CHEMISTRY DRAFT SAMPLE EXAMINATION
STAGE 2

Section 7 of the *WACE Manual: 2008 Revised Edition* outlines the policy on WACE examinations.

Further information about the WACE Examinations policy can be accessed from the Curriculum Council website at http://www.curriculum.wa.edu.au

The purpose for providing a sample examination is to provide teachers with an example of how the course will be examined. Further finetuning will be made to this sample in 2008 by the examination panel following consultation with teachers, measurement specialists and advice from the Assessment, Review and Moderation (ARM) panel.

2008/19994

Western Australian Certificate of Education Draft Sample Examination
Question/Answer Booklet

CHEMISTRY
STAGE 2

Please place your student identification label in this box

Student Number: In figures | | | | | | | | |

In words _____

_____

Time allowed for this paper
Reading time before commencing work: Ten minutes
Working time for paper: Three hours

Material required/recommended for this paper
To be provided by the supervisor
Question/answer booklet
Separate multiple-choice answer sheet
Data sheet

To be provided by the candidate
Standard items: Pens, pencils, eraser, correction fluid, ruler, highlighter
Special items: Scientific calculator

Important note to candidates
No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

This paper is for students who have completed Units 2A and 2B.

Structure of this paper

Section	Suggested working time	Number of questions available	Number of questions to be attempted	% of paper	Marks
ONE Multiple choice	50 minutes	25	25	26	50
TWO Short response	60 minutes	11	11	41	78
THREE Extended response	70 minutes	5	5	32	60
			Total	100	188

Instructions to candidates

1. The rules for the conduct of Curriculum Council examinations are detailed in the *Student Information Handbook*. Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.
   Section One Answer all questions in the separate multiple-choice answer sheet provided.
   Section Two Answer **all** questions in the spaces provided in this Question/Answer Booklet.
   Section Three Answer **all** questions in the spaces provided in this Question/Answer Booklet

3. A blue or black ballpoint or ink pen should be used.

4. For full marks, chemical equations should refer only to those species consumed in the reaction and the new species produced. These species may be **ions** [for example $Ag^+(aq)$], **molecules** [for example $NH_3(g)$,$NH_3(aq)$,$CH_3COOH(\ell)$, $CH_3COOH(aq)$] or **solids** [for example $BaSO_4(s)$,$Cu(s)$, $Na_2SO_4(s)$].

5. Additional information which may be necessary to answer questions is located on the separate Chemistry data sheet.

SECTION ONE—MULTIPLE-CHOICE [50 marks]

This section has **TWENTY FIVE (25)** questions. Attempt **ALL** questions.

Answer all questions in Section 1 on the separate Multiple-Choice Answer Sheet provided, using a blue or black pen or B or 2B pencil. Each question in this part is worth 2 marks.

Suggested working time: 50 minutes.

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1. Which of the following statements is **true**?

[2 marks]

(A) The pH of a strong acid is greater than that of a strong base.
(B) The pH of a weak acid is less than the pH of a strong base.
(C) The pH of a weak base is greater than the pH of a strong base.
(D) The pH of a strong base is less than the pH of a strong acid.

2. In which of the following pairs of substances are both the elements underlined in the same oxidation state?

[2 marks]

(A) $\underline{N}_2O_3$ and $\underline{N}_2O_5$
(B) $Na_2\underline{S}_2O_3$ and $K_2\underline{Cr}O_4$
(C) $K_2\underline{Cr}_2O_7$ and $Na_2\underline{S}O_4$
(D) $\underline{S}O_3$ and $\underline{N}H_3$.

3. Which one of the following combinations of particles does magnesium ion Mg^{2+} have?

[2 marks]

(A) 10 electrons, 12 protons and 14 neutrons
(B) 10 electrons, 14 protons and 12 neutrons
(C) 12 electrons, 12 protons and 12 neutrons
(D) 12 electrons, 10 protons and 10 neutrons.

4. Why does a 1.00 mol L^{-1} solution of calcium chloride ($CaC\ell_2$) conduct an electric current even better than a 1 mol L^{-1} solution of sodium chloride ($NaC\ell$)?

[2 marks]

(A) $CaC\ell_2$ has a higher molecular weight than $NaC\ell$.
(B) 111 grams of $CaC\ell_2$ are needed for a 1.00 mol L^{-1} solution, while only 58.5 grams of $NaC\ell$ are needed.
(C) More ions are present in a given volume of 1 mol L^{-1} $CaC\ell_2$ solution than in the same volume of 1 mol L^{-1} $NaC\ell$ solution.
(D) $CaC\ell_2$ is more soluble in water than $NaC\ell$.

