A Level AQA Chemistry

Chapter 3 – answers

OXFORD Revise

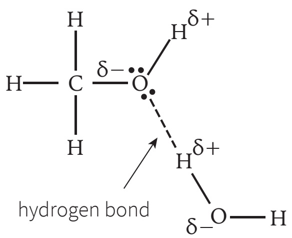
Question	Answers	Extra information	Mark	AO Spec reference
01.1	Strong attraction between oppositely charged ions Large amount of energy needed to overcome attraction	Allow named charges and ions	1 1	AO1 3.1.3.1 3.1.3.4
01.2	Ions can bond to water/ can be attracted to polar bonds/H bonds of water		1	AO1 3.1.3.1 3.1.3.4
01.3	$K(s) + H_2O(l) \rightarrow K^+(aq) + OH^-(aq) + \frac{1}{2}H_2\ (g)$	Accept multiples Must include state symbols	1 1	AO1 3.1.2.5
01.4	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$		1	AO1 3.1.1.3
01.5	This question is marked using Levels of Response. Examiners should apply a 'best-fit' approach to the marking. **Level 3 (5–6 marks)** All stages are covered and the explanation of each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from stage 1 to stage 2, stage 3, and then stage 4. Coherent communication requires that there is a comparison between the types of bonding and that the bonding is correct for each substance.	**Indicative Chemistry Content** **Stage 1: – K** 1a K has metallic bonding 1b there is attraction/ bonding between the positive nucleus/ ion and the delocalised electrons in K 1c K has a giant/lattice structure **Stage 2: – KBr** 2a Ionic bonding in KBr 2b There is attraction/ bonding between the + and – ions in KBr 2c KBr has a giant/lattice structure	6	AO3 3.1.3.1 3.1.3.2 3.1.3.3 3.1.3.4

A Level AQA Chemistry
Chapter 3 – answers

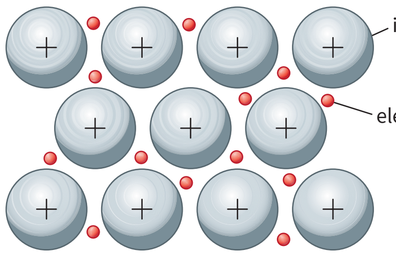
Question	Answers	Extra information	Mark	AO Spec reference
	Level 2 (3–4 marks) All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete. Answer is mainly coherent and shows some progression from stage 1 to stage 2, stage 3 and then stage 4. **Level 1 (1–2 marks)** Two stages are covered but the explanation 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. Answer shows some progression between two stages	**Stage 3: –** Br_2 3a Covalent (molecular) bonding 3b shared pair of electrons 3c van der Waals forces of attraction **Stage 4: – comparison of bonding** 3a The ionic bonds are stronger (or wtte) than the metallic bonds and/or vdw forces 3b there is stronger attraction (or wtte) between the + and – ions in KBr than in K or Br_2 3c so more energy is needed to overcome the forces increasing the melting point		
02.1	Attraction between positive metals ions 'sea' of delocalised electrons		1 1	3.1.3.3 AO1
02.2	Rows of ions can slide over each other		1	3.1.3.3 AO1
02.3	Fe_2O_3		1	3.1.2.4 AO1
02.4	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$		1	AO1 3.1.1.3
02.5	Iron has a sea of delocalised electrons which can move to carry the charge Iron oxide has ions which cannot move (in solid state) so charge can't be carried	OWTTE	1 1 1 1	3.1.3.4 AO1

A Level AQA Chemistry

Chapter 3 – answers

Question	Answers	Extra information	Mark	AO Spec reference
03.1	Covalent bonds Shared pair of electrons		1 1	3.1.3.1 AO1
03.2	Ethanol can form hydrogen bonds Propane has van der Waals H bonds require more energy to break		1 1 1	3.1.3.7 AO3
03.3	 1st mark showing correct structures of both molecules 2nd mark δ+ and δ− charges on H and O respectively 3rd mark H bond (dotted or dashed line) from lone pair on O to H		3	3.1.3.7 AO3
03.4	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$		1	3.1.2.5 AO2
03.5	$\frac{25}{46} = 0.543$ mol $V = \frac{nRT}{P}$ OR $\frac{(0.54 \times 5 \times 8.31 \times 2000)}{101 \times 10^3} = V$ $= 0.444\ m^3$	Allow e.c.f. Mark 2 for recall of formula mark 3 for moles of gas = mol ethanol × 5 Final mark for correct rounding of their answer	1 1 1	3.1.2.3 AO2 MS0.0, 2.2, 2.3, 2.4

