CHEMISTRY

PAPER 1C, 1CR 2019 - 2023

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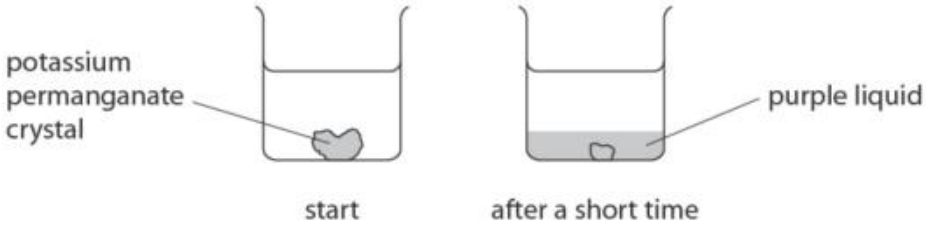
1 – (4CH1/1C_Summer_2019_Q1) – *Principles Of Chemistry*

Potassium permanganate is a purple solid that is soluble in water.

A crystal of potassium permanganate is placed in a beaker containing water.



(a) After a short time, the crystal becomes smaller and the liquid at the bottom of the beaker becomes purple.

Which statement explains this observation?

(1)

☒ **A** the crystal condenses in the water

☒ **B** the crystal dissolves in the water

☒ **C** the crystal evaporates in the water

☒ **D** the crystal melts in the water

(b) The beaker is left until there is no further change in the appearance of the liquid.

(i) Which statement describes the final appearance of the liquid?

(1)

☒ **A** all of the liquid is purple

☒ **B** none of the liquid is purple

☒ **C** only the bottom half of the liquid is purple

☒ **D** only the top half of the liquid is purple

(ii) Which process causes this change in appearance?

(1)

☒ **A** condensation

☒ **B** crystallisation

☒ **C** diffusion

☒ **D** evaporation

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(c) The formula of potassium permanganate is $KMnO_4$

How many different elements are there in potassium permanganate?

(1)

☒ **A** 3

☒ **B** 4

☒ **C** 6

☒ **D** 7

(Total for Question 1 = 4 marks)

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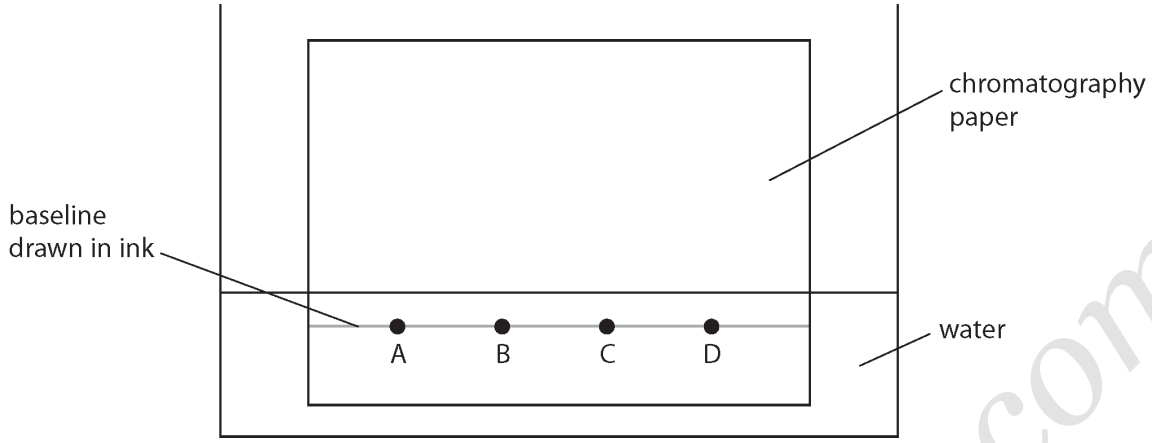
2 – (4CH1/1C_Summer_2019_Q4) – *Principles Of Chemistry*

A student uses this apparatus to investigate the colours in four different inks, A, B, C and D.



(a) Explain two mistakes the student made when setting up his experiment.

(4)

1 .....

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.....

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2 .....

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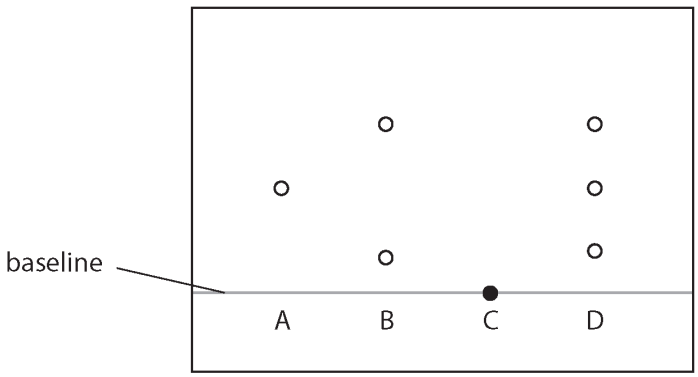
(b) Another student does the experiment but does not make any mistakes.

The diagram shows her results.



(i) State how many colours ink D contains.

(1)

.....

(ii) State which of the inks tested could be mixed together to make ink D.

(1)

.....

(iii) Explain which of the inks tested is insoluble in water.

(2)

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(Total for Question 4 = 8 marks)

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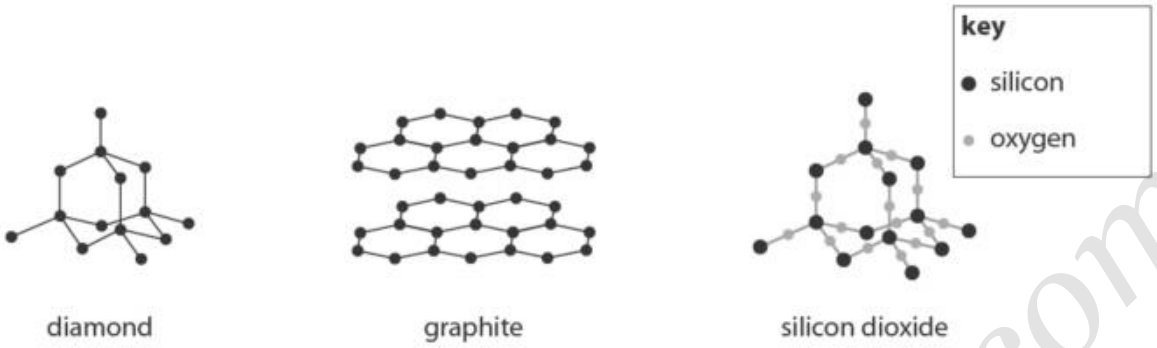
3 – (4CH1/1C_Summer_2019_Q7) – *Principles Of Chemistry*

Diamond, graphite and silicon dioxide all have giant covalent structures.

The diagram shows the structures of these three substances.



diamond graphite silicon dioxide

(a) Explain why silicon dioxide has a high melting point.

(2)

(b) Explain why graphite conducts electricity.

(2)

(c) State why diamond is hard but graphite is soft.

(2)

(Total for Question 7 = 6 marks)

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4 – (4CH1/1C_Summer_2019_Q9) – *Inorganic Chemistry, Principles Of Chemistry*

Halon 1301 is a compound used in some fire extinguishers.

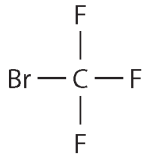
Halon 1301 has the percentage composition by mass of

C 8.05% Br 53.69% F 38.26%

(a) Show, by calculation, that the empirical formula of this compound is $CBrF_3$

(2)

(b) The diagram shows the displayed formula of a molecule of Halon 1301.



Draw a dot-and-cross diagram to show all the outer electrons in this molecule.

(2)

(c) The boiling point of Halon 1301 is –58 °C.

Explain why Halon 1301 has a low boiling point.

(2)

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(Total for Question 9 = 6 marks)

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5 - (4CH1/1C_Summer_2019_Q14) - *Principles Of Chemistry*

A salt can be made by reacting an acid with an insoluble base.

A student has a sample of copper(II) oxide.

The student uses this method.

Stage 1 pour 50 cm^3 of dilute sulfuric acid into a beaker

Stage 2 warm the acid using a Bunsen burner

Stage 3 add a small amount of copper(II) oxide to the warm acid and stir the mixture

Stage 4 add further amounts of copper(II) oxide until copper(II) oxide is in excess

Stage 5 filter the mixture

Stage 6 obtain crystals from the filtrate

(a) State why the acid is warmed in stage 2.

(1)

.....

.....

(b) State how the student would know that the copper(II) oxide is in excess in stage 4.

(1)

.....

.....

(c) State why the mixture is filtered in stage 5.

