Index Number:_____ SEC06/1.21s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2021 SUPPLEMENTARY SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	I
DATE:	11th October 2021
TIME:	4:00 p.m. to 6:05 p.m.

Useful data:

Relative atomic masses: O = 16; Na = 23; S = 32.

Standard temperature and pressure (stp): 0 °C and 1 atm (760 mm Hg)

The molar volume for gases at stp = 22.4 dm^3

Specific heat capacity of water = 4.2 J g^{-1} $°C^{-1}$

Faraday constant = 96500 C mol^{-1}

Avogadro constant, L = 6.02 x 10^{23}

$\Delta H = mc\Delta\theta$

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions.
- Write all your answers in the spaces provided in this booklet.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated in brackets.
- You are reminded of the necessity for orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.
- A Periodic Table is printed on the back of this booklet.

For examiners' use only:

Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
Score													
Maximum	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**20**	**20**	**100**

Section A

1. Some ice cubes are placed in a closed container fitted with a thermometer. A group of students decided to carry out some tests on the ice cubes by heating the container.

a) Explain, in terms of the kinetic theory of matter, what happens to the molecules of water when it changes from solid to liquid.

_____

_____(2)

b) While the ice cubes were melting, the students noted that the temperature did **not** change although the container was still being heated. Why does this happen?

_____(1)

c) How can the students tell that the ice cubes were pure?

_____(1)

d) Water and oil are two liquids that do **not** mix together.

i) What is the name given to such liquids?

_____(1)

ii) Name a separating technique that is used to separate oil from water.

_____(1)

6

(Total: 6 marks)

2. Complete the following paragraph using terms from the word bank shown. Each term may be used only once.

hygroscopic	solution	efflorescent	solid	deliquescent	powder

Hydrated copper(II) sulfate contains water of crystallisation but it is still observed to be in the _____ state. When water is added to some copper(II) sulfate crystals and the contents well-stirred a blue _____ is obtained. When copper(II) sulfate crystals are heated in a crucible it is observed that a _____ remains in the crucible. Common salt (NaCl) is said to be _____ because it absorbs water from the surrounding air and dissolves in it. On the other hand, concentrated sulfuric acid is _____ and in some cases may be used as a drying agent. Hydrated sodium carbonate, $Na_2CO_3.10H_2O$ loses some of its water of crystallisation to the atmosphere indicating that it is _____.

6

(Total: 6 marks)

3. a) Air is a mixture of gases. State **ONE** property which proves that air is a mixture of gases and **not** just one compound.

_____(1)

b) Besides oxygen, give the names of **TWO** gases present in clean air.

_____(2)

c) Although oxygen is needed for living organisms it can also be a disadvantage since it causes iron objects to rust. Give the name or formula of **ONE** other substance, besides oxygen, which needs to be present for iron to rust.

_____(1)

d) A metal wall ornament and a fan need to be protected so that they do not rust. Give **TWO** different ways that can be used to protect the two metal objects from rusting.

Method 1: _____ (1)

Method 2: _____ (1)

6

(Total: 6 marks)

4. a) Oxygen may be prepared in the laboratory by using hydrogen peroxide.

i) Give a balanced equation for the reaction.

_____(2)

ii) Give the name or formula of the catalyst used in the reaction.

_____(1)

iii) The oxygen gas produced in this experiment is required to be dry. Name the gas collection technique that needs to be used to collect dry oxygen.

_____(1)

b) Zinc oxide is produced when zinc is burnt in oxygen. Give **TWO** reasons why sodium oxide **cannot** be prepared in the same way.

_____

_____(2)

6

(Total: 6 marks)

Please turn the page.

5. a) Hydrogen burns in oxygen to produce water. Give a balanced equation for the reaction.

_____(2)

b) When hydrogen is passed over heated copper(II) oxide the following redox reaction occurs:

$$2CuO\ (s) + H_2\ (g) \rightarrow 2Cu\ (s) + H_2O\ (l)$$

i) Give the name or the formula of the substance being oxidised. Explain your answer.

Substance: _____ (1)

Explanation: _____ (1)

ii) Give the name or the formula of the substance being reduced. Explain your answer.

