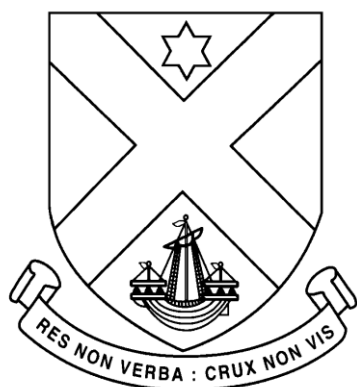




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Exam Number / name: _____

**ST ANNE'S DIOCESAN COLLEGE****TRIAL EXAMINATION 2016****PHYSICAL SCIENCES****PAPER 2 CHEMISTRY**

Time: 3 hours

200 Marks

Examiner: S Schwartz

Moderator: M Schwartz (MHS)

The use of other IEB teachers' questions, in whole or in part, is gratefully acknowledged.

- Weighting of knowledge areas (**Target**): Quantitative Chemistry 10%(10%) / Bonding 11%(10%) / Energy change & Rates 10%(10%) / Equilibrium 14.5%(15%) / Acids & Bases 15(15%) / Electrochemistry 19.5(20%) / Organic 20(20%)
- Cognitive Levels (**Target**): 1 – 14.5%(15%); 2 – 40.5%(40%); 3 – 34.5%(35%); 4 – 10.5%(10%)

READ THE FOLLOWING INSTRUCTIONS CAREFULLY

- This paper consists of:
 - p2-14 Questions 1 to 7;
 - p15-18 Chemistry Data Sheets Tables 1 to 4
 - p19 APPENDIX A
 - p20 APPENDIX B

Please make sure that your question paper is complete.

- The data sheets may be detached if necessary.
- Read the questions carefully and answer in any order, with clear numbering.
- Show your working in all calculations, including equations used.
- Units need not be included in the working of calculations, but appropriate units must be shown in the answer.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	TOTAL	
/20	/28	/28	/25	/35	/27	/37	/200	%

QUESTION 1

MULTIPLE CHOICE QUESTIONS

(use APPENDIX A)

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer.

1.1 Which one of the following would decolourise bromine water most rapidly?

- A C_4H_8 B HCOOH C C_4H_{10} D $\text{CH}_3\text{CH}_2\text{OH}$

1.2 The melting points of several compounds are shown in the table below:

Compound	Melting point ($^{\circ}\text{C}$)
CH_4	-182.5
C_6H_{14}	-95.0
C_8H_{18}	-56.5
$\text{C}_{18}\text{H}_{38}$	28.0

The increase in melting point moving down the table is directly due to...

- A an increase in the strength of the hydrogen bonds
 B the increased ionic nature of the compounds
 C the increase in the molecular masses of the compounds
 D an increase in the strength of the London forces between the molecules

1.3 Hydrogen bonding holds the molecules together in...

- A CH_3OCH_3 B CH_3COOH C CH_3OOCH D CH_3COCH_3

1.4 Diamond and graphite differ because...

- A diamond is purer than graphite B the carbon atoms in diamond are bigger
 C carbon has different valencies D the carbon atoms are differently arranged

1.5 Consider the reaction taking place in a closed container: $\text{A}(\text{g}) + 2 \text{B}(\text{g}) \rightleftharpoons \text{AB}_2(\text{g})$ $\Delta H < 0$

The addition of a suitable catalyst would...

- A speed up the reverse reaction only
 B decrease the rate of the reverse reaction
 C result in a higher yield of product
 D allow equilibrium to be reached in a shorter time period

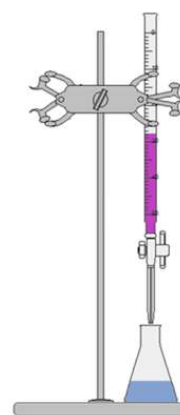
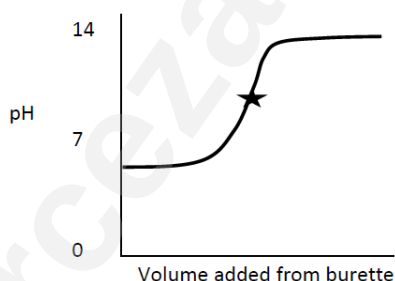
- 1.6 1 mole of PCl_5 gas is heated in a closed container. 50% of the PCl_5 gas decomposes to set up the equilibrium represented by the balanced equation below.



