Hilton College

Department of Physical Sciences

2015

Trial Examination - Chemistry (Paper 2)

Marks: 200 **Time: 3 hours**

EXAMINER: Mr M Green

MODERATOR: Mr S van Wyk

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This paper consists of:
    - A question paper of **19 pages** and **10 questions.**
    - Three pages of data and formulae (Pages 17, 18 and 19) which can be detached.

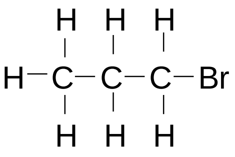
2. **Please check that your question paper is complete.**
3. Read the questions carefully.
4. It is in your own interest to write legibly and to set your work out neatly.
5. Use the data and formulae whenever necessary.
6. Start each question on a new page of your answer book.
7. Number your answers in the same way as the questions are numbered.
8. All working must be shown.
9. Units need not be used in the calculations.
    They **MUST** be shown in the answers, however.
10. No programmable calculators may be used

QUESTION 1 MULTIPLE CHOICE QUESTIONS

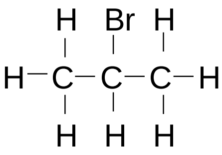
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Place a cross on the correct answer, using the Answer Grid on the inside of your green Answer Book.

1.1 In an experiment, propan-1-ol, is dehydrated by passing it over hot aluminium oxide. The hydrocarbon obtained is then allowed to react with bromine to give compound **X.** The structural formula for compound **X** is…

A.



B.



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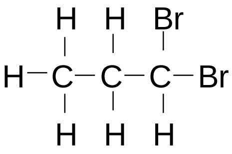

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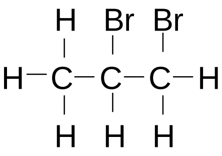


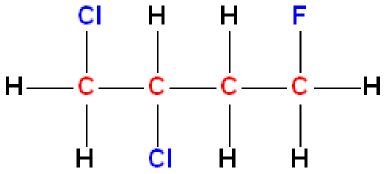
1.2 Name this molecule.

A 1,2-dichloro-4-fluorobutane

B 1-fluoro-3,4-dichlorobutane

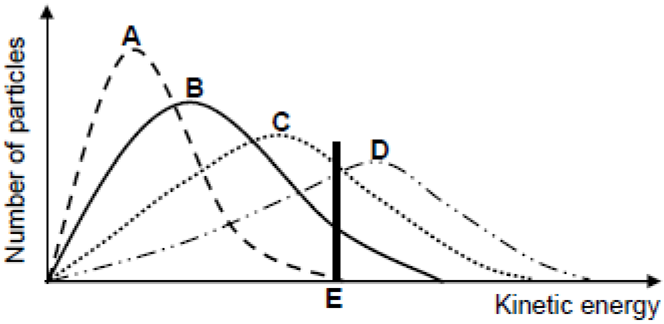
C 3,4-dichloro-1-fluorobutane

D 4-fluoro-1,2-dichlorobutane

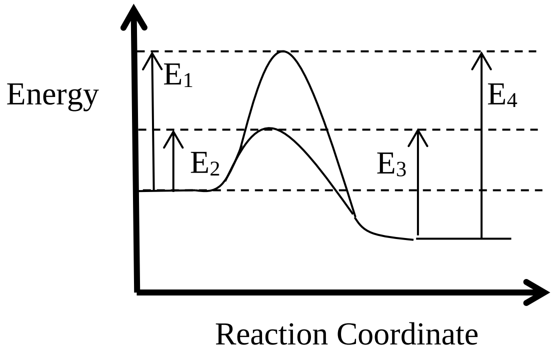


1.3 The Maxwell-Boltzmann energy distribution curves below show the number of particles as a function of their kinetic energy for a reaction at four different temperatures. The activation energy for the reaction is represented by E.

Which one of these curves (A to D) represents a reaction which will NOT take place?



1.4 The diagram shows the energy profile for a reaction that occurs with and without a catalyst



Which one of the following can be deduced from the diagram?

A E_4 is the activation energy of the reverse catalysed reaction.

B The enthalpy change of the reaction is ($E_4 – E_1$).

C The enthalpy change of the reaction is ($E_2 – E_3$).

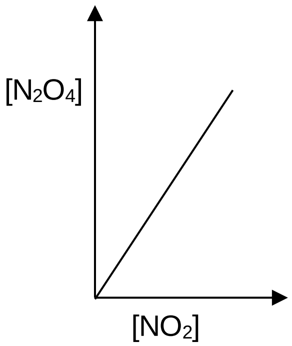
D The enthalpy change of the reaction is decreased by using a catalyst.

1.5 In a closed system <u>at constant temperature</u>, NO_2 (g) always exists in equilibrium with N_2O_4(g).

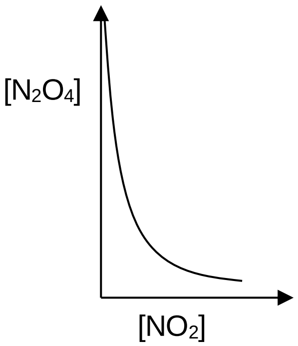
$$2\,NO_2\,(g) \rightleftharpoons N_2O_4\,(g)$$

At equilibrium, the best representation of the relationship between their concentrations is…

A



B



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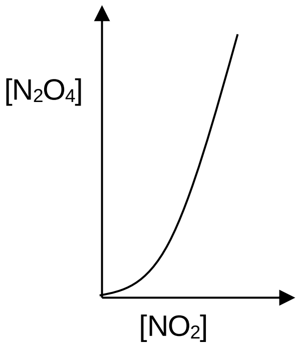
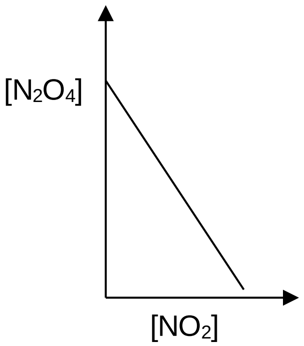


D



1.6 Consider the following reaction:

$$a\,X(g) + b\,Y(g) \leftrightharpoons c\,Z(g)$$

Both an increase in temperature and an increase in pressure favour the forward reaction.

Which one of the following descriptions of the forward reaction and the relationship between the number of moles of a, b and c is correct?

	Forward reaction	Relationship between number of moles a, b and c
A	exothermic	$c > a+b$
B	endothermic	$c < a+b$
C	exothermic	$c < a+b$
D	endothermic	$c > a+b$

1.7 The amalgam in a tooth filling contains tin (Sn). When a piece of aluminium from a sweet wrapper touches the amalgam, a small current momentarily flows and some pain may be experienced.

Given: $A\ell^{3+}(aq) + 3e^- \leftrightharpoons A\ell(s)$ E° = -1.66V

$Sn^{2+}(aq) + 2e^- \leftrightharpoons Sn(s)$ E° = -0.13V

Which one of the following is a feature of the cell that is obtained in the mouth?

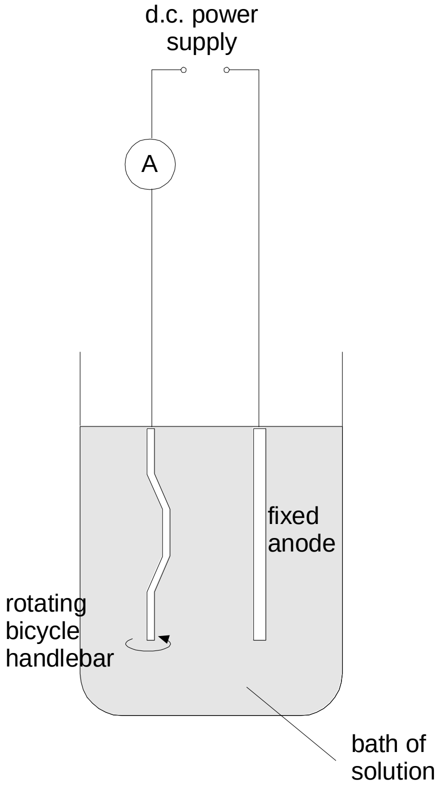
A Electrons flow from the Sn to the $A\ell$.

B The concentration of Sn^{2+} ions in the saliva increases.

C The cell potential is +1.53V.

D $A\ell^{3+}(aq)$ is the oxidising agent in this reaction.

1.8 Bicycle handlebars made from steel can be protected from corrosion by plating with chromium.



Which of the options below will be the most suitable to ensure the success and safety of this process?

	Polarity of handlebar	Aqueous electrolyte solution
A	Negative	Chromium chloride
B	Negative	Chromium nitrate
C	Positive	Chromium chloride
D	Positive	Chromium nitrate

1.9 When sulphur dioxide comes into contact with one's eyes, it results in a burning sensation. A possible reason for this is that …

A the SO_2 crystals penetrate the membranes of the eyes.

B sulphurous acid is produced when SO_2(g) reacts with water in the eyes.

C sulphuric acid is a strong acid and is produced when SO_2(g) reacts with water in the eyes.

D SO_2(g) has a pungent smell which causes the eyes to water.

1.10 Which one of the following statements is *always* true about monoprotic acids?

A The amount of dissociation of a weak acid and a strong acid is the same.

B A strong acid produces more H_3O^+ ions in water than a weak acid.

C The pH of a strong acid is always smaller than the pH of a weak acid.

D One mole of a strong acid gives more H^+ ions in water than one mole of a weak acid.

[10 X 2 = 20]

QUESTION 2:

Copper turnings react with dilute nitric acid according to the following balanced chemical equation:

$$3Cu_{(s)} + 8HNO_{3\,(aq)} \rightarrow 3Cu(NO_3)_{2\,(aq)} + 2NO_{(g)} + 4H_2O_{(l)}$$

A student adds 19,05 g of copper to a beaker containing 0,5 dm^3 of a 1,4 $mol.dm^{-3}$ solution of nitric acid.

