



A' Level Chemistry

Year 2

Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.



Grade Accelerator

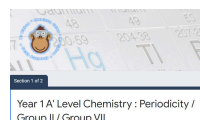
Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs

Quizlet

Quizlet Classes
Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker



Condensed Notes
Keywords & Definitions
Key Concepts
Application
Key Skills



Online Forms
Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.



1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!

2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy**.



If you struggle with the questions in the pack, **STOP!** and complete some more revision.



If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

0 6

This question is about some Period 3 elements and their oxides.

0 6 . 1

Write an equation for the reaction of phosphorus with an excess of oxygen.

[1 mark]

0 6 . 2

Describe a test you could carry out in a test tube to distinguish between sodium oxide and the product of the reaction in Question 6.1

[3 marks]

0 6 . 3

State the type of crystal structure shown in silicon dioxide and in sulfur trioxide.

[2 marks]

Silicon dioxide _____

Sulfur trioxide _____

0 6 . 4

Explain why silicon dioxide has a higher melting point than sulfur trioxide.

[4 marks]



0 6 . 5

Write an equation for the reaction of sulfur trioxide with potassium hydroxide solution.

[1 mark]

0 6 . 6

Write an equation for the reaction of an excess of magnesium oxide with phosphoric acid.

[1 mark]

0 6 . 7

Draw the displayed formula of the undissociated acid formed when sulfur dioxide reacts with water.

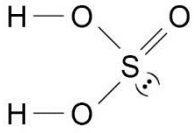
[1 mark]

Turn over for the next question

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Question	Answers	Mark	Additional Comments/Guidance
06.1	$P_4 + 5 O_2 \rightarrow P_4O_{10}$	1	allow $4 P + 5 O_2 \rightarrow P_4O_{10}$ allow multiples ignore state symbols
06.2	<p>React with water / add water / solution (of substances in question)</p> <p>Add litmus paper / universal indicator / measure pH (with pH meter)</p> <p><u>M3 is dependent on M2</u> Litmus: blue with sodium oxide (solution) and red with phosphorus oxide (solution) OR If blue litmus added phosphorus oxide solution goes red OR If red litmus added sodium (hydr)oxide goes blue</p> <p>Universal Indicator: blue/ purple with sodium oxide (solution) and red with phosphorus oxide (solution)</p> <p>pH meter or Universal Indicator: sodium (hydr)oxide (solution) has a higher pH (than phosphorus oxide (solution)) or vv</p> <p>sodium (hydr)oxide pH (12 to 14) and phosphorus oxide (solution) pH (-1 to 2)</p>	<p>1</p> <p>1</p> <p>1</p>	<p>If no M1 then CE = 0/3</p> <p>Allow other reagents in solution, eg sodium carbonate solution, that give a positive result Allow other indicators with appropriate colour changes</p> <p>For pH meter or Universal Indicator: allow sodium (hydr)oxide (solution) has a higher pH and phosphorus oxide (solution) has lower pH.</p>

06.3	For silicon dioxide - giant covalent (molecule)/ macromolecular For sulfur trioxide - molecular / (simple) molecule	1 1	Do not allow simple covalent
06.4	Covalent bonds (between atoms) in SiO ₂ Van der Waals <u>between molecules</u> / intermolecular forces in SO ₃ Covalent bonds are stronger than van der Waals forces (Covalent bonds) take more energy to be <u>overcome/broken</u> or (Van der Waals) take less energy to be <u>overcome/broken</u>	1 1 1 1	If covalent bonds between molecules of SiO ₂ lose M1 only If hydrogen bonds in SO ₃ lose M2 only If metallic or ionic max score = 1 (either M1 or M2) If IMF in SiO ₂ then max 1 (M2 only) Allow dipole-dipole forces between molecules For M3 and M4 comparison is required/implied
06.5	SO ₃ + 2KOH → K ₂ SO ₄ + H ₂ O SO ₃ + KOH → KHSO ₄ SO ₃ + 2OH ⁻ → SO ₄ ²⁻ + H ₂ O SO ₃ + OH ⁻ → HSO ₄ ⁻	1	Allow multiples Ignore state symbols
06.6	3 MgO + 2 H ₃ PO ₄ → Mg ₃ (PO ₄) ₂ + 3 H ₂ O	1	Allow multiples Ignore state symbols

Question	Answers	Mark	Additional Comments/Guidance
06.7		1	Ignore lone pairs
Total		13	

0 7 . 1 When anhydrous aluminium chloride reacts with water, solution **Y** is formed that contains a complex aluminium ion, **Z**, and chloride ions.

Give an equation for this reaction.

[1 mark]

0 7 . 2 Give an equation to show how the complex ion **Z** can act as a Brønsted–Lowry acid with water.

[1 mark]

0 7 . 3 Describe **two** observations you would make when an excess of sodium carbonate solution is added to solution **Y**.
Give an equation for the reaction. In your equation, include the formula of each complex aluminium species.

[3 marks]

Observation 1 _____

Observation 2 _____

Equation



0 7 . 4 Aqueous potassium hydroxide is added, until in excess, to solution Y.

Describe **two** observations you would make.

For each observation give an equation for the reaction that occurs.

In your equations, include the formula of each complex aluminium species.

[4 marks]

Observation 1 _____

Equation 1

Observation 2 _____

Equation 2

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Turn over for the next question

Turn over ►



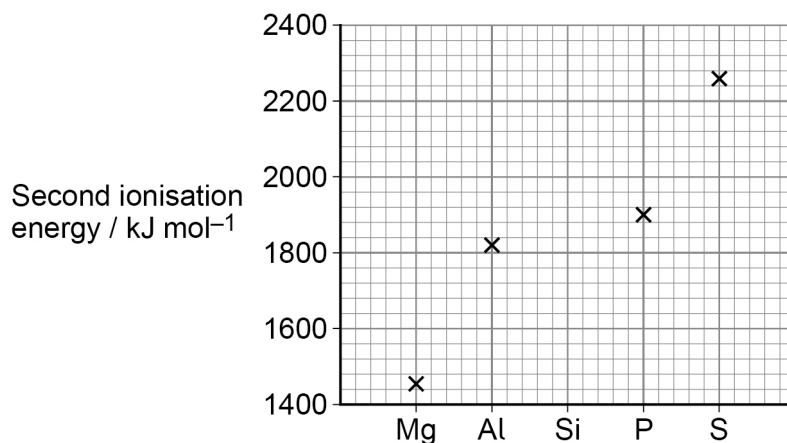
Question	Answers	Additional Comments/Guidance	Mark
07.1	$\text{AlCl}_3 + 6\text{H}_2\text{O} \rightarrow [\text{Al}(\text{H}_2\text{O})_6]^{3+} + 3\text{Cl}^-$	Allow $\text{AlCl}_3 + 6\text{H}_2\text{O} \rightarrow \text{Al}(\text{H}_2\text{O})_5(\text{OH})^{2+} + \text{H}^+ + 3\text{Cl}^-$ Or equation to form $\text{Al}(\text{H}_2\text{O})_4(\text{OH})_2^+$	1
07.2	$[\text{Al}(\text{H}_2\text{O})_6]^{3+} + \underline{\text{H}_2\text{O}} \rightarrow [\text{Al}(\text{H}_2\text{O})_5(\text{OH})]^{2+} + \underline{\text{H}_3\text{O}^+}$	allow equations to form $[\text{Al}(\text{H}_2\text{O})_4(\text{OH})_2]^+$	1
07.3	<u>white</u> ppt/solid	M1 and M2 in either order	1
	effervescence/bubbles/fizzing		1
	$2[\text{Al}(\text{H}_2\text{O})_6]^{3+} + 3\text{CO}_3^{2-} \rightarrow 2[\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3] + 3\text{CO}_2 + 3\text{H}_2\text{O}$		1
07.4	<u>White</u> ppt/solid	only allow spectator ions in a balanced equation	1
	$[\text{Al}(\text{H}_2\text{O})_6]^{3+} + 3\text{OH}^- \rightarrow [\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3] + 3\text{H}_2\text{O}$		1
	Colourless solution forms / ppt or solid dissolves		1
	$[\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3] + \text{OH}^- \rightarrow [\text{Al}(\text{H}_2\text{O})_2(\text{OH})_4]^- + \text{H}_2\text{O}$ OR $[\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3] + \text{OH}^- \rightarrow [\text{Al}(\text{OH})_4]^- + 3\text{H}_2\text{O}$		1
Total			9

0 3

This question is about Period 3 elements.

Figure 2 shows the **second** ionisation energies of some elements in Period 3.

Figure 2



0 3 . 1

Draw a cross (x) on **Figure 2** to show the **second** ionisation energy of silicon.

[1 mark]

0 3 . 2

Identify the element in Period 3, from sodium to argon, that has the highest **second** ionisation energy.

Give an equation, including state symbols, to show the process that occurs when the **second** ionisation energy of this element is measured.

If you were unable to identify the element you may use the symbol **Q** in your equation.

[2 marks]

Element _____

Equation

0 3 . 3

Explain why the atomic radius decreases across Period 3, from sodium to chlorine.

[2 marks]



0 3 . 4 Identify the element in Period 3, from sodium to chlorine, that has the highest electronegativity.

[1 mark]

0 3 . 5 Phosphorus burns in air to form phosphorus(V) oxide.
Give an equation for this reaction.

[1 mark]

7

Turn over for the next question

Turn over ►



Question	Answers	Additional comments/Guidelines	Mark
03.1	Cross at 1580	Allow a cross drawn for Si that is between the values for Mg and Al	1
03.2	M1 Na M2 $\text{Na}^+(\text{g}) \rightarrow \text{Na}^{2+}(\text{g}) + \text{e}^-$	M2 Allow $\text{Q}^+(\text{g}) \rightarrow \text{Q}^{2+}(\text{g}) + \text{e}^-$ State symbols essential Allow correct equation consequential on their element	1 1
03.3	The number of protons increases OR nuclear charge increases Shielding is similar/same OR electrons are added to the same shell	Allow same number of shells	1 1
03.4	Chlorine/Cl		1
03.5	$4\text{P} + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$ OR $\text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$	Allow multiples Ignore state symbols Do not allow equations with P_2O_5	1

0 3

This question is about elements in Period 3 and their compounds.

0 3 . 1

When a piece of sodium is added to 200 cm³ of water in a large beaker a vigorous reaction occurs. The temperature of the water increases by 25 °C

Give an equation, including state symbols, for the reaction of sodium with water.

Suggest why it is dangerous to react a similar piece of sodium with 10 cm³ of water in a boiling tube.

[2 marks]

Equation

Why it is dangerous

0 3 . 2

Give an equation for the reaction of phosphorus(V) oxide with water.

Suggest a pH for the solution formed.

[2 marks]

Equation

pH

0 3 . 3

Explain, in terms of crystal structure and bonding, why silicon(IV) oxide has a higher melting point than phosphorus(V) oxide.

[4 marks]



0 3 . 4 An element in Period 3 forms an oxide that is insoluble in water.
This oxide reacts with sulfuric acid and with aqueous potassium hydroxide.

Give the formula for this oxide.

Give an equation for the reaction of this oxide with sulfuric acid.

[2 marks]

Formula _____

Equation _____

0 3 . 5 Give the formula of a hydroxide of an element in Period 3 used in medicine.

[1 mark]

0 3 . 6 Identify the element in Period 3, from sodium to chlorine, that has the
largest atomic radius.

[1 mark]

12

Turn over for the next question

Turn over ►



Question	Answers	Additional comments/Guidelines	Mark
03.1	$2 \text{Na(s)} + 2 \text{H}_2\text{O(l)} \rightarrow 2 \text{NaOH(aq)} + \text{H}_2\text{(g)}$	Allow ionic equations Allow multiples	1
	Temperature will go up more or reactants can shoot out of the tube	Allow the mixture could explode or glass could shatter or hydrogen could ignite/is flammable Ignore reaction is exothermic/vigorous	1

Question	Answers	Additional comments/Guidelines	Mark
03.2	$\text{P}_4\text{O}_{10} + 6 \text{H}_2\text{O} \rightarrow 4 \text{H}_3\text{PO}_4$	Allow ionic equations	1
	Allow -1 to + 2	Do not allow equations from P_2O_5	1

Question	Answers	Additional comments/Guidelines	Mark
03.3	M1 SiO_2 is macromolecular / giant covalent / giant molecule	Do not allow giant, giant atomic or giant ionic	1
	M2 Strong <u>covalent</u> bonds (between atoms) or <u>covalent</u> bonds need a lot of energy to be broken/overcome		1
	M3 P_4O_{10} is <u>molecular</u> or <u>simple covalent molecule</u>		1
	M4 Weak van der Waals forces <u>between molecules</u> or van der Waals forces <u>between molecules</u> break easily		1

Question	Answers	Additional comments/Guidelines	Mark
03.4	Al_2O_3		1
	$\text{Al}_2\text{O}_3 + 3 \text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3 \text{H}_2\text{O}$ or $\text{Al}_2\text{O}_3 + 6 \text{H}^+ \rightarrow 2 \text{Al}^{3+} + 3 \text{H}_2\text{O}$		1

Question	Answers	Additional comments/Guidelines	Mark
03.5	$\text{Mg}(\text{OH})_2$		1

Question	Answers	Additional comments/Guidelines	Mark
03.6	Na / sodium		1

0 5

This question is about Period 3 elements and their compounds.

0 5 . 1Which is **not** a correct statement about magnesium hydroxide?**[1 mark]**Tick (✓) **one** box.

It is used to neutralise stomach acid

It forms a solution with pH = 14 at 25 °C

It has the empirical formula H_2MgO_2 **0 5 . 2**

Give an equation for the reaction of aluminium oxide with sulfuric acid.

[1 mark]

0 5 . 3

Identify a reagent or test that could be used to distinguish between aqueous solutions of sulfur dioxide and sulfur trioxide with the same concentrations.

State the observation in each case.

[3 marks]

Reagent or test _____

Observation with sulfur dioxide solution _____

Observation with sulfur trioxide solution _____

Question 5 continues on the next page**Turn over ►**

0 5 . 4 The mass spectrum of the element phosphorus has a peak at $\frac{m}{z} = 124$

Give the formula of the species responsible for this peak.

[2 marks]

0 5 . 5 Give an equation for the reaction of phosphorus(V) oxide with sodium hydroxide solution.

[1 mark]

0 5 . 6 Draw the displayed formula of the molecule formed when phosphorus(V) oxide reacts with water.

[1 mark]



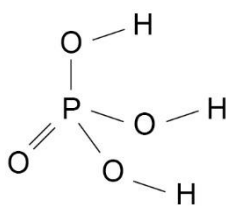
Question	Answers	Additional Comments/Guidelines	Mark
05.1	forms a solution with pH = 14 at 25°C		1 AO1

Question	Answers	Additional Comments/Guidelines	Mark
05.2	$\text{Al}_2\text{O}_3 + 3\text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$	allow multiples ignore state symbols	1 AO2

Question	Answers	Additional Comments/Guidelines	Mark
05.3	universal indicator SO ₂ (aq) orange-red SO ₃ (aq) red or pH meter SO ₂ (aq) pH 2–3 SO ₃ (aq) pH 0–1 or any named metal carbonate (or formula) or Mg or Ca or Zn SO ₂ (aq) slower effervescence SO ₃ (aq) faster effervescence	if reagent is incomplete lose M1 and mark on allow correct comparison of acidic colours (red, orange, yellow) allow correct comparison of acidic pH ignoring values allow observation allow correct comparison allow named oxidising agent eg (acidified) KMnO ₄ or (acidified) K ₂ Cr ₂ O ₇ SO ₂ (aq) correct colour acidified change SO ₃ (aq) no visible change or NVC allow (acidified) barium chloride solution or allow (acidified) barium chloride solution SO ₂ (aq) no visible change or NVC SO ₃ (aq) white precipitate	1 1 1 AO3

Question	Answers	Additional Comments/Guidelines	Mark
05.4	$^{31}\text{P}_4^+$	Allow P_4^+ = 1 mark Allow ^{31}P = 1 mark	2 AO3

Question	Answers	Additional Comments/Guidelines	Mark
05.5	$\text{P}_4\text{O}_{10} + 12\text{NaOH} \rightarrow 4\text{Na}_3\text{PO}_4 + 6\text{H}_2\text{O}$	allow formation of acid salts $\text{P}_4\text{O}_{10} + 4\text{NaOH} + 2\text{H}_2\text{O} \rightarrow 4\text{NaH}_2\text{PO}_4$ $\text{P}_4\text{O}_{10} + 8\text{NaOH} \rightarrow 4\text{Na}_2\text{HPO}_4 + 2\text{H}_2\text{O}$	1 AO1

Question	Answers	Additional Comments/Guidelines	Mark
05.6		must show all bonds	1 AO2

Question	Answers	Additional Comments/Guidelines	Mark
05.7	<p>This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.</p> <p>Level 3 5–6 marks</p> <p>All stages are covered and the description of each stage is generally correct and virtually complete.</p> <p>Answer is communicated coherently and shows a logical progression from stage 1 to stage 2 and stage 3.</p>	<p>indicative chemistry content contradictions negate statements</p> <p>Stage 1 structure</p> <p>1a) NaCl ionic lattice or giant ionic 1b) Cl₂ and HCl molecular (covalent) or Cl₂ and HCl are (simple) molecules</p>	6 AO1 AO3
	<p>Level 2 3–4 marks</p> <p>All stages are covered but the description of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete.</p> <p>Answer is mainly coherent and shows progression from stage 1 to stage 2 and/or stage 3.</p>	<p>Stage 2 forces responsible for melting point</p> <p>2a) NaCl <u>attractions</u> between + and – ions 2b) Cl₂ vdw forces 2c) HCl dipole dipole forces</p> <p>Stage 3 comparison of melting point</p> <p>3a) ionic bonds stronger than IMF 3b) chlorine/Cl₂ is a bigger (molecule) than HCl or chlorine/Cl₂ has more electrons than HCl 3c) more/stronger forces <u>between molecules</u> in Cl₂ than those in HCl or more/stronger <u>IMF</u> in Cl₂ than those in HCl or vdw <u>between molecules</u> in Cl₂ > dipole dipole between molecules in HCl</p>	

Question	Answers	Additional Comments/Guidelines	Mark
05.7 cont	<p>Level 1 1–2 marks</p> <p>Two stages are covered but the description of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete.</p> <p>Answer includes isolated statements and these are presented in a logical order.</p> <p>Level 0 0 marks</p> <p>Insufficient correct chemistry to gain a mark.</p>		