A Level AQA Chemistry
Chapter 3 – answers

Question	Answers	Extra information	Mark	AO Spec reference
04.1		Mark 1 Must be ions. Either by label or by showing + charge Mark 2 Must be 9 electrons (or equal to number of atoms	1 1	3.1.3.3 AO1
04.2	<u>Ions</u> can slide past each other	Penalise use of atoms Allow rows	1	3.1.3.4 AO1
04.3	$5s^1\ 4d^{10}$	Can be in either order	1	3.1.1.3 AO3
04.4	Marks awarded for this answer will be determined by the quality of written communication as well as the standard of the scientific response. Examiners should apply a ‘best-fit’ approach to the marking. **Additional tests limits to lower mark within a level.** This would include, for example, adding silver nitrate to the already identified sodium carbonate. Use of hydrochloric acid with silver nitrate also limits to lower mark within a level as this would not be a logical sequence/method that would work. Level 3 5–6 marks: All stages are covered and each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from Stage 1 to Stages 2 and 3 to identify all three compounds in a logical sequence with results and equations for all compounds stated. **Covers 2 tests with matching observations, conclusions and equations**		6	3.2.3.1 AO3

A Level AQA Chemistry

Chapter 3 – answers

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr>
<td></td>
<td>
<table>
<tr><td>Level 2

3–4 marks</td><td>All stages are covered but stage(s) may be incomplete or may contain inaccuracies

OR two stages are covered and are generally correct and virtually complete.

Answer is communicated mainly coherently and shows a logical progression from Stage 1 to Stages 2 and 3.

Covers 2 compounds

Isolated tests on named compounds – max LEVEL 2</td></tr>
<tr><td>Level 1

1–2 marks</td><td>Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR only one stage is covered but is generally correct and virtually complete.

Answer includes isolated statements but these are not presented in a logical order.</td></tr>
</table>
</td>
<td>Indicative Chemistry Content

Stage 1: Suggested tests
1a Add named acid to all 3 (not HCl)
1b Add $AgNO_3$
1c addition of dilute NH_3
Ignore additional test for CO_2 produced

Stage 2: Expected observations – conclusions
2a Na_2CO_3 will fizz with acid
2b NaCl gives white ppt with $AgNO_3$ which dissolves in NH_3
2c NaBr give a cream ppt with $AgNO_3$ that does not dissolve in dilute ammonia
Additional incorrect observations loses mark
Stage 3: Equations – state symbols must match method
3a $Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + CO_2 + H_2O$ … or ionic
3b $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$ … or ionic

OR

$AgNO_3 + NaBr \rightarrow AgBr + NaNO_3$ … or ionic
3c correct state symbols</td>
<td></td>
<td></td>
</tr>
</table>

A Level AQA Chemistry

Chapter 3 – answers

OXFORD Revise

Question	Answers	Extra information	Mark	AO Spec reference
05.1	This question is marked using Levels of Response. Examiners should apply a ‘best-fit’ approach to the marking.	**Indicative Chemistry Content** Contradictions (eg molecules, IMFs, covalent bonding,) negate statements. **Stage 1: – Water** 1a Has hydrogen bonding 1b Between H atom and long pair on oxygen 1c Can form 2 H bonds **Stage 2: – Ammonia** 2a Has hydrogen bonding 2b between H atom and lone pair on nitrogen 2c can form 1 H bond **Stage 3: – Methane** 3a van der Waals forces of attraction 3b caused by temporary dipoles **Stage 4: – Comparison of bonding** 3a The hydrogen bonds are stronger (or wtte) than the vdw forces 3b Water makes more H bonds than ammonia 3c so more energy is needed to overcome the forces increasing the boiling point	6	3.1.3.7 AO3
	Level 3 (5–6 marks) All stages are covered and the explanation of each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from stage 1 to stage 2, stage 3 and then stage 4. Coherent communication requires that there is a comparison between the types of bonding and that the bonding is correct for each substance.			
	Level 2 (3–4 marks) All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete. Answer is mainly coherent and shows some progression from stage 1 to stage 2, stage 3 and then stage 4.			
	Level 1 (1–2 marks) Two stages are covered but the explanation 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. Answer shows some progression between two stages			

A Level AQA Chemistry
Chapter 3 – answers

Question	Answers	Extra information	Mark	AO Spec reference
05.2	Ammonia can form hydrogen bonds with H_2O Methane is not polar / cannot form hydrogen bonds		1 1	AO1 3.1.3.4 3.1.3.6
05.3	Ammonia: 3 bonding pairs + 1 lone pair Pyramidal and 107° Diagram Boron trihydride: 3 bonding pairs + 0 lone pairs Trigonal planar and 120° Diagram	Diagram for ammonia must include lone and dash/wedge bonds Diagram for BH_3 does not need lp or wedge/dash bonds	1 1 1 1 1 1	AO3 AO1 3.1.3.5
05.4	Dative (covalent) bond Both electrons come from nitrogen /same atom	Allow both e^- come from ammonia	1 1	3.1.3.2 AO1
05.5	Moles ammonium chloride = $\frac{25\,000}{53.5}$ = 467.3 (467.2897) Mass NH_3 = 467.3 × 17 = 7 943.9g (7 944.1) = 7.94 kg	Allow e.c.f., give full credit to any method that produces the correct answer	1 1 1 1	3.1.2.5 MS0.4 AO2
05.6	Moles of HCl = 467.3 $V = \frac{\text{mol}}{\text{conc}} = \frac{467.3}{2.5} = 186.9\,\text{dm}^3$	For 500 moles $\frac{500}{25} = 20\,\text{dm}^3$	1 1	3.1.2.5 MS0.4 AO2