(1)

.....

.....

(d) State the colour of the filtrate obtained in stage 5.

(1)

.....

(e) Describe how the student could obtain a pure, dry sample of hydrated copper(II) sulfate crystals from the filtrate in stage 6.

(5)

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(f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is

$$CuO(s) + H_2SO_4(aq) + 4H_2O(l) \rightarrow CuSO_4.5H_2O(s)$$

(i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.

Show that the maximum possible mass of $CuSO_4.5H_2O$ crystals that can be obtained is about 30 g.

[M_r of CuO = 79.5 M_r of $CuSO_4.5H_2O$ = 249.5]

Give your answer to an appropriate number of significant figures.

(3)

mass = ... g

(ii) In this experiment, the actual yield of $CuSO_4.5H_2O$ crystals is 23.92 g.

Calculate the percentage yield of $CuSO_4.5H_2O$

(2)

percentage yield = ... %

(Total for Question 14 = 14 marks)

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ANSWERS

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1 – (4CH1/1C_Summer_2019_Q1) – *Principles Of Chemistry*

(a)	**B** (the crystal dissolves in water) A is not correct as the crystal does not condense C is not correct as the crystal does not evaporate D is not correct as the crystal does not melt		**1**
(b) (i)	**A** (all of the liquid is purple) B is not correct as the crystal will remain dissolved C is not correct as the particles will have diffused throughout the whole of the liquid D is not correct as the particles will have diffused throughout the whole of the liquid		**1**
(ii)	**C** (diffusion) A is not correct as condensation describes the process of a gas changing into a liquid B is not correct as crystallisation describes the process of a soluble solid forming from a solution C is not correct as evaporation describes the process of a liquid changing into a gas		**1**
(c)	**A** (3) B is not correct as there are only 3 elements present not 4 C is not correct as there are only 3 elements present not 6 D is not correct as there are only 3 elements present not 7		**1**
		Total	**4**

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2 – (4CH1/1C_Summer_2019_Q4) – *Principles Of Chemistry*

a		Explanations that link together the following two pairs of points: **M1** baseline has been drawn in ink **M2** and therefore it will interfere with /contaminate the results **M3** the water level is above the ink spots **M4** and therefore the inks will mix with the water	 **ACCEPT** not drawn in pencil **ACCEPT** will produce other colours/will move up the paper/will get mixed up with the ink samples **ALLOW** pencil will not interfere with the results/ pencil will not dissolve **ACCEPT** too high/above the baseline **ACCEPT** the spots are under water **ACCEPT** the inks will dissolve in the water / the inks will wash off the paper	**4**
b	(i)	3		**1**
	(ii)	A **AND** B		**1**
	(iii)	An explanation that links together the following two points: **M1** C **M2** because the spot/ink did not move (up)	 **ACCEPT** did not spread/stayed on the baseline **M2** DEP on **M1**	**2**
			Total	**8**

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3 – (4CH1/1C_Summer_2019_Q7) – *Principles Of Chemistry*

a	An explanation that links together the following two points: **M1** (silicon dioxide has) many/strong (covalent) bonds **M2** (therefore) a large amount of (heat/thermal) energy is required to break the bonds/ overcome the forces	**ACCEPT** strong (electrostatic) forces of attraction between the nuclei of atoms and the bonding electrons **IGNORE** more energy Any mention of intermolecular forces/forces between molecules or ions/ionic bonding /metallic bonding scores 0 out of 2	**2**
b	An explanation that links together the following two points: **M1** (graphite has) delocalised electron(s) **M2** that are able to flow (through the structure)	**IGNORE** sea of electrons **IGNORE** free electrons **ACCEPT** are able to move / are mobile **IGNORE** references to carrying charge/ current **M2** dep on mention of electrons Any mention of ions in graphite scores 0 out of 2	**2**

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c	**M1** (diamond is hard because) it has a 3D lattice/rigid lattice /tetrahedral lattice /every carbon is bonded to four other carbons **M2** (graphite is soft because) the layers can slide over one another	**ALLOW** 3D/ rigid/ tetrahedral structure **REJECT** mention of intermolecular forces in diamond **IGNORE** mention of intermolecular forces between layers in graphite	**2**
		Total	**6**