Substance: _____ (1)

Explanation: _____ (1)

6

(Total: 6 marks)

6. The following question deals with the action of heat on various substances. Consider the following substances:

A	Sodium nitrate, $NaNO_3$
B	Copper(II) hydroxide, $Cu(OH)_2$
C	Sodium chloride, NaCl
D	Sodium hydrogencarbonate, $NaHCO_3$
E	Lead(II) nitrate, $Pb(NO_3)_2$
F	Sodium carbonate, Na_2CO_3

Choose a substance from the table above that correspond to each statement. Each substance in the table may be used only once.

a) **TWO** substances which do **not** decompose on heating; _____ and _____ (2)

b) a substance which on heating produces a solid and gives off two gases, one of which is a brown gas; _____ (1)

c) a substance which produces a black solid on heating; _____ (1)

d) a substance which on heating produces carbon dioxide as one of the products; _____ (1)

e) a substance which on heating produces oxygen gas only. _____ (1)

6

(Total: 6 marks)

7. Some iron filings are placed in a boiling tube and dilute hydrochloric acid is added carefully. The following reaction occurs.

$$Fe\ (s) + 2HCl\ (aq) \rightarrow FeCl_2\ (aq) + H_2\ (g)$$

a) How can it be shown that hydrogen gas is given off in the reaction?

_____(1)

b) Once the reaction is over, sodium hydroxide solution is added to the contents of the boiling tube. An immediate precipitate is observed.

i) Give the name or formula of the iron product formed.

_____(1)

ii) What is the colour of the immediate precipitate formed?

_____(1)

c) After a few minutes, the colour of the precipitate formed in part (b) changes to a brown colour. Explain this observation.

_____(1)

d) The fact that iron forms coloured compounds shows that iron is a transition element. State **TWO** other properties associated with transition elements.

_____

_____(2)

6

(Total: 6 marks)

8. Explain the following information about petrol by answering the questions that follow.
Petrol is mostly a mixture of saturated hydrocarbons, most of which have between four and eight carbon atoms. Adding oxygen containing organic compounds, such as alcohols, reduces the risk of incomplete combustion.

a) What are saturated hydrocarbons?

_____

_____(2)

b) Give the name and draw the structural formula of the straight chain alkane with five carbon atoms.

Name: _____(1)

(1)

c) Draw the structure of an additive that reduces the risk of incomplete combustion.

(1)

d) What are the risks of incomplete combustion of petrol?

_____ (1)

6

(Total: 6 marks)

9. Charcoal is usually produced by heating wood or other organic materials in a closed container. Although this method of producing charcoal has been known since antiquity, charcoal was shown to be an element in 1772 by Antoine Lavoisier.

a) What is an element?

_____(1)

b) Which element makes up charcoal?

_____(1)

c) Name **TWO** gaseous products that are likely to form when wood is burned in a closed container.

_____(2)

d) How will the production of the products given in part (c) change if wood is burned in an open container?

_____

_____(2)

6

(Total: 6 marks)

10. Polyvinylchloride (PVC) was accidentally discovered in 1872. PVC was produced in a flask containing chloroethene which was left exposed to sunlight.

a) Draw the structure of:

i) chloroethene;

(1)

ii) PVC.

(1)

b) PVC forms easily from chloroethene but is hard to prepare it from chloroethane. Explain.

_____

_____(2)

c) Which **ONE** of the two compounds (PVC or chloroethene) would have the highest melting point? Explain with reference to the bonding present.

_____

_____(2)

6

(Total: 6 marks)

Section B:

11. This question is about electrolysis.

a) i) Draw a labelled diagram to show how the apparatus of a simple experiment for the electrolysis of dilute sodium chloride solution is set up. The diagram must include:

- the polarities of the electrodes;
- the names of the two electrodes;
- the relative amount of the gases produced;
- the name/s of the gases collected at each electrode;
- the electrolyte. (10)

This question continues on next page.

ii) Give the half equation occurring at the positive electrode.

_____(2)

iii) Give the half equation occurring at the negative electrode.

_____(2)

iv) The reactions occurring at the electrodes during electrolysis may be either a reduction or an oxidation. State the type of reaction occurring at the positive electrode in part (a) (ii) and explain your answer.