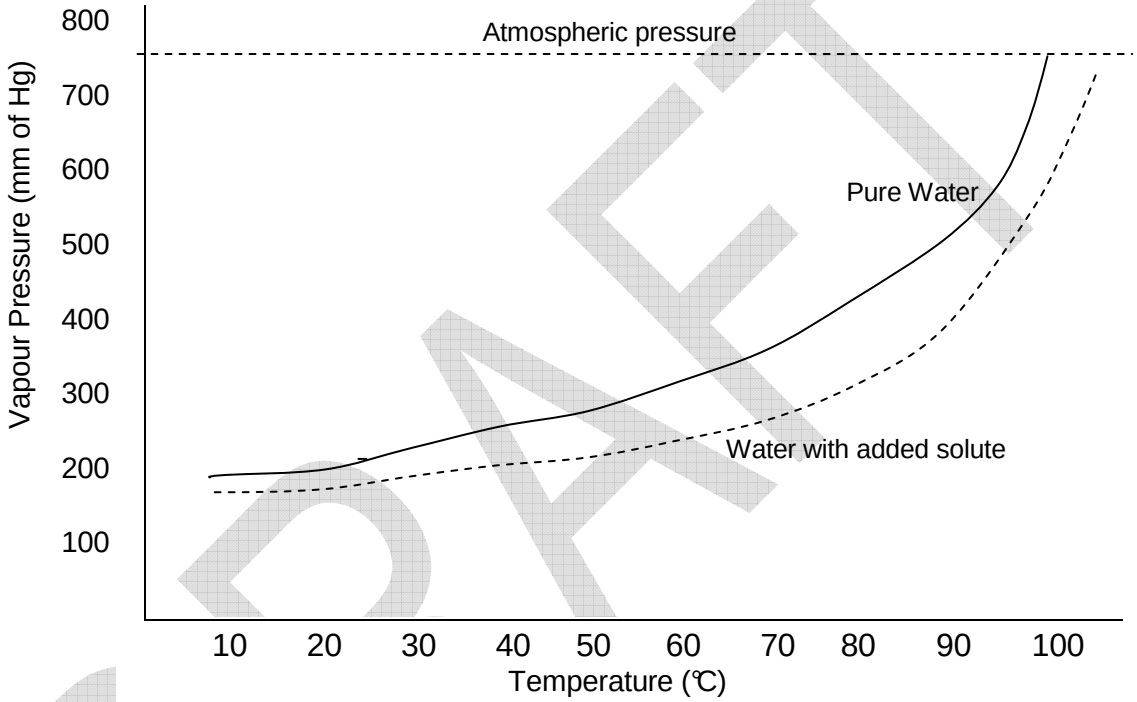
5. Which of the following will conduct electricity?

i molten sulfur
ii ammonia solution
iii mercury
iv sodium hydroxide solution.

[2 marks]

(A) iv only
(B) i and iv only
(C) i, ii and iii only
(D) ii, iii and iv only.

6. The graph shows the relationship between the vapour pressure of water and the temperature. It also shows the effect on the vapour pressure when a solute is added to water.



It can be seen that the presence of the solute:

[2 marks]

(A) lowers the vapour pressure and increases the boiling point
(B) lowers the vapour pressure and decreases the boiling point
(C) increases the vapour pressure and increases the boiling point
(D) increases the vapour pressure and decreases the boiling point.

7. A small beaker containing ammonium thiocyanate and barium hydroxide stands in a puddle of water on the bench. As the reaction proceeds the water around the beaker freezes, cementing it to the bench top. This indicates that the reaction is:

[2 marks]

(A) endothermic as heat is absorbed
(B) exothermic as heat is absorbed
(C) endothermic as heat is released
(D) exothermic as heat is released.

8. Natural gas is a mixture of hydrocarbons, but is mainly :

[2 marks]

(A) methane
(B) ethane
(C) propane
(D) butane

9. Sulfuric acid is a stronger acid than acetic (ethanoic) acid because:

[2 marks]

(A) sulfuric acid has two ionisable hydrogen atoms while acetic acid has only one ionisable hydrogen atom.
(B) sulfuric acid is more soluble in water than acetic acid.
(C) the pH of a sulfuric acid solution is greater than that of an acetic acid solution of the same concentration.
(D) sulfuric acid ionises more completely than acetic acid in aqueous solution.

