Government of **Western Australia**
Curriculum Council

WACE
Western Australian Certificate of Education

Western Australian Certificate of Education Examination, 2010

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

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet
Multiple-choice Answer Sheet
Chemistry Data Sheet

To be provided by the candidate

Standard items: pens, pencils, eraser, correction fluid/tape, ruler, highlighters

Special items: non-programmable calculators satisfying the conditions set by the Curriculum Council for this course

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.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of exam
Section One: Multiple-choice	25	25	45	25	25
Section Two: Short answer	12	12	70	80	40
Section Three: Extended answer	5	5	65	70	35
				Total	100

Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2010.* 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 on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Sections Two and Three: Write your answers in this Question/Answer Booklet.

3. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.

4. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
   - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
   - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

See next page

Section One: Multiple-choice **25% (25 Marks)**

This section has **25** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 45 minutes.

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1. When a small amount of sodium chloride solid was added to a sodium chloride solution, it dissolved. From this observation, what can be concluded about the original sodium chloride solution?

   (a) It was saturated.
   (b) It was concentrated.
   (c) It was dilute.
   (d) It was unsaturated.

2. A student investigated how the pressure in a diving pool varied with depth. He filled a balloon with helium and tied it to the end of a long pole. Then he submerged the balloon to various depths and observed the result. Which one of the following best describes what happed to the balloon as it went deeper?

   (a) The balloon got larger because the pressure of the water around it increased compared with the pressure inside the balloon.
   (b) The balloon got larger because the pressure of the water around it decreased compared with the pressure inside the balloon.
   (c) The balloon got smaller because the pressure of the water around it increased compared with the pressure inside the balloon.
   (d) The balloon got smaller because the pressure of the water around it decreased compared with the pressure inside the balloon.

3. 5 g of three different solids are added to 1.00 L of water in a beaker. After continued stirring, it is noted that there is a white insoluble solid in the beaker. Which one of the following lists contains chemicals that will produce this observation?

   (a) ammonium sulfate, potassium nitrate and sodium iodide
   (b) sodium iodide, potassium nitrate and copper(II) sulfate
   (c) barium nitrate, calcium chloride and potassium iodide
   (d) barium nitrate, sodium sulfate and potassium chloride

See next page

4. When a few drops of iron(III) bromide ($FeBr_3$) solution are added to a few drops of lithium hydroxide (LiOH) solution, a precipitate is formed. When a solution of lithium nitrate ($LiNO_3$) is added to the iron(III) bromide solution, no precipitate is formed.

   On the basis of this information, the net ionic equation for the formation of the precipitate is which one of the following?

   (a) $FeBr_3(aq) + LiOH(aq) \rightarrow Fe(OH)_3(s) + LiBr(aq)$
   (b) $Li^+(aq) + Br^-(aq) \rightarrow LiBr(s)$
   (c) $FeBr_3(aq) + 3\ LiOH(aq) \rightarrow Fe(OH)_3(s) + 3\ LiBr(aq)$
   (d) $Fe^{3+}(aq) + 3\ OH^-(aq) \rightarrow Fe(OH)_3(s)$

5. Pure water boils at 100.0°C and 101.3 kPa pressure. The table below shows the boiling point when 1.00 mol of different solutes are added to a litre of water.

Solute	Boiling point (°C)
KBr	101.0
$ZnBr_2$	101.5
$A\ell Br_3$	102.0

   Which statement **best** explains the trend illustrated in the table?

   (a) Dissolving solute particles change the properties of the solvent.
   (b) The solutes lower the vapour pressure.
   (c) Different solutes have different abilities to raise the boiling point.
   (d) The greater the concentration of solute particles, the higher the boiling point.

6. A chemical equation uses numbers and symbols to state what has been produced from the reactants. For example:

$$CH_4 + \mathbf{x}\ O_2 \rightarrow CO_2 + 2\ H_2O$$

$$Ca + \mathbf{x}\ CH_3COOH \rightarrow Ca^{2+} + 2\ CH_3COO^- + H_2$$

   The value of x in both equations is 2. The number 2 is required so that

   (a) there is no excess reactant.
   (b) both sides of the equation have the same number of particles.
   (c) the number of atoms and overall charge of the reactants is the same as the products.
   (d) the reactants produce double the products.

7. Which one of the following statements **best** defines the term *isotopes*?

   (a) Isotopes are atoms of the same element that have different numbers of electrons.
   (b) Isotopes are atoms with the same mass number and different numbers of neutrons.
   (c) Isotopes are atoms of the same element with different mass numbers.
   (d) Isotopes are atoms of the same element bonded in different arrangements.