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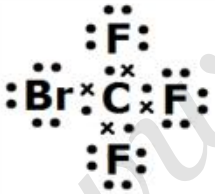
4 – (4CH1/1C_Summer_2019_Q9) – *Inorganic Chemistry, Principles Of Chemistry*

a	**M1** C 8.05 ÷ 12 **OR** 0.671 **and** Br 53.69 ÷ 80 **OR** 0.671 **and** F 38.26 ÷ 19 **OR** 2.01 **M2** divide all numbers by 0.671 (to obtain ratio 1 : 1 : 3)	 **ALLOW** ECF from **M1** If division by atomic numbers or numerators and denominators reversed 0 marks **Alternative method** **M1** M_r (of $CBrF_3$) = 149 **M2** $\frac{12}{149} \times 100 = 8.05$ (%) **and** $\frac{80}{149} \times 100 = 53.69$ (%) **and** $\frac{57}{149} \times 100 = 38.26$ (%)	**2**
b	 **M1** all four bonding pairs correct **M2** rest of electrons correct	**ACCEPT** any combination of dots and crosses **IGNORE** inner shell electrons even if incorrect **M2** DEP on **M1**	**2**

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c	An explanation that links together the following two points:		
	M1 the intermolecular forces (of attraction) are weak	**ACCEPT** London forces/dispersion forces/dipole-dipole forces **ALLOW** intermolecular bonds	**2**
	M2 therefore little energy is required to overcome the forces	**ALLOW** little energy is required to separate the molecules **ALLOW** little energy is required to break the bonds as long as it is clear that the bonds are between molecules **IGNORE** less energy Any mention of covalent bonds/ionic bonds/metallic bonds breaking scores 0 out of 2	
		Total	**6**

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5 – (4CH1/1C_Summer_2019_Q14) – *Principles Of Chemistry*

a	to increase the rate of reaction	**ACCEPT** to make the reaction faster/ to speed up the reaction **REJECT** any reference to increasing the solubility of copper(II) oxide	1
b	(the copper(II) oxide/it) stops disappearing **OR** mixture turns cloudy (black) **OR** (black) solid settles (at the bottom of the beaker)	**ALLOW** stops dissolving **REJECT** any other colour **REJECT** any other colour **ALLOW** copper(II) oxide/ it settles (at the bottom of the beaker) **IGNORE** precipitate	1
c	to remove excess/unreacted copper(II) oxide/solid/base (from the mixture)	**ACCEPT** to separate the copper(II) sulfate solution (from the copper(II) oxide/unreacted solid/excess solid)	1
d	blue		1

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e	**M1** heat/boil the filtrate	**NOTE:** If the solution is heated to remove all the water then only **M1** can be awarded **NOTE** If the solution is left to evaporate all the water without heating only 1 mark can be awarded	**5**
	M2 until crystals form in a cooled sample/ on a glass rod	**ACCEPT** to crystallisation point /to form a saturated solution /until crystals start to form /to remove some of the water **M2** dep on **M1**	
	M3 leave the solution to cool/crystallise	**NOTE**: If the solution is left to completely evaporate after heating then award MAX 3	
	M4 filter (to remove the crystals)	**ACCEPT** decant the (excess) solution **IGNORE** references to washing the crystals	
	M5 dry the crystals on filter paper/on paper towel/in a warm oven /in a desiccator /leave to dry	**REJECT** hot oven or any method of direct heating e.g. Bunsen burner No **M5** if crystals washed after drying	

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f	i	• calculate the moles of CuO • calculate the mass of $CuSO_4.5H_2O$ • give the answer to an appropriate number of significant figures Example calculation **M1** *n*[CuO] = 9.54 ÷ 79.5 OR 0.120 (mol) **M2** mass of $CuSO_4.5H_2O$ = 0.120 × 249.5 **OR** 29.94 (g) **M3** = 29.9 **OR** **M1** 79.5 (g) → 249.5 (g) **M2** 9.94 (g) → (249.5 ÷ 79.5) × 9.54 (g) **OR** 29.94 (g) **M3** = 29.9	Final answer must be to 3 sig figs Final answer must be to 3 sig figs 29.94 with no working scores 2 29.9 with no working scores 3	**3**
	ii	**M1** (23.92 ÷ 29.9) × 100 OR (23.92 ÷ **M3** from (i)) × 100 **M2** = 80(%)	**ALLOW** use of **M2** from (i) 29.94 gives 79.89% **ALLOW** any number of sig figs **ACCEPT** answer of 79.7(3)% using 30g Correct answer without working scores 2	**2**
			Total	**14**

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