HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 2 - CHEMISTRY

TRIALS 2021
EXAMINER: J. KNOX-WHITEHEAD **TIME: 3 HRS**
TOTAL 150

Instructions

1. Answer ALL the questions.

2. This question paper consists of TWO sections:

3. SECTION A (20)
   SECTION B (130)

   Answer SECTIONS A and B in the ANSWER BOOK.

4. Non-programmable calculators may be used.

5. Appropriate mathematical instruments may be used.

6. Number the answers correctly according to the numbering system used in this question paper.

7. Data sheets and a periodic table are attached for your use.

8. Give brief motivations, discussions, et cetera where required.

9. Numbers must be rounded off to **two decimal** places

SECTION A

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A-D) next to the question number (1.1-1.10) in the ANSWER BOOK.

1.1 Which one of the following compounds will decolourise bromine water the fastest under normal conditions?

A Ethene

B Ethanal

C Ethanol

D Ethane (2)

1.2 An organic compound was mistakenly named as 4,5-diethylpentan-3-ol. What is the correct IUPAC name for this compound?

A 1,2-diethylpentan-3-ol

B 4-ethylheptan-5-ol

C 4-ethylheptan-3-ol

D 4-ethylhexan-5-ol (2)

1.3 The heat of reaction (ΔH) and the activation energy (E_a) for a reaction are -111 $kJ.mol^{-1}$ and 43 $kJ.mol^{-1}$ respectively. The activation energy for the reverse reaction will be …

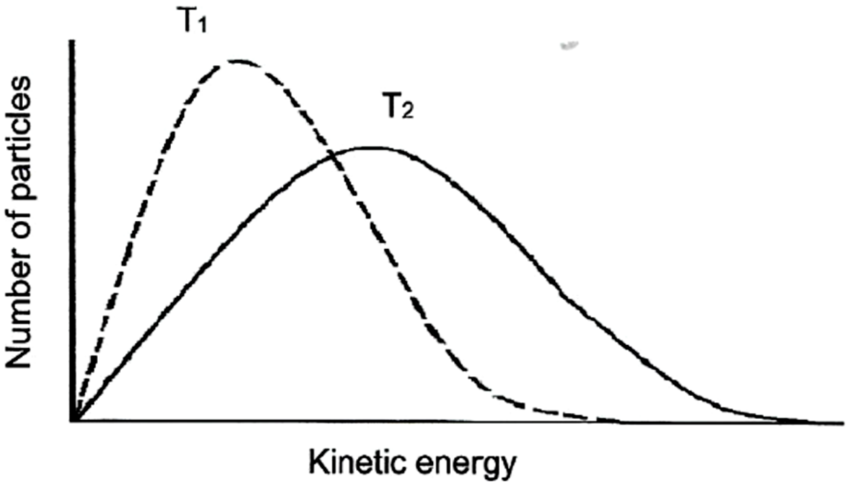
A -43 $kJ.mol^{-1}$

B 111 $kJ.mol^{-1}$

C 154 $kJ.mol^{-1}$

D 68 $kJ.mol^{-1}$ (2)

1.4 The energy distribution curves for particles in a fixed mass of gas at two different temperatures, T_1 and T_2, are shown below:



Which ONE of the following is the correct interpretation of the curves as the temperature of the gas changes from T_1 to T_2?

	Activation energy (Ea)	Number of effective collisions
A	Remains the same	Increases
B	Decrease	Deceases
C	Decrease	Increases
D	Remains the same	Decreases

(2)

1.5 The reaction which is represented by the balanced equation below has reached equilibrium in a closed container:

$$A_2(g) + B_2(g) \leftrightarrows 2AB(g) \qquad \Delta H < 0$$

How will the equilibrium be influenced if first the volume of the container is decreased and then the temperature is increased?

A Initially there is no change and then the forward reaction is favoured.

B The reverse reaction is favoured by both changes.

C Initially there is no change and then the reverse reaction is favoured.