How many moles of gas are present in the container at equilibrium?

- A 0.5 B 1.0 C 1.5 D 2.0
- 1.7 A suitable indicator for an acid-base titration must show a sharp colour change...
- A over a relatively small pH range B at a pH higher than 7
- C over a relatively large pH range D at a pH of 7
- 1.8 The diagram shows the equipment used for an acid-base titration and the pH curve obtained. Which solution is in the burette?

- A HCl
- B NaOH
- C CH_3COOH
- D Na_2CO_3



- 1.9 A sample of silver contains impurities of gold. During purification by electrolysis, the impure silver is used as an electrode. Which one of the following is the best choice of anode and cathode for this process?

	ANODE	CATHODE
A	Impure silver	Pure gold
B	Pure gold	Impure silver
C	Impure silver	Pure silver
D	Pure silver	Impure silver

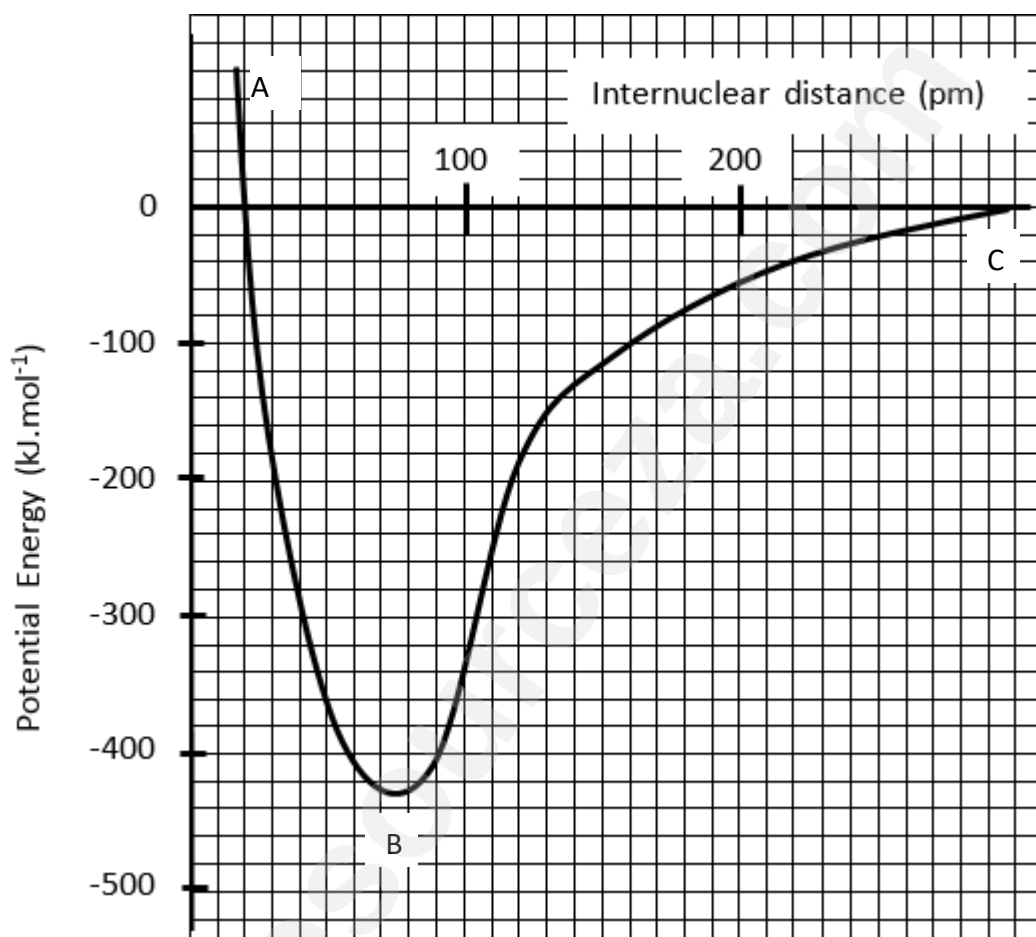
- 1.10 Which statement about the industrial production of aluminium is FALSE?

