WJEC EDUQAS AS CHEMISTRY · COMPONENT 1

CHEMISTRY



EXAM QUESTION PACK

1.5 SOLID STRUCTURES

SCORE	PERCENTAGE
/54	%

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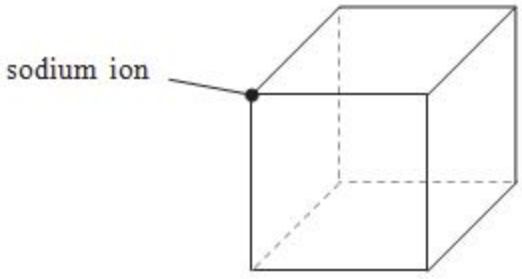
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1. (a) A section of the crystal structure of sodium chloride is shown below.



(i) Indicate, with a cross, the position of any chloride ion on this diagram

[1]

(ii) State the crystal co-ordination number of a **chloride** ion in the structure of sodium chloride.

[1]

(b) 'Rock salt', used on roads in winter, consists mainly of crystalline sodium chloride that is contaminated by a small quantity of insoluble mudstone.
Gwen added powdered rock salt to water and filtered out the insoluble material. She then evaporated the filtrate to dryness to produce pure white crystals of sodium chloride.
State **two** steps that she should have carried out to ensure that she obtained the **maximum** amount of sodium chloride from her rock salt crystals.

[2]

(c) The minerals 'rock salt', NaCl, and kainite, $KCl.MgSO_4.3H_2O$, both contain chloride ions.

(i) Give a chemical test that produces the same result for both of these compounds. You should state the reagent(s) used and the result of the test.

[2]

(ii) Give a chemical test, other than a flame test, that will show that these two compounds are different. You should assume that they are present as aqueous solutions.

Give the reagent(s) used and the result of the test for each compound.

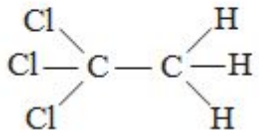
[2]

(d) A common reaction of the halogens is the formation of the anion, X^-.

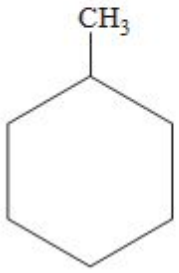
(i) State, in terms of electronic structure, why this occurs. [1]

(ii) Give a reason why the tendency to form the X^- ion decreases down the halogen group. [1]

(e) One compound previously used in correction fluid was 1,1,1-trichloroethane, but this has been replaced by compounds such as methylcyclohexane, which has a much less adverse effect on the environment.



1,1,1-trichloroethane



methylcyclohexane

(i) Explain, in terms of bond strengths, why 1,1,1-trichloroethane has an effect on the ozone layer but methylcyclohexane does not. [2]

(ii) Hept-1-ene is an isomer of methylcyclohexane. CH_3—

$$CH_2—CH_2—CH_2—CH_2—CH = CH_2$$

Describe a chemical test that gives a positive result for hept-1-ene but not for methylcyclohexane. [2]

Reagent(s) .....

Observation .....

(Total 14)

2. (a) Both sodium chloride and caesium chloride have giant ionic structures.

(i) Draw a labelled diagram to show the arrangement of ions in a crystal of caesium chloride.

[2]

(ii) Give a reason why sodium chloride has a different structure from caesium chloride.

[1]

(b) Both diamond and graphite have giant covalent structures

(i) Describe the structure and bonding in graphite.

[3] QWC [1]

(ii) Explain why graphite can conduct electricity whilst diamond cannot.

[2]

(iii) Iodine, I_2, also contains covalent bonds. Explain why solid iodine can be converted into a vapour at a much lower temperature than diamond. [3]

Total [12]

3. (a) Explain the fact that the melting temperature of sodium is much lower than the melting temperature of magnesium.
You should include reference to the type(s) of bonding involved and how this bonding affects melting temperatures. You may include a diagram if you consider it helpful. [3]

(b) In an experiment, 1-chlorobutane was heated with aqueous sodium hydroxide and the resulting solution was acidified. Aqueous silver nitrate was then added and a white precipitate was observed.