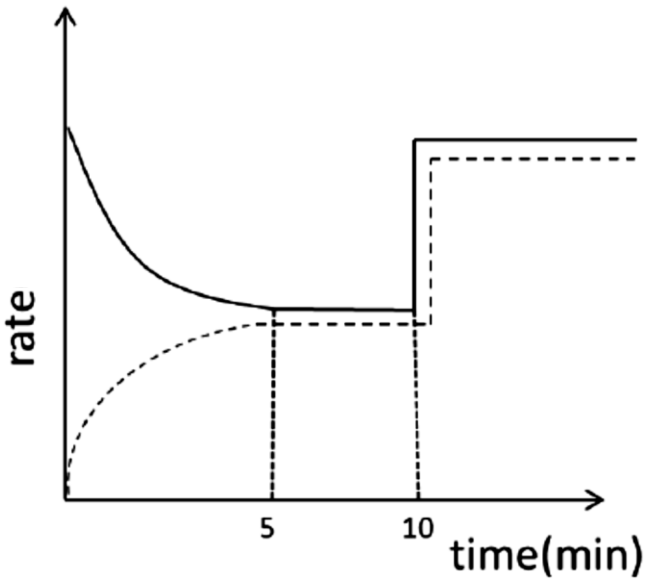
D Initially the reverse reaction is favoured and then the forward reaction is favoured.

(2)

1.6 The graph below represents the change in the rate of reaction versus time for the reversible reaction that took place when an amount of hydrogen gas and iodine gas were sealed in a container. The equation for the reaction is:

$$H_2(g) + I_2(g) \leftrightarrows 2HI(g) \qquad \Delta H < 0$$

Equilibrium was first established after 5 minutes.



What change in the conditions was made at 10 minutes to change the rate of the reaction as indicated on the graph?

A The temperature was increased.

B The temperature was decreased.

C The volume of the reaction mixture was increased.

D A catalyst was added. (2)

1.7 Consider the four different solutions below. Which of these solutions is a dilute weak acid solution?

A 0,1 mol.dm^{-3} $HC\ell$ solution

B 0,5 mol.dm^{-3} oxalic acid solution

C 5 mol.dm^{-3} CH_3COOH solution

D 0,5 mol.dm^{-3} CH_3COONa solution (2)

1.8 Which ONE of the following species CANNOT act as a Bronsted-Lowry acid and a Bronsted-Lowry base?

A $H_2PO_4^-$

B H_2O

C CH_3COOH

D $C_2O_4H^-$ (2)

1.9 You are supplied with the following half-cell: $Fe(s)/Fe^{3+}$ ($1 mol.dm^{-3}$). This half-cell should be used to produce the highest possible potential difference. The most suitable half-cell combination for this purpose is:

A $Pt,SO_2(g)/SO_4^{2-}$ ($1mol.dm^{-3}$)

B $Mg(s)/Mg^{2+}$ ($1mol.dm^{-3}$)

C $Pt,Br_2(g)/Br^-$ ($1mol.dm^{-3}$)

D $Co(s)/Co^{2+}$ ($1mol.dm^{-3}$) (2)

1.10 Which ONE of the following pairs will react spontaneously?

A $Mg^{2+}(aq) + Zn(s)$

B $Mg^{2+}(aq) + Cu(s)$

C $Cu^{2+}(aq) + Ag(s)$

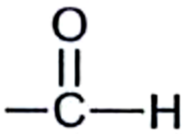
D $Ag^+(aq) + Pb(s)$ (2)

[20]

SECTION B

QUESTION 2

2.1 The structural formula of a functional group of a certain organic compound is given below:



2.1.1 Define the term *functional group*. (2)

Write down the:

2.1.2 NAME of this functional group. (1)

2.1.3 NAME of the homologous series to which this functinal group belongs. (1)

2.2 Consider the condensed structural formula of the organic compound below:

$$CH_3CH_2COOCH_2CH_3$$

The above-mentioned organic compound has one FUNCTIONAL isomer.

2.2.1 Define the term *functional isomer*. (2)

2.2.2 Draw the structural formula of the FUNCTIONAL ISOMER of this compound. (2)

The compound shown above can be prepared in a laboratory.