- A Alumina is extracted from bauxite ore.
- B Alumina is electrolysed to produce aluminium.
- C Addition of cryolite results in fluoride emissions.
- D The graphite cathode needs to be replaced regularly.

[10 X 2 = 20]

QUESTION 2 BONDING

- 2.1 The graph shows the change in potential energy with a change in distance between two hydrogen nuclei.



- 2.1.1 What type of bond forms between two hydrogen atoms? (1)
- 2.1.2 Explain why this type of bond forms between two atoms. (2)
- 2.1.3 From the graph, estimate...
- the bond energy in a hydrogen molecule (1)
 - the bond length in a hydrogen molecule (1)
- 2.1.4 Explain why the energy changes in going from B to A. (2)

Question 2 continues overleaf.

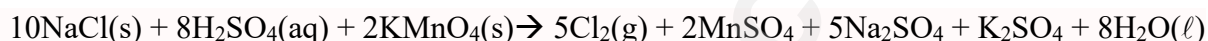
2.2 Our bodies require about 1 teaspoon of table salt per day. Sodium is essential for electrical impulses to travel along nerves and for muscle function.

2.2.1 Make use of Lewis diagrams to show the formation of the bond in NaCl from Na and Cl atoms. (4)

2.2.2 Why is it incorrect to talk about the “molecular” mass of NaCl? (2)

2.2.3 The average mass of a salt crystal is 3.2 mg. How many ions are there in a salt crystal? (5)

2.2.4 The purity of a sample of NaCl was tested by means of the following redox reaction:



(a) Supply the missing word:
In a redox reaction, _____ are transferred. (1)

(b) **Name** the oxidising agent in the above reaction. (2)

(c) **Name** the reagent that provides an acidic medium in the above reaction. (1)

(d) What role is played by the Na^+ , K^+ and SO_4^{2-} ions in the above reaction? (1)

(e) When 20 g of the impure NaCl was treated with excess H_2SO_4 and KMnO_4 , 4 g of pure water was formed. Calculate the % purity of the NaCl sample. (5)

[28]

QUESTION 3 THE WORLD'S WORST INDUSTRIAL DISASTER

The chemical compound methyl isocyanate (MIC) is used in the production of pesticides. The molecular formula of MIC is CH_3NCO . In December 1984, at Union Carbide Corporation in the central Indian city of Bhopal, water accidentally got into a tank of MIC resulting in a runaway exothermic reaction. The high temperatures and the presence of iron from corroding pipelines accelerated the process, causing pressure to build up in the tank. When the emergency pressure valve burst, about 40 tons of MIC escaped into the atmosphere. The toxic gas resulted in the deaths of nearly 4000 people.

3.1 Draw the Lewis structure for CH_3NCO , clearly indicating to which atom the electrons belong. (3)

3.2 In each case, state the molecular geometry around the atom in bold.

3.2.1 CH_3NCO 3.2.2 CH_3NCO 3.2.3 CH_3NCO (3)

3.3 What type of intermolecular forces would you expect there to be between molecules of MIC in the liquid phase? (1)

MIC reacts with water as follows:



3.4 Draw a potential energy profile graph to represent this reaction.

Label the axes as well as the following:

- Energy of the reactants
- Energy of the products
- Activated complex
- Activation energy (E_A)
- Heat of reaction, ΔH

(6)

3.5 The iron from the corroding pipe lines catalysed the reaction.

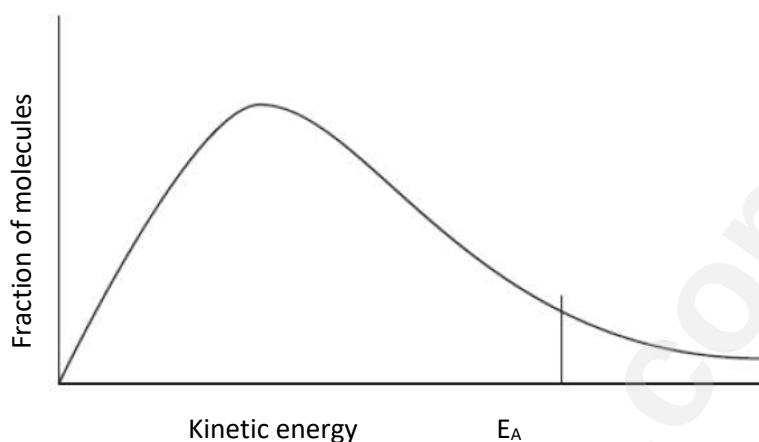
3.5.1 Define a *catalyst*. (2)

3.5.2 Use a dashed line (- - - -) to show the effect of a catalyst on your drawing in 3.4. (1)

3.5.3 Magnesium can be used as a sacrificial anode to prevent the corrosion of iron. Make use of the Redox Table to explain this statement. (2)

Question 3 continues overleaf.

- 3.6 The graph shows the Maxwell-Boltzmann distribution of the kinetic energy of the molecules for a sample of MIC at a particular temperature.



- 3.6.1 On the copy of this graph in Appendix B, draw in the curve which represents the energy distribution at a **higher** temperature. (2)
- 3.6.2 With reference to your new curve and collision theory, explain how increasing the temperature affects the rate of a reaction. (3)
- 3.7 Suppose 12 g of MIC is mixed with 2.5 g of water. Refer to the reaction equation above.
- 3.7.1 Determine which is the limiting reactant. (3)
- 3.7.2 Calculate the volume of $\text{CO}_2(\text{g})$ that would be formed at STP. (2)

[28]

QUESTION 4 CHEMICAL EQUILIBRIUM

A fertiliser company produces ammonia on a large scale at a temperature of 450°C and a pressure of 200 atm.

The balanced equation below represents the reaction that takes place in a sealed container.



To meet an increased demand for fertiliser, the management of the company instructs Courtney, their chemical engineer to make the necessary adjustments to increase the yield of ammonia.

In a trial run on a small scale in the laboratory, Courtney makes adjustments to the TEMPERATURE, PRESSURE and CONCENTRATION of the equilibrium mixture.

The graph represents the results obtained.



- 4.1 Identify what Courtney did to the equilibrium mixture at each of the following times. Thereafter, clearly explain the subsequent changes in the concentrations of the reagents according to Le Chatelier's principle.

4.1.1 t_1

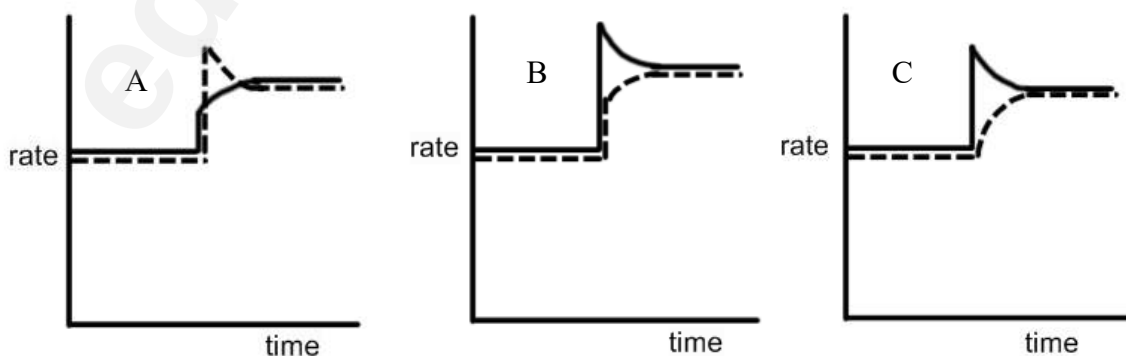
4.1.2 t_2

4.1.3 t_3

(3 x 4)

- 4.2 The graphs below show how the reaction rate changes with time for each of the three changes made (not in the same order). Link each rate-time graph (A, B, C) to the correct time (t_1 , t_2 , t_3) in the above graph.

———— rate of forward reaction
 - - - - - rate of reverse reaction

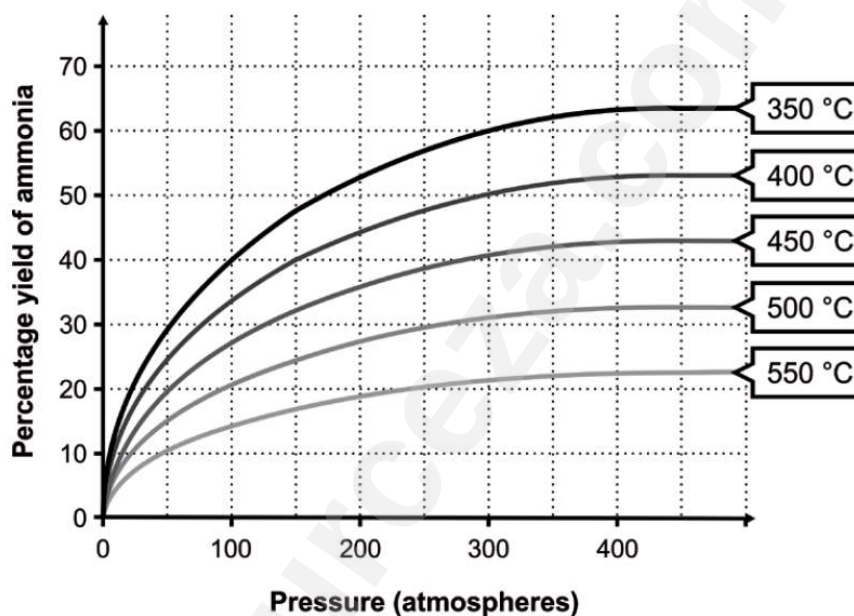


(3)

Question 4 continues overleaf.

4.3 Courtney now injects 5 mol N_2 and 5 mol H_2 into a 5 dm^3 sealed empty container. Equilibrium is reached at 450°C . Upon analysis of the equilibrium mixture, she finds that the mass of ammonia is 20.4 g. Calculate the value of the equilibrium constant (K_c) at 450°C . (7)

4.4 The graph below shows how the percentage yield of ammonia varies with changes in temperature and pressure.



4.4.1 Use the graph to estimate the percentage yield obtained under the conditions used by this company, viz. 450° and 200 atm. (1)

4.4.2 According to this graph the highest yield of ammonia would be obtained at 350° and 400 atm. State why this company does not use...

- (a) the lower temperature
- (b) the higher pressure

(2)

[25]

QUESTION 5 ORGANIC CHEMISTRY

A <pre> H H H H C = C - C - C - H H H H </pre>	B <pre> H H - C - H H H H - C - C - C - H Br H H </pre>	C <pre> H H - C - H H C H H H H H H - C - C - C - C - C - C - H H H H H H H H H - C - H H </pre>
D 2-pentanol	E <pre> H O H - C - C - O - H H </pre>	F heptanoic acid

- 5.1 Provide IUPAC names for compounds A, B, C and E. (8)
- 5.2 Provide the IUPAC name of a positional isomer of compound A. (2)
- 5.3 Draw the structural formulae for compounds D and F. (4)
- 5.4 Name the homologous series to which compound B belongs. (1)
- 5.5 Name the functional group of compound E. (1)
- 5.6 Which one of compounds A to F is a saturated hydrocarbon? (1)
- 5.7 Compound B can undergo two different reactions. Name the reaction type AND draw the structural formula/e of the product/s when B reacts in...
- 5.7.1 hot dilute aqueous NaOH (3)
- 5.7.2 hot concentrated NaOH in ethanol (3)
- 5.8 Write the condensed structural formula of a chain isomer of compound C. (2)
- 5.9 Compound D reacts with compound E in the presence of concentrated H_2SO_4 .
- 5.9.1 Name the type of reaction that occurs. (1)
- 5.9.2 The final step in the experimental procedure involves pouring the reaction mixture into a beaker of water. Provide detailed reasons for this step, including reference to the various intermolecular forces involved. (6)
- 5.9.3 Give the IUPAC name of the organic product of this reaction. (2)
- 5.9.4 Compound F is a structural isomer of the compound in 5.9.3. What type of structural isomer is it? (1)

[35]

QUESTION 6 ACIDS AND BASES

The acid ionization constants (K_a values) for the ionization of several acids at 25° are provided in the table below.