Type of reaction: _____(1)

Explanation: _____

_____(1)

b) In a different electrolysis experiment concentrated sodium chloride solution is used for the electrolysis. In this case it is observed that chlorine gas is given off.

i) State the polarity of the electrode at which chlorine gas is produced.

_____(1)

ii) Give a balanced half equation to show how chlorine gas, Cl_2, is obtained.

_____(2)

iii) Give **ONE** reason why chlorine is one of the products when concentrated sodium chloride solution (brine) is electrolysed.

_____(1)

20

(Total: 20 marks)

12. a) Shampoos with a high pH level can cause skin problems. The best pH level for shampoos is between pH 5 and pH 7.

i) What does pH 5 on a shampoo label indicate?

_____(1)

ii) Give the name or formula of a substance which has pH 7.

_____(1)

iii) What name is given to solutions which have a pH higher than 7?

_____(1)

iv) Give the name or formula of a substance which has a pH greater than 7.

_____(1)

b) Copper(II) sulfate may be made by various chemical reactions. Complete the following equations:

i) $CuO + H_2SO_4 \rightarrow CuSO_4 +$ _____ (1)

ii) $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O +$ _____ (1)

c) Give **ONE** observation that can be made during the reaction in part (b) (ii).

_____(1)

d) Copper(II) sulfate reacts with sodium carbonate solution according to the following equation:

$$CuSO_4 + Na_2CO_3 \rightarrow CuCO_3 + Na_2SO_4$$

i) Give a balanced ionic equation for the reaction. (Omit spectator ions.)

_____

_____(3)

ii) If sodium carbonate is **not** available, give the name or formula of another compound which may be used, and which will also produce copper(II) carbonate as one of the products.

_____(1)

iii) How is the copper(II) carbonate formed in the reaction removed?

_____(1)

e) In an experiment some sodium sulfite reacts with 15.0 cm^3 hydrochloric acid of concentration 1.0 mol dm^{-3}. The equation for the reaction is:

$$Na_2SO_3\ (s) + 2HCl\ (aq) \rightarrow 2NaCl\ (aq) + H_2O(l) + SO_2(g)$$

i) Calculate the amount in moles of hydrochloric acid used.

_____

_____(2)

ii) Calculate the amount in moles of sodium sulfite that is required to react completely with the amount of HCl in part (e) (i).

_____

_____

_____(3)

This question continues on next page.

iii) Calculate the mass in grams of sodium sulfite in part (e) (ii).

_____

_____

_____(3)

20

(Total: 20 marks)

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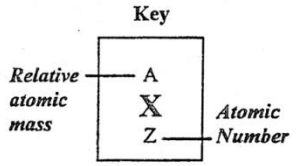
PERIODIC TABLE



I	II											III	IV	V	VI	VII	VIII
1 **H** 1																	4 **He** 2
7 **Li** 3	9 **Be** 4											11 **B** 5	12 **C** 6	14 **N** 7	16 **O** 8	19 **F** 9	20 **Ne** 10
23 **Na** 11	24 **Mg** 12											27 **Al** 13	28 **Si** 14	31 **P** 15	32 **S** 16	35.5 **Cl** 17	40 **Ar** 18
39 **K** 19	40 **Ca** 20	45 **Sc** 21	48 **Ti** 22	51 **V** 23	52 **Cr** 24	55 **Mn** 25	56 **Fe** 26	59 **Co** 27	59 **Ni** 28	63.5 **Cu** 29	65 **Zn** 30	70 **Ga** 31	73 **Ge** 32	75 **As** 33	79 **Se** 34	80 **Br** 35	84 **Kr** 36
85 **Rb** 37	88 **Sr** 38	89 **Y** 39	91 **Zr** 40	93 **Nb** 41	96 **Mo** 42	99 **Tc** 43	101 **Ru** 44	103 **Rh** 45	106 **Pd** 46	108 **Ag** 47	112 **Cd** 48	115 **In** 49	119 **Sn** 50	122 **Sb** 51	128 **Te** 52	127 **I** 53	131 **Xe** 54
133 **Cs** 55	137 **Ba** 56	139 **La** 57	178.5 **Hf** 72	181 **Ta** 73	184 **W** 74	186 **Re** 75	190 **Os** 76	192 **Ir** 77	195 **Pt** 78	197 **Au** 79	201 **Hg** 80	204 **Tl** 81	207 **Pb** 82	209 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
223 **Fr** 87	226 **Ra** 88	227 **Ac** 89															

