CHEMISTRY

PAPER 1C, 1CR 2020 - 2025

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1 – (4CH1/1C_Summer_2020_Q1) – *Principles Of Chemistry*

This question is about chemical elements.

Use the Periodic Table to help you answer this question.

(a) (i) Identify the element with atomic number 5

(1)

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(ii) Give the symbol of a metallic element in Period 3

(1)

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(iii) Identify the element whose atoms contain 14 protons.

(1)

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(iv) Identify the element whose atoms have the electronic configuration 2.5

(1)

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(v) Give the name of the compound formed between oxygen and the element with atomic number 13

(1)

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(b) The position of an element in the Periodic Table can be used to predict its properties.

(i) Which group contains elements that are all unreactive?

(1)

☒ **A** Group 2

☒ **B** Group 5

☒ **C** Group 6

☒ **D** Group 0

(ii) Which of these is the least reactive element in Group 1?

(1)

☒ **A** caesium

☒ **B** lithium

☒ **C** potassium

☒ **D** sodium

2 – (4CH1/1C_Summer_2020_Q2) – *Principles Of Chemistry*

(a) The boxes list changes that may happen in a laboratory and the names of some changes.

Draw one straight line from each change to its correct name.

(3)

Change	Name of change
ice turns into water	diffusion
solid carbon dioxide turns directly into a gas	dissolving
a solute is stirred into a solvent	evaporation
	freezing
	melting
	sublimation

(b) A student has two solids, X and Y.

One of these solids is a pure substance and the other is a mixture.

Describe how the student could identify which solid is pure and which is a mixture by measuring a physical property of each solid.

(3)

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3 – (4CH1/1C_Summer_2020_Q5) – *Principles Of Chemistry, Inorganic Chemistry*

(a) Chlorine, bromine and iodine are elements in the Periodic Table.

Explain how the position of these elements in the Periodic Table depends on their electronic configurations.

(2)

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(b) Chlorine reacts with methane to form CH_3Cl and HCl

(i) State the condition necessary for this reaction.

(1)

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(ii) Give the equation for this reaction.

(1)

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(iii) The bonds in a molecule of CH_3Cl are covalent.

Explain, in terms of electrostatic attractions, what is meant by a covalent bond.

(2)

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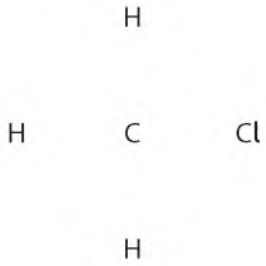
(iv) Draw a dot-and-cross diagram for a molecule of CH_3Cl

Show only the outer electrons of the atoms.

(2)



(v) CH_3Cl has a simple molecular structure.

Explain why CH_3Cl has a low boiling point.

(2)

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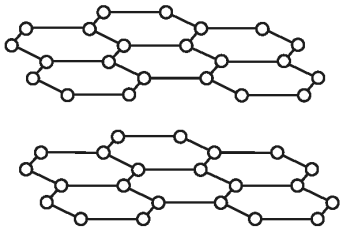
(c) Graphite is another substance that contains covalent bonds.

The diagram shows the structure of graphite.



Most covalent substances do not conduct electricity.

Explain why graphite is able to conduct electricity.

(2)

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4 – (4CH1/1C_Summer_2020_Q9) – *Inorganic Chemistry, Principles Of Chemistry*

Sodium hydrogencarbonate ($NaHCO_3$) is also known as baking soda.

Baking soda can be used to make cakes increase in size in an oven.

This is the equation for the reaction that takes place when baking soda is heated.

$$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$$

(a) (i) What type of reaction is this?

(1)

☒ **A** combustion

☒ **B** decomposition

☒ **C** oxidation

☒ **D** reduction

(ii) Suggest why the reaction makes the cakes increase in size.

(1)

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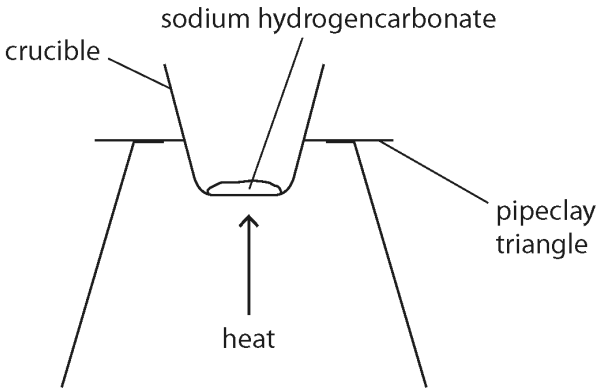
(b) A student uses this apparatus to investigate the reaction that takes place when sodium hydrogencarbonate is heated.



This is the student's method.

- weigh a crucible and record the mass
- add some sodium hydrogencarbonate to the crucible, reweigh it and record the mass
- heat the crucible and contents for five minutes, then allow to cool before weighing and recording the mass
- heat the crucible and contents again for a further three minutes, then allow to cool before weighing and recording the mass

(i) Give a reason why the crucible and contents are heated for a further three minutes.

