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TRINITYHOUSE
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TRINITYHOUSE HIGH SCHOOL
PHYSICAL SCIENCES GRADE 12 PRELIM EXAMINATION
PAPER 2 - CHEMISTRY

MARKS: 200

TIME: 3 HOURS

EXAMINERS AND MODERATORS:

MRS MILLETT-CLAY; MRS SHEPPARD; MRS GOVENDER

NAME: _____

KEY: _____

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This paper consists of 29 pages, and a Data Sheet.
2. Please make sure that your question paper is complete.
3. Write your name in the space above.
4. Read the questions carefully.
5. ALL of the questions in this paper must be answered.
6. Question 1 consists of 10 multiple-choice questions. There is only one correct answer to each question. The questions must be answered on the grid provided. The letter that corresponds with your choice of the correct answer must be marked with a cross as shown in the example below:

A	B	~~C~~	D
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7. Use data and formulae whenever necessary.
8. You may use approved, non-programmable and non-graphical calculators, unless otherwise stated.
9. Show the necessary steps in calculations.
10. Where appropriate take your final answer to 2 decimal places.
11. It is in your own interest to write legibly and to set out your work neatly.

QUESTION	1	2	3	4	5	6	7	8	9	TOT	%
MAXIMUM	20	29	18	18	22	21	23	13	36	200	
MARK											

QUESTION 1 – MULTIPLE CHOICE

Select the answer that you consider to be the most correct and make a cross (X) over the symbol representing your choice (A, B, C or D) next to the question number in the **grid below**:

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

1.1 How many hydrogen atoms are there in 7 g ammonium hydroxide?

- A $1,204 \times 10^{23}$
- B $3,010 \times 10^{23}$
- C $4,816 \times 10^{23}$
- D $6,020 \times 10^{23}$

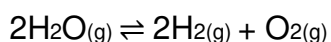
1.2 Which molecule is a polar molecule?

- A CO_2
- B CH_4
- C HBr
- D KF

- 1.3 Total amount of energy, in kilojoules, for the forward reaction in the equation below is....



- A 268 k J absorbed
 - B 268 k J released
 - C 1072 k J released
 - D 1072 k J absorbed
- 1.4 Consider the gas-phase equilibrium system represented by the equation:



Given that the forward reaction is **endothermic**, which of the following changes will **decrease** the equilibrium amount of H_2O ?

- A Decreasing the volume of the container (the total pressure increases)
 - B Adding more oxygen
 - C Adding a solid phase catalyst
 - D Increasing the temperature at constant pressure
- 1.5 Which one of the following indicators is most suitable for use in the titration of nitric acid with lithium hydroxide?

	INDICATOR	pH RANGE OF INDICATOR
A	CRESOL BLUE	1,2 – 1,8
B	METHYL ORANGE	3,1 – 4,4
C	BROMOTHYMOLO BLUE	6,0 – 7,6
D	PHENOLPHTHALEIN	8,4 - 10

- 1.6 While attempting to standardise an acid, two students each did five titrations. Their burette readings (from zero) are shown in the table below.

	Volume NaOH (cm ³) at end point				
Student A	24,93	24,75	25,02	25,16	24,98
Student B	25,02	25,53	24,16	23,75	24,63

If the expected volume was 25,00 cm³, which of the following statements is true?

- A Student A's results are more accurate and more precise than student B's results.
 - B Student B's results are more accurate and more precise than student A's results.
 - C Student A's results are more accurate but less precise than student B's results.
 - D Student B's results are more accurate but less precise than student A's results.
- 1.7 A sample of platinum contains impurities of gold. During purification by electrolysis(electrorefining), impure platinum is used as the electrode. Which one of the following is the best choice of anode and cathode for this process?

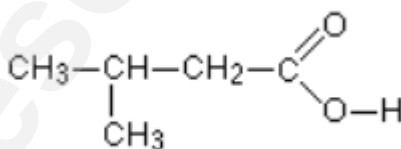
	Cathode	Anode
A	Pure gold	Impure platinum
B	Impure gold	Pure platinum
C	Pure platinum	Impure platinum
D	Impure platinum	Pure platinum

- 1.8 Sodium aluminium hexafluoride, better known as cryolite, is added to aluminium oxide (alumina) in the industrial process for the extraction of aluminium.