140 **Ce** 58	141 **Pr** 59	144 **Nd** 60	147 **Pm** 61	150 **Sm** 62	152 **Eu** 63	157 **Gd** 64	159 **Tb** 65	162 **Dy** 66	165 **Ho** 67	167 **Er** 68	169 **Tm** 69	173 **Yb** 70	175 **Lu** 71
232 **Th** 90	231 **Pa** 91	238 **U** 92	237 **Np** 93	244 **Pu** 94	243 **Am** 95	247 **Cm** 96	247 **Bk** 97	251 **Cf** 98	252 **Es** 99	257 **Fm** 100	258 **Md** 101	259 **No** 102	260 **Lr** 103

Index Number:_____ SEC06/2B.21s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2021 SUPPLEMENTARY SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	IIB
DATE:	12th October 2021
TIME:	4:00 p.m. to 6:05 p.m.

Useful data:

Relative atomic masses: H = 1, C = 12, O = 16.

Standard temperature and pressure (stp): 0 °C and 1 atm (760 mm Hg)

The molar volume for gases at stp = 22.4 dm^3

Specific heat capacity of water = 4.2 J g^{-1} °C^{-1}

Avogadro constant, L = 6.02 x 10^{23}

$\Delta H = mc\Delta\theta$

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions from Section A. Write all your answers for Section A in the spaces provided in this booklet.
- Answer **TWO** questions from Section B. Write all your answers for Section B in the spaces provided in this booklet.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated in brackets.
- You are reminded of the necessity for orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.
- A Periodic Table is printed on the back of this booklet.

For examiners' use only:

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Score														
Maximum	6	12	6	6	6	6	6	6	6	20	20	20	20	100

Section A: Answer ALL questions.

1. A pressure cooker is a pot with a sealable lid. Uncooked food and water are placed in the pot. The pot is closed and heated until a high pressure is reached.

a) Water in the pressure cooker starts to turn into a gas.

i) Name this change of state.

_____(1)

ii) At what temperature does this change occur at standard pressure?

_____(1)

b) Give **TWO** reasons why the pressure in the pressure cooker increases as it is heated.

Reason 1: _____

_____

Reason 2: _____

_____(2)

c) A pressure cooker is filled with air only and sealed. The air has a temperature of 293 K and a pressure of 1 atm. Calculate the pressure in the container if it is heated to 423 K. Assume that the volume of the container does **not** change.

_____

_____

_____(2)

6

(Total: 6 marks)

2. Underline the best answer to complete the paragraph:

a) A covalent bond is the attraction between positive nuclei and electrons which have been (lost / shared / valence) between them. This (intramolecular / intermolecular / lattice) bond is strong. As molecules are (positively / negatively / neutrally) charged, (intramolecular / intermolecular / chemical) attractions are weak. Therefore, simple covalent compounds typically have (low / moderate / high) melting points. (5)

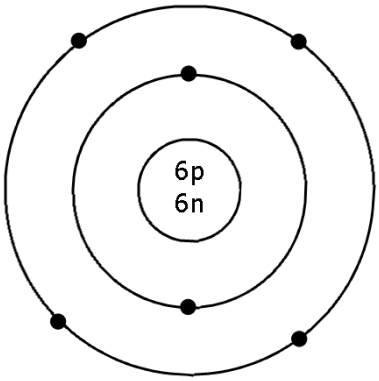
b) A giant covalent compound is one in which there are no (intramolecular / intermolecular / chemical) bonds – only covalent bonds. Thus, they are generally (malleable / hard / soft) and have (low / moderate / high) melting points. (3)

c) An ionic bond is the attraction between oppositely charged (cations / molecules / ions). All cations in the (molecule / lattice / intermolecule) are attracted to anions within the same structure. Ionic bonds are generally (weaker / similar / stronger) compared to covalent bonds, and the melting points of ionic compounds are typically (low / moderate / high). (4)