10. Which of the following reactions does **not** represent a redox reaction?

[2 marks]

(A) $A\ell(OH)_3 + OH^- \rightarrow A\ell(OH)_4^-$
(B) $2Na + C\ell_2 \rightarrow 2NaC\ell$
(C) $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$
(D) $H_2SO_4 + 2HBr \rightarrow SO_2 + 2H_2O + Br_2$

11. Which one of the following is the most likely product when pent-2-ene reacts with chlorine water?

[2 marks]

(A) 2,2-dichloropentane
(B) 2,3-dichloropentene
(C) 2,3-dichloropentane
(D) 1,2-dichloropentane.

12. A sealed syringe holds a fixed volume of gas at a certain temperature and pressure. Which of the following will **not** cause a change in the pressure of the gas inside the syringe?

[2 marks]

(A) releasing half of the gas in the syringe
(B) heating the syringe
(C) reducing the volume of the syringe by pushing on the plunger
(D) a decrease in atmospheric pressure.

13. Which of the following substances contain both ionic and covalent bonds?

[2 marks]

(A) MgF_2
(B) $CH_3CH_2COOH(\ell)$
(C) $Ca(NO_3)_2$
(D) $HC\ell(g)$

14. Three different solids in equal amounts are added to 200 mL of water in a beaker. After continued stirring, it was noted that there was a white insoluble solid in the beaker. The three solids were most likely to be:

[2 marks]

(A) sodium sulfate, ammonium nitrate and potassium iodide
(B) barium nitrate, potassium sulfate and sodium chloride
(C) barium nitrate, calcium chloride and potassium iodide
(D) copper nitrate, sodium sulfate and potassium carbonate.

15. Which one of the following sets of formulae contains only **one** saturated chain hydrocarbon? Do not consider any cyclic forms of the compounds.

[2 marks]

(A) C_2H_6, C_3H_6, C_4H_8
(B) C_2H_6, C_4H_{10}, C_6H_{12}
(C) C_2H_6, C_3H_8, C_8H_{18}
(D) CH_4, C_2H_6, C_6H_{14}.

16. Selenium is element 34 on the periodic table. Selenium forms:

[2 marks]

(A) a covalent hydride
(B) an ionic oxide
(C) a network solid with chlorine
(D) a covalent fluoride with formula SeF_5.

17. In which of the following equations is nitric acid acting as an oxidising agent?

i $P_4O_{10} + 4HNO_3 \rightarrow 4HPO_3 + 2N_2O_5$
ii $3Fe^{2+} + 4HNO_3 \rightarrow 3Fe^{3+} + NO + 2H_2O + 3NO_3^-$
iii $CO_3^{2-} + 2HNO_3 \rightarrow CO_2 + H_2O + 2NO_3^-$
iv $Cu + 4HNO_3 \rightarrow Cu^{2+} + 2NO_3^- + 2H_2O + 2NO_2$

[2 marks]

(A) i and iii
(B) ii and iv
(C) i, ii and iv
(D) ii, iii and iv.

18. Boiling red cabbage leaves in water produces a red coloured solution. When dilute sodium hydroxide was added to the solution, it turned purple. When dilute hydrochloric acid was added to the red solution, no colour change occurred.

Which of these substances, when added, is most likely to cause the red solution to change colour?

[2 marks]

(A) a cleaning solution containing ammonia
(B) salt water
(C) lemon juice
(D) vinegar.

19. Two elements have the following electron configurations

X: 2,8,4
Y: 2,6

Which one of the following represents the most likely formula of a compound formed between X and Y?

[2 marks]

(A) XY
(B) X_2Y
(C) XY_2
(D) X_2Y_3.

20. Which of the following elements has an oxide which reacts with water to form an acidic solution?

[2 marks]

(A) Sodium
(B) Iron
(C) Sulfur
(D) Magnesium.

21. Which of the following are Brønsted-Lowry acid-base reactions?

i $Mg + 2\,H^+ \rightarrow Mg^{2+} + H_2$
ii $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$
iii $3\,Cu + 8\,H^+ + 2\,NO_3^- \rightarrow 3\,Cu^{2+} + 2\,NO + 4\,H_2O$
iv $NH_2^- + H_2O \rightarrow NH_3 + OH^-$

[2 marks]

(A) ii only
(B) i and iii only
(C) ii, ii and iv only
(D) ii and iv only.

22. Which of the following substances will have the highest melting point?

[2 marks]

(A) carbon dioxide
(B) silicon dioxide
(C) nitrogen dioxide
(D) sulfur dioxide.

23. The chemical properties of an element are mainly influenced by its:

[2 marks]

(A) group in the periodic table
(B) number of electrons
(C) number of valence electrons
(D) atomic number.