2.1 Define molar mass. (2)

2.2 Calculate the number of moles of each reactant. (4)

2.3 How many atoms are there in 19,05 g of copper? (2)

2.4 Determine which of the reactants is the limiting reactant. (3)

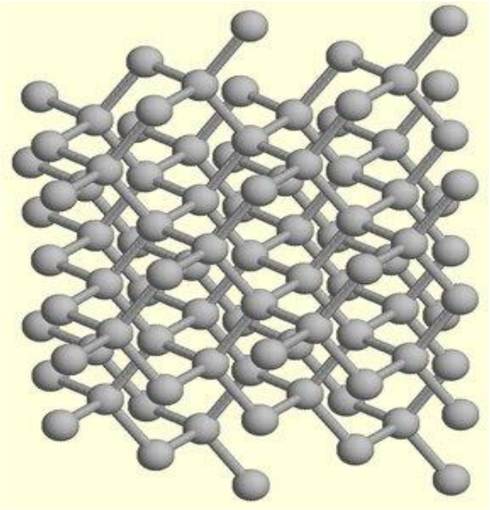
2.5 Calculate the mass of water that is produced. (3)

2.6 Calculate the percentage yield of nitrogen (II) oxide (NO) produced if 3 dm^3 of NO is obtained at S.T.P. (4)

[18]

QUESTION 3:

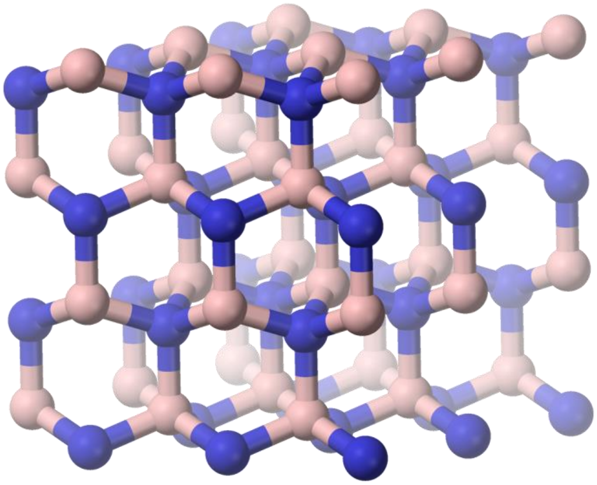
3.1 The diagram alongside shows part of the atomic lattice for diamond, in which each carbon atom is bonded to four others, to form a huge "molecule" containing many millions of millions of carbon atoms.



3.1.1 Define a covalent bond. (2)

3.1.2 Give two reasons why diamond has a high melting point. (2)

3.2 The crystalline structure of the cubic form of boron nitride (BN_3) is shown below.



3.2.1 Define the term electronegativity. (2)

3.2.2 Using electronegativities, determine the nature of the intramolecular bond which occurs within boron nitride? (3)

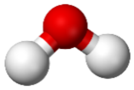
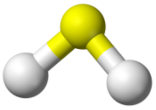
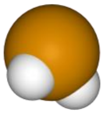
3.3 The table below shows the melting points of sodium chloride and magnesium oxide.

Compound	**Melting point (°C)**
NaCl	801
MgO	2 800

3.3.1 Explain why the melting points of these compounds are high. (2)

3.3.2 Why does MgO have a higher melting point than NaCl? (2)

3.4 The table below shows the boiling points of the Group VI hydrides.

Compound	**Melting point (°C)**	**Molecule**
H_2O	100	
H_2S	–60	
H_2Se	–41	
H_2Te	–2	

3.4.1 Name the intermolecular force that exists in

3.4.1.1 hydrogen sulphide (1)

3.4.1.2 water (1)

3.4.2 Explain how a hydrogen bond is formed. (3)

3.4.3 Consider H_2S, H_2Se and H_2Te. Explain why H_2Te has the highest boiling point of the three compounds. (2)

[20]

QUESTION 4:

A group of learners use the reaction between hydrochloric acid and magnesium powder to investigate one of the factors that influence the rate of a chemical reaction. The reaction that takes place is:

$$Mg(s) + 2HC\ell\ (aq) \rightarrow MgC\ell_2\ (aq) + H_2(g)$$

The learners use the apparatus and follow the method shown below to conduct the investigation.

Method – Experiment 1:

Step 1: Place a spatula of magnesium powder in a conical flask and add 50 cm^3 $HC\ell$ (aq) of known concentration.

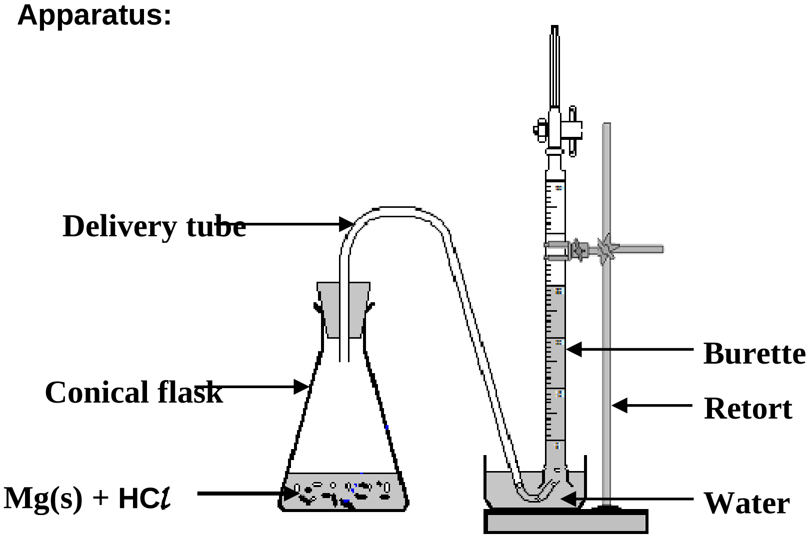
Step 2: Simultaneously start the stopwatch and close the flask with the rubber stopper containing the delivery tube.

