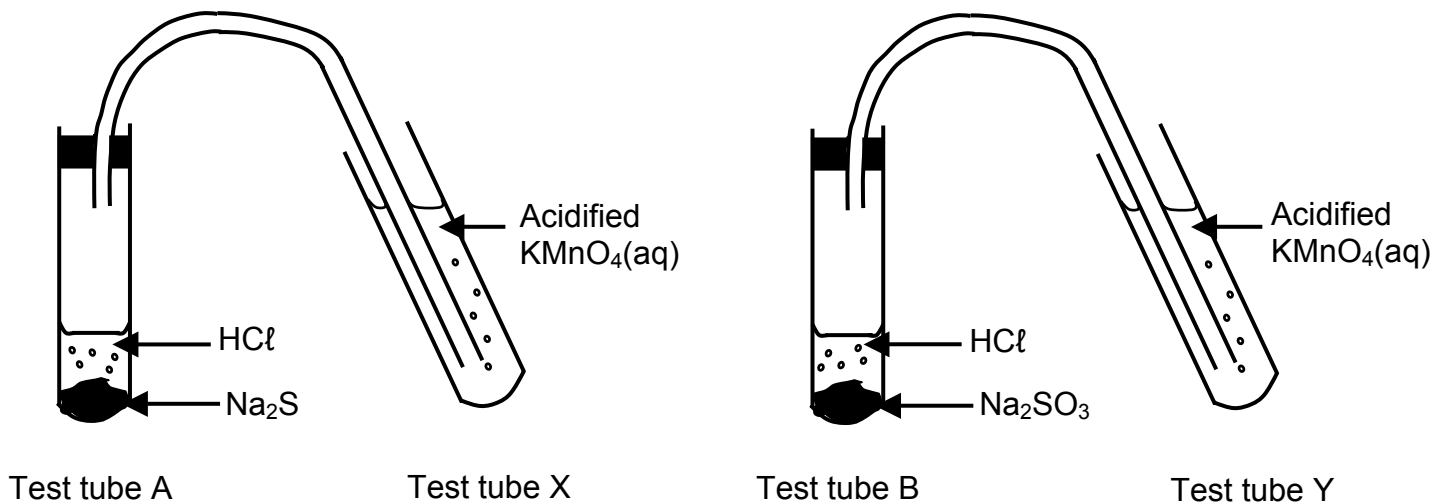
Data: Cl_2	
Molar mass	$71 \text{ g}\cdot\text{mol}^{-1}$
Density	$3,17 \text{ g}\cdot\text{dm}^{-3}$
Melting point	$- 101 \text{ }^\circ\text{C}$
Boiling point	$- 35 \text{ }^\circ\text{C}$

- 2.3.1 Show his calculation of R correct to three decimal places (four significant figures). (4)
- 2.3.2 When the gas in this container is cooled down to $-30 \text{ }^\circ\text{C}$ it is found that the value of R is not equal to $8,31 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$. Give a reason for this. (2)

[22]

QUESTION 3 (Start on a new page)

Dilute HCl is added to sodium sulphide (Na_2S) in test tube A and concentrated HCl is added to sodium sulphite (Na_2SO_3) in test tube B. The gases formed in test tubes A and B are passed through purple acidified solutions of potassium permanganate (KMnO_4) in test tubes X and Y respectively.



3.1 Write down the **NAME** of the gas that is formed in:

3.1.1 Test tube A (2)

3.1.2 Test tube B (2)

3.2 In which test tube, X or Y, is a precipitate formed? (1)

3.3 Write down the relevant half-reaction to support the answer in QUESTION 3.2.

Use the table of Standard Electrode Potentials (Table 4). (2)

3.4 Name the type of reaction that takes place in test tube Y. (2)

3.5 Refer to test tube Y:

3.5.1 What will be observed when the gas is bubbled through the purple KMnO_4 ? (2)

3.5.2 Write down the relevant half-reaction that represents the change that KMnO_4 undergoes. (2)

The gas formed in test tube A is now bubbled through a test tube Z containing a blue solution of copper sulphate.