Acid	K_a at 25°C
HI	3.2×10^9
HBr	1.0×10^9
HCl	1.3×10^6
HF	6.6×10^{-4}
HNO ₂	7.2×10^{-4}
HCOOH	1.8×10^{-4}
H ₂ S	1.1×10^{-7}

- 6.1 Describe and explain the trend in the strength of the first four (Group VII) acids. (3)
- 6.2 Kwen likes her tea weak, with lots of milk and sugar.
- 6.2.1 What does the word *weak* mean in this context? (1)
- 6.2.2 Define the term *weak acid*. (1)
- 6.2.3 Give the **name** of the weakest monoprotic acid in the table. (2)
- 6.3 In preparation for a prac, Tori the lab technician made up aqueous solutions of HCl and HF of different concentrations. Unfortunately she was called away before labelling them and then could not remember which was which. She measured the pH of each solution and concluded that the solution with the lower pH was the HCl.
- 6.3.1 Why would Tori make this deduction? (1)
- 6.3.2 Clearly explain a possible error in her logic. (3)
- 6.4 H₂S is a diprotic acid.
- 6.4.1 Explain what the word *diprotic* means. (1)
- 6.4.2 Write down **two** equations to show the stepwise ionization of H₂S in water. (2 x 2)

Question 6 continues overleaf.

- 6.5 In a titration, 25.0 cm^3 of an aqueous solution of HNO_2 was neutralised by 34.5 cm^3 of 0.12 mol.dm^{-3} NaOH solution.
- 6.5.1 Write down the balanced equation which represents this chemical reaction. (2)
- 6.5.2 Select the most suitable indicator for this titration from the table below. Explain your choice. (3)
- 6.5.3 Calculate the concentration of the HNO_2 solution. (3)
- 6.5.4 Make use of a hydrolysis reaction to explain whether the pH of the resulting salt solution will be equal to 7, less than 7 or greater than 7. (3)

Indicator	pH range
Methyl orange	3.1 – 4.4
Phenolphthalein	8.3 – 10.0
Bromothymol blue	6.0 – 7.6

[27]

QUESTION 7 ELECTROCHEMISTRY

7.1 A standard galvanic cell is constructed by connecting a standard $\text{Pb}^{2+} | \text{Pb}$ electrode and a standard $\text{Ti}^{3+} | \text{Ti}$ electrode via a sensitive voltmeter. When a salt bridge is inserted into the electrolyte solutions, the voltmeter reads 1.5 V and the titanium rod starts to erode.

7.1.1 What are the conditions that make this cell a “standard” cell? (2)

7.1.2 Write down the half-reaction occurring at the titanium electrode. Hence, state whether this electrode is the anode or the cathode. (3)

7.1.3 Write down the overall ionic equation taking place in this cell. (2)

7.1.4 Calculate the standard potential of the $\text{Ti}^{3+} | \text{Ti}$ half-cell. (3)

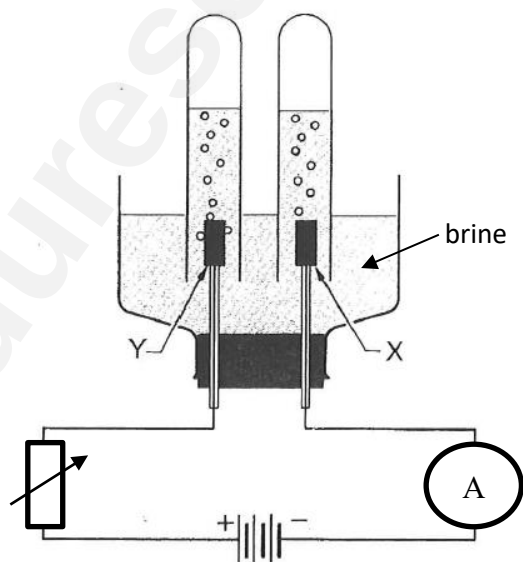
7.1.5 Calculate the mass of titanium(III) nitrate necessary to prepare 250 cm^3 of electrolyte solution for the standard $\text{Ti}^{3+} | \text{Ti}$ half-cell. (4)

7.1.6 How will the reading on the voltmeter be affected if...

(a) The titanium(III) nitrate solution is diluted by adding water (1)

(b) The cell reaction is allowed to reach equilibrium (1)

7.2 The Chlor-Alkali process involves the electrolysis of brine to produce some very important chemical compounds. The apparatus shown here is used to study this process in the laboratory.



7.2.1 What is the chemical formula of brine? (2)

7.2.2 Provide the labels for the electrodes X and Y and write down the half-reaction that occurs at each one. (3)

Question 7.2 continues overleaf.

Chlorine reacts with hydroxide ions to form contaminant hypochlorite ions as follows.

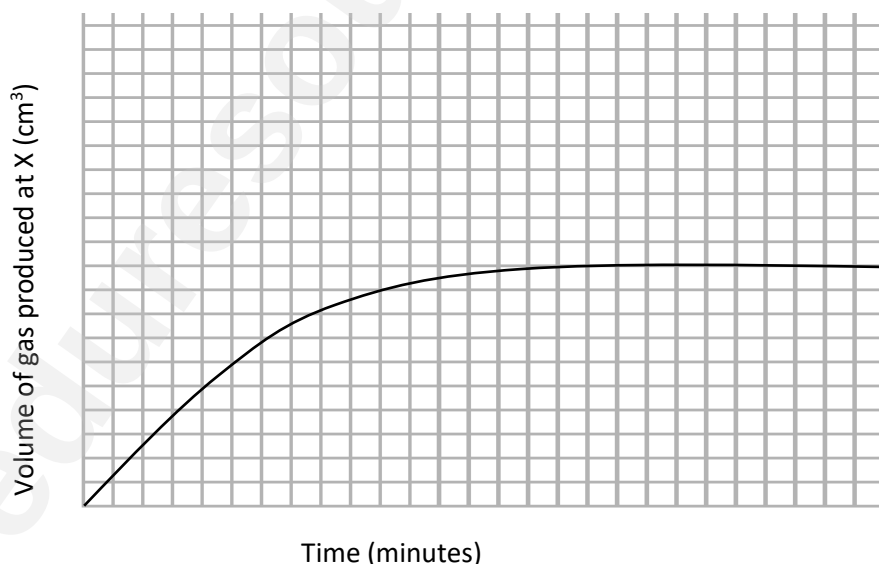


- 7.2.3 Use Le Chatelier's Principle to explain how acidifying the brine will affect the amount of hypochlorite produced. (3)
- 7.2.4 Name the preferred type of industrial cell used for this process. (1)
- 7.2.5 Explain clearly how this type of cell (in 7.2.4) prevents the above reaction from occurring in industry. (3)
- 7.2.6 The rheostat is used to maintain a constant current of 5 A for 30 minutes. Calculate the volume of the gas formed at electrode X at STP. (5)

The test tubes are replaced with inverted measuring cylinders in order to measure the volume of gas produced as a function of time.

The following curve was obtained when using a 25% brine solution at 25°C.

- 7.2.7 On the copy of this graph in Appendix B, sketch in the curves you would expect when...
- (a) Using a 50% brine solution at 40°C (2)
- (b) Using a 25% brine solution at 10°C (2)



[37]

IT'S THE END!

**EXAMINATION DATA SHEET FOR THE PHYSICAL SCIENCES
(CHEMISTRY)**

TABLE 1 PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Magnitude of charge on electron	e	$1,6 \times 10^{-19} \text{ C}$
Mass of an electron	m_e	$9,1 \times 10^{-31} \text{ kg}$
Standard pressure	p^θ	$1,01 \times 10^5 \text{ Pa}$
Molar gas volume at STP	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature	T^θ	273 K
Avogadro's constant	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$
Faraday's constant	F	$96\,500 \text{ C} \cdot \text{mol}^{-1}$

TABLE 2 CHEMISTRY FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$	$n = \frac{V}{V_m}$
$c = \frac{n}{V} \quad \text{OR} \quad c = \frac{m}{MV}$		$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14} \text{ at } 298 \text{ K}$
$Q = It$	$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta$ $E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta$	

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TABLE 4 STANDARD ELECTRODE POTENTIALS

