Secondary 3 (IP) EOY Answers

2017 Sec 3 End-of-Year Exam Chemistry Answers

Paper 1

1.	**B**	2.	**D**	3.	**D**	4.	**C**	5.	**A**
6.	**B**	7.	**B**	8.	**C**	9.	**B**	10.	**C**
11.	**C**	12.	**B**	13.	**C**	14.	**D**	15.	**B**
16.	**A**	17.	**B**	18.	**C**	19.	**A**	20	**B**
21.	**B**	22.	**B**	23.	**A**	24.	**D**	25.	**C**
26.	**D**	27.	**B**	28.	**A**	29.	**A**	30	**B**

Paper 2

Question	Answers	Marks
A1		
(a)	Spot **A** is **more soluble in water** than spot **B** while Spot C **is not/least soluble in water**.	[1]
(b)	He would observe that the boiling occurred over **a range of temperatures [1]**, because the colourless liquid was **impure**/**a mixture [1]**. Not accepted: The liquid contained several substances (vague)/the boiling point was higher (than the b.p. of which component? This is impossible to ascertain)	[2]
	Total	**[3]**
A2		
(a)	protons: 16 valence electrons: 6	[2]
(b)(i)	 Not penalized although not recommended: -Brackets for calcium/no brackets for sulfide -not pairing of “dot” with “cross” for transferred electrons	[1]
(b)(ii)	No. Calcium sulfide has a **giant ionic crystal lattice [1]** at room temperature. Its **ions are held in fixed positions/are not mobile [1]**. Note: Penalty for any contradictory terms e.g. use of “atoms”/”molecules” interchangeably with “ions”. Not penalised although not recommended: Use of “mobile charged particles” instead of “ mobile ions”.	[2]
	Total	**[5]**

A3

Concentration of H^+ ions for the solution = 0.001 mol dm^{-3}
Maximum concentration of H^+ ions from arsenic acid
= 0.0005 × 3
= 0.0015 mol dm^3 **[1]**

Since the **concentration of H^+ ions is lower than the maximum H^+ ion concentration [1]**, it shows that arsenic acid **does not dissociate fully [1]** and is a weak acid. [3]

Accept:
0.001/0.0005=2 [1]
At pH 3, **2 moles of H+ ions are produced per mole of acid** but H_3AsO_4 should be **tribasic**. [1]
This shows that arsenic acid **does not dissociate fully [1]** and is a weak acid.

Total [3]

A4

(a)(i) Gas syringe / eudiometer [1]

Accept: syringe

(a)(ii) $C_{12}H_{22}O_{11}$ [1]

(a)(iii) Assuming 100 g of compound, [2]

	C	H	O
mass / g	41.5	6.40	52.1
molar mass / g mol^{-1}	12.0	1.0	16.0
no of moles **[1]**	3.458	6.40	3.256
simplest ratio	1.062	1.965	1
mole ratio	1	2	1

empirical formula = CH_2O **[1]**

(a)(iv) When the number of atoms of some elements are very close together, there is a possibility that they appear to be the same number. [1]

Accept: The empirical formula method involves rounding off values to the nearest whole number, resulting in inaccuracies.

Reject: It is inaccurate because the ratios are not the same.

(b)(i) Filtration [1]

(b)(ii) Crystallisation [1]

Total [7]

A5

(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^3$ [1]

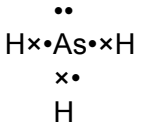
(b)(i) The two isotopes have different numbers of neutrons / numbers of nucleons / nucleon mass / atomic mass. [1]

(b)(ii) Let x be the percentage abundance of ^{73}As [2]
$74.9 = [75(100 - x) + 73x] \div 100$ **[1]**
$2x = 10$
x =5.00 % **[1]**