3.6 What is observed in this test tube? (2)

3.7 Write down the balanced equation for the reaction that takes place in test tube Z. (3)

3.8 Name the type of reaction that takes place in test tube Z. (2)

[20]

QUESTION 4 (Start on a new page)

4.1 Cl_2 gas is prepared in the laboratory and then bubbled through water to which a few drops of the indicator bromothymol blue were added. Bromothymol blue is yellow in an acid and blue in a base.

4.1.1 What will the colour of the solution be immediately after Cl_2 gas is bubbled through it? (2)

4.1.2 Write down the **FORMULA** of the product that is formed in the reaction between Cl_2 and H_2O and that is responsible for the colour of the indicator in the solution. (2)

After a while it is observed that the solution becomes colourless.

4.1.3 Give an explanation for this observation. (2)

4.2 Potassium nitrate is used in the preparation of explosives.

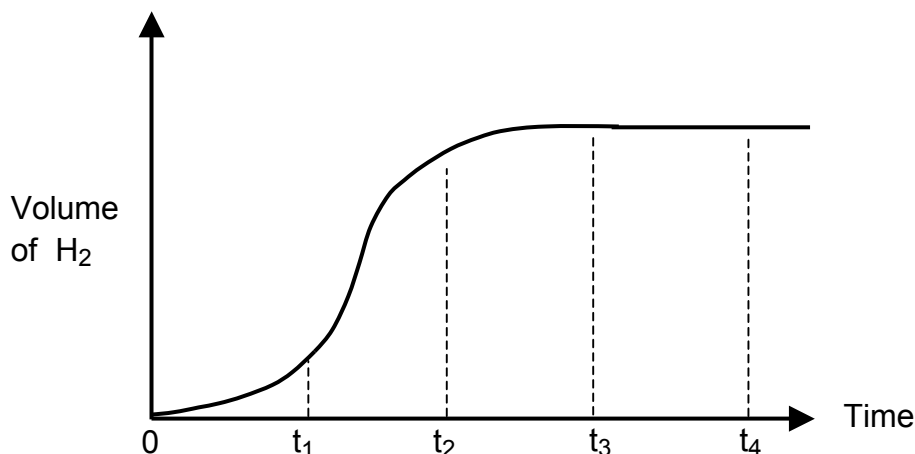
4.2.1 Why is potassium nitrate a suitable reagent in explosives? (2)

4.2.2 Write down the balanced equation of a reaction that potassium nitrate undergoes, to support the answer in QUESTION 4.2.1. (2)

[10]

QUESTION 5 (Start on a new page)

A 5 g piece of zinc of which the surface had not been cleaned, is added to an **excess** of 1 mol.dm^{-3} dilute hydrochloric acid at room temperature. The volume of hydrogen gas produced is measured at regular intervals. A sketch graph representing the total volume of hydrogen gas produced as a function of time is given below:



- 5.1 What does the slope of the graph represent? (2)
- 5.2 Explain why the graph becomes flat after t_3 . (2)
- 5.3 The experiment was repeated three times, each time changing one of the conditions. Graphs with a similar shape to the one shown in the sketch were obtained, although the total volume of H_2 and the slope of the graph were different in some cases.

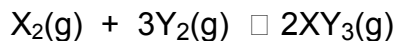
Complete the table by writing down the question number and next to it only **INCREASES**, **DECREASES** or **STAYS THE SAME**.

Applied change	Effect of the change on the volume of H_2 gas produced	Effect of the change on the slope between t_1 and t_2
5 g of powdered Zn is used	5.3.1	5.3.2
2 mol.dm^{-3} HCl is used	5.3.3	5.3.4
A catalyst is used	5.3.5	5.3.6

(12)
[16]

QUESTION 6 (Start on a new page)

The following hypothetical reversible reaction reaches equilibrium in a closed container with a fixed volume of 2 dm³:



The values of the equilibrium constant (K_c) at different temperatures for this reaction are given below:

Temperature (°C)	K_c
400	0,8
600	2,5
800	4,0

- 6.1 Is this reaction exothermic or endothermic? (1)
- 6.2 Give an explanation for the answer in QUESTION 6.1. (3)
- 6.3 State the effect of adding more $\text{Y}_2(\text{g})$ on the:
(Write down only **INCREASES**, **DECREASES** or **STAYS THE SAME**.)
- 6.3.1 Rate of the reverse reaction at the new equilibrium (2)
- 6.3.2 Amount of $\text{X}_2(\text{g})$ at the new equilibrium (2)
- 6.4 When an amount of X_2 and Y_2 is placed in the 2 dm³ container **at 800 °C** a reaction takes place, and it is found that the equilibrium concentration of both Y_2 and XY_3 is 0,4 mol.dm⁻³. Calculate the initial amount (in mol) of X_2 and Y_2 placed in the container. (9)

[17]

QUESTION 7 (Start on a new page)

- 7.1 A small piece of iron is placed into a dilute acidified solution of potassium dichromate. The potassium dichromate is in excess. A reaction takes place in which the orange colour of the potassium dichromate solution changes. At completion of the reaction(s) it is found that no iron(II) (Fe^{2+}) ions were present in the solution, but the mass of the piece of iron decreased.
- 7.1.1 Write down an equation for the half-reaction that explains the decrease in the mass of the iron. (2)
- 7.1.2 Write down an equation for the half-reaction that explains the change in colour of the orange solution. (2)
- 7.1.3 Explain, referring to the table of Standard Electrode Potentials (Table 4), why Fe^{2+} ions are not present at the completion of the reaction(s). (3)
- 7.2 Hydrogen peroxide (H_2O_2) has a tendency to react with itself (decompose) if stored for a long period. For this reaction write down the equation for the: (Use the table of Standard Electrode Potentials (Table 4).)
- 7.2.1 Oxidation half-reaction (2)
- 7.2.2 Reduction half-reaction (2)
- 7.2.3 Balanced overall reaction (2)
- Hydrogen peroxide is commonly used in the bleaching of hair.*
- 7.2.4 Which one of the half-reactions (7.2.1 or 7.2.2) explains this use of H_2O_2 ? (1)
- 7.2.5 Give a reason for the answer to QUESTION 7.2.4. (2)
- 7.3 Calculate the emf of the electrochemical cell based on the half-reactions in QUESTION 7.2. (4)
- [20]**

QUESTION 8 (Start on a new page)

A 200 cm³ solution of hydrochloric acid has a pH of 1.

8.1 Calculate the volume of water that has to be added to this solution to change the pH to 2. (5)

8.2 Sodium carbonate crystals (Na₂CO₃·10H₂O) is used to neutralise the **original** hydrochloric acid (with a pH of 1).

8.2.1 Write down the balanced equation for the neutralisation reaction. (3)

8.2.2 Calculate the mass of sodium carbonate crystals that will be required to neutralise 200 cm³ of the hydrochloric acid solution. (6)

8.2.3 Choose from the following table the most suitable indicator for the reaction. (1)

Indicator	pH range in which the colour changes
Methyl red	4,8 – 6,0
Neutral red	6,8 – 8,0
Chlorophenol red	7,0 – 8,8

8.2.4 Give a reason for the answer to QUESTION 8.2.3. (2)

[17]

QUESTION 9 (Start on a new page)

9.1 A certain hydrocarbon contains two hydrogen atoms for every carbon atom. The relative formula mass of the compound is 42.

9.1.1 Write down the molecular formula for this compound. (2)

This hydrocarbon is bubbled through a solution of bromine in an organic solvent.

9.1.2 What is observed in this experiment? (2)

9.1.3 What type of reaction took place? (2)

9.1.4 Use structural formulae to write down an equation that explains the observation in QUESTION 9.1.2. (4)

9.2 Consider the following organic compounds:

A HCOOH

B CH₃COOH

C HCOOCH₂CH₃

D CH₃CH₂COOH

E CH₃CH₂CH₂OH

9.2.1 Write down the structural formula for an isomer of E. (2)

9.2.2 Write down the IUPAC (systematic) name of B. (2)

9.2.3 Write down the functional group of C. (2)

9.2.4 Write down the formula of the organic acid used in the preparation of C. (2)

[18]

TOTAL: 200

**DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS**

**SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN**

**DATA FOR PHYSICAL SCIENCE
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR NATUUR- EN SKEIKUNDE
VRAESTEL 2 (CHEMIE)**