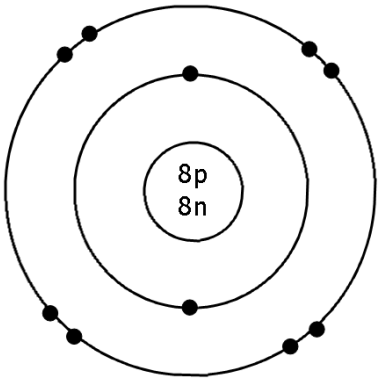
12

(Total: 12 marks)

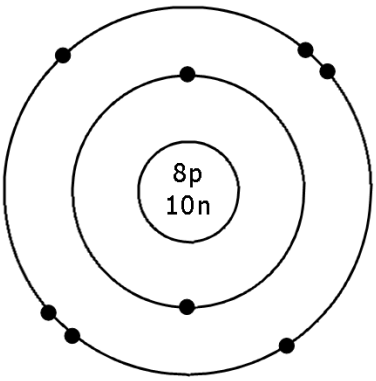
3. Look at the electronic configurations drawn below.



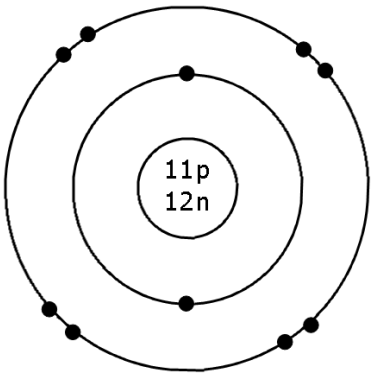
Particle A



Particle B



Particle C



Particle D

From the configurations above, choose a:

a) negatively charged ion; _____ (1)

b) positively charged ion; _____ (1)

c) particle with a mass number of 12; _____ (1)

d) pair of isotopes; _____ and _____ (1)

e) particle in Group 4 of the periodic table; _____ (1)

f) neutral particle. _____ (1)

6

(Total: 6 marks)

Please turn the page.

4. The following equation shows the action of nitric acid on copper.

$$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$$

a) Give the oxidation state of copper at the start and at the end of the reaction.

Oxidation state of copper at the start of the reaction: _____

Oxidation state of copper at the end of the reaction: _____ (2)

b) What role is nitric acid playing in this reaction?

_____(1)

c) Different products are formed when dilute nitric acid reacts with magnesium oxide. Give the equation for this reaction.

_____(2)

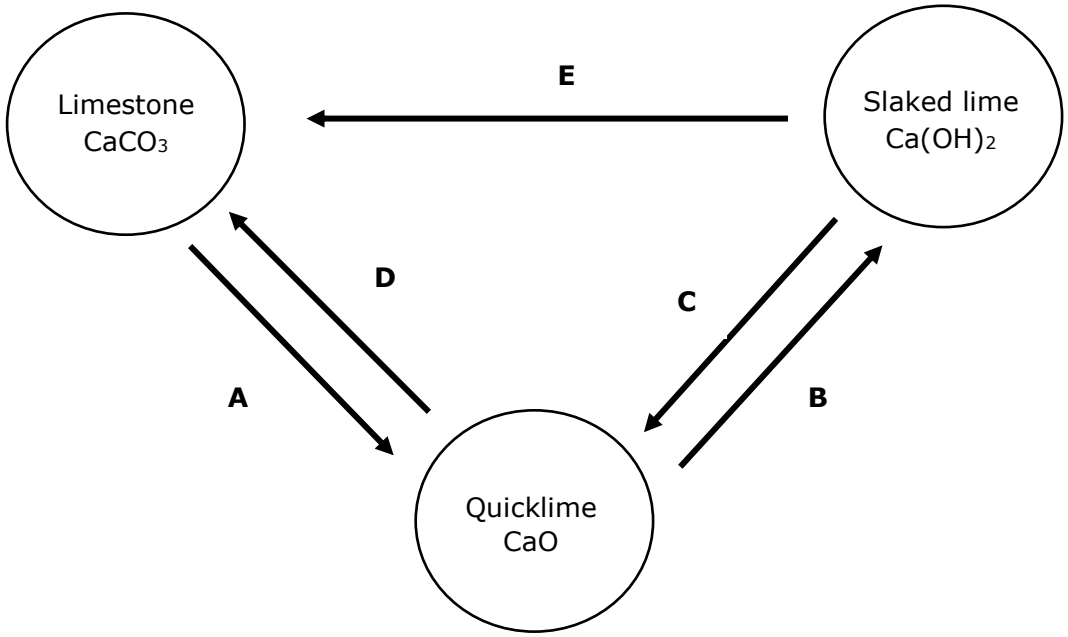
d) Explain the role of nitric acid in the reaction in part (c).