2.2.3 Write down the NAME of this reaction. (1)

2.2.4 Write down the IUPAC name of the alcohol needed to prepare this compound. (1)

2.2.5 Write downTWO reaction conditions for this reaction. (2)

2.2.6 How can one easily identify whether the product is being formed? (1)

2.3 When a sample of <u>impure</u> butane (C_4H_{10}) of mass 26 g burns in excess oxygen, 34 g of CO_2 forms. The balanced equation for this reaction is given below:

$$2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$$

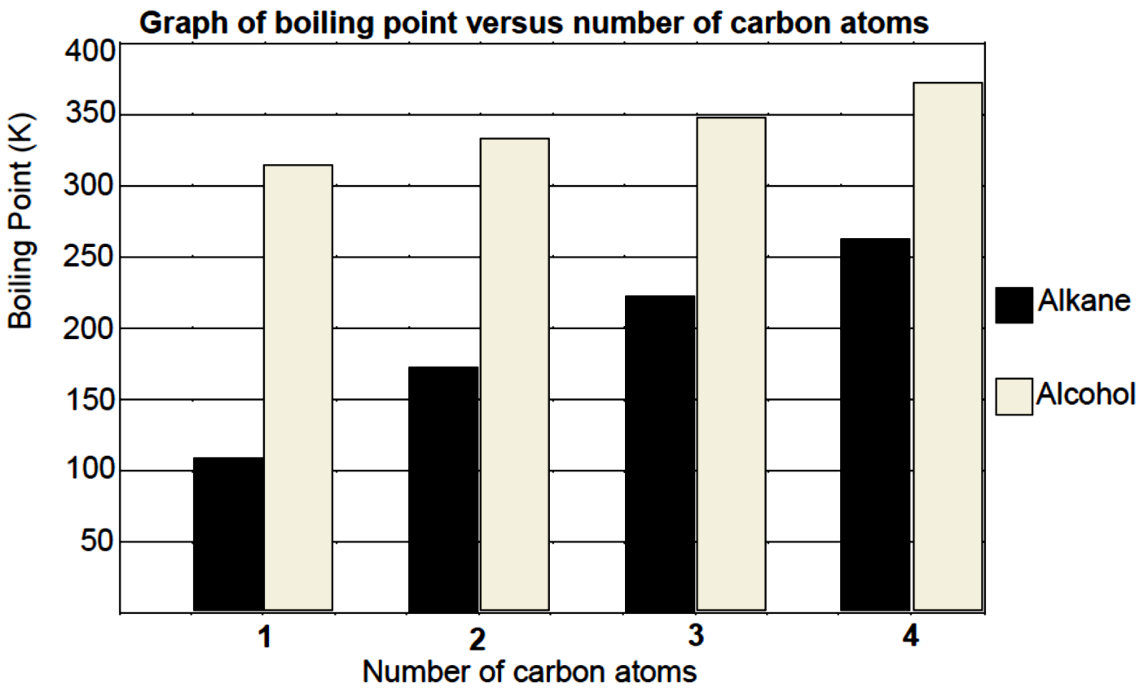
2.3.1 Why is this type of reaction of hydrocarbons useful? (1)

2.3.2 Calculate the percentage purity of the sample of butane. (5)

[19]

QUESTION 3

The graph below shows the results obtained when investigating the relationship between boiling points of straight chain alkanes and alcohols and the number of carbon atoms per molecule.