What is the reason for adding the cryolite to the reaction mixture?

- A It prevents the graphite electrodes from corroding due to the large electric current being passed through the electrodes.
 - B It helps reduce the melting point of the alumina to reduce the electrical costs of keeping alumina molten.
 - C It acts as a protective layer to protect the iron container from the intense heat required during the extraction process.
 - D It acts as a catalyst to help speed up the extraction process.
- 1.9 Which one of the following reactions will not take place with an alkene?
- A Hydrohalogenation
 - B Combustion
 - C Hydrogenation
 - D Dehydration

- 1.10 The IUPAC name for the following compound is:

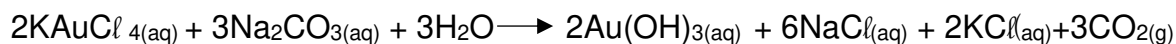


- A 2-methylbutanoic acid
- B pentanoic acid
- C 3-methylbutanoic acid
- D butanoic acid

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QUESTION 2 - STOICHIOMETRY

- 2.1 Gold (III) hydroxide is used during the electrolytic process to plate watches, rings and cutlery. It is prepared at S.T.P according to the following balanced chemical equation.



To prepare a fresh supply of gold (III) hydroxide two chemists mix 120,96 g of KAuCl_4 with 153,70 g of Na_2CO_3 , both dissolved in an excess of water.

- 2.1.1 Calculate which of the given reactants is the limiting reagent. (6)

- 2.1.2 Calculate the mass of $\text{Au}(\text{OH})_3$ that should be produced during this reaction. (3)

- 2.1.3 What mass of the other reactant (excluding water) is in excess? (4)

- 2.1.4 The yield of the gold(III)hydroxide at the end of the reaction is 67,93 g. Calculate the percentage yield obtained. (3)

- 2.1.5 Calculate the volume of CO₂ produced during this reaction. (3)

- 2.2 A standard solution of sodium sulphate (Na₂SO₄) has a concentration of 0,8 mol.dm⁻³. The solution was diluted by pipetting 40 cm³ into a volumetric flask and filling it up to the 250 cm³ mark with distilled water.

- 2.2.1 Define **concentration** (2)

- 2.2.2 Calculate the concentration of the new diluted solution. (5)

2.2.3 How many sodium particles are there present in this dilute solution? (3)

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QUESTION 3 - BONDING AND FORCES

- 3.1 From the list given below select only the **one** chemical substance that best fits the description given.

Substances can only be used once and not all need to be used:

CO₂ NaF Pb H₂O CBr₄ SiO₂ NH₃ Hg I₂ PH₃

- 3.1.1 A pyramidal shaped polar molecule which has polar bonds, that is held together by H – bonds in a gas state. (2)

- 3.1.2 A giant molecular crystal held together by covalent bonds. (2)

- 3.1.3 A non-polar molecule with polar bonds that has van der Waals forces between the molecules in a liquid. (2)

- 3.1.4 Atoms held together by metallic bonds in the solid state. (2)

- 3.1.5 A non-polar molecule with non-polar bonds that is found as a solid at room temperature due to weak London forces. (2)

- 3.1.6 A polar molecule held together in the liquid state by H- bonds. (2)

- 3.2 Refer to the table below that compares the Hydrides of group VI with each other

HYDRIDES OF GROUP VI	MELTING POINT (°C)	BOILING POINT (°C)
H ₂ O	0	100
H ₂ S	-85	-61
H ₂ Se	-60	-42
H ₂ Te	-40	-2

- 3.2.1 Explain why H₂O has a much higher melting point in comparison to the other hydrides. (3)

- 3.2.2 Give a reason for the trend of increasing boiling points down the rest of the group. (3)

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QUESTION 4 - RATES AND ENERGY

The following statement is made: "The physical state of the reactants will influence the rate at which hydrogen gas is formed when zinc reacts with a $0,5 \text{ mol.dm}^3$ sulphuric acid solution."