The experiment was repeated using 1-bromobutane and in this case a cream precipitate was observed. Explain these observations.

You should include:

- the type of reaction that occurs between the halogenoalkane and sodium hydroxide
- an equation for this reaction
- the identity of the coloured precipitates.
- an equation to show the formation of these precipitates.

[4] QWC [1]

(c) Describe how the structures of sodium chloride and caesium chloride are similar and how they are different. Give a reason for any difference.You may include a diagram if you consider it helpful.

[3]

(d) When hydrogen bromide, HBr, is added to propene, C_3H_6, two different products are possible. In practice, however, more of one of the products is formed.
Explain why more of one product is formed.

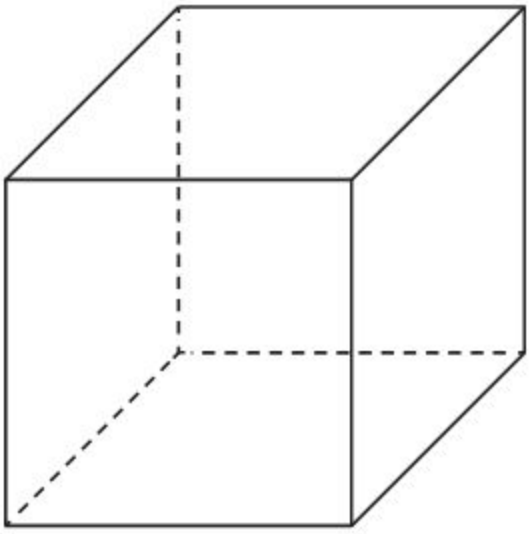
You should:

- state the type of reaction involved
- identify the two possible products
- state which of the two products predominates.
- give the reason why more of this product is formed.

[4] QWC [1]

(Total 16)

4. Complete and label the diagram to show the positions of the ions present in caesium chloride, CsCl. [1]



(Total 1)

5. When the temperature is increased, both solid iodine and diamond change directly into their gaseous state - they sublime.

(a) In each case, name the force or bond that is being overcome when the solid changes into a gas.

[2]

Iodine.....

Diamond.....

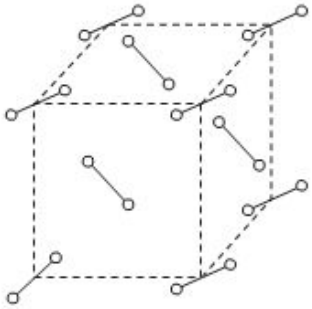
(b) State, with a reason, which solid would have the higher sublimation temperature.

[1]

(Total 3)

6.

(a) The structures of solid iodine and diamond are shown below.



Iodine



Diamond

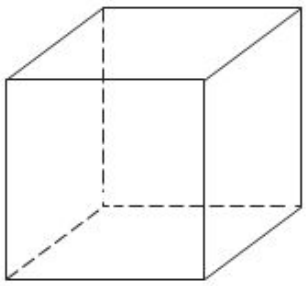
Use these diagrams to help you explain why

- iodine vapourises easily but diamond does not vapourise until about 3550 °C
- neither iodine nor diamond conduct electricity

[4]

QWC [1]

(b) Potassium iodide has the same cubic structure as sodium chloride. Use the diagram below to identify and show the positions of the species involved. [2]



(c)You are given an aqueous solution containing 0.05 mol of barium chloride and a supply of potassium sulfate solution.

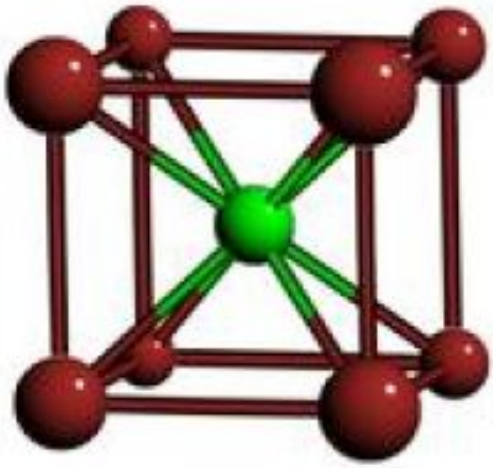
Devise a method to obtain the maximum amount of pure dry barium sulfate.You should assume that a risk assessment has been carried out.

[4] QWC [1]

(Total 12)

2

(a) (i)



Clear 8 coordination number (1)
Labels of both Cl^- and Cs^+ (either way round) (1) [2]

(ii) Cs^+ ion larger than Na^+ so can have a larger coordination number. [1]

(b) (i) Any three from the following for (1) each up to 3 max – can gain these from labelled diagram

- Layers of carbon atoms.
- Hexagons of carbon atoms / each carbon bonded to three others.
- Weak forces between layers.
- Delocalised electrons above and below plane. [3]

QWC: organisation of information clearly and coherently; use of specialist vocabulary where appropriate. [1]

(ii) Delocalised electrons in graphite can move to carry a current (1)
Diamond has no delocalised electrons (1) [2]

(iii) Van der Waals forces between molecules need to be broken to form iodine gas (1)

Covalent bonds need to be broken to form a gas from diamond/graphite (1)

Van der Waals forces are much weaker than covalent bonds (1)

[3]

Total [12]

3.

(a) both contain metallic bonds/ positive ions and delocalised electrons labelled on diagram (1)

those in magnesium are stronger/ harder to break/ need more energy to break (1)

because **2** electrons are involved in delocalisation/ attraction to the positive ions (1) [3]

(b) reaction is hydrolysis of halogenoalkane/ nucleophilic substitution of halogenoalkane (1)

$C_4H_9X + OH^- \rightarrow C_4H_9OH + X^-$ X can be Cl or Br (1)

(white precipitate is) silver chloride and (cream precipitate is) silver bromide (1)

$Ag^+(aq) + X^-(aq) \rightarrow AgX(s)$ or $AgNO_3 + X^- \rightarrow AgX + NO_3^-$ (1)

- state symbols ignored [4]

QWC selection of form and style of writing appropriate to purpose and to complexity of subject matter [1]

(c) caesium ions are bigger than sodium ions – accept 'atoms' (1)

co-ordination number 6 : 6 for sodium and 8 : 8 for caesium (1)

both cubic (1) [3]

(d) reaction is electrophilic addition (1)

two possible products are 1-bromopropane and 2-bromopropane (1)

more 2-bromopropane formed (1)

because of greater stability of intermediate positive ion/ 2° carbocation (1)

[4]

QWC legibility of text; accuracy of spelling, grammar and punctuation, clarity of meaning [1]

Total [16]

4.

Cs^+ and Cl^- (or names caesium and chlor**id**e) with Cl^- at each corner and Cs^+ in centre of cube [1]

5.

(a) Iodine contains weak van der Waals forces / bonds between each molecule (1)
Less energy is needed to overcome these weaker forces (1) *
Diamond contains strong covalent bonds between each atom (1)
and more energy is needed to overcome these 'bonds' (1) *
* alternative marks

Neither iodine nor diamond contain free / delocalised electrons to carry the charge (necessary for them to conduct electricity) (1) [4]

QWC: organise information clearly and coherently, using specialist vocabulary when appropriate [1]

(b) K^+ and I^- correctly given (1) and in their correct places on the diagram (1) [2]

(c) An excess / stoichiometric / 0.05 mol (1) of potassium sulfate (aq) is added to the barium chloride solution
Mixture is stirred (1) * and then filtered (1)
Precipitated barium sulfate is then washed with distilled water (1)
and dried (1) * [4]
* alternative marks

QWC: Select and use a form and style of writing appropriate to purpose and to complex subject matter [1]

Total [12]

6.

(a) iodine force is Van der Waals/ induced dipole-induced dipole (1)

diamond force is covalent bond/ description of attractive forces in a covalent bond (1) [2]

(b) diamond would have a higher sublimation temperature because it has stronger forces/ forces are harder to break [1]