TABEL 1 : FISIESE KONSTANTES

TABLE 1 : PHYSICAL CONSTANTS

Avogadro-konstante Avogadro's constant	N_A of/or L	$6,02 \times 10^{23} \text{ mol}^{-1}$
Molêre gaskonstante Molar gas constant	R	$8,31 \text{ J.K}^{-1}.\text{mol}^{-1}$
Standaarddruk Standard pressure	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molêre gasvolume by STD Molar gas volume at STP	V_m	$22,4 \text{ dm}^3.\text{mol}^{-1}$
Standaardtemperatuur Standard temperature	T^θ	273 K

TABEL 2 : FORMULES

TABLE 2 : FORMULAE

$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$	$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$
$pV = nRT$	$K_w = [\text{H}^+][\text{OH}^-] = 10^{-14} \text{ by/at } 298 \text{ K}$
$n = \frac{m}{M}$	$pH = -\log[\text{H}^+]$
$c = \frac{n}{V}$	$E_{\text{sel}}^\theta = E_{\text{oksideermiddel}}^\theta - E_{\text{reduseermiddel}}^\theta$
$c = \frac{m}{MV}$	$E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta$
	$E_{\text{sel}}^\theta = E_{\text{katode}}^\theta - E_{\text{anode}}^\theta$
	$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta$

TABEL 3 : DIE PERIODIEKE TABEL VAN ELEMENTE

TABLE 3 : THE PERIODIC TABLE OF ELEMENTS

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

SENIOR CERTIFICATE EXAMINATIONS - MARCH 2004

TABLE 4A: STANDAARD-ELEKTRODEPOTENSIALE

TABLE 4A: STANDARD ELECTRODE POTENTIALS

Halfreaksie / Half-reaction		E° /volt
	$F_2 + 2e^- \rightleftharpoons 2F^-$	+2,87
	$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
	$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+1,51
	$Au^{3+} + 3e^- \rightleftharpoons Au$	+1,42
	$Cl_2 + 2e^- \rightleftharpoons 2Cl^-$	+1,36
	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+1,33
	$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1,23
	$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+1,21
	$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+1,20
	$Br_2 + 2e^- \rightleftharpoons 2Br^-$	+1,09
	$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO + 2H_2O$	+0,96
	$Ag^+ + e^- \rightleftharpoons Ag$	+0,80
	$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$	+0,80
	$Hg^{2+} + 2e^- \rightleftharpoons Hg$	+0,79
	$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0,77
	$O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+0,68
	$I_2 + 2e^- \rightleftharpoons 2I^-$	+0,54
	$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+0,45
	$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+0,40
	$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+0,34
	$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2 + 2H_2O$	+0,17
	$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+0,16
	$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+0,15
	$S + 2H^+ + 2e^- \rightleftharpoons H_2S$	+0,14
	$2H^+ + 2e^- \rightleftharpoons H_2$	0,00
	$Fe^{3+} + 3e^- \rightleftharpoons Fe$	-0,04
	$Pb^{2+} + 2e^- \rightleftharpoons Pb$	-0,13
	$Sn^{2+} + 2e^- \rightleftharpoons Sn$	-0,14
	$Ni^{2+} + 2e^- \rightleftharpoons Ni$	-0,25
	$Co^{2+} + 2e^- \rightleftharpoons Co$	-0,28
	$Cd^{2+} + 2e^- \rightleftharpoons Cd$	-0,40
	$Fe^{2+} + 2e^- \rightleftharpoons Fe$	-0,44
	$Cr^{3+} + 3e^- \rightleftharpoons Cr$	-0,74
	$Zn^{2+} + 2e^- \rightleftharpoons Zn$	-0,76
	$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	-0,83
	$Mn^{2+} + 2e^- \rightleftharpoons Mn$	-1,18
	$Al^{3+} + 3e^- \rightleftharpoons Al$	-1,66
	$Mg^{2+} + 2e^- \rightleftharpoons Mg$	-2,37
	$Na^+ + e^- \rightleftharpoons Na$	-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

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Increasing reducing ability / Toenemende reduceervermoë



SENIOR CERTIFICATE EXAMINATIONS - MARCH 2004

TABEL 4B: STANDAARD-ELEKTRODEPOTENSIALE
 TABLE 4B: STANDARD ELECTRODE POTENTIALS

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Halfreaksie / Half-reaction	E° / volt
$\text{Li}^+ + \text{e}^- \rightleftharpoons \text{Li}$	-3,05
$\text{K}^+ + \text{e}^- \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^+ + \text{e}^- \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^+ + \text{e}^- \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$	-2,37
$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mn}$	-1,18
$2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2 + 2\text{OH}^-$	-0,83
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^- \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}$	-0,44
$\text{Cd}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^- \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ni}$	-0,25
$\text{Sn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	-0,04
$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2$	0,00
$\text{S} + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{S}$	+0,14
$\text{Sn}^{4+} + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^- \rightleftharpoons \text{Cu}^+$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{SO}_2 + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightleftharpoons 4\text{OH}^-$	+0,40
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{I}_2 + 2\text{e}^- \rightleftharpoons 2\text{I}^-$	+0,54
$\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{Hg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Hg}$	+0,79
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^- \rightleftharpoons \text{NO}_2 + \text{H}_2\text{O}$	+0,80
$\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}$	+0,80
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightleftharpoons \text{NO} + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2 + 2\text{e}^- \rightleftharpoons 2\text{Br}^-$	+1,09
$\text{Pt}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,21
$\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2 + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$	+1,36
$\text{Au}^{3+} + 3\text{e}^- \rightleftharpoons \text{Au}$	+1,42
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{F}_2 + 2\text{e}^- \rightleftharpoons 2\text{F}^-$	+2,87

Increasing reducing ability / Toenemende reduseervermoë



ANTWOORDBLAD**ANSWER SHEET**

NATUUR- EN SKEIKUNDE HG (TWEEDE VRAESTEL) PHYSICAL SCIENCE HG (SECOND PAPER)
NOVEMBER 2002

Eksamennommer Examination number																			
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DEPARTEMENT VAN ONDERWYS
DEPARTMENT OF EDUCATION

SENIORSERTIFIKAAT-EKSAMEN SENIOR CERTIFICATE EXAMINATION

NATUUR- EN SKEIKUNDE HOËR GRAAD TWEEDE VRAESTEL (CHEMIE)
PHYSICAL SCIENCE HIGHER GRADE SECOND PAPER (CHEMISTRY)

- 1.1 A B C D
- 1.2 A B C D
- 1.3 A B C D
- 1.4 A B C D
- 1.5 A B C D
- 1.6 A B C D
- 1.7 A B C D
- 1.8 A B C D
- 1.9 A B C D
- 1.10 A B C D
- 1.11 A B C D
- 1.12 A B C D
- 1.13 A B C D
- 1.14 A B C D
- 1.15 A B C D

Vir die gebruik van die nasiener For the use of the marker	
Punte behaal Marks obtained	
Nasiener se paraaf Marker's initials	
Nasiener se nommer Marker's number	

**DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS**

**PHYSICAL SCIENCE HG PAPER 2
NATUUR- EN SKEIKUNDE HG VRAESTEL 2**

(MARCH 2004)

MARKING MEMORANDUM

MEMORANDUM VAN PUNTETOEKENING

QUESTION 1 / VRAAG 1

- 1.1 C 1.2 A 1.3 C 1.4 B 1.5 D 1.6 D 1.7 C 1.8 A
 1.9 C 1.10 A 1.11 D 1.12 B 1.13 B 1.14 C 1.15 B

[60]

QUESTION 2 / VRAAG 2

- 2.1 2.1.1 C (Sodium/Natrium) ✓✓
 2.1.2 A (Carbon/Koolstof) ✓✓
 2.1.3 D (Sodium chloride/Natriumchloried) ✓✓
 2.1.4 E (Water) ✓✓ (8)

2.2 2.2.1 $n(\text{O}_2) = \frac{m}{M} = \frac{2}{32} = \frac{1}{16} \text{ mol} \checkmark$ $n(\text{H}_2) = \frac{m}{M} = \frac{2}{2} = 1 \text{ mol} \checkmark$

$pV = nRT \checkmark$

$V = \frac{nRT}{p} = 16 \checkmark \times 4 \checkmark = 64 \text{ dm}^3 \checkmark$

OR/OF $\frac{1}{16} \text{ mol} \checkmark$ has a volume of $4 \text{ dm}^3 \checkmark$

$\square 1 \text{ mol} \checkmark$ has a volume of $4 \checkmark \times 16 \checkmark = 64 \text{ dm}^3 \checkmark$

(6)

- 2.2.2 Equal to/Gelyk aan ✓✓ (2)

- 2.3 2.3.1 $pV = nRT$

$R = \frac{pV}{nT} = \frac{(1125,0 \times 10^3)(11,00 \times 10^{-3}) \checkmark}{\checkmark 5 \times 298 \checkmark} = 8,305 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \checkmark$ (4)

- 2.3.2 At a low temperature the intermolecular forces (forces of attraction) become prominent and the gases occupy a smaller volume, therefore R is not $8,31 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \checkmark \checkmark$

(2)
 [22]

QUESTION 3 / VRAAG 3

- 3.1 3.1.1 Hydrogen sulphide ✓✓ (2)
 3.1.2 Sulphur dioxide / Sulphur(IV) oxide ✓✓ (2)
- 3.2 X ✓ (1)
- 3.3 $\text{H}_2\text{S} \rightarrow \text{S} + 2\text{H}^+ + 2\text{e}^-$ ✓✓ (2)
- 3.4 Redox ✓✓ (2)
- 3.5 3.5.1 Colour change - purple to colourless ✓✓ (2)
 3.5.2 $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$ ✓✓ (2)
- 3.6 Precipitate ✓✓ (2)
- 3.7 $\text{H}_2\text{S} + \text{CuSO}_4 \checkmark \rightarrow \text{CuS} + \text{H}_2\text{SO}_4 \checkmark$ (bal)✓ (3)
- 3.8 Precipitate or ion exchange or acid-base ✓✓ (2)
- [20]**

QUESTION 4 / VRAAG 4

- 4.1 4.1.1 Yellow ✓✓ (2)
 4.1.2 HCl ✓✓ (also HOCl) (2)
 4.1.3 Bleaching or oxidising of indicator ✓✓ (because of the formation of HOCl) (2)
- 4.2 4.2.1 Potassium nitrate thermally decomposes ✓ into oxygen ✓ and potassium nitrite - ^ explosive (2)
 4.2.2 $2\text{KNO}_3 \xrightarrow{\Delta} \text{O}_2 + 2\text{KNO}_2 \checkmark$ (Bal.) ✓ (2)

[10]

QUESTION 5 / VRAAG 5

- 5.1 Rate of reaction ✓✓ (2)
- 5.2 All zinc used up ✓✓ (also reaction stops) (2)
- 5.3 5.3.1 Stays the same ✓✓ (2)
 5.3.2 Increases ✓✓ (2)
 5.3.3 Stays the same ✓✓ (2)
 5.3.4 Increases ✓✓ (2)
 5.3.5 Stays the same ✓✓ (2)
 5.3.6 Increases ✓✓ (2)

[16]

QUESTION 6 / VRAAG 6

- 6.1 Endothermic ✓ (1)
- 6.2 At high temperature Kc increases ✓ i.e. [products] increases ✓ hence forward reaction favoured ✓ endothermic (3)
- 6.3 6.3.1 Increases ✓✓ (2)
 6.3.2 Decreases ✓✓ (2)

6.4
$$\frac{[XY_3]^2}{[X_2][Y_2]^3} = K_c \checkmark$$

$$\frac{0,4^2}{[X_2](0,4)^3} = 4$$

$$[X_2] = \frac{(0,4)^2}{4 \times (0,4)^3} = 0,625 \text{ mol.dm}^{-3} \checkmark$$

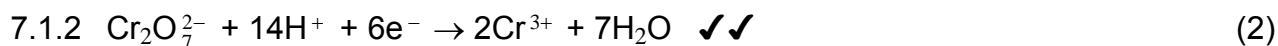
	X ₂	Y ₂	XY ₃
[Equilibrium]	0,625	0,4	0,4
Mole at eq	0,625 × 2 = 1,25 ✓	0,4 × 2 = 0,8 ✓	0,4 × 2 = 0,8
Mole used/Formed	0,8 ÷ 2 = 0,4 ✓	0,8 × $\frac{3}{2}$ = 1,2 ✓	0,8

Initial amount X₂ = 1,25 + 0,4 ✓ = 1,65 mole ✓

Y₂ = 0,8 + 1,2 = 2,0 mole ✓

(9)
[17]

QUESTION 7 / VRAAG 7



7.1.3 The iron would be oxidised to Fe^{2+} ✓ and then to Fe^{3+} ✓

OR $\text{Cr}_2\text{O}_7^{2-}$ is a strong oxidising agent ✓✓ and oxidises Fe^{2+} to Fe^{3+} ✓ (3)



7.2.5 Bleaching is an oxidation reaction. H_2O_2 is a strong O.A. ✓✓ (2)

7.3 $E^\circ = E^\circ_{\text{red}} - E^\circ_{\text{ox}}$ ✓
 $= 1,77\text{V} - (+0,68\text{V})$ ✓
 $= 1,09\text{V}$ ✓ (4)

[20]

QUESTION 8 / VRAAG 8

8.1 $\text{pH} = -\log [\text{H}^+]$

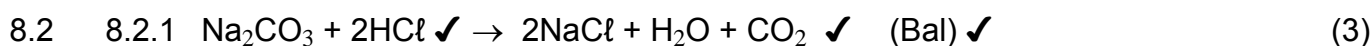
original $[\text{H}^+] = 10^{-1} \text{ mol} \cdot \text{dm}^{-3}$ ✓ new $[\text{H}^+] = 10^{-2} \text{ mol} \cdot \text{dm}^{-3}$

$$\begin{aligned} \text{no. of moles of original } [\text{H}^+] &= cV \\ &= 10^{-1} \times 0,2 \text{ mol} \\ &= 2 \times 10^{-2} \text{ mol} \quad \checkmark \end{aligned}$$

$$\begin{aligned} \text{no. of mole of new } [\text{H}^+] &= cV \\ &= 10^{-2} V \end{aligned}$$

$$\begin{aligned} 10^{-2} V &= 2 \times 10^{-2} \text{ mol} \\ V &= 2 \text{ dm}^3 \quad \checkmark \end{aligned}$$

$$\hat{\text{Amount of H}_2 \text{ to be added}} = 2\,000 \text{ cm}^3 - 200 \text{ cm}^3 \quad \checkmark = 1\,800 \text{ cm}^3 \quad \checkmark \quad (5)$$



8.2.2 $n(\text{HCl}) = 0,02 \text{ mol} \quad \checkmark$

$n(\text{Na}_2\text{CO}_3) = 0,01 \text{ mol} \quad \checkmark \checkmark$

$m = nM \quad \checkmark = 0,01 \times 286 \quad \checkmark$

$= 2,86 \text{ g} \quad \checkmark \quad (6)$

8.2.3 Methyl red ✓ (1)

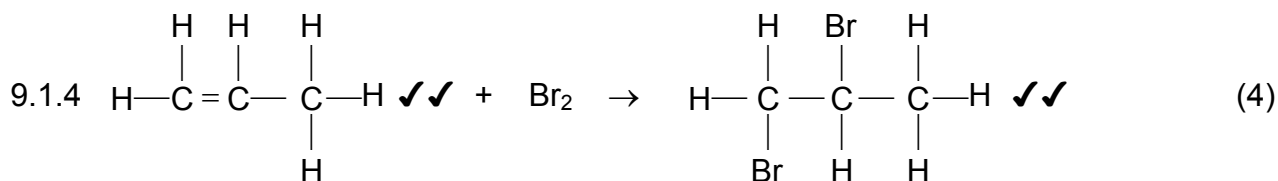
8.2.4 The reaction between a strong acid (HCl) and a weak base (Na₂CO₃) ✓ will yield on acidic solution at the endpoint. ✓ (2)**[17]**

QUESTION 9 / VRAAG 9

9.1 9.1.1 C_3H_6 ✓✓ (2)

9.1.2 Decolourizes bromine water ✓✓ (2)

9.1.3 Addition ✓✓ (2)



9.2.2 Ethanoic acid ✓✓ (2)



9.2.4 Methanoic acid ✓✓ (2)

[18]