See next page

8. Which one of the following statements **best** describes how elements are arranged on the Periodic Table?

   (a) Elements are arranged in order of increasing mass and in periods according to the number of valence electrons.
   (b) Elements are arranged in order of increasing atomic number and in groups according the number of valence electrons.
   (c) Elements are arranged in order of increasing number of protons and in groups according to the number of occupied electron shells.
   (d) Elements are arranged in order of increasing mass number and in periods according to the number occupied electron shells.

9. A company is designing a new range of saucepans. The base of the saucepan should conduct heat well and evenly while the handle should be a good insulator. Which one of the following lists of substances would be the most appropriate for these tasks?

	Base	**Handle**
(a)	aluminium	aluminium
(b)	copper	plastic
(c)	glass	glass
(d)	plastic	copper

10. A student has been given a compound that is solid at room temperature and asked to classify it as covalent network, covalent molecular, ionic or metallic substance. Which one of the following sets of observations conclusively identifies the substance as ionic?

   (a) The substance does not conduct electricity as a solid, but does as a liquid.
   (b) The substance does not conduct electricity as a solid, but does when dissolved in water.
   (c) The substance has a high melting and boiling point.
   (d) The substance does not conduct electricity as a solid but is soluble in water.

11. Which one of the following lists classifies all of the substances correctly?

	Strong electrolyte	**Non-electrolyte**	**Weak electrolyte**
(a)	sodium hydroxide	methane	acetic (ethanoic) acid
(b)	nitric acid	silver chloride	carbon dioxide
(c)	silver chloride	acetic (ethanoic) acid	ammonia
(d)	methane	silver chloride	acetic (ethanoic) acid

12. On some Periodic Tables, hydrogen is placed in Group 1. Which one of the following statements **best** accounts for this placement?

   (a) It is a gas at room temperature.
   (b) It has one valence electron.
   (c) It can form positive and negative ions.
   (d) It forms an acidic oxide.

See next page

13. According to the Arrhenius theory, what is produced when sodium hydroxide is dissolved in water?

(a) hydroxide ions
(b) electrons
(c) water molecules
(d) hydrogen ions

14. In which one of the following reactions is H_2SO_4 **not** acting as an acid?

(a) $H_2SO_4(aq) + 2\ NaOH(aq) \rightarrow H_2O(\ell) + Na_2SO_4(aq)$
(b) $H_2SO_4(aq) + BaC\ell_2(aq) \rightarrow 2\ HC\ell(aq) + BaSO_4(s)$
(c) $H_2SO_4(aq) + Mg(s) \rightarrow H_2(g) + MgSO_4(aq)$
(d) $H_2SO_4(aq) + 2\ NaHCO_3(aq) \rightarrow 2\ H_2O(\ell) + 2\ CO_2(g) + Na_2SO_4(aq)$

15. In which list are the following 1.00 mol L^{-1} solutions correctly arranged in order of decreasing pH: calcium hydroxide, nitric acid, acetic (ethanoic) acid, sulfuric acid, ammonia and sodium chloride?

(a) $Ca(OH)_2 > NH_3 > NaC\ell > CH_3COOH > HNO_3 > H_2SO_4$
(b) $NH_3 > Ca(OH)_2 > NaC\ell > HNO_3 > CH_3COOH > H_2SO_4$
(c) $HNO_3 > H_2SO_4 > CH_3COOH > NaC\ell > NH_3 > Ca(OH)_2$
(d) $H_2SO_4 > HNO_3 > CH_3COOH > NaC\ell > NH_3 > Ca(OH)_2$

16. Which one of the following is the conjugate base of HS^-?

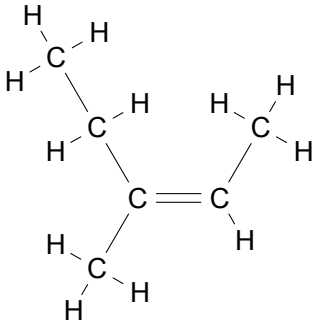
(a) S^{2-}
(b) OH^-
(c) H^+
(d) H_2S

17. How many hydrogen atoms are present in a molecule of methylcyclohexane?

(a) 10
(b) 12
(c) 14
(d) 16

See next page

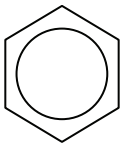
18. Examine the molecule shown below.



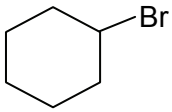
Which one of the following is the correct name for this molecule?

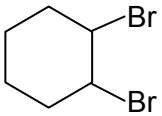
(a) trans-3-methylpent-2-ene
(b) cis-3-ethylbut-2-ene
(c) trans-1-ethyl-1,2-dimethylethene
(d) cis-3-methylpent-3-ene

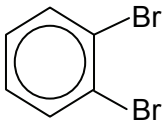
19. The benzene molecule (C_6H_6) can be represented as shown here.

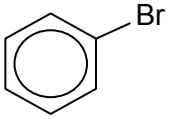


Which one of the following shows the product formed when benzene reacts with bromine (Br_2) in the presence of an aluminium bromide catalyst?

(a) 

(b) 

(c) 

(d) 

20. Zn, CO and H_2 are all reducing agents. Which one of the following statements **best** explains why this is the case?

(a) They can all readily donate electrons.
(b) They are all difficult to oxidise.
(c) None of them can be reduced.
(d) They all react with oxygen.

See next page

21. Which one of the following represents oxidation?

(a) $Cr_2O_7^{2-} \rightarrow CrO_4^{2-}$
(b) $Mn^{2+} \rightarrow MnO_4^-$
(c) $SO_4^{2-} \rightarrow SO_2$
(d) $NO_2 \rightarrow NO_2^-$

22. In which one of the following compounds is nitrogen in the highest oxidation state?

(a) N_2
(b) N_2O_5
(c) NO
(d) N_2O_4

23. Methanol, which can be used in fuel cells to provide power for laptops, can be produced by the following redox reaction:

$$CO(g) + 2\ H_2(g) \rightarrow CH_3OH(\ell)$$

Which one of the following statements is true?

(a) In this reaction hydrogen is the oxidising agent and carbon monoxide is the reducing agent.
(b) The oxidation number of carbon changes from +2 to -2.
(c) The oxygen has been reduced.
(d) The hydrogen has been reduced.

24. Which one of the following changes is exothermic?

(a) melting ice
(b) boiling water
(c) burning natural gas
(d) subliming carbon dioxide

25. Increasing the temperature of a reaction increases the rate of the reaction. Which one of the following does **not** increase when the temperature is increased?

(a) the average speed of the particles
(b) the number of particles with sufficient energy to react
(c) the activation energy
(d) the total number of collisions

End of Section One

See next page

Section Two: Short answer **40% (80 Marks)**

This section has **12** questions. Answer **all** questions. Write your answers in the space provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 70 minutes.

Question 26 **(6 marks)**

(a) Write the chemical formula for each of the following: (3 marks)

(i) Calcium chloride _____

(ii) Nitrogen dioxide _____

(iii) Sodium carbonate-10-water _____

(b) Name each of the following compounds: (3 marks)

(i) PH_3 _____

(ii) $KMnO_4$ _____

(iii) PbI_2 _____

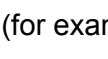
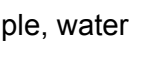
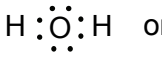
Question 27 **(6 marks)**

Complete the table below.

Symbol	Atomic number	Mass number	Number of electrons	Number of neutrons	Electron Configuration
	19	40	19		
$^{27}_{13}Al^{3+}$	13			14	

Question 28 **(4 marks)**

For each species listed in the table below, draw the structural formula, representing all valence shell electron pairs either as **:** or as —.

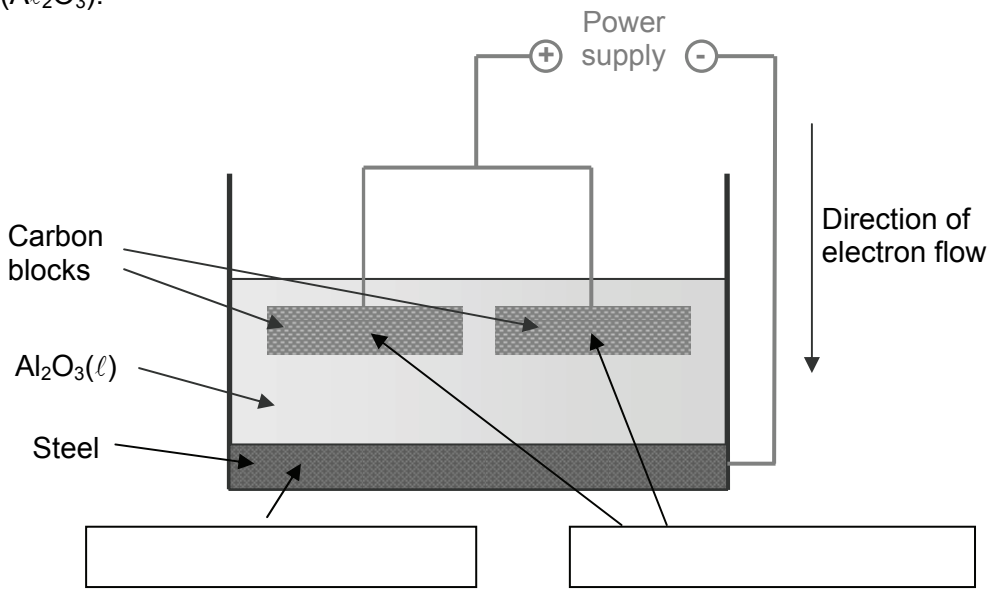
(for example, water  or  or )

Species	Structural formula
Carbon dioxide (CO_2)	
Magnesium fluoride (MgF_2)	

See next page

Question 29 **(11 marks)**

Below is a diagram of the electrolytic cell used to produce aluminium from molten aluminium oxide ($A\ell_2O_3$).



The reactions occurring at the electrodes are shown below.

$$A\ell^{3+}(\ell) + 3\ e^- \rightarrow A\ell(s)$$
$$2\ O^{2-}(\ell) + C(s) \rightarrow CO_2(g) + 4\ e^-$$

(a) Complete the diagram by:

(i) Adding the words **anode** and **cathode** to the correct boxes above. (1 mark)

(ii) Showing the direction of the movement of $A\ell^{3+}$ ions in the cell. (1 mark)

(b) Combine the two half-equations to give the overall redox reaction for the process occurring. (2 marks)

See next page

(c) Explain why the $A\ell_2O_3$ needs to be in the liquid state. (2 marks)

(d) An early method of producing aluminium used the reaction of aluminium oxide with sodium metal to produce aluminium metal and sodium oxide.

(i) Write a balanced equation for this reaction. (2 marks)

(ii) Using the idea of oxidation numbers, explain how sodium is acting as a reducing agent in this process. (3 marks)

Question 30 **(8 marks)**

Bore water is often used for watering of gardens and sports ovals. Bore water contains iron compounds, most commonly in the form of iron(II) hydrogencarbonate. When the bore water is exposed to oxygen, the following reaction can occur:

$$4Fe^{2+}(\quad) + 8\ HCO_3^-(\quad) + 2\ H_2O(\quad) + O_2(\quad) \rightarrow 4\ Fe(OH)_3(\quad) + 8\ CO_2(\quad)$$

(a) Write the state symbols for the equation above in the brackets provided. (2 marks)

(b) Use your data sheet to predict what would be observed during this reaction. (1 mark)

_____

_____

(c) Write an equation to show why the acidity of the water increases. (2 marks)

(d) Bore water can be treated with chlorine to remove the iron compounds. The equation for this redox reaction is shown below:

$$2\ Fe^{2+}(aq) + 6\ HCO_3^-(aq) + C\ell_2(g) \rightarrow 2\ Fe(OH)_3(s) + 2\ C\ell^-(aq) + 6\ CO_2(g)$$

(i) Describe the role of chlorine in this process. (2 marks)

_____

_____

(ii) Suggest one safety procedure that would have to be followed to ensure that this water treatment process was carried out safely. (1 mark)

_____

_____

See next page

Question 31 **(9 marks)**

The solubility of copper(II) sulfate ($CuSO_4$) in water is 22 g $100g^{-1}$ (22 g per 100 g of water) at 25°C.

10 g of copper(II) sulfate was added to 25 g of water in a beaker at 25°C, stirred vigorously for three minutes and left to stand.

(a) Would the solution be unsaturated or saturated? (1 mark)

(b) Describe the appearance of the contents of the beaker. (2 marks)

(c) The open beaker was left to stand in a laboratory at 25°C.

(i) What would happen to the amount of water in the beaker? Circle one of the choices below and explain your answer in relation to the kinetic energy of the particles. (3 marks)

increase no change decrease

(ii) What would happen to the amount of **solid** copper(II) sulfate in the beaker? Circle one of the choices below and explain your answer. (3 marks)

increase no change decrease

See next page

Question 32 **(7 marks)**

Tap water in most areas of Australia is fluorinated to improve the dental health of those who drink the water. A sample of tap water from Perth was analysed and found to contain 4.56 mg of fluoride in 5.00 L of water (1000 mg = 1.000 g). Show all your workings in the following calculations.

(a) Calculate the concentration of fluoride ions in this water in:

(i) grams per litre (g L^{-1}); and (2 marks)

(ii) moles per litre (mol L^{-1}). (2 marks)

(b) Fluorine is added to drinking water in the form of hexafluorosilicic acid (H_2SiF_6). Calculate the percentage by mass of fluorine in this compound. (3 marks)

See next page

Question 33 **(6 marks)**

Write **balanced net ionic equations** and describe what will be observed when the following chemicals are added together. In your observations give the colour of any precipitates or gases formed.