Step 3: Measure the volume of the $H_2(g)$ formed in time intervals of 20 seconds.

Method – Experiment 2:

Repeat steps 1 to 3 above, but use only 25 cm^3 of the same $HC\ell$ (aq) diluted to 50 cm^3 with distilled water.

Apparatus:



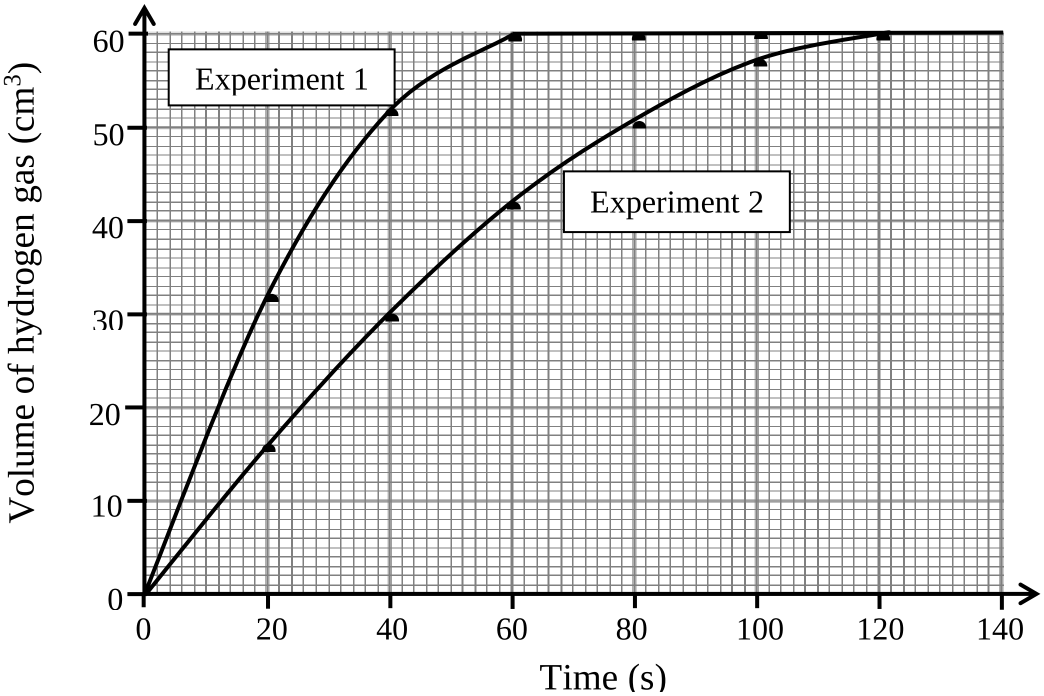
4.1 How does the concentration of the acid used in Experiment 2 differ from the concentration of the acid used in Experiment 1? Write down only GREATER THAN, SMALLER THAN or EQUAL TO (1)

4.2 Write down a hypothesis for this investigation. (2)

4.3 Why should the learners ensure that equal amounts of magnesium powder are used in each of the two experiments? (2)

After completing the investigation, the learners used their results to plot the graph below.

Graph of volume of hydrogen gas versus time



4.4 Write down the volume of hydrogen gas formed during the first minute in:

4.4.1. Experiment 1 (1)

4.4.2 Experiment 2 (1)

4.5 Which one of the experiments (Experiment 1 or Experiment 2) took place at the faster rate? Refer to the shape of the curves to motivate your answer. (2)

4.6 Give a reason why the final volume of gas produced is the same in both experiments. (1)

4.7 What conclusion can the learners draw from the results obtained? (2)

4.8 How will an increase in the temperature influence the following?

Note: In each case write down only INCREASES, DECREASES or REMAINS THE SAME

4.8.1 Final volume of gas obtained in each experiment (1)

4.8.2 Volume of gas obtained in each experiment after 40s (1)

[14]

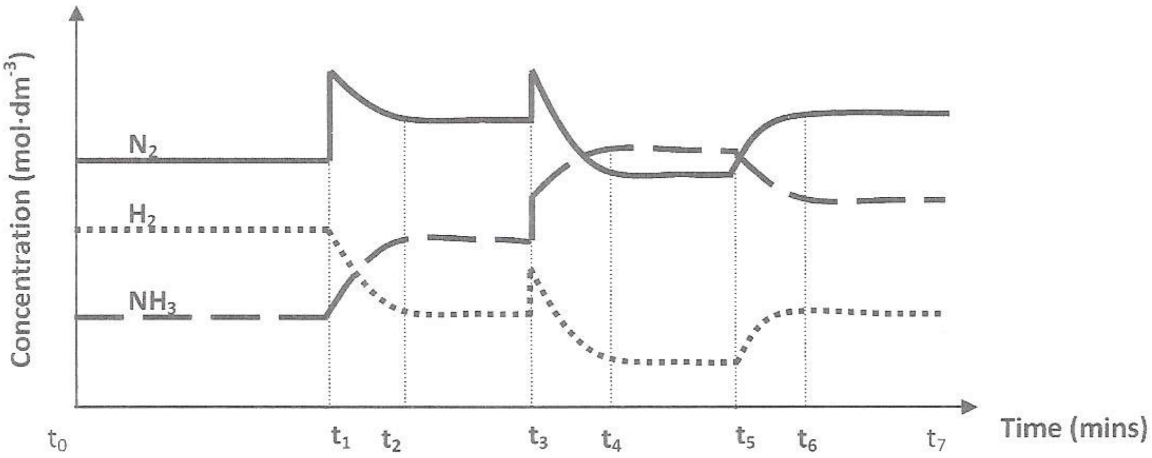
QUESTION 5

A fertiliser company produces ammonia on a large scale at a temperature of 450°C. The balanced equation below represents the reaction that takes place in a sealed 2 dm^3 container.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \qquad \Delta H < 0$$

To meet an increased demand for fertiliser, the management of the company instructs their engineers to make the necessary adjustments to the dynamic chemical equilibrium of the reaction to increase the yield of ammonia.

In a trial run on a small scale in the laboratory, the engineer makes adjustments to the equilibrium mixture.



The graphs below represent the results obtained.

5.1 Explain what is meant by the term “dynamic chemical equilibrium”. (3)

5.2 Give one time interval during which the reaction would have been in dynamic chemical equilibrium. (2)

5.3 Using le Chatelier’s Principle, identify and explain the changes made to the equilibrium mixture between each of the following times:

5.3.1 t_1 and t_2 (3)

5.3.2 t_5 and t_6 (3)

5.4 At t_3, both the reactants and product showed a sudden increase in concentration.

5.4.1 What do you think happened at this point to cause the increase in concentration? (2)

5.4.2 Using le Chatelier’s Principle, explain how the equilibrium now re-establishes itself between t_3 and t_4. (3)

5.5 At t_7, the following amounts of reactant and product were present at equilibrium at a temperature of 450°C :

- 1,28 mol of H_2,
- 49,6 g of N_2
- 12,31 dm^3 of NH_3 gas at STP

Note also that the volume of the reaction container is 2 dm^3

5.5.1 Write down an expression for the equilibrium constant (Kc) for this reaction. (2)

5.5.2 Calculate the value of Kc for this reaction at 450°C. (7)

5.5.3 What does the magnitude of Kc indicate about the equilibrium position of the reaction? (2)

5.6 What would happen to the value of the equilibrium constant (Kc) calculated in 5.5.2 above, under the following conditions?
(Simply answer INCREASE, DECREASE or STAY THE SAME)

5.6.1 $N_{2\,(g)}$ is removed from the system

5.6.2 The temperature is decreased to 350°C

5.6.3 The size of the reaction vessel is increased (3)

[30]

QUESTION 6

Sulphur dioxide gas, amongst other gases, is released as a pollutant when coal, a fossil fuel, is burned in a power station. This gas is highly soluble and will dissolve easily in atmospheric water to form sulphurous acid, a form of acid rain. The acid ionizes in water according to the following equation:

$$H_2SO_3 + H_2O \rightarrow H_3O^+ + HSO_3^-$$

6.1 Define an acid according to Bronsted and Lowry? (2)

6.2 What is the name of the H_3O^+ ion produced in this reaction? (1)

6.3 Rewrite the equation and identify the acid-base conjugate pairs in this reaction. (2)

6.4 Sulphurous acid is a weak acid.

6.4.1 What is meant by the concept of a weak acid? (2)

6.4.2 Which of the following indicators would be most suitable to find the end point when sulphurous acid reacts with sodium hydroxide? Explain your reasoning. (3)

Indicator	**pH Range**
Phenolpthalein	8,2 – 10
Bromothymol Blue (4)	6,0 – 7,6
Methyl Orange	3,2 – 4,4

6.5 Brad finds some sulphuric acid solution in a bottle labeled 'dilute sulphuric acid'. He wants to determine the concentration of the sulphuric acid solution. To do this, he decides to titrate the sulphuric acid against a **standard** potassium hydroxide (KOH) solution.

6.5.1 What is a standard solution? (2)

In the laboratory a schoolboy makes up a potassium hydroxide solution (KOH) to neutralize the sulphuric acid solution.

6.5.2 Calculate the mass of KOH which he must use to make 300 cm^3 of a 0,2 $mol.dm^{-3}$ KOH solution. (4)

6.5.3 Explain what a pH reading represents? (2)

6.5.4 Write a balanced chemical equation for the reaction between H_2SO_4 and KOH. (3)

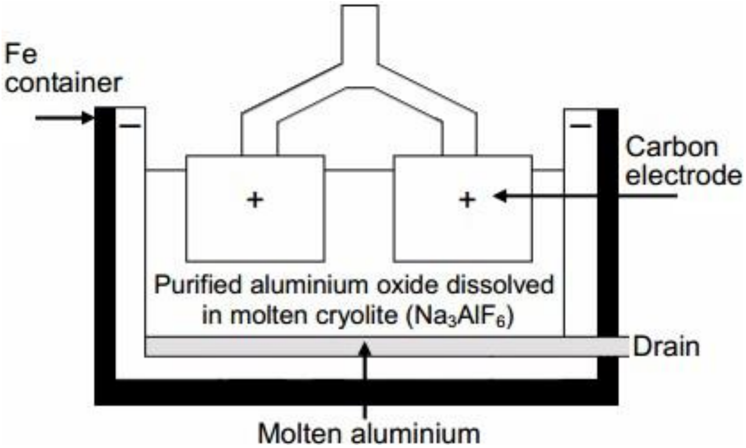
6.5.5 During the titration he finds that 15 cm^3 of the KOH solution neutralizes 20 cm^3 of the H_2SO_4 solution. Calculate the concentration of the H_2SO_4 solution. (5)

[26]

QUESTION 7

Aluminium is one of the most abundant metals on earth, yet it is expensive - largely because of the amount of electricity needed to extract it. Aluminium ore is called bauxite. The bauxite is purified to yield a white powder, aluminium oxide, from which aluminium can be extracted.

The diagram below shows an electrolytic cell used for the extraction of aluminium at temperatures as high as 1000^0C.



7.1 State the energy conversion that takes place in this electrolytic cell. (2)

7.2 Is aluminium formed at the positive or negative electrode? Write down POSITIVE or NEGATIVE only. (1)

7.3 Use the Table of Standard Reduction Potentials to write down the half-reaction for the formation of aluminium. (2)

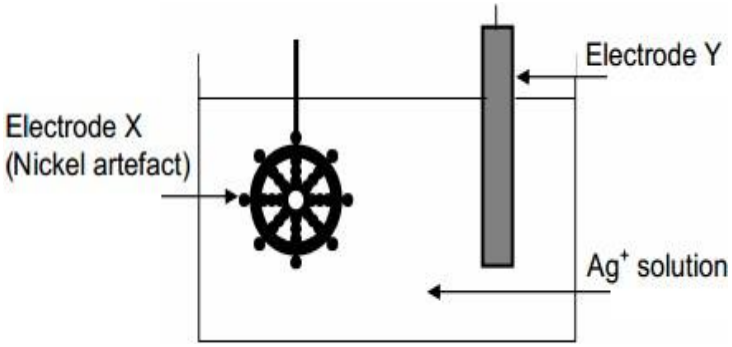
7.4 Does this process have a carbon footprint and add to global warming? Explain your answer. (2)

[7]

QUESTION 8

An attractive silver appearance can be created by electroplating artefacts made from cheaper metals, such as nickel, with silver.

The simplified diagram alongside represents an arrangement that can be used to electroplate a nickel artefact with silver.



8.1 Which electrode (cathode/anode) will the nickel artefact represent? (1)

8.2 Name the metal represented by electrode Y. (1)

8.3 Write down the half-reaction responsible for the change that occurs at the surface of the artefact. (2)

8.4 If the process runs for 1 hour with the current reading a steady 0,5 A, how many moles of Ag will be deposited onto the nickel artefact?
[Note: you will need to use the formula **Q = It** in your answer]. (6)

8.5 Give a reason why the concentration of the electrolyte can remain constant during electroplating. (2)

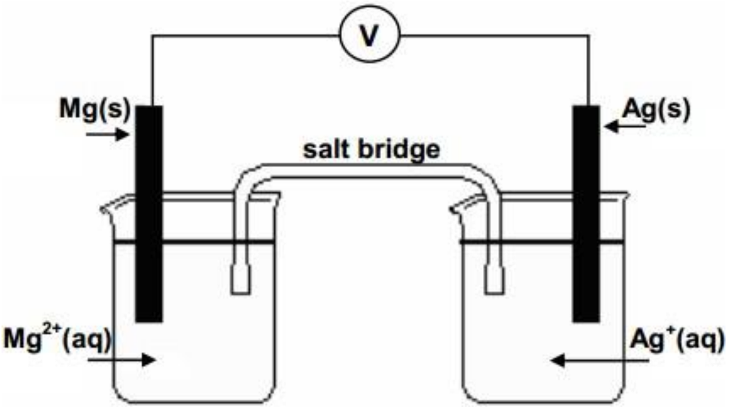
8.6 In industry some plastic articles are sometimes electroplated. Explain why plastic must be coated with graphite before electroplating. (2)

8.7 Give a reason why, from a business point of view, it is not advisable to plate platinum with silver. (1)

[15]

QUESTION 9

The diagram below represents a galvanic (voltaic) cell functioning under standard conditions with magnesium and silver as electrodes.



9.1 State TWO standard conditions under which this cell operates. (2)

9.2 Write down the definition for a reducing agent. (2)

9.3 Identify the anode of this cell and give a reason for your answer. (2)

9.4 Write down the cell notation (symbolic notation) of this cell. (3)

9.5 Write down the balanced equation for the net (overall) cell reaction that takes place in this cell. (3)

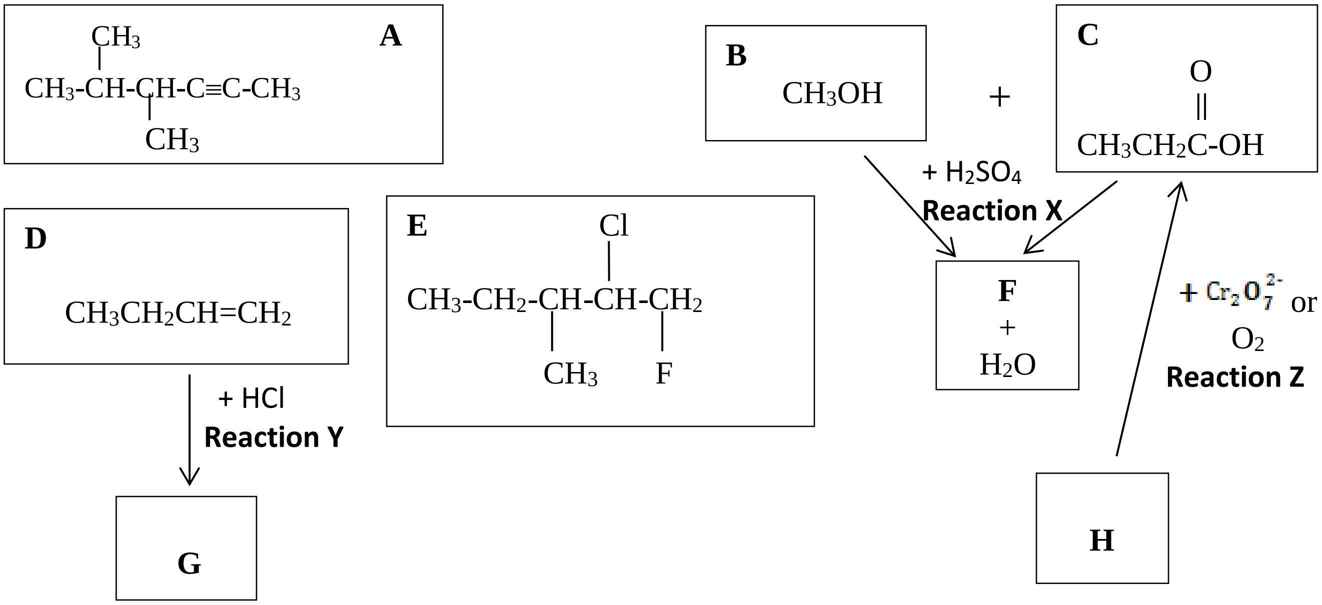
9.6 Calculate the reading on the voltmeter under standard conditions. (3)

9.7 How will an increase in the concentration of the Ag^{+} ions influence the reading on the voltmeter?
Write down only INCREASES, DECREASES or REMAINS THE SAME and explain the answer. (3)

[18]

QUESTION 10

Consider the compounds A to H represented below:



10.1 For compound **A**:

10.1.1 Give the IUPAC name. (2)

10.1.2 Name the two products formed when an alkane is combusted in pure oxygen. (2)

10.2 For compound **E**:

10.2.1 Give the IUPAC name. (3)

10.2.2 To which homologous series does this compound belong? (1)

10.3 10.3.1 Give the IUPAC name for compound **D**. (2)

10.3.2 Name reaction type **Y**. (1)

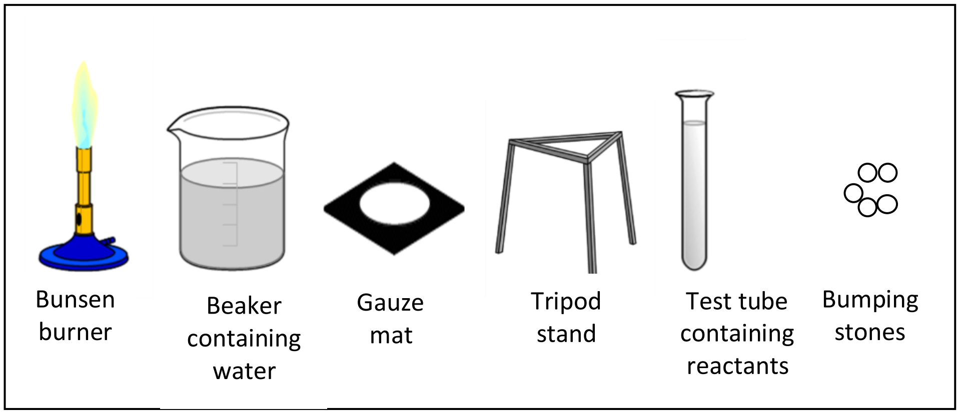
10.3.3 **G** is the product of Reaction **Y**. Give the condensed structural formula and name of compound **G**. (2)

10.4 10.4.1 Name or draw the functional group of compound **C**. (1)

10.4.2 Name compound **H**. (2)

10.4.3 Name reaction type **Z**. (1)

10.5 In an experiment to produce compound **F** by means of reaction type **X**, the following apparatus is supplied.



10.5.1 Name reaction type **X**. (1)

10.5.2 Name the reactants **B** and **C**. (2)

10.5.3 What is the purpose of adding the H_2SO_4? (1)

10.5.4 Explain two safety precautions that are built into the design of your experiment by using the above apparatus? (2)

After heating the reaction mixture gently for about 30 minutes, the contents of the test tube are poured into another beaker containing about 100 cm^3 of water. Two layers form and the distinctive smell of the product can be detected. (The product usually forms the top layer.)