(c)	As arsenic molecules sublime, (arrangement) the molecules that were initially **closely packed** will move **far apart [1]**; (movement) molecules that were **vibrating about fixed positions** will move at **high speeds [1]** as a gas; (explanation) by **gaining heat energy** / **gaining kinetic energy** / **overcoming the intermolecular forces of attraction [1]**. Reject: gaseous molecules fly / float / move freely strong covalent bonds were broken	[3]
(d)	The **ease of losing electrons increases [1]** down the group / the **ease of gaining electrons decreases [1]** down the group.	[1]
	Total	**[8]**
A6		
(a)	**W** is copper(II) hydroxide / $Cu(OH)_2$ **Y** is ammonia / NH_3 No marks for missing oxidation state of copper	[2]
(b)	NH_4^+ and I^-	[2]
(c)	It is iodine / I_2 **[1]** $2NH_4I(aq) + Cl_2(g) \rightarrow 2NH_4Cl(aq) + I_2(s)$ **[1]** OR It is astatine / At_2 **[1]** $2NH_4At(aq) + Cl_2(g) \rightarrow 2NH_4Cl(aq) + At_2(s)$ **[1]**	[2]
(d)	Add acidified silver nitrate / acidified lead(II) nitrate. A yellow precipitate will form. (test for iodide / astatide ion by precipitation) OR Add aqueous bromine / Bubble fluorine gas. A black solid will form. (test for iodide / astatide ion by displacement)	[1]
(e)	Calcium sulfate is sparingly soluble so some of the calcium sulfate may have remained dissolved / calcium ion concentration was too low to form enough precipitate. Reject: Calcium is less reactive than barium so it did not react. Ammonia was present (it would have reacted with the acid). Barium hydroxide / carbonate was formed (it would have reacted with the acid).	[1]
	Total	**[8]**
A7		
(a)	A compound is made up of **two or more elements** that are **chemically combined**. Reject: Mixture of elements (the term mixture is different from compounds) Elements that are bonded together (need to be <u>different</u> elements) Mentioning “atoms” or “ions” (compounds can include both) Substances that are combined together (substances is vague)	[1]
(b)	Transition metal compounds tend to be coloured / have high	[1]

	melting and boiling point. Reject: Lustrous, shiny, malleable, ductile, less reactive to air/water, have different oxidation states (these are properties of the transition metals, not their compounds) Soluble / Insoluble in water (they are neither all soluble nor insoluble)	
(c)	$CrO_4^{2-}(aq) + Pb^{2+}(aq) \rightarrow PbCrO_4(s)$	[1]
(d)	TiC*l*4 is likely to be **simple or discrete molecules** / have a **simple molecular structure**. **[1]** Its low melting and boiling points show that it has **weak intermolecular forces of attraction [1]** that require little energy to overcome. Its lack of electrical conductivity in any state shows that there are **no mobile charged particles available [1]**. Accept: Simple covalent structure Reject: Simple covalent bond (bonding is different from structure) Any contradiction in answers (e.g. it has a simple molecular structure with weak electrostatic forces of attraction between ions).	[3]
	Total	**[6]**

B8		
(a)(i)	*n* $MgCO_3$ = 4.03 g/84.3 g mol^{-1} = 0.047805 mol *n* H_2SO_4 = (250/1000) dm^3 × 0.2 mol dm^{-3} = 0.05 mol **[1]** $MgCO_3$ is the limiting reagent **[1]** (*n* $MgCO_3$:*n* H_2SO_4 1:1) Mass of $MgSO_4$ = 0.047805 mol × 120.4 g mol^{-1} = 5.76 g (3sf) **[1]**	**[3]**
(a)(ii)	To increase the rate of reaction OR increase surface area OR ensure that reactants are evenly mixed *Not accepted: dissolve faster, ensure complete reaction of reactants*	**[1]**
(a)(iii)	The hydrated crystals decompose at high temperature OR water of crystallisation is lost (as steam) OR the anhydrous salt. $MgSO_4$, is formed.	**[1]**
(b)	126/246.4 × 100 = 51.1%	**[1]**
(c)	Magnesium oxide or magnesium hydroxide or magnesium **[1]** Reaction of dilute acid with (an excess of an insoluble) base/metal. **[1]** *Not accepted if formula is given* *Not accepted for method: neutralisation, titration, react acid with insoluble solid/reactant/substance*	**[2]**
(d)	Calcium sulfate is relatively insoluble **[1]** and will coat calcium carbonate and prevent further reaction with sulfuric acid **[1]** (Also accept low yield of calcium sulfate/ cannot separate calcium sulfate and calcium carbonate). *Not accepted if stated that product obtained will be impure without explanation about difficulty in separating product and reactant*	**[2]**