(a) Zinc metal is added to dilute hydrochloric acid. (3 marks)

Equation: _____

Observation: _____

_____

_____

(b) Nitric acid solution is added to lead(II) carbonate solid. (3 marks)

Equation: _____

Observation: _____

_____

_____

See next page

Question 34 **(6 marks)**

(a) Name a reagent which, when added to each of the following pair of substances, could be used to tell apart the two substances. Also note what would be observed in each case. (Equations are not required.)

Solid sodium chloride and solid sodium hydrogencarbonate. (3 marks)

Reagent: _____

Observation for	
sodium chloride	**sodium hydrogencarbonate**

(b) Name a reagent which, when added to each of the following pair of substances, could be used to tell apart the two substances. Also note what would be observed in each case. (Equations are not required.)

Solid potassium hydroxide and solid zinc hydroxide. (3 marks)

Reagent: _____

Observation for	
potassium hydroxide	**zinc hydroxide**

See next page

Question 35 **(5 marks)**

Phosphoric acid (H_3PO_4) is a polyprotic acid that is often used in the home to remove limescale from shower screens and the insides of kettles and coffee makers.

(a) With the aid of equations, explain why phosphoric acid is classified as a polyprotic acid. (3 marks)

(b) Phosphoric acid is very effective in removing limescale from kettles and shower screens. Limescale contains a number of salts, with one component being calcium oxide. Write an ionic equation for the reaction between phosphoric acid and calcium oxide. (2 marks)

See next page

Question 36 **(6 marks)**

With the help of appropriate equations, explain how the pH of 1.00 mol L^{-1} sodium hydroxide solution (NaOH) differs from the pH of 1.00 mol L^{-1} ammonia solution (NH_3).

See next page

Question 37 **(6 marks)**

Airbags in cars are designed to expand in less than 40 milliseconds when a collision occurs, to reduce the risk of severe injury. When ignited with an electric current, a mixture of sodium azide (NaN_3) and sodium nitrate ($NaNO_3$) will react explosively. The reaction can be represented by the following equation:

$$NaNO_3(s) + 5\ NaN_3(s) \rightarrow 3\ Na_2O(s) + 8N_2(g)$$

(a) An airbag was produced containing 750.0 g of sodium azide and 205 g of sodium nitrate. Determine the limiting reagent in this reaction. Show all your working. (4 marks)

(b) Calculate the volume the airbag will inflate to at STP. Show all your working. (2 marks)

End of Section Two

See next page

Section Three: Extended answer **35% (70 Marks)**

This section contains **five (5)** questions. You must answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 65 minutes.

Question 38 **(21 marks)**

Marble, which is mainly calcium carbonate ($CaCO_3$), can be used in kitchen bench tops and floor tiles. The use of vinegar, which contains acetic acid (CH_3COOH), to clean marble bench tops is not recommended, as it reacts with the marble. This reaction can be represented by the following equation:

$$CaCO_3(s) + 2\ CH_3COOH(aq) \rightarrow Ca^{2+}(aq) + 2\ CH_3COO^-(aq) + H_2O(\ell) + CO_2(g)$$

(a) Other than water, suggest a cleaning agent that is more appropriate than vinegar for cleaning marble. Justify your answer. (2 marks)

See next page

Some marble from a bench top was tested for percentage of calcium carbonate and found to contain silica (SiO_2) as its only impurity. A 6.77 g sample was allowed to react completely with hydrochloric acid. The carbon dioxide produced was found to occupy 1.33 L at STP.

(b) Calculate the percentage of calcium carbonate in the marble sample. Show all your working. (4 marks)

Marble chips are a commonly used reactant in chemical experiments. A student conducted an experiment to evaluate the effect of changing concentration on the rate of reaction by immersing marble chips in hydrochloric acid at different concentrations.

The mass of the reaction vessel was measured over time for two different concentrations of hydrochloric acid and the following data was obtained.