10.5.5 Write the structural formula and name of the product **F**. (4)

10.5.6 Give the structural formula of a straight chain isomer of **F** belonging to a different homologous series. (2)

10.5.7 Predict and explain which of **F** or the isomer in 10.5.6 will have the higher boiling point. (3)

[32]

EXAMINATION DATA SHEET FOR THE PHYSICAL SCIENCES (CHEMISTRY)

TABLE 1 PHYSICAL CONSTANTS

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

TABLE 2 CHEMISTRY FORMULAE

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

PERIODIC TABLE

Key

Atomic number (Z) 1 2.1 **Electronegativity**

H

1

Relative atomic mass

	I	II											III	IV	V	VI	VII	0
1	1 2.1 **H** 1																	2 **He** 4
2	3 1.0 **Li** 7	4 1.5 **Be** 9											5 2.0 **B** 10.8	6 2.5 **C** 12	7 3.0 **N** 14	8 3.5 **O** 16	9 4.0 **F** 19	10 **Ne** 20
3	11 0.9 **Na** 23	12 1.2 **Mg** 24.3											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
4	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** 65.4	31 1.6 **Ga** 70	32 1.8 **Ge** 72.6	33 2.0 **As** 75	34 2.4 **Se** 79	35 2.8 **Br** 80	36 **Kr** 84
5	37 0.8 **Rb** 85.5	38 1.0 **Sr** 88	39 1.2 **Y** 89	40 1.4 **Zr** 91	41 1.6 **Nb** 93	42 1.8 **Mo** 96	43 1.9 **Tc** 99	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** 121	52 2.1 **Te** 128	53 2.5 **I** 127	54 **Xe** 131
6	55 **Cs** 133	56 **Ba** 137.3		72 **Hf** 178.5	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 200.6	81 **Tℓ** 204.4	82 **Pb** 207	83 **Bi** 209	84 **Po** -	85 **At** -	86 **Rn** -
7	87 **Fr**	88 **Ra**																
				57 **La**	58 **Ce**	59 **Pr**	60 **Nd**	61 **Pm**	62 **Sm**	63 **Eu**	64 **Gd**	65 **Tb**	66 **Dy**	67 **Ho**	68 **Er**	69 **Tm**	70 **Yb**	71 **Lu**
				89 **Ac**	90 **Th**	91 **Pa**	92 **U**	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lw**

TABLE 4 STANDARD ELECTRODE POTENTIALS

Half –reaction			E°/ volt
$Li^+ + e^-$	⇌	Li	-3.05
$K^+ + e^-$	⇌	K	-2.93
$Cs^+ + e^-$	⇌	Cs	-2.92
$Ba^{2+} + 2e^-$	⇌	Ba	-2.90
$Sr^{2+} + 2e^-$	⇌	Sr	-2.89
$Ca^{2+} + 2e^-$	⇌	Ca	-2.87
$Na^+ + e^-$	⇌	Na	-2.71
$Mg^{2+} + 2e^-$	⇌	Mg	-2.37
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	-1.66
$Mn^{2+} + 2e^-$	⇌	Mn	-1.18
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	-0.83
$Zn^{2+} + 2e^-$	⇌	Zn	-0.76
$Cr^{2+} + 2e^-$	⇌	Cr	-0.74
$Fe^{2+} + 2e^-$	⇌	Fe	-0.44
$Cd^{2+} + 2e^-$	⇌	Cd	-0.40
$Co^{2+} + 2e^-$	⇌	Co	-0.28
$Ni^{2+} + 2e^-$	⇌	Ni	-0.25
$Sn^{2+} + 2e^-$	⇌	Sn	-0.14
$Pb^{2+} + 2e^-$	⇌	Pb	-0.13
$Fe^{3+} + 3e^-$	⇌	Fe	-0.04
$2H^+ + 2e^-$	⇌	$H_2(g)$	0.00
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+0.14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+0.15
$Cu^{2+} + e^-$	⇌	Cu^+	+0.16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+0.17
$Cu^{2+} + 2e^-$	⇌	Cu	+0.34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+0.40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+0.45
$I_2 + 2e^-$	⇌	$2I^-$	+0.54
$O_2(g) + 2H^+ + e^-$	⇌	H_2O_2	+0.68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+0.77
$Hg^{2+} + 2e^-$	⇌	Hg	+0.79
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+0.80
$Ag^+ + e^-$	⇌	Ag	+0.80
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+0.96
$Br_2 + 2e^-$	⇌	$2Br^-$	+1.09
$Pt^{2+} + 2e^-$	⇌	Pt	+1.20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+1.21
$O_2 + 4H^+ + 4e^-$	⇌	$2H_2O$	+1.23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+1.33
$C\ell_2 + 2e^-$	⇌	$2C\ell^-$	+1.36
$Au^{3+} + 3e^-$	⇌	Au	+1.42
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+1.51
$H_2O_2 + 2H^+ + e^-$	⇌	$2H_2O$	+1.77
$F_2(g) + 2e^-$	⇌	$2F^-$	+2.87

Increasing oxidising ability ↓

Increasing reducing ability ↑