Increasing oxidising ability	Half –reaction		E°/volt	Increasing reducing ability
	$\text{Li}^+ + \text{e}^-$	$\rightleftharpoons$ Li	-3.05	
	$\text{K}^+ + \text{e}^-$	$\rightleftharpoons$ K	-2.93	
	$\text{Cs}^+ + \text{e}^-$	$\rightleftharpoons$ Cs	-2.92	
	$\text{Ba}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Ba	-2.90	
	$\text{Sr}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Sr	-2.89	
	$\text{Ca}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Ca	-2.87	
	$\text{Na}^+ + \text{e}^-$	$\rightleftharpoons$ Na	-2.71	
	$\text{Mg}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Mg	-2.37	
	$\text{Al}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ Al	-1.66	
	$\text{Mn}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Mn	-1.18	
	$2\text{H}_2\text{O} + 2\text{e}^-$	$\rightleftharpoons$ $\text{H}_2(\text{g}) + 2\text{OH}^-$	-0.83	
	$\text{Zn}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Zn	-0.76	
	$\text{Cr}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ Cr	-0.74	
	$\text{Fe}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Fe	-0.44	
	$\text{Cd}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Cd	-0.40	
	$\text{Co}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Co	-0.28	
	$\text{Ni}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Ni	-0.25	
	$\text{Sn}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Sn	-0.14	
	$\text{Pb}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Pb	-0.13	
	$\text{Fe}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ Fe	-0.04	
	$2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{H}_2(\text{g})$	0.00	
	$\text{S} + 2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{H}_2\text{S}(\text{g})$	+0.14	
	$\text{Sn}^{4+} + 2\text{e}^-$	$\rightleftharpoons$ Sn^{2+}	+0.15	
	$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ $\text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0.17	
	$\text{Cu}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Cu	+0.34	
	$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$\rightleftharpoons$ 4OH^-	+0.40	
	$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^-$	$\rightleftharpoons$ $\text{S} + 2\text{H}_2\text{O}$	+0.45	
	$\text{I}_2 + 2\text{e}^-$	$\rightleftharpoons$ 2I^-	+0.54	
	$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$ H_2O_2	+0.68	
	$\text{Fe}^{3+} + \text{e}^-$	$\rightleftharpoons$ Fe^{2+}	+0.77	
	$\text{Hg}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ Hg	+0.79	
	$\text{NO}_3^- + 2\text{H}^+ + \text{e}^-$	$\rightleftharpoons$ $\text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0.80	
	$\text{Ag}^+ + \text{e}^-$	$\rightleftharpoons$ Ag	+0.80	
	$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^-$	$\rightleftharpoons$ $\text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0.96	
	$\text{Br}_2 + 2\text{e}^-$	$\rightleftharpoons$ 2Br^-	+1.09	
	$\text{Pt}^{2+} + 2\text{e}^-$	$\rightleftharpoons$ 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	
	$\text{Cl}_2(\text{g}) + 2\text{e}^-$	$\rightleftharpoons$ 2Cl^-	+1.36	
	$\text{Au}^{3+} + 3\text{e}^-$	$\rightleftharpoons$ 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	
	$\text{F}_2(\text{g}) + 2\text{e}^-$	$\rightleftharpoons$ 2F^-	+2.87	

APPENDIX A

Exam number / name:

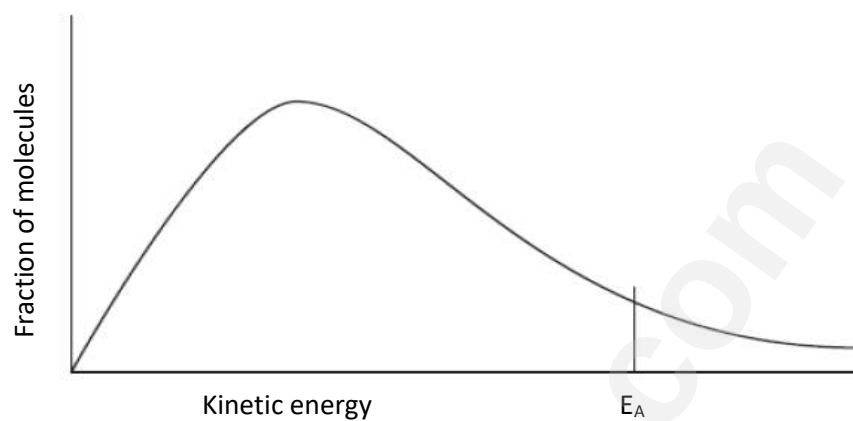
QUESTION 1**MULTIPLE CHOICE ANSWER GRID****MARK ONLY THE CORRECT ANSWER WITH A CROSS.**

Eg.	A	~~B~~	C	D
------------	----------	---------------------	----------	----------

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

APPENDIX B

Q 3.6.1



Q 7.2.7