24. The following chemical reaction is taking place in a sealed container:

$$2NO(g) + 2H_2(g) \longrightarrow N_2(g) + 2H_2O(g) \qquad \Delta H = 1664 \text{ kJ}$$

Which of the following changes made to the system would increase the **rate of production** of N_2?

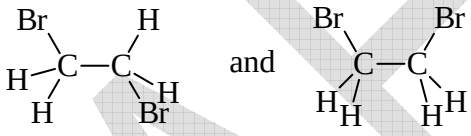
i Adding a catalyst
ii Increasing the temperature
iii Increasing the pressure
iv Cooling to cause the $H_2O(g)$ to condense to liquid water.

[2 marks]

(A) i and ii only
(B) iii and iv only
(C) i, ii and iii only
(D) ii, iii and iv only

25. Which of the following pairs of compounds are isomers?

i $HCOOCH_3$ and CH_3COOH

ii 

iii 

[2 marks]

(A) i only
(B) ii only
(C) iii only
(D) all of the above.

END OF SECTION ONE

SECTION TWO—SHORT RESPONSE [78 marks]

Section two contains **eleven (11)** questions. Attempt **ALL** questions in the spaces provided.

In this section, unless asked to write molecular equations, chemical equations should refer only to those species consumed in the reaction and the new species produced. These species may be **ions** [for example $Ag^+(aq)$, **molecules** [for example $NH_3(g)$,$NH_3(aq)$,$CH_3COOH(\ell)$, $CH_3COOH(aq)$] or **solids** [for example $BaSO_4(s)$,$Cu(s)$, $Na_2SO_4(s)$].

Suggested working time: 60 minutes

Question 1 ***(8 marks)***
Write balanced **molecular** equations for any reactions that occur in the following procedures. If no reaction occurs, write 'no reaction'.

(a) An iron nail is placed in a solution of copper (II) sulfate producing copper metal and iron(II) sulphate.

[2 marks]

(b) Lead (II) nitrate solution is mixed with a sodium sulphate solution.

[2 marks]

(c) Butane is burnt in air.

[2 marks]

(d) Propene and hydrogen gas are passed over a platinum catalyst.

[2 marks]

Question 2 ***(8 marks)***
Write balanced **ionic** equations for any reactions that occur in the following procedures. If no reaction occurs, write 'no reaction'.

(a) A dilute solution of silver nitrate is added dropwise to an acidified solution of sodium chloride.
[2 marks]

_____

(b) Dilute nitric acid solution added to a potassium carbonate solution.
[2 marks]

_____

(c) Acetic ethanoic acid is added to a solution of lead nitrate.
[2 marks]

_____

(d) Dilute hydrochloric solution is added to a piece of zinc metal.
[2 marks]

_____

Question 3 **(8 Marks)**
Write observations for any reactions that occur in the following procedures.
The first example has been done for you. If no change is observed, you should state this.

(a) Pentene-l-ene is shaken with a little bromine water.

The orange coloured bromine water went colourless.

(b) Dilute hydrochloric acid solution is added to solid calcium carbonate.
[2 marks]

_____

_____

(c) Barium sulfate solution is mixed with sodium carbonate solution.
[2 marks]

_____

_____

(d) Dilute sulfuric acid solution is added to a solution of potassium hydroxide.

[2 marks]

_____

_____

(e) Bromine water is mixed with a KI solution and dichloromethane (an organic solvent) is added to the mixture, which is then shaken.

[2 marks]

_____

_____

Question 4 (9 marks)

(a) Complete the table by providing the required information for the three unknown elements X, Y and Z.

[6 marks]

Unknown element	Number of protons	Number of neutrons	Electron configuration	Name of the element
X	12	12		
Y		17		Chlorine
Z		18	2,8,7	

(b) Briefly describe the nature of the elements Y and Z.

[3 marks]

_____

_____

_____

Question 5 (4 marks)

Vitamin C is a water-soluble vitamin that helps the body fight infection. Humans cannot produce this vitamin and it is best obtained from fruits and vegetables in their diet. The results of an analysis of vitamin C showed that it has an empirical formula of $C_3H_4O_3$ and an approximate formula mass of 180.

Use this information to determine the molecular formula of vitamin C.

[4 marks]

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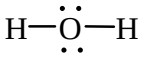
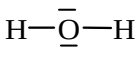
Question 6 (6 marks)

For each species listed in the table below, draw an electron dot diagram showing all valence electrons. Use **:** or — to represent a pair of electrons.

[for example, water  or  or  and so on]

[6 marks]

Species	Electron dot diagram
Methane (CH_4)	
Carbon dioxide (CO_2)	
Potassium chloride ($KC\ell$)	

Question 7 (9 marks)
Complete the table below by **naming** a substance found around the home that exhibits the **bonding type** indicated. Describe its **use** and the **related property**.

[Each answer is worth 1 mark]

Bonding type	Name	Use and related property
Covalent molecular		
Ionic		
Covalent network		

Question 8 (8 marks)
The molecular formula for the hydrocarbon C_5H_{10} can be drawn a number of different ways. These different representations of the molecular formulae are called isomers. Draw **four (4)** isomers for this compound, **two** structural isomers and **two** geometric isomers of C_5H_{10} . You must name each isomer using IUPAC nomenclature.

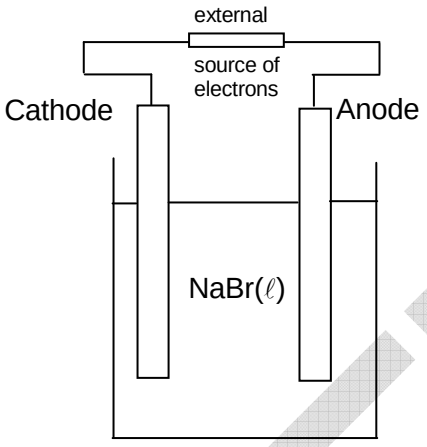
[2 marks each]

Structural Isomer Name	Structural Isomer Name
Geometric Isomer Name	Geometric Isomer Name

Question 9 (8 marks)

Electrolysis is a process that can be used to produce metals from their compounds. In 1806, Sir Humphry Davy produced sodium metal for the first time through the electrolysis of molten sodium bromide.

The diagram below is a simplified representation of the type of electrolytic cell that Davy may have used to produce sodium metal. The electrodes were made out of platinum.



(a) Write a half equation to represent the formation of sodium at the cathode.

[2 marks]

(b) Write a half equation to represent the formation of bromine at the anode.

[2 marks]

(c) On the diagram show the movement of the ions in the molten electrolyte.

[2 marks]

(d) On the diagram show the direction of the movement of the electrons in the external circuit.

[2 marks]

Question 10 (5 marks)
A student was given a sample of butter, containing only saturated fats, and a sample of polyunsaturated margarine. Both of these compounds have long hydrocarbon chains.

(a) What do the terms 'saturated' and 'unsaturated' mean in this context?

[2 marks]

(b) What does the term polyunsaturated mean in relation to the structure of margarine?

[1 mark]

(c) Describe a simple chemical test that the student could use to determine which sample was the margarine. Include any relevant observations.

[2 marks]

Question 11 (5 marks)
Analysis of a 0.112g sample of a hydrocarbon that had an empirical formula CH_2 revealed that the gas occupied 44.7 mL at STP.

(a) Calculate the number of moles of gas in the sample.

[2 marks]

(b) Calculate the formula mass of the gas.

[1 mark]

(c) Determine the molecular formula of the hydrocarbon.

[2 marks]

_____

_____

_____

_____

END OF SECTION TWO

SECTION THREE—EXTENDED RESPONSE [60 marks]

Section Three has **FIVE (5)** questions. Attempt **ALL** questions in the spaces provided below.

In descriptive responses, marks are awarded for relevant chemical content, including equations, diagrams and illustrative examples of the chemistry you are describing.

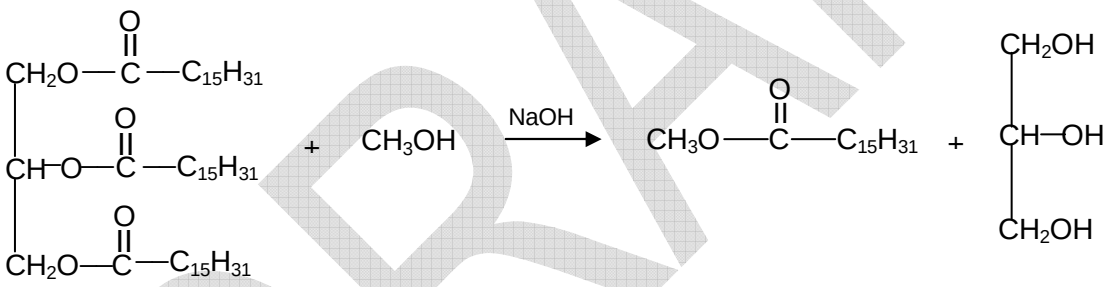
Calculations are to be set out in detail. Marks will be awarded for correct equations and clear setting out, even if you cannot complete the calculation. Express numerical answers to three (3) significant figures and provide units where appropriate.