3.1 Define the term *boiling point*. (2)

3.2 What trend in boiling point is observed for the ALKANES? (1)

3.3 Explain the trend observed in QUESTION 3.2. (2)

3.4 Both butane and butan-1-ol contain four carbon atoms per molecule.

3.4.1 Is butan-1-ol a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for your answer. (2)

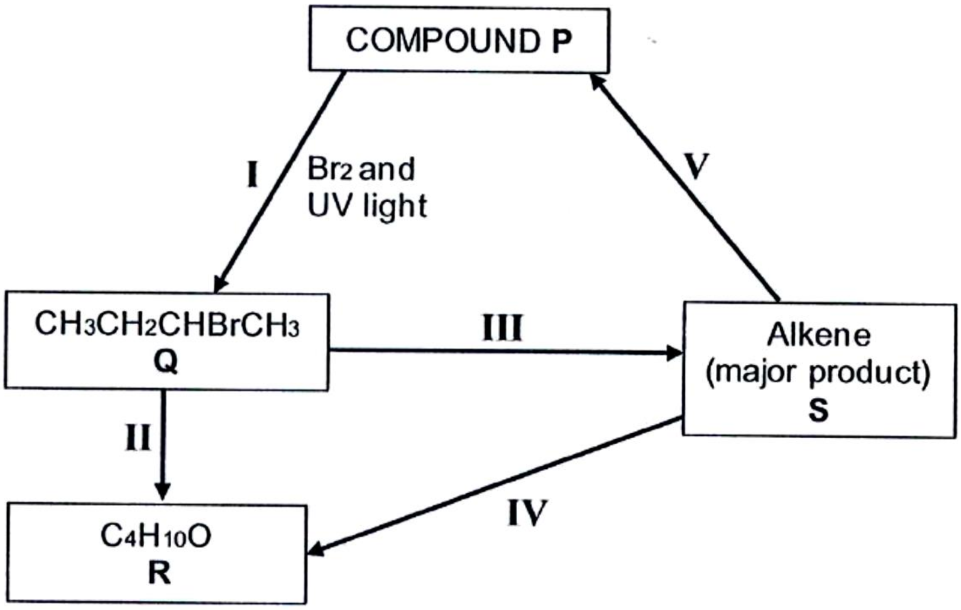
3.4.2 How does the boiling point of butan-1-ol compare to that of butane as shown in the graph? Write down only HIGHER THAN, LOWER THAN or EQUAL TO. (1)

3.4.3 By referring to the different types of intermolecular forces, briefly explain the difference in boiling points of butane and butan-1-ol. (3)

[11]

QUESTION 4

Study the following series of organic reactions and answer the questions that follow.



4.1 Write down the type of reaction represented by:

4.1.1 **I** (1)

4.1.2 **II** (1)

4.1.3 **V** (1)

4.2 During reaction **III**, compound **Q** reacts with a base to form compound **S**. Write down:

4.2.1 Two reaction conditions for this reaction. (2)

4.2.2 The IUPAC name of compound **Q**. (2)

4.2.3 The STRUCTURAL FORMULA of the major product **S** formed. (2)

4.2.4 Is compound **S** a SATURATED or UNSATURATED hydrocarbon? Explain your answer. (2)

4.3 Consider reaction **IV**. Write down:

4.3.1 The TYPE of addition reaction that takes place. (1)

4.3.2 The NAME or FORMULA of the catalyst that is used. (1)

4.4 Consider reaction **II.**

4.4.1 Write down the FORMULA of the INORGANIC product that is formed in reaction **II**. (1)

4.4.2 Which homologous series does the product **R** belong to? (1)

[15]

QUESTION 5

A Grade 12 learner wants to investigate the rate of a reaction. He places a beaker containing nitric acid on a very sensitive scale in a fume cupboard. He adds a few pieces of copper to the beaker. The mass of the beaker and its contents are recorded every 15 s from the instant the copper is added to the beaker until all the copper has been used up.

The reaction which occurs is represented by the following equation:

$$Cu(s) + 4HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 4NO(g) + 2H_2O(\ell) \qquad \Delta H < 0$$

The following results were obtained:

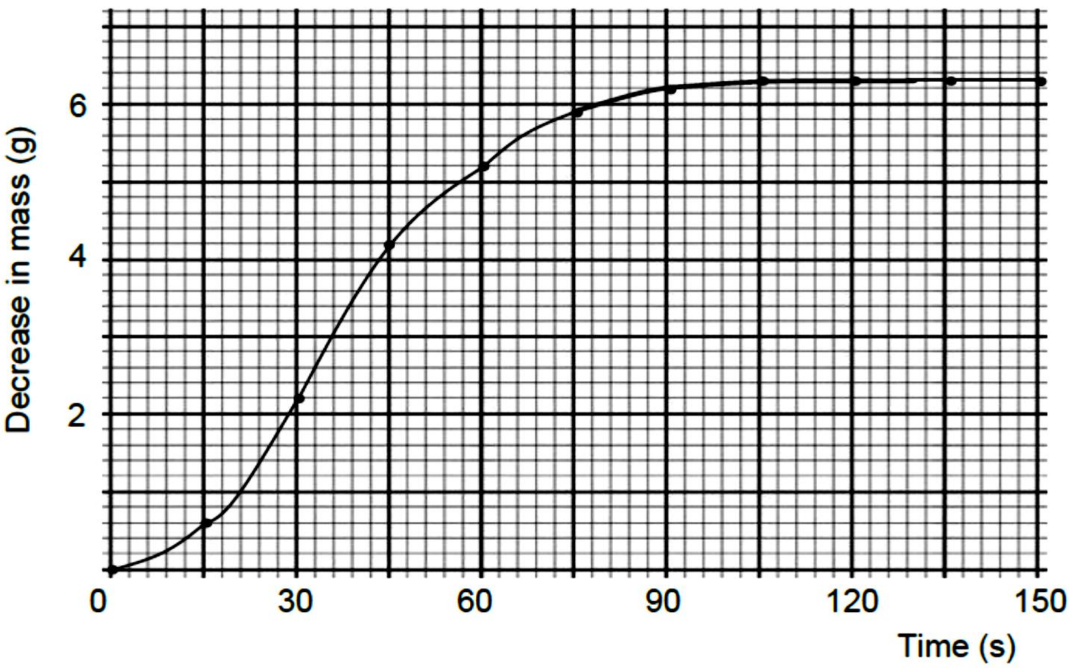
Time (s)	Mass of the beaker and contents (g)	Decrease in mass (g)
0	114,6	0,0
15	114,0	0,6
30	112,4	2,2
45	110,4	4,2
60	109,4	5,2
75	108,7	5,9
90	108,4	6,2
105	108,3	6,3
120	108,3	6,3
135	108,3	6,3
150	108,3	6,3

5.1 In terms of energy change, name the type of reaction which occurs. (1)

5.2 Give a reason why the mass of the beaker and its contents DECREASES. (1)

5.3 Use the values in the table and calculate the average rate of the reaction in $g.s^{-1}$ for the total duration of the reaction. (3)

Study the graph below which shows the decrease in mass against time for this reaction:



5.4 Give a reason for the shape of the graph from 105 s to 120 s. (1)

5.5 Give a reason why the rate of the reaction INCREASES from 0 s to 30 s. (1)

5.6 Give a reason why the rate of the reaction DECREASES from 45 to 105 s. (1)

5.7 Use the collision theory to explain the answer to QUESTION 5.6. (2)

5.8 Calculate the mass of copper used during this reaction. (4)

5.9 Except for adding a catalyst, name THREE other changes which can be made in order to INCREASE the rate of this reaction. (3)