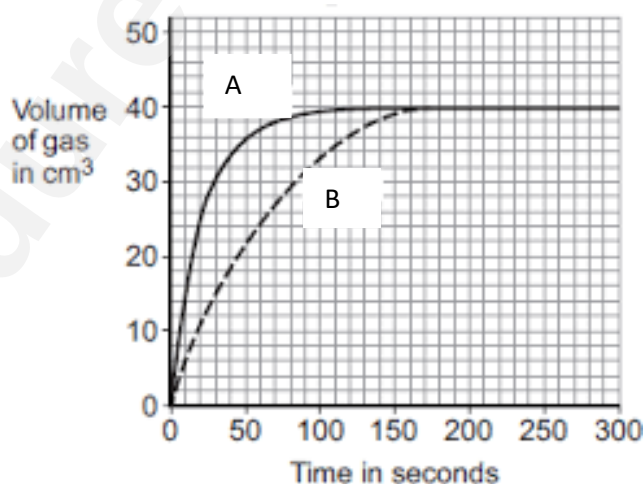
4.1 Describe an experiment to prove this statement for different physical states of zinc under the following headings:

4.1.1 Hypothesis: (2)

4.1.2 Method if the following is used with enough $0,5 \text{ mol.dm}^3$ sulphuric acid. (3)

- (i) 1 g of chunks of zinc
- (ii) 1 g of powdered zinc

4.2 The results of the reaction rates for the above experiments are represented by the graphs of the volume of hydrogen gas evolved vs time shown below:



4.2.1 Which of the two curves represents experiment (ii)? (1)

- 4.2.2 Which of the two curves represents the highest reaction rate, and state the time interval on that curve that represents the highest reaction rate. (2)

Curve _____

Time interval _____

- 4.2.3 Why is curve A horizontal after 90 seconds? (2)

- 4.2.4 Calculate the reaction rates for both curves separately while the rates are increasing. (3)

- 4.3 4.3.1 Define a catalyst (2)

- 4.3.2 How will a positive catalyst change graph B? (1)

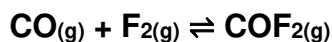
- 4.3.3 State the effect that a positive catalyst will have on each of the following. (write ONLY INCREASE, DECREASE OR NO EFFECT)

- (a) The heat of the reaction (b) Energy of the products (2)

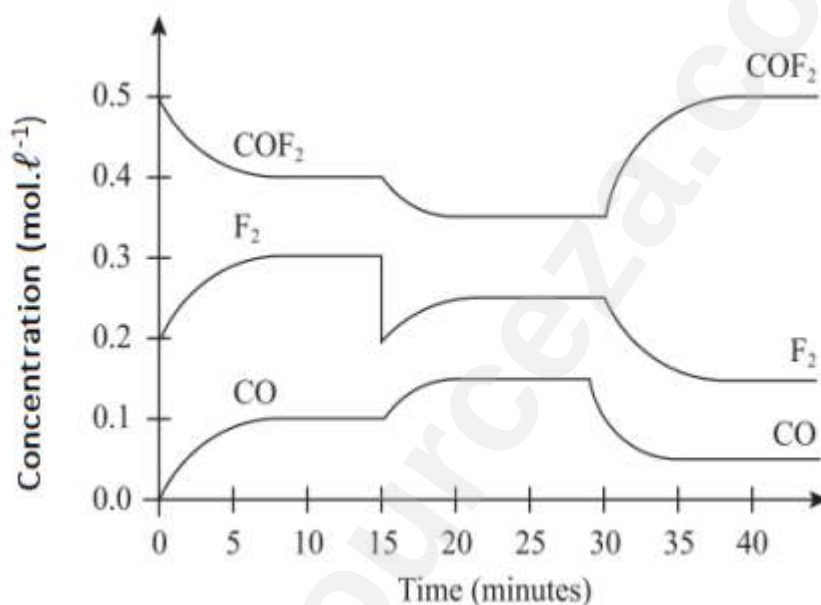
[18]

QUESTION 5 – CHEMICAL EQUILIBRIUM

- 5.1 Carbon monoxide reacts with fluorine to produce carbon oxyfluoride as shown in the equation:



Tsungayi studied this reaction and measured the concentration of each of these gases in a sealed 2 l reaction vessel over a period of time. The results are shown below.