_____(1)

6

(Total: 6 marks)

5. The following diagram shows the relationship between limestone ($CaCO_3$), quicklime (CaO) and slaked lime ($Ca(OH)_2$).



a) State what needs to be done during the reaction to bring about each of the changes A, B, C, D, and E.

i) the change in reaction A; _____ (1)

ii) the change in reaction B; _____ (1)

iii) the change in reaction C; _____ (1)

iv) the change in reaction D; _____ (1)

v) the change in reaction E. _____ (1)

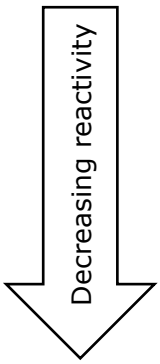
b) In what type of industry, are these chemicals most commonly used in Malta?

_____(1)

6

(Total: 6 marks)

6. The following is a list of metals according to their decreasing reactivity.



Potassium
Sodium
Calcium
Magnesium
Aluminium
Zinc
Iron
Lead
Copper
Silver

a) From the above list give:

i) the element which is least likely to react with water;

_____(1)

ii) the element that may be used in a sacrificial anode to protect an iron structure;

_____(1)

iii) the metal which is most likely used to make coins;

_____(1)

iv) the metal that is most commonly used in galvanising.

_____(1)

b) Give the equation for the reaction between iron filings and copper(II) sulfate.

_____ (2)

6

(Total: 6 marks)

Please turn the page.

7. Chlorine, bromine, and iodine are elements that belong to the same group in the Periodic Table.

a) How many electrons would each of these elements have in their outer shell?

_____(1)

b) How do these elements react in terms of loss or gain of electrons?

_____(1)

c) Which of the elements listed above is the:

i) most reactive? _____ (1)

ii) least reactive? _____ (1)

d) Give the equation for the reaction between chlorine gas and potassium iodide.

_____(2)

6

(Total: 6 marks)

8. There are several chemicals which have the same colour. However, there are tests one could carry out in the laboratory which would help to distinguish between them. In each of the following cases, state what test would be carried out on each pair of solid substances and what would be observed in each case.

a) Iron(II) chloride and copper(II) chloride are both green solids.

i) Test: _____(1)

ii) Observation with iron(II) chloride:

_____(1)

iii) Observation with copper(II) chloride:

_____(1)

b) Ammonium chloride and aluminium chloride are both white solids.

i) Test: _____(1)

ii) Observation with ammonium chloride:

_____(1)

iii) Observation with aluminium chloride:

_____(1)

6

(Total: 6 marks)

9. Fill in the blanks by choosing the words from the following word bank. Every word may be used once, more than once, or not all.

distillation	transportation	fuels
liquids	hydrocarbons	distillates
fractions	road-surfacing	fractional distillation

Crude oil is a mixture of _____. This mixture may be separated on an industrial scale by a process very similar to _____ into components called_____. The components that boil first are gases that are used as _____. There are however other components of crude oil that boil at higher temperatures. These are also used as fuels but are _____ and are commonly used in _____. **(Total: 6 marks)**

6

Section B: Answer TWO questions from this section.

10. This question is about energetics.

a) Define heat of neutralisation. (3)

b) Describe an experiment you would carry out in the laboratory to determine the heat of neutralisation using hydrochloric acid and sodium hydroxide solutions. Your description should include a labelled diagram of the setup used and a description of the experiment. (7)

c) Two students carried out the experiment in part (b). They obtained the following results:

- 25 cm^3 of 0.1 mol dm^{-3} hydrochloric acid solution.
- 25 cm^3 of 0.1 mol dm^{-3} sodium hydroxide solution.
- Initial temperature = 21 °C.
- Final temperature = 44 °C.