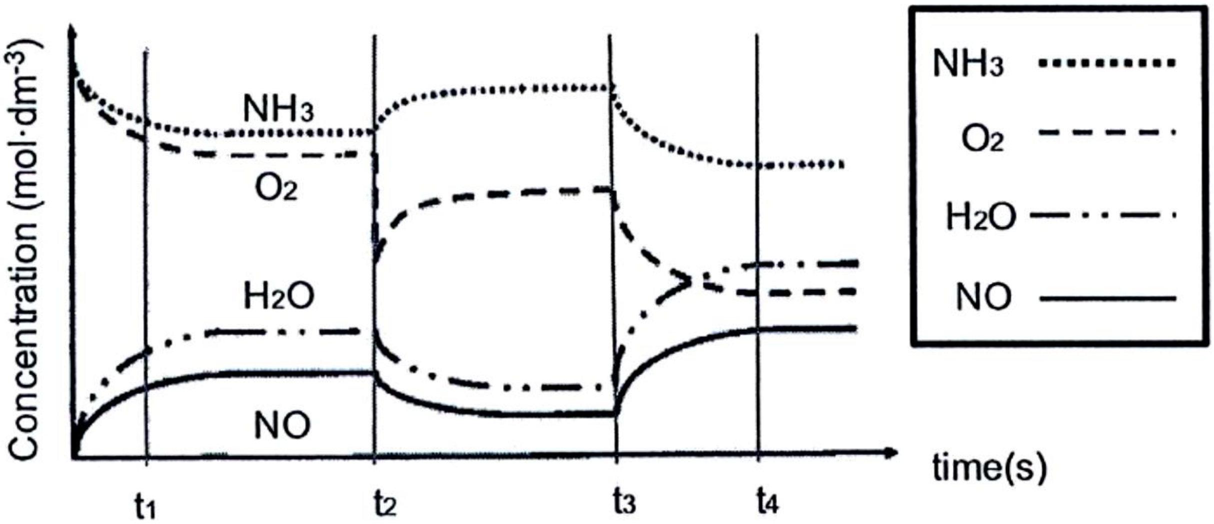
[17]

QUESTION 6

6.1 In an experiment, ammonia gas and oxygen gas are introduced into a container at a certain temperature. The container is sealed and the reaction taking place reaches equilibrium according to the following balanced chemical equation:

$$4NH_3(g) + 5O_2(g) \leftrightarrows 4NO(g) + 6H_2O(g)$$

The graph below shows the change in concentration of reactants and products with time:



6.1.1 State *Le Chatelier's principle*. (2)

6.1.2 If numerical values were given for concentration on the y-axis, would it be possible to calculate the equilibrium constant (K_c) for this reaction at time **t_1**? Explain the answer. (2)

6.1.3 Identify the change which was introduced to the reaction at time **t_2** and explain the subsequent changes in concentrations of all substances immediately after time **t_2**. (4)

6.1.4 At time t_3 the temperature of the container is decreased. Is the forward reaction EXOTHERMIC or ENDOTHERMIC? Explain how you reached this conclusion. (2)

6.2 Phosphorus pentachloride decomposes into phosphorus trichloride and chlorine gas. When gaseous phosphorous pentachloride is sealed in a closed container the following equilibrium is established:

$$PC\ell_5(g) \rightleftharpoons PC\ell_3(g) + C\ell_2(g)$$

6.2.1 An unknown mass of phosphorus pentachloride is sealed in an empty 2000 cm^3 container. The system is allowed to reach equilibrium at 250ºC.
When the equilibrium mixture was analysed the concentrations of $PC\ell_5$ and $C\ell_2$ were 0,7 $mol.dm^{-3}$ and 0,5 $mol.dm^{-3}$ respectively.
Calculate the K_c value at 250ºC. (5)

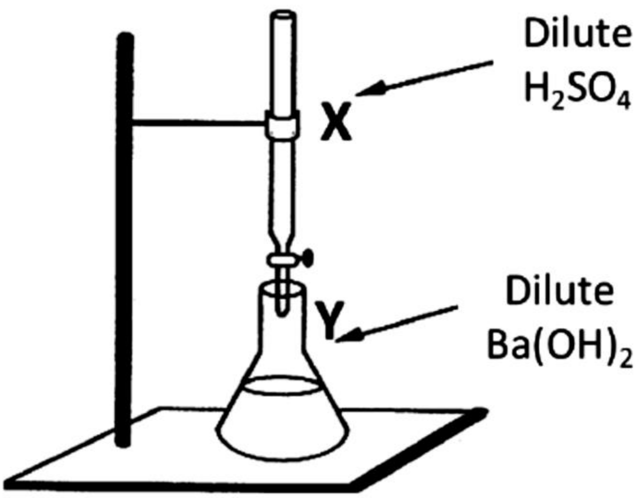
6.2.2 Calculate the mass of phosphorus pentachloride that was originally placed in the container. (4)

[19]

QUESTION 7

7.1 The following apparatus is used for the titration of a dilute alkali ($Ba(OH)_2$) with a dilute acid (H_2SO_4). The balanced equation for the reaction is as follows:

$$H_2SO_4\,(aq) + Ba(OH)_2\,(aq) \rightarrow BaSO_4(s) + 2H_2O(\ell)$$



7.1.1 What type of reaction takes place when an acid is added to an alkali? (1)

7.1.2 Write down the NAME of the dilute alkali. (1)

7.1.3 Name the piece of apparatus labelled **X**. (1)

7.1.4 Methyl orange is used as an indicator for this titration.

7.1.4.1 State the definition for the *end point* of a titration. (2)

7.1.4.2 What will you observe in **Y** when the titration reaches the end point? (2)

7.1.5 The concentration of the dilute alkali is 0,1 $mol.dm^{-3}$.

7.1.5.1 Calculate the pH of the alkali solution BEFORE the titration. (4)

7.1.5.2 During the reaction, 50 cm^3 of the dilute alkali reacts completely with 30 cm^3 of the dilute acid. Calculate the mass of barium sulphate that will form during the reaction. (5)

7.2 Two test tubes contain solutions of $NH_4C\ell$ and CH_3COONa. Their pH values are less than 7 and greater than 7 respectively. Rewrite the following hydrolysis equations in the ANSWER BOOK and complete them to explain this behaviour.

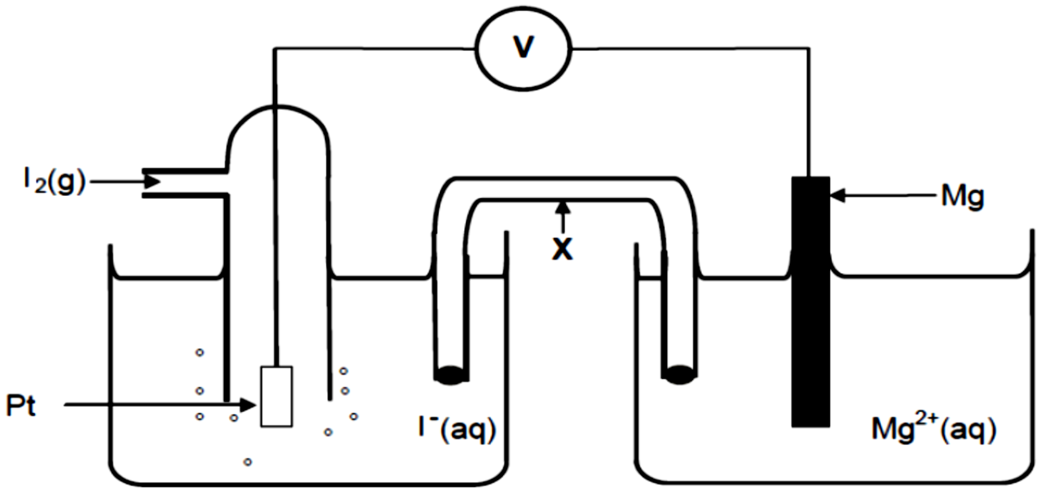
7.2.1 $NH_4^+ (aq) + H_2O(\ell) \rightarrow$ ______________ + ______________ (2)

7.2.2 $CH_3COO^- (aq) + H_2O(\ell) \rightarrow$ ______________ + ______________ (2)

[20]

QUESTION 8

A galvanic cell is set up using a magnesium half-cell and an iodine half-cell as shown in the diagram below:



8.1 Write down the type of energy conversion that occurs in this cell. (1)

8.2 Write down the NAME and FUNCTION of the component labelled **X**. (2)

8.3 Name the standard reference electrode against which all other electrode potentials are measured. (1)

8.4 The I_2 ***/*** I^- half-cell requires a platinum electrode when the galvanic cell is operating. Give TWO reasons why platinum is suitable for this purpose. (2)