- 5.1.1 Identify which gases are present in the reaction vessel at the start of the experiment and state their concentration. (4)

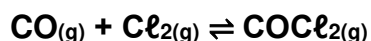
- 5.1.2 State the time at which the reaction reached equilibrium for the first time. (2)

- 5.1.3 State *Le Chatelier's principle*. (2)

- 5.1.4 At $t = 15$ minutes, Tsungayi made a change to the system. Deduce from the graph what change was made. (2)

- 5.1.5 At $t = 30$ min, the temperature of the reaction vessel was decreased. Use Le Chatelier's principle to explain if the **reverse reaction** is ENDOTHERMIC or EXOTHERMIC. (4)

- 5.2 Phosgene is prepared according to the reaction:



- 5.2.1 Write the expression for the equilibrium constant for this reaction. (1)

- 5.2.2 At a certain temperature, equilibrium is established in a 500 ml flask with a mixture, which on analysis, contained 1,5 mol of phosgene, 0,15 mol of carbon monoxide and 1,0 mol of chlorine. (4)

Calculate the equilibrium constant for this reaction.

- 5.2.3 In a 1 000 ml flask, at the same temperature and pressure, 0,2 mol of chlorine and 0,1 mol of carbon monoxide remained at equilibrium. What was the concentration of the phosgene produced in the second flask at equilibrium? (3)

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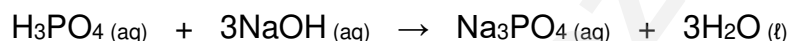
QUESTION 6 – ACIDS AND BASES

6.1 Phosphoric acid (H_3PO_4) is a weak, polyprotic acid.

6.1.1 Define a weak acid? (2)

6.1.2 Give a reason why phosphoric acid is referred to as a **polyprotic** acid. (2)

6.2 A student needs to determine the concentration of a phosphoric acid solution. She decides to titrate the phosphoric acid against a standard sodium hydroxide solution. The balanced chemical equation is given below:



6.2.1 Calculate the mass of NaOH needed to make up 500 cm^3 of a $0,22 \text{ mol.dm}^{-3}$ NaOH solution. (4)

6.2.2 During the titration she found that 15 cm^3 of the $0,22 \text{ mol.dm}^{-3}$ NaOH solution neutralises 20 cm^3 of the phosphoric acid solution. Calculate the concentration of the phosphoric acid solution. (4)

6.2.3 What is meant by “hydrolysis of a salt”? (2)

6.2.4 Which one of the indicators listed below should be used in this titration? Briefly explain your answer by referring to the hydrolysis of Na_3PO_4 . (4)

Include one or more equations with your answer.

Name of indicator	pH range of indicator
Methyl orange	3,1 – 4,4
Bromothymol blue	6,0 – 7,6
phenolphthalein	8,4 – 10,0

6.3 Solution **A** is ethanoic acid of concentration $0,05 \text{ mol.dm}^{-3}$
Solution **B** is hydrochloric acid of concentration $0,05 \text{ mol.dm}^{-3}$
Solution **C** is hydrochloric acid of concentration $0,5 \text{ mol.dm}^{-3}$

Which solution/s (**A**, **B** or **C**?) would you expect to have...

6.3.1 the higher pH? (1)

6.3.2 the lowest K_c value? (1)

6.3.3 the greater electrical conductivity? (1)

[21]

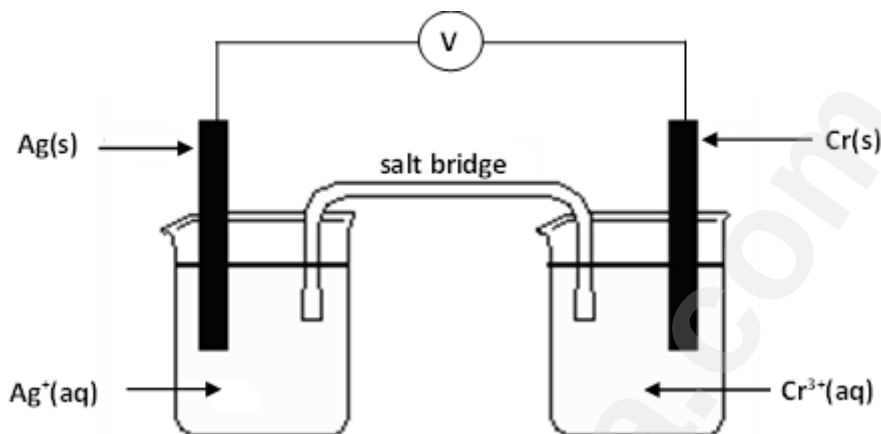
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QUESTION 7 - GALVANIC CELL