B9		
(a)	An element with properties intermediate between the metals and non-metals/properties of both metals and non-metals. *Not accepted references to compounds or alloys.*	**[1]**
(b)	**[1]** Gray arsenic **[1]** The presence of delocalized valence electrons	**[2]**
(c)(i)	 *Not accepted without lone pair of electrons; ionic formulations not accepted.*	**[1]**
(c)(ii)	Arsine is a simple covalent compound with a low boiling point, hence it has weak intermolecular forces between the molecules **[1]** and little energy is needed to overcome these forces of attraction. **[1]** Arsine is insoluble in water due to an inability to form strong interactions/intermolecular forces with water molecules. Accept reference to weak interactions/weak intermolecular forces **[1]** (Also accept reference to inability to hydrogen bonding). *Not accepted arsine molecules are non-polar.*	**[3]**
(d)	$3Cu^{2+} + 2AsO_3^{3-} \rightarrow Cu_3(AsO_3)_2$	**[1]**
(e)	Number of moles of As_2O_3 = 8870 g ÷ 197.8 g mol^{-1} =44.84 mol Number of moles of As = 89.69 mol **[1]** Mass of As = 6.717 kg % yield = 5.33 kg ÷ 6.717 kg × 100% = 79.4% **[1]**	**[2]**
EITHER B10		
(a)	Compounds are often colourless; one common oxidation state (one simple cation)	**[1]**
(b)(i)	310 seconds (±10 secs)	**[1]**
(b)(ii)	As the temperature decreases, the speed of the reacting particles (ions and/or molecules) (of the developer) decreases. **[1]** There are fewer particles that have a combined kinetic energy greater than or equal to the activation energy **[1]**. A lower frequency of effective collisions between silver bromide and sodium hydroxide particles and hence rate of film development decreases. **[1]** *Accepted answers that refer to an increase in temperature.*	**[3]**
(b)(iii)	As concentration increases, the rate of reaction for development increases [1] There are **more reacting particles per unit volume** and hence **more frequent effective collisions** between silver bromide and sodium hydroxide particles occur. **[1]**	**[2]**
(b)(iv)	The rate of reaction in developing the film is increased. **[1]** A smaller particle size (from the powdering) results in an increase in surface area (for the same mass) of silver ions exposed for reaction with the developer and hence more frequent effective collisions **[1]**	**[2]**
(c)	Darker areas received more light; hence, more silver ions changed to silver atoms. *Not accepted non-uniform spread of silver chloride – the answer needs to be focused on generation of an accurate negative.*	**[1]**

OR B10		
(a)	Bromine in solution is red/brown/orange and more strongly coloured /more intensely coloured/more darkly coloured (than chlorine) or chlorine in solution is pale green/almost colourless so less strongly coloured/paler/less intensely coloured *Accepted a reference to an increase in intensity of colour down group 17.*	**[1]**
(b)	From 0 - 5 minutes, the rate of displacement decreases **[1]** as the concentration of bromide ions decreases, the rate of displacement slows down as the concentration of bromide ions decreases, less reacting particles per unit volume and hence a greater frequency of effective collisions between bromide ions and chlorine gas. **[1]** From 5 – 6 minutes, the rate of displacement is zero **[1]** as the reaction stops since bromide ions (limiting reagent) are used up. **[1]**	**[4]**
(c) (i)	Experiments 2 and 3.	**[1]**
(c)(ii)	At a higher temperature, the particles have more kinetic energy **[1]** and hence move at higher average speeds resulting in a higher collision rate. At a higher temperature there is a greater proportion of particles with combined kinetic energies greater than the activation energy. **[1]** Hence a greater number of successful/effective collisions and a faster rate of reaction **[1]**	**[3]**
(d)	No reaction occurs since bromine is less reactive (accept less oxidizing) than chlorine	**[1]**