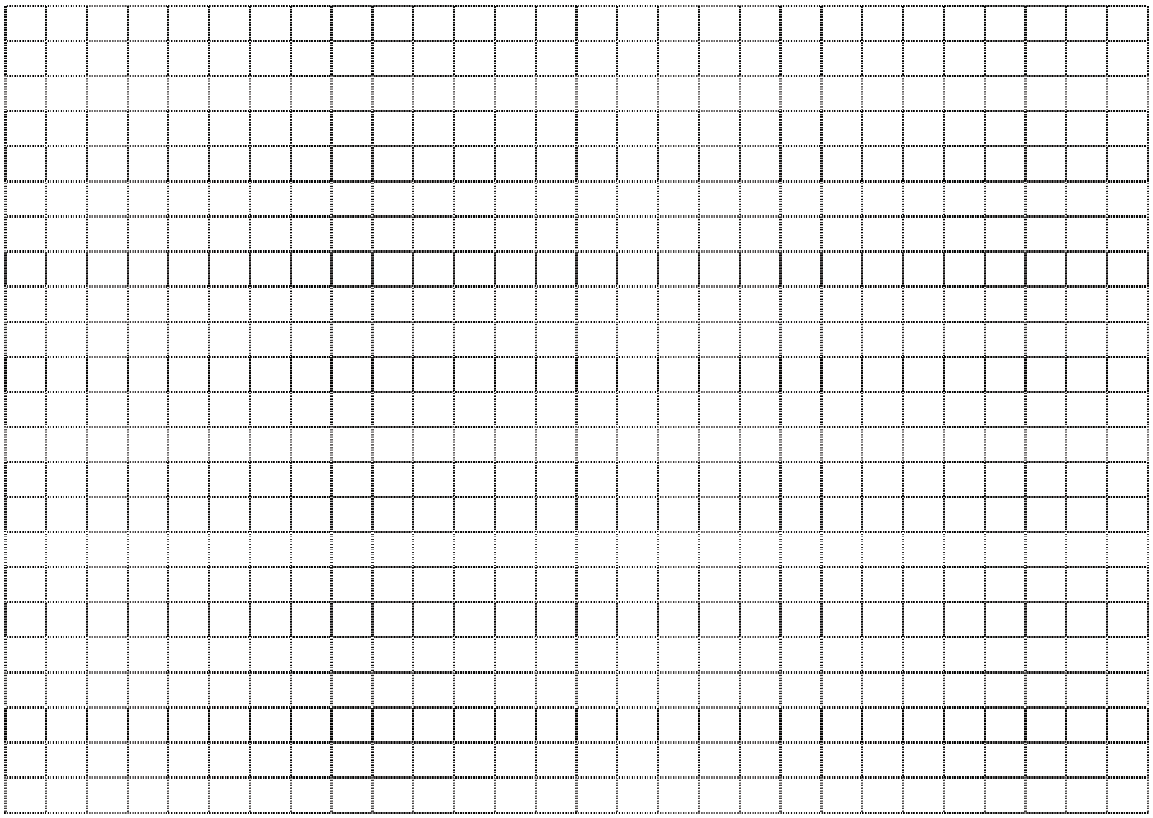
	Mass lost (g)	
Time (s)	**1.00 mol L^{-1} $HC\ell$ solution**	**2.00 mol L^{-1} $HC\ell$ solution**
0	0	0
10	2.00	4.00
20	3.50	7.00
30	5.50	9.00
40	7.00	10.0
50	8.20	10.6
60	9.00	11.0
120	11.0	11.0
180	11.0	11.0

See next page

(c) List two variables that need to be controlled in this experiment. (2 marks)

(d) Graph the data from the table for (c) on the grid below. (4 marks)

If you wish to have a second attempt at this item, the grid is repeated on page 35.
Indicate clearly on this page if you have used the second grid and cancel the working on the grid on this page.



(e) Explain the shape of the 1.00 mol L^{-1} graph between time = 0 s and 120 s. (2 marks)

See next page

(f) Explain the shape of the 1.00 mol L^{-1} graph after time = 120 s. (1 mark)

(g) (i) What does the graph show about the effect of changing acid concentration on rate of reaction? (1 mark)

(ii) Explain this relationship in terms of collision theory. (2 marks)

In a separate experiment, a student investigated the impact of increasing temperature on the rate of the reaction between marble chips (calcium carbonate) and hydrochloric acid.

(h) (i) What relationship would the student expect to observe? (1 mark)

(ii) Explain this relationship in terms of collision theory. (2 marks)

See next page

Question 39 **(9 marks)**

Nicotine is a highly toxic and addictive chemical found in cigarettes. It contains carbon, hydrogen and nitrogen. A 3.44 g sample of nicotine was completely combusted and found to produce 9.34 g of carbon dioxide and 2.68 g of water. Show all your working in the following calculations.

(a) Determine the empirical formula of nicotine. (6 marks)

(b) The molar mass of nicotine was found to be 162 g mol^{-1}. Calculate the molecular formula of the compound. (3 marks)