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

A voltmeter is connected across the electrodes



7.1 State the standard conditions under which this cell operates. (2)

7.2 In which direction do electrons flow in the external circuit when this cell delivers a current? Write down only 'from **Cr** to **Ag**' or 'from **Ag** to **Cr**'. (1)

7.3 Write down the half reaction that takes places at the anode. (2)

7.4 Calculate the initial emf of this cell. Show all working. (3)

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

- 7.6 The salt bridge maintains electrical neutrality. Describe, with reasons the movement of ions **INTO** and **OUT OF** the salt bridge in the **CHROMIUM** half-cell. (3)

- 7.7 How will an increase in the concentration of the Ag^+ ions influence the current that the cell delivers? (1)
Write down only **INCREASES**, **DECREASES** or **REMAINS THE SAME**.

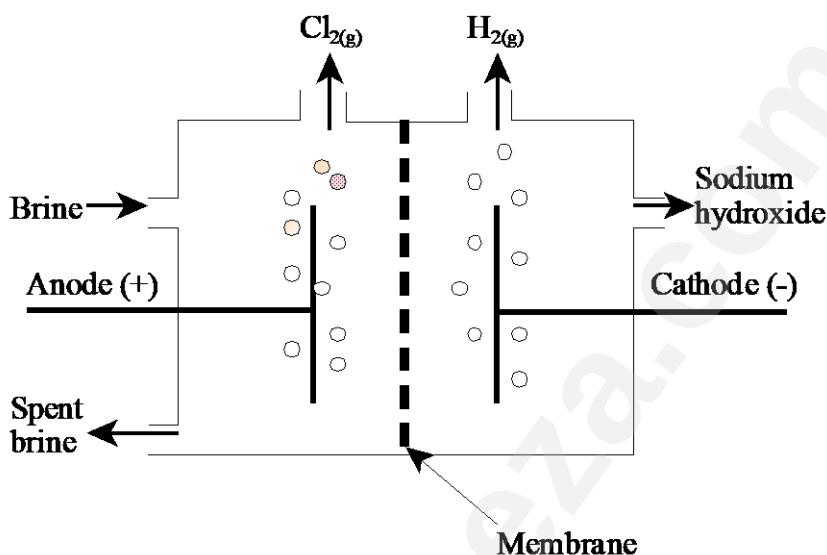
- 7.8 How will an increase in the concentration of the Ag^+ ions influence the initial emf? (2)
Write down **INCREASES**, **DECREASES** or **REMAINS THE SAME** and explain your answer.

- 7.9 The mass of the silver electrode was 7,3 g before the cell is connected. (6)
After some time the silver electrode's mass increases to 63,2 g after it is dried. Calculate the time that it took for the silver electrode to undergo this mass increase if a current of 10,5 A was used.

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QUESTION 8 – ELECTROLYTIC CELLS

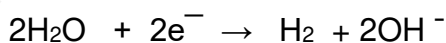
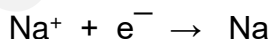
Approximately 30 million tons of chlorine are used throughout the world annually. Chlorine is produced industrially by the electrolysis of brine. The diagram represents a membrane cell used in the production of chlorine gas.