8.5 Write down the cell notation for the above cell. (3)

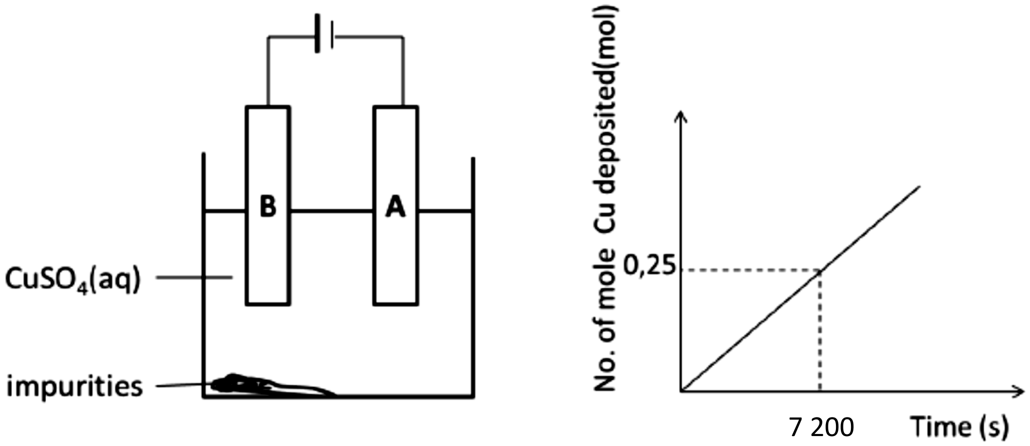
8.6 The voltmeter is now replaced with a 3V bulb. Will the bulb glow to its maximum brightness? Support your answer with a suitable calculation. (5)

8.7 The cell reaction in the above galvanic cell reaches equilibrium. How will this affect the glowing of the above bulb? (1)

[15]

QUESTION 9

High purity copper is obtained by electrolysis using a thin, pure copper cathode and an ACIDIFIED solution of copper (II) sulphate.



9.1 At which electrode would pure copper be deposited? Write only **A** or **B**. (1)

9.2 Write down the reduction half-reaction for this cell. (2)

9.3 During the purification of copper, an impure sludge forms at the bottom of the container. This sludge contains metals such as silver and platinum.

9.3.1 The mass of impurities formed in an hour is 8,5 g when a constant current is used. Use the graph to calculate the percentage purity of the impure copper that was used as the anode. (5)

9.3.2 With reference to their reducing ability, explain why silver and platinum do not form ions during the purification process. (2)

9.3.3 Why is the sludge of economic importance? (1)

9.4 The copper (II) sulphate is an electrolyte and the concentration remains constant for the duration of the reaction.

9.4.1 Define an *electrolyte*. (2)

9.4.2 Explain why the concentration of the solution remains constant. (1)

[14]

TOTAL 150

CAPS
INFORMATION FOR PHYSICAL SCIENCES GR 12
PAPER 2 (CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^θ	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^θ	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at 298 K	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ $E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{reducing\ agent}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*: 29

Electronegativity / *Elektronegatiwiteit*: 1,9

Symbol / *Simbool*: Cu

Approximate relative atomic mass / *Benaderde relatiewe atoommassa*: 63,5

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)
1 2,1 **H** 1																	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 **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**

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TABLE 4A: STANDARD REDUCTION POTENTIALS

Half-reactions			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(l) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(l)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	– 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	– 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	– 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	– 0,27
$Co^{2+} + 2e^-$	⇌	Co	– 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	– 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	– 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	– 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	– 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	– 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	– 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	– 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	– 1,18
$Al^{3+} + 3e^-$	⇌	Al	– 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	– 2,36
$Na^+ + e^-$	⇌	Na	– 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	– 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	– 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	– 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	– 2,93
$Li^+ + e^-$	⇌	Li	– 3,05

Increasing oxidising ability (↑)

Increasing reducing ability (↓)

TABLE 4B: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↓

Increasing reducing ability ↑

Half-reactions			E^θ (V)
$Li^+ + e^-$	⇌	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	− 2,36
$Al^{3+} + 3e^-$	⇌	Al	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**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
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87