(1)

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(ii) The student considered using a lid on the crucible in the experiment.

Suggest an advantage and a disadvantage of using a lid on the crucible.

(2)

(c) The table shows some of the student's results.

mass of crucible and sodium hydrogencarbonate in g	29.75
mass of empty crucible in g	26.50

(i) Calculate the mass of sodium hydrogencarbonate that the student uses.

(1)

mass = ... g

(ii) Using this equation, calculate the maximum mass of sodium carbonate (Na_2CO_3) that could form in the student's reaction.

$$2NaHCO_3(s) \longrightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$$

[M_r of $NaHCO_3 = 84$ M_r of $Na_2CO_3 = 106$]

(3)

maximum mass = ... g

(d) In a second experiment, the student uses a larger mass of sodium hydrogencarbonate.

She calculates that she should obtain 4.8 g of sodium carbonate.

She actually obtains 4.2 g of sodium carbonate.

(i) Calculate the percentage yield from the student's experiment.

(2)

percentage yield = ... %

(ii) Other than spillages, suggest a possible reason why the student's actual yield is less than expected.

(1)

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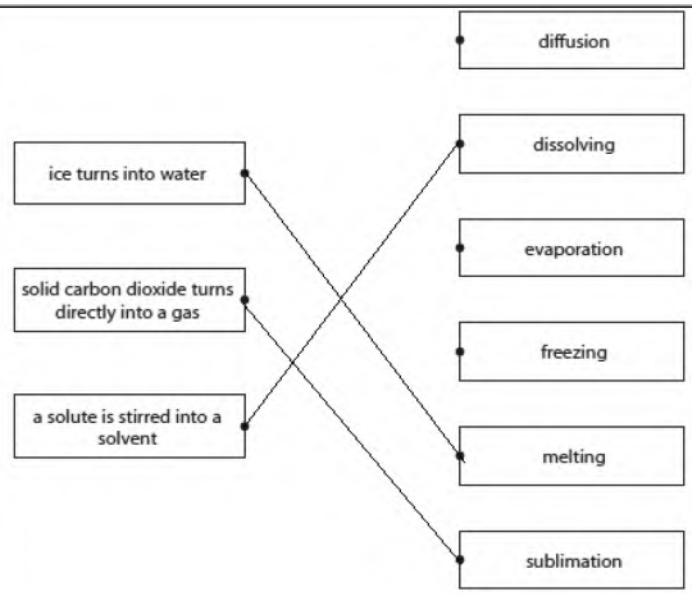
ANSWERS

1 – (4CH1/1C_Summer_2020_Q1) – *Principles Of Chemistry*

(a)	(i)	Boron/B		1 cler
	(ii)	Na/Mg/Al		1 cler
	(iii)	Silicon/Si		1 cler
	(iv)	Nitrogen/N	ALLOW N_2	1 cler
	(v)	aluminium oxide	ALLOW Al_2O_3	1 cler
(b)	(i)	**D** Group 0 is correct because Group 0 contains elements that are all unreactive **A** is not correct because Group 2 does not contain elements that are all unreactive **B** is not correct because Group 5 does not contain elements that are all unreactive **C** is not correct because Group 6 does not contain elements that are all unreactive		1 comp
	(ii)	**B** lithium is correct because lithhium is the least reactive element in Group 1 **A** is not correct because caesium is not the least reactive element in Group 1 **C** is not correct because potassium is not the least reactive element in Group 1 **D** is not correct because sodium is not the least reactive element in Group 1		1 comp

2 – (4CH1/1C_Summer_2020_Q2) – *Principles Of Chemistry*

(a)		1 mark for each correct line form boxes on left If more than one line from a box on left column do not award mark for that box	3 cler
(b)	a description including M1 measure the melting point M2 if fixed/sharp melting point the substance is pure M3 if melts over range of temperatures the substance is a mixture	ALLOW measure boiling point for M1 and substitute b.p. for m.p in M2 and boils for melts in M3 ALLOW max 2 if reference to freezing point as opposed to melting point	3 grad

3 – (4CH1/1C_Summer_2020_Q5) – *Principles Of Chemistry, Inorganic Chemistry*

(a)		Any two from M1 all in Group 7/same group M2 because all have 7/same number of electrons in outer shell M3 the number of shells determines the Period they are in		2 Grad
(b)	(i)	Ultraviolet radiation	ALLOW UV radiation ALLOW ultraviolet light /UV light/ultraviolet rays/UV rays	1 cler
	(ii)	$Cl_2 + CH_4 \rightarrow CH_3Cl + HCl$	ALLOW multiples	1 Grad
	(iii)	M1 attraction between shared pair of electrons M2 and nuclei of the two/both atoms (in the bond) **OR** M1 bonding/shared pair of electrons M2 attracted to (both) nuclei of atoms (in the bond)	ALLOW M1 attraction of (two) nuclei M2 for shared/bonded pair of electrons (between them)	2 Exp
	(iv)	M1 the four shared pairs of electrons between carbon and the other four atoms M2 rest of molecule correct including the three lone pairs of electrons around chlorine atom	M2 DEP M1 ALLOW any combination of dots and crosses	2 Grad
	(v)	M1 weak forces of attraction between molecules/weak intermolecular forces M2 little (heat) energy needed to overcome them	ALLOW weak bonds between molecules /weak intermolecular bonds IGNORE less energy 0 marks if implication is that covalent bonds are weak/broken	2 Exp

(c)	Explanation including M1 (one) electron (per carbon atom) delocalised M2 (so) free to move (between layers)	IGNORE sea of electrons /free electrons M2 DEP on mention of electrons 0 marks if mention of ions in graphite	2 Exp

4 – (4CH1/1C_Summer_2020_Q9) – *Inorganic Chemistry, Principles Of Chemistry*

(a)	(i)	**B** decomposition **A** is not correct because when sodium hydrogencarbonate is heated combustion does not take place C is not correct because when sodium hydrogencarbonate is heated oxidation does not take place D is not correct because when sodium hydrogencarbonate is heated reduction does not take place		1 comp
	(ii)	(because) carbon dioxide/gas is produced/given off		1 grad
(b)	(i)	to obtain a constant mass OWTTE / to show the reaction is complete OWTTE	ACCEPT to ensure only Na_2CO_3 is left (in crucible) ACCEPT to ensure all the $NaHCO_3$ has reacted /decomposed	1 exp
	(ii)	M1 advantage: to stop any solid/Na_2CO_3/$NaHCO_3$ spitting out/being lost M2 disadvantage: the gas(es)/CO_2/H_2O/steam could not easily escape OWTTE	REJECT references to stopping gases escaping	2 exp

(c)	(i)	3.25 (g)		1 exp
	(ii)	• calculate moles of $NaHCO_3$ • use equation to determine moles of Na_2CO_3 • multiply by M_r to find mass of Na_2CO_3 Example calculation: M1 3.25 ÷ 84 **OR** 0.0387 (mol) M2 0.0387 ÷ 2 **OR** 0.01935 (mol) M3 0.01935 x 106 = 2.05 (g) **OR** • use of equation to relate mass of $NaHCO_3$ to mass of Na_2CO_3 • shows how to find mass of Na_2CO_3 using 3.25g $NaHCO_3$ • correct evaluation of answer Example calculation: M1 (2x84)/168 (g) $NaHCO_3$ → 106 (g) Na_2CO_3 M2 3.25 (g $NaHCO_3$)→ (106÷168) x 3.25 (g Na_2CO_3) M3 2.05 (g Na_2CO_3)	mark CQ on (i) ALLOW any number of sig figs except 1 2.05 (g) without working scores 3 marks 4.1 (g) without working scores 2 marks mark CQ on (i)	3 exp
(d)	(i)	M1 percentage yield = 4.2÷4.8 **OR** 0.875 M2 = (0.875 x 100) = 87.5 (%)	ACCEPT 88 (%) Correct answer without working scores 2	2 grad
	(ii)	any one from M1 sodium hydrogencarbonate was impure M2 not all sodium hydrogencarbonate reacted/decomposed		1 grad

5 – (4CH1/1C_Summer_2020_Q10) – *Inorganic Chemistry, Principles Of Chemistry*

(a)	M1 red lead oxide → lead(II) oxide + M2 oxygen	must have (II) ACCEPT answers in either order If formulae given allow 1 mark for O_2 even if formula for lead(II) oxide is incorrect	2 grad
(b)	• dividing percentages by A*r* • correct results of divisions • divide by smallest to obtain correct ratio/EF Example of calculation: Pb O M1 86.6÷207 13.4÷16 M2 0.42 0.84 M3 (0.42÷0.42 =)1 (0.84÷0.42 =) 2	0 marks if division by atomic numbers or calculation upside down ACCEPT alternative methods	3 exp
(c) (i)	M1 Pb_3O_4 (s) + $4HNO_3$ (aq) M2 $2Pb(NO_3)_2$(aq) + $2H_2O$	both state symbols required ALLOW upper case letters for state symbols both numbers required	2 grad

(c) (ii)	description that makes reference to the following three points: M1 warm/heat (nitric) acid M2 add/mix/react (red) lead oxide (and stir) M3 filter to obtain lead(II) nitrate solution **AND** three of the following points: M4 heat/boil (lead(II) nitrate) solution/filtrate M5 until crystals form in a cooled sample/on a glass rod OWTTE M6 leave solution to cool / leave solution for more crystals to form M7(and then) filter off crystals/lead nitrate M8 suitable method of drying the crystals eg using filter paper/using paper towel/in a warm oven	 REJECT boil IGNORE references to adding excess(red) lead oxide ALLOW to remove lead(IV) oxide/PbO_2 ALLOW to remove (unreacted/excess) red lead oxide/Pb_3O_4 If heat to dryness only M4 can be scored ACCEPT to crystallisation point/to form a saturated solution /until crystals start to form /to remove some of the water M5 DEP M4 ACCEPT decant off the solution M7 DEP M6 IGNORE references to washing REJECT hot oven or any method of direct heating eg Bunsen ALLOW leave to dry but not just dry the crystals No M8 if crystals are washed after drying	6 exp