8.1 What is brine? (2)

8.2 Write the electrochemical reaction taking place at the anode. (2)

8.3 These are two possible reduction reactions which could take place at the cathode:



8.3.1 Which one of these reactions takes place? (1)

8.3.2 Explain why the other reaction does not take place. (2)

8.4 Deduce the overall net cell reaction. (2)

8.5 Name the two types of Chlor-Alkali Industrial cells that are no longer in use, as a result of the health hazards they pose to humans and name the hazards each of these two cells pose. (4)

[13]

QUESTION 9 - ORGANIC CHEMISTRY

Consider the molecules listed in the table below:

A. <pre> H H H H — C — C — C = C — C — H H H H </pre>	B. ethyl methanoate
C. <pre> H H H H H H H Br — C — C — C — C — C — C — H H H H H H H H </pre>	D. <pre> CH₃ — CH₂ — C — OH O </pre>

9.1 Define the following terms:

9.1.1 Saturated hydrocarbons.

(2)

9.1.2 Functional group.

(2)

9.1.3 Chain isomer.

(2)

9.2 Name the functional group of the following compounds:

9.2.1 D

(2)

9.2.2 C

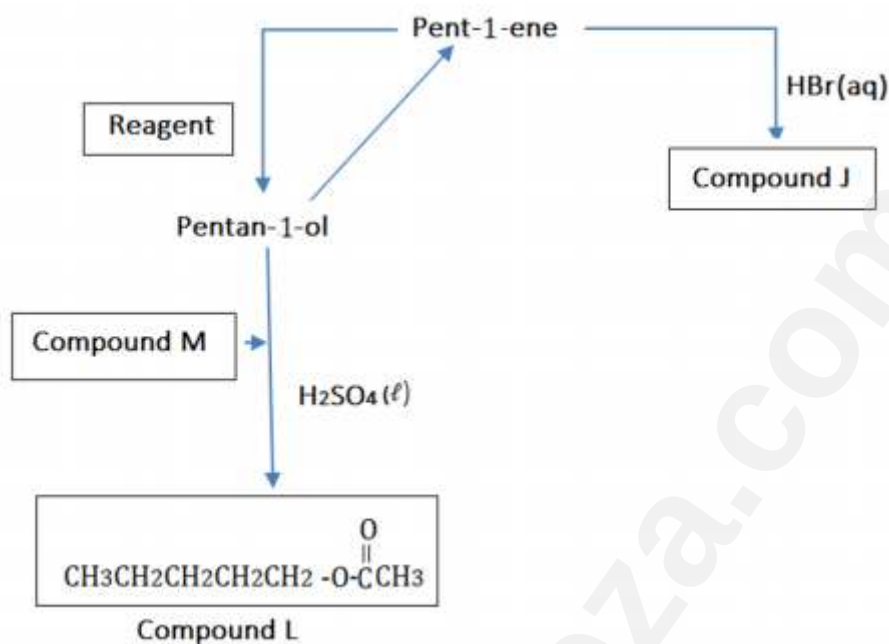
(2)

9.3 Write the balanced reaction for the complete combustion of **COMPOUND A**. (4)

9.4 Provide the IUPAC name for **COMPOUND C**. (3)

9.5 **COMPOUND B** and **COMPOUND D** have the same molecular mass. State which of these compounds has the higher boiling point and explain why its boiling point is higher. (4)

Some of the reactions of **pent-1-ene** are shown in the reaction pathway below.



9.6 Pent-1-ene is reacted with HBr to form **COMPOUND J**.

9.6.1 Provide the IUPAC name for **COMPOUND J** and any other products formed. (3)

9.6.2 Name the **SPECIFIC TYPE** of reaction that results in the formation of **COMPOUND J**. (1)

9.7 Pent-1-ene forms pentan-2-ol normally, but pent-1-ene can form a small amount of pentan-1-ol.

9.7.1 State the reagent(s) required to convert pent-1-ene to pentan-1-ol. (2)

- 9.7.2 Draw the structural formula for the positional isomer of pentan-1-ol and explain why it is a positional isomer. (3)

9.8 Pentan-1-ol is reacted with **COMPOUND M** under acidic conditions to produce **COMPOUND L**.

- 9.8.1 Name the homologous series to which **COMPOUND L** belongs to. (1)

- 9.8.2 Draw the structural formula of **COMPOUND M**. (2)

- 9.8.3 Name a functional isomer of **COMPOUND L**. (2)

- 9.8.4 Name one use that **COMPOUND L** is produced for. (1)

[36]

TOTAL FOR PAPER = 200