The equation for the reaction is given below:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

i) Calculate the total mass of the solutions after mixing. Assume the density of the solutions to be 1 g cm^{-3}. (1)

ii) Calculate the change in temperature. (1)

iii) Calculate the heat energy produced during this reaction. (1)

iv) Calculate the change in heat of neutralisation. (2)

v) The data book value for the change in heat of neutralisation is 57,900 J mol^{-1}. Compare the value calculated in part (c) (iv) with the book value and explain why these values are different. (2)

d) Draw a labelled energy level diagram including activation energy for an exothermic reaction. (3)

(Total: 20 marks)

11. This question is about reversible reactions and equilibria.

a) The following is a reversible reaction.

$$CuSO_4.5H_2O \rightleftharpoons CuSO_4 + 5H_2O$$

i) What does reversible reaction mean? (1)

ii) On heating, the reversible reaction goes to the right. How may the reaction be reversed? (1)

b) The following reaction may reach dynamic equilibrium.

$$CaCO_3 \rightleftharpoons CaO + CO_2$$

i) What does dynamic equilibrium mean? (1)

ii) List **THREE** factors which influence the position of equilibrium. (3)

c) Catalysts are sometimes used in industrial processes such as the Haber Process.

i) Write a balanced equation for the chemical reaction that takes place in the Haber Process. Include state symbols. (3)

ii) What is a catalyst? (2)

iii) Why is a catalyst used? (1)

iv) Give the name of the catalyst used in this process. (1)

v) What are the conditions in terms of concentration and pressure that favour the production of ammonia during this process? (2)

vi) The reaction that produces ammonia in the Haber Process is exothermic. Explain how the production of ammonia can be increased by varying temperature. (1)

vii) A temperature of around 450 °C is employed. Why is such a temperature used during this process? (1)

viii) Explain the effect of temperature on a reaction in terms of particles. (3)

(Total: 20 marks)

12. A class of chemistry students is studying the rates of various chemical reactions.

a) For each chemical reaction in parts (i), (ii), and (iii), choose the best way of measuring the rate of reaction from the table below.

A: Change in colour intensity	C: Change in pH
B: Decrease in mass	D: Increase in mass

i) Absorption of carbon dioxide by calcium hydroxide. (1)

ii) Reaction between acidified potassium permanganate solution and hydrogen peroxide. (1)

iii) Addition of dilute sulfuric acid to sodium carbonate. (1)

b) The class also investigates factors affecting the rate of production of alcohol from glucose. Volume of carbon dioxide produced by the reaction is measured at regular intervals as a measure of rate of fermentation.

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

The largest gas syringes available to the class have a volume of 1 dm^3. They need to calculate the maximum mass of glucose that may be used in each solution. Calculate:

i) the amount of carbon dioxide (in moles) in 1 dm^3 of gas at STP; (2)

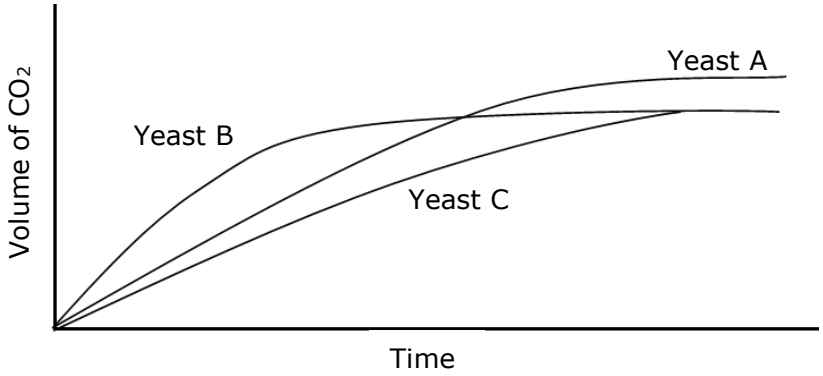
ii) the amount of glucose (in moles) required to produce 1 dm^3 of carbon dioxide; (1)

iii) the mass of glucose required to produce 1 dm^3 of carbon dioxide. (2)

c) The students set up three different containers each containing glucose dissolved in water. To each container, they add the same mass of a different type of yeast. The volume of carbon dioxide produced is plotted against time for the reaction using Yeast A, Yeast B, and Yeast C. Compare the three types of yeast in terms of:

i) rate of fermentation; (2)