Suggested working time: 70 minutes.

Question 1 (12 marks)

The chemical reaction that produces biodiesel is exothermic. Biodiesel consists of molecules called fatty acid esters. These are produced from triglyceride molecules which are found in plant, animal, and recycled cooking oils. These oils are mixed with excess methanol and the reaction mixture is heated for up to 13 hours to achieve a suitable yield of biodiesel and glycerol. Sodium hydroxide is a catalyst for this reaction.

When the process is complete, excess methanol is recovered by distillation. The mixture separates into two layers. The upper layer contains the biodiesel. Glycerol, a valuable by-product, sinks to the bottom of the reaction vessel and is removed. The biodiesel is washed in water to remove any water-soluble impurities. This generates alkaline waste water.



triglyceride + methanol → fatty acid ester + glycerol

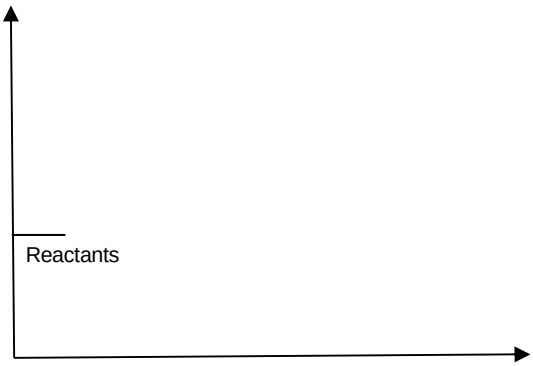
(a) This chemical reaction is exothermic. Use this information, and information given in the passage, to draw on the axes provided:

(i) a labelled energy profile diagram showing ΔH and the activation energy.

[4 marks]

(ii) a second energy profile showing the effect of the added sodium hydroxide.

[1 mark]



SEE NEXT PAGE

(b) Name two reaction conditions that are used to increase the rate of the biodiesel reaction

[2 marks]

(i) _____

(ii) _____

(c) For each of the reaction conditions that you selected use the collision theory to explain how they increase the rate of the biodiesel reaction.

[4 marks]

(i)

(ii)

(d) Solid sodium hydroxide is added to the reaction mixture. Give one reason why safety precautions should be taken when handling sodium hydroxide.

[1 mark]

_____

_____

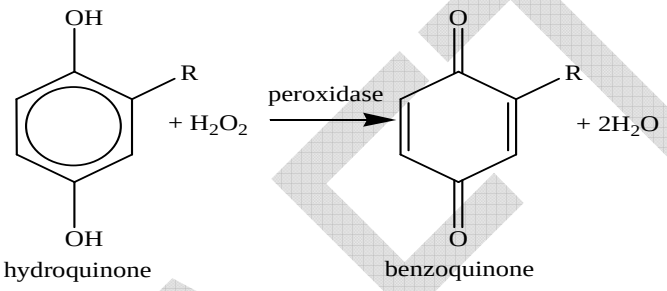
Question 2 (11 marks)

The South American bombardier beetle has an unusual way of dealing with predators. When threatened, it releases an explosive spray of a boiling hot corrosive liquid containing benzoquinone.

Inside the beetle there are two separate chambers: one containing a solution of hydroquinone and hydrogen peroxide, the other containing a mixture of two enzymes. Enzymes are biological catalysts.

When the beetle is attacked, the mixture of hydroquinone and hydrogen peroxide is released into the reaction chamber containing the enzymes. Exothermic reactions then occur to produce benzoquinone and oxygen which is released explosively as a hot spray from a gland on the tip of its abdomen.

The equations for the two reactions are given below.



)

(Equation 1)

$$2H_2O_2(\ell) \rightarrow 2H_2O(\ell) + O_2(g)$$

(Equation 2)

(a) A student investigates the effect of the concentration of hydrogen peroxide on the rate of the decomposition reaction (equation 2) in the laboratory. She adds a solid catalyst to hydrogen peroxide solution and measures the rate at which oxygen is given off.

(i) List TWO variables you would expect to control in this experiment.

[2 marks]

_____

_____

_____

_____

(ii) List ONE variable you **have to** measure and ONE other variable that you **could** measure to determine the rate of reaction.

[2 marks]

Variable you **have to** measure _____

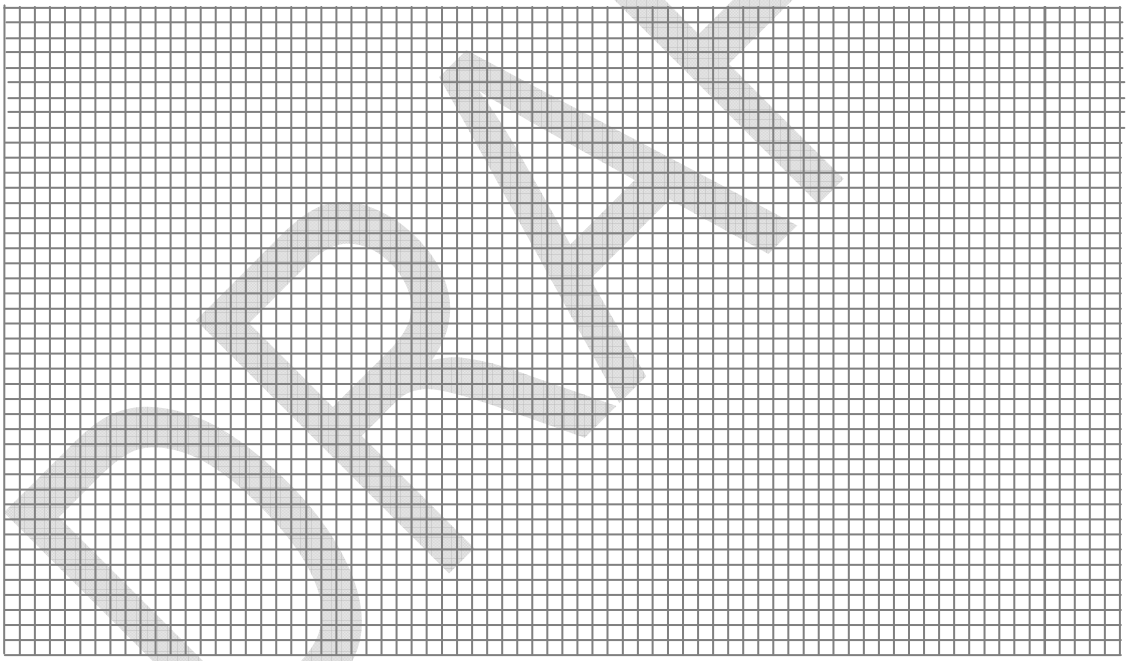
Variable that you **could** measure _____

(b) The table below shows the results of a series of experiments in which the initial rate of the reaction was found for different starting concentrations of hydrogen peroxide.

Hydrogen peroxide concentration (mol L^{-1})	Rate of decomposition (s^{-1})
0.05	0.13
0.10	0.27
0.15	0.41
0.20	0.53
0.25	0.75
0.35	0.94

(i) Plot the data on the graph paper below.

[5 marks]



(ii) Based on the data above, write a conclusion for this experiment.

[2 marks]

Question 3 (12 marks)

A student dissolved 2.62 g of lead nitrate in 100.0 mL of distilled water in a clean beaker. An excess of dilute aluminium sulfate solution was added to the lead nitrate solution and a precipitation reaction occurred.

(a) Write a balanced molecular equation for this reaction.

[2 marks]

(b) Calculate the mass of precipitate formed.

[3 marks]

Another of 2.62 g sample of lead nitrate was dissolved in 100.0 mL of distilled water in a clean beaker. This solution was then added to 55.0 mL of 0.132 $molL^{-1}$ aluminium sulfate solution. The same reaction occurs.

(c) Calculate the number of moles of aluminium sulfate that was added to the 100 mL of lead nitrate solution.

[2 marks]

(d) Determine the limiting reagent. Show all your working in full.

[3 marks]

(e) Would you expect the same amount of precipitate to be produced as in part (b)? Justify your answer without performing any additional calculations.

[2 marks]

Question 4 (12 marks)

When copper(II)sulfate is dissolved in water a blue coloured solution of $Cu^{+2}(aq)$ions are formed and when treated with excess concentrated ammonia solution the initial precipitate of copper hydroxide dissolves to give a deep blue solution. When ethanol is added to the solution deep blue crystals precipitate. When the solution is filtered the crystals smell of ammonia, and an unstable salt with formula $Cu(NH_3)_xSO_4.\ _yH_2O$ has been formed.

(a) When 1·4009 g of the unstable salt is heated at 300°C, the salt decomposes and the ammonia is driven off. The ammonia that is produced is captured and found to occupy 508·1 mL at STP. Calculate the number of moles of ammonia (x) in the 1·4009 g sample of the complex salt.