See next page

Question 40 **(21 marks)**

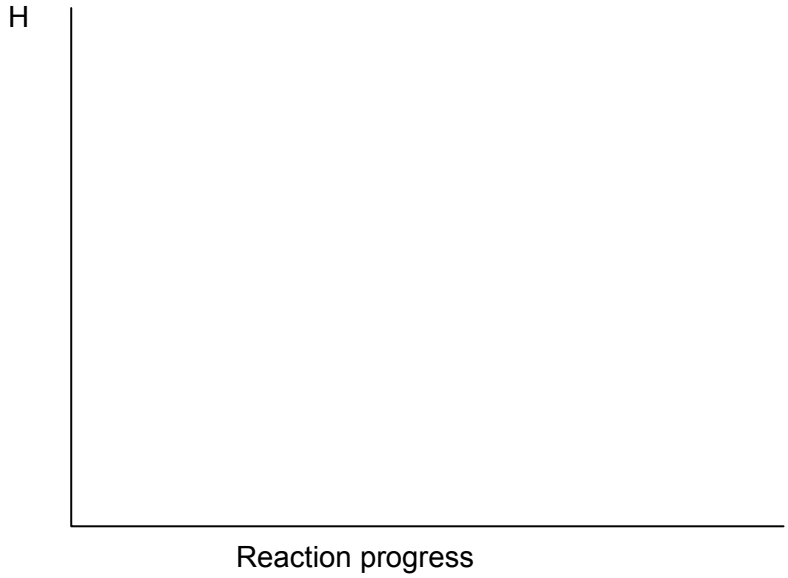
(a) Petrol is a mixture of organic compounds called hydrocarbons. The major component of petrol is octane (C_8H_{18}). What characteristic of an organic compound causes it to be classified as a hydrocarbon? (1 mark)

(b) Hydrocarbons are often used as fuels. State the chemical property of hydrocarbons that allows these compounds to be used for this purpose. (1 mark)

(c) Write the balanced chemical equation for octane when it is reacting as a fuel in the open air. (2 marks)

(d) Sketch an appropriately labelled energy profile diagram for this reaction of octane, illustrating: (4 marks)

(i) the relative enthalpies of the reactants and products;
(ii) a reasonable activation energy; and
(iii) heat of reaction.



See next page

(e) Explain the difference in enthalpy between the products and reactants, by referring to the energy changes that occur in the breaking and formation of bonds. (2 marks)

(f) Draw a structural diagram for octane, showing all bonds. (2 marks)

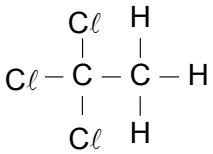
(g) Draw and name the structural formula of an isomer of octane containing one ethyl group. (3 marks)

Name _____

See next page

(h) Under certain conditions, hydrocarbons can react with halogens to form compounds called 'halogenated hydrocarbons'.

1, 1, 1-trichloroethane is used as a solvent in correction fluid used for covering typing errors and has the following structure:



I. What two reactants are required to produce trichloroethane through a substitution reaction? (2 marks)

_____

_____

II. This reaction does not occur spontaneously. What is required for the reaction to occur? (1 mark)

_____

(i) Halogenated hydrocarbons can also be produced through addition reactions. Write an equation for such a reaction between ethene and liquid bromine. (2 marks)

(j) Describe what will be observed as this reaction proceeds. (1 mark)

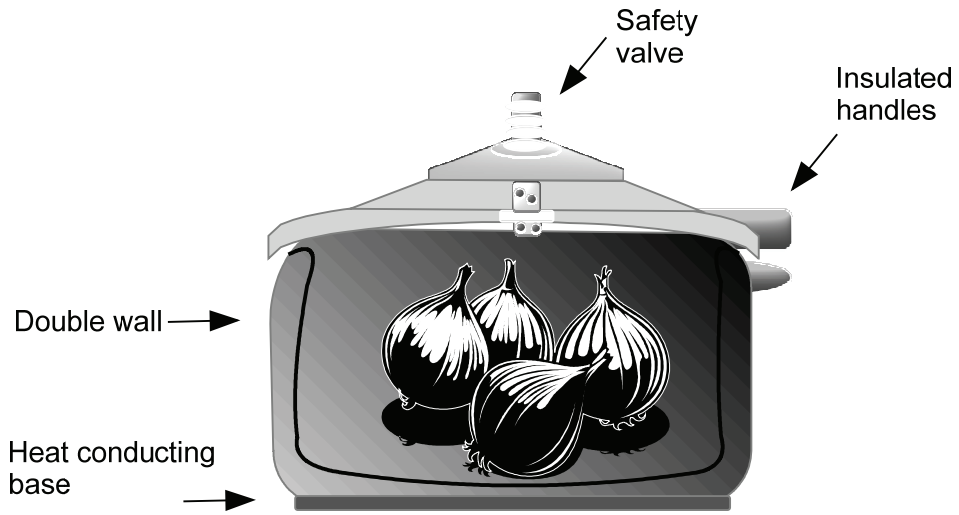
_____

_____

See next page

Question 41 **(10 marks)**

A pressure cooker is a cooking device that has a deep pan with a lid that forms an airtight seal when it is closed. Water is added to the pressure cooker and it is heated on a cooking hob until the water is boiling.



Pressure cooker cross section

The water inside the pressure cooker can reach a temperature of approximately 120°C, which allows the pressure cooker to cook food more quickly than an unsealed saucepan.

Water in a normal (unsealed) saucepan will boil at approximately 100°C. However, the boiling point of water increases as the surrounding pressure increases. Therefore the high pressure inside the cooker raises the boiling point of the water, allowing it to reach higher temperatures before it boils. The temperatures achieved inside a pressure cooker are considerably higher than those in a normal saucepan.

Pressure cookers are often made of stainless steel, an alloy containing iron and chromium. The handle is manufactured from plastic. There is a safety valve that will release air if the pressure inside the cooker goes above a certain level.

(a) Why must the lid of a pressure cooker form a complete seal for the cooker to operate properly? (2 marks)

(b) Explain why it is necessary to have a safety valve in the lid of the pressure cooker. (2 marks)

See next page

(c) Use the idea of vapour pressure to explain why the boiling point of the water increases in the pressure cooker. (4 marks)

(d) Explain why stainless steel is described as a ‘homogeneous mixture’. (2 marks)

See next page

Question 42 **(9 marks)**

Sodium carbonate, carbon dioxide and silicon dioxide (sand) are compounds that contain oxygen. However, their physical properties are quite different. A selection of these properties is given on the table below.

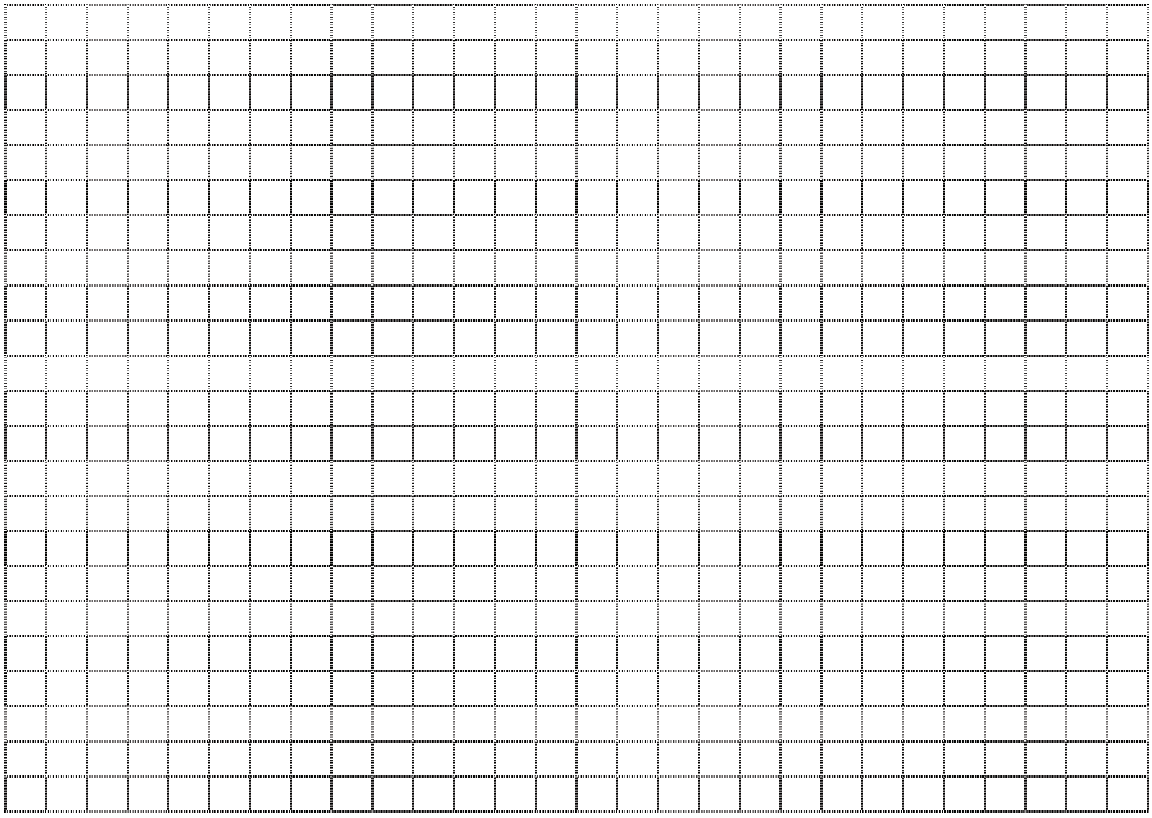
Compound	Melting point (^oC)	Electrical conductivity as a solid	Electrical conductivity as a liquid
Na_2CO_3	851	Very poor	Good
SiO_2	1713	Very poor	Very poor
CO_2	-57	Very poor	Very poor

Explain the properties of each substance in terms of their bonding.

End of questions

Additional working space

Additional working space



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