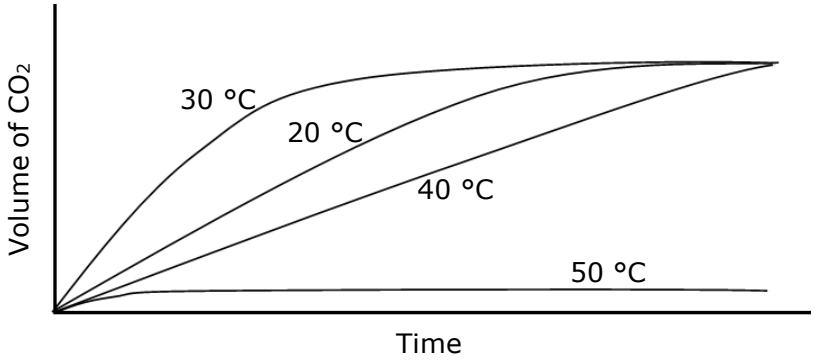
ii) amount of products produced. (2)



d) In another experiment, the class investigates the effect of temperature on the rate of fermentation using the same yeast. For this, they measure the rate of fermentation at four different temperatures as indicated on the sketch below. At which temperature does the reaction:

i) happen at the highest rate? (1)

ii) produce very little product? (1)



e) The results obtained in part (d) are different than those for other reactions, such as addition of acid to a carbonate.

i) How does temperature usually affect the rate of chemical reactions? (1)

ii) Explain your answer to part (e) (i) in terms of the kinetic theory of matter. (2)

iii) Sketch a graph showing the rate of formation of carbon dioxide by reaction of an acid on a carbonate at a particular temperature and label the sketch A. On the same axes, sketch a graph showing the rate of the same reaction at a higher temperature and label the sketch B. (3)

(Total: 20 marks)

Please turn the page.

13. Long chain alkanes such as decane, $C_{10}H_{22}$, can undergo cracking under suitable conditions. One of the products is ethene, which may be hydrolysed to produce ethanol.

a) Write a balanced chemical equation including state symbols for each process indicated below:

i) Cracking of decane. (3)

ii) Hydrolysis of ethene. (3)

b) Ethanol may also be produced naturally.

i) Name the homologous series to which ethanol belongs. (1)

ii) Draw the structure of ethanol showing **all** bonds and identify the functional group of ethanol by drawing a circle around it. (2)

iii) Name **TWO** industrial uses for ethanol. (2)

c) In the production of vermouth, wine is heated with herbs. During this process ethanol and aromatic molecules evaporate. These molecules are reclaimed and added back to the heated wine to give it a fruity and aromatic, smell and taste. If vermouth is allowed to stand for too long, it turns sour. The sourness is due to ethanoic acid.

i) Draw the structure of ethanoic acid showing **all** bonds. (1)

ii) To which homologous series does ethanoic acid belong to? (1)

iii) Write a balanced chemical equation to show how ethanoic acid reacts with sodium hydroxide solution. Include state symbols. (3)

iv) Draw a labelled diagram to show how the ethanol that evaporates during the heating of wine with aromatic herbs is recovered. (4)

(Total: 20 marks)

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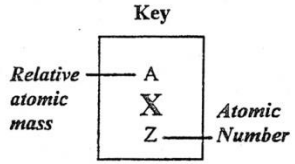
PERIODIC TABLE



I	II											III	IV	V	VI	VII	VIII
																	4 He 2
7 Li 3	9 Be 4											11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
23 Na 11	24 Mg 12											27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18
39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27	59 Ni 28	63.5 Cu 29	65 Zn 30	70 Ga 31	73 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36
85 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178.5 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	252 Es 99	257 Fm 100	258 Md 101	259 No 102	260 Lr 103