[2 marks]

(b) Calculate the mass of the ammonia in the 1·4009 g sample.

[2 marks]

(c) Another 1·4009 g of the unstable salt is heated at 300°C driving off all the ammonia and water, leaving only 0·9055g of copper(II)sulfate behind. Calculate the mass of water in a 1·4009 g sample of the unstable salt.

[3 marks]

(d) Calculate the number of moles of water in a 1·4009 g sample of the unstable salt.

[1 mark]

(e) Calculate the number of moles of copper(II) sulfate in the 0·90551g sample of copper(II) sulfate.

[1 mark]

(f) Using the information from (a) to (e) determine the empirical formula of the unstable copper salt.

[3 marks]

Question 5 (13 marks)

Magnesium is found everywhere. It is in the Earth's crust, in sea water, in the chlorophyll in green plants and in the bodies of animals including humans. When heated strongly in air, magnesium bursts into flame, giving off intense heat and bright white and ultraviolet light. Oddly, spraying water onto burning magnesium does not put out the fire. Instead, hot magnesium reacts with water, giving off flammable, explosive hydrogen gas and it will also continue to burn in carbon dioxide.

Commercial preparation of magnesium involves electrolysing molten magnesium chloride. The main resources for obtaining magnesium chloride are sea water and sea shells. Strongly heating calcium carbonate, such as oyster shells or limestone, produces calcium oxide (CaO), also known as lime. Next, adding lime to sea water precipitates out magnesium hydroxide. Then, hydrochloric acid is added, dissolving the precipitate. Evaporating the resulting solution yields solid magnesium chloride. Finally, electrolysing molten magnesium chloride produces magnesium metal and chlorine gas. Using this method, one tonne of sea water can yield roughly one kilogram of magnesium.

An 'alkaline-earth' metal, magnesium is in Group 2 of the periodic table. Its physical properties include being ductile, malleable when hot, and silvery in colour. The low atomic mass and open crystal structure of magnesium give it a relatively low density.

Magnesium is often alloyed with aluminium, and sometimes with small amounts of copper and manganese. Aircraft, helicopters, rockets and performance cars need strong but light components. Often these are made of aluminium-magnesium alloys, such as magnalium and duralumin. Other such alloys make frames for suitcases and portable tools and equipment.

(a) Write balanced chemical equations for two of the reactions that are involved in the production of magnesium chloride from sea water:

(i) calcium oxide reacting with water to produce calcium hydroxide

_____

_____

(ii) calcium carbonate decomposing to produce calcium oxide

_____

_____

[4 marks]

(b) Explain why a carbon dioxide fire extinguisher or water could not be used to extinguish the burning magnesium alloy wheels of a high performance racing car.

[3 marks]

_____

_____

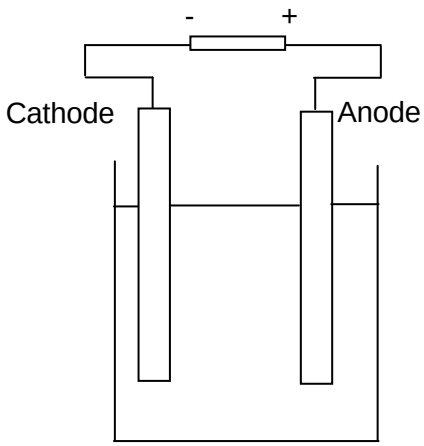
_____

_____

_____

(c) On the diagram of an electrolytic cell filled with molten magnesium chloride show the direction of the movement of the ions inside the cell and write balanced anode and cathode reactions.

[4 marks]



Anode reaction:

Cathode reaction:

(d) Metal alloys are often stronger than pure metals, which explains why alloys are more commonly used than pure metals. Suggest a reason why magnesium alloys in aircraft, helicopter, rocket and performance car components contain large amounts of aluminium but only small amounts of metals such as copper and manganese.

[2 marks]

END OF PAPER

ACKNOWLEDGEMENTS

Section 3
Question 2 Adapted from: Oxford, Cambridge and RSA Examinations. (2000). *OCR Advanced Subsidiary GCE in Chemistry (Salters) (3887), OCR Advanced GCE in Chemistry (Salters) (7887): Specimen question papers and mark schemes* (p. 105–107, q. 6). Retrieved October, 2006, from http://www.ocr.org.uk/Data/publications/specimen_assessment_materials/cquartetOCRTempFileY3R8iY3TBH.pdf.

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