A Level AQA Chemistry
Chapter 3 – answers

Question	Answers	Extra information	Mark	AO Spec reference
05.7	Ammonium chloride is a (giant) ionic (lattice) / ionically bonded Strong attraction between oppositely charged ions Ammonia is simple molecular Hydrogen bonds between molecules Ionic bonds are stronger so more energy needed to separate ions or reserves argument	Allow named ions Ignore 'covalent ' as the intermolecular forces Ignore van der waals/London etc.	1 1 1 1 1	3.1.3.4 3.1.3.7 AO3
06.1	Water has hydrogen bonds Dihydrogen sulfide only has van der Waals forces H bonds are much stronger than van der Waals forces	Allow dipole-dipole interaction/ forces	1 1 1	3.1.3.6 3.1.3.7 AO3
06.2	Both have van der Waals forces only Dihydrogen selenide has more electrons so stronger van der Waals	Allow reverse argument	1 1	3.1.3.7 AO3
06.3	As the water freezes the molecules a held in an expanded structure	Allow any reference to larger spaces between molecules caused by hydrogen bonds	1	AO1
06.4	2 bonding pairs and 2 lone pairs Correct V shape shown labelled bent or non-linear Bond angle of 104.5°		1 1 1	AO1
06.5	Giant covalent	Allow covalent macromolecule	1	3.1.3.5 AO1
06.6	Diamond has 4 covalent bonds between carbon atoms Graphite has layers which can slide past each other		1 1	3.1.3.5 AO1
06.7	Graphite has delocalised electrons Which can move/flow to carry charge/current		1 1	3.1.3.5 AO1

A Level AQA Chemistry

Chapter 3 – answers

Question	Answers	Extra information	Mark	AO Spec reference
06.8	Both are giant covalent (macromolecules) Melting needs the strong covalent bonds to be broken	 OWTTE	1 1	3.1.3.5 AO1
06.9	Diamond (4 bonding pairs) Tetrahedral 109.5° Diagram much use wedge/dash bonds Graphite (3 bonding pairs + 0 lone pairs) Trigonal planar 120° Diagram	Diagrams do not have to be to scale as long as they are able to communicate the basic shape Graphite diagram must show hexagonal structure but does not need to show layers (as the Q refers to repeated structure of carbon atoms)	 1 1 1 1 1 1	AO3 AO1 3.1.3.5
07.1	Decreases Increase in shielding		1 1	3.1.1.3 AO1
07.2	Iodine has more electrons Stronger van der Waals forces		1 1	3.1.3.7 AO1
07.3	Fluoride has a full outer shell No space for more electrons so no further reactions		1 1	3.1.1.1 AO1
07.4	$Xe(g) + 2F_2(g) \rightarrow XeF_4(s)$		1	3.1.2.5 AO2

A Level AQA Chemistry
Chapter 3 – answers

OXFORD Revise

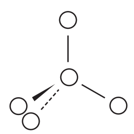
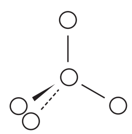
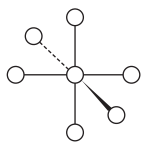
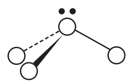
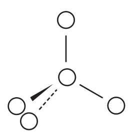
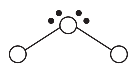
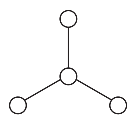
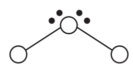
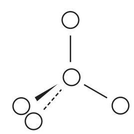
Question	Answers	Extra information	Mark	AO Spec reference
07.5	XeF_4 (4 bonding pairs, 2 lone pairs) Square planar 90 Diagram KrF_2 (2 bonding pairs 3 lone pairs) linear 180 Diagram	Diagrams do not have to be to scale as long as they are able to communicate the basic shape Diagrams must show lone pairs and wedge/dash bonds if appropriate to indicate shape	 1 1 1 1 1 1	AO3 AO1 3.1.3.5
07.6	Van der Waals / permanent dipole-permanent dipole		1	3.1.3.5 AO3
07.7	M_r XeF_2 = 131.3 + 19 + 19 = 169.3 $\frac{4500}{169.3}$ = 26.58 moles		1 1 1	3.1.2.5 AO2
08.1	Al ion is a 3+ ion Oxygen is a 2– ion Small highly charged ions form strong bonds	 Allow hard to break/separate	1 1 1	3.1.3.1 AO3
08.2	Radii decreases Increasing nuclear charge Same shielding		1 1 1	3.1.1.3 3.2.1.2 AO2

A Level AQA Chemistry
Chapter 3 – answers

Question	Answers	Extra information	Mark	AO Spec reference
08.3	$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$	Allow Al_2Cl_6 Allow multiples	1	3.1.2.5 3.2.1.2 AO1
08.4	Dative (Covalent bond) formed with both electrons from one atom	Allow co-ordinate bond	1 1	3.1.3.2 AO1
08.5	Aluminium chloride is molecular covalent Weak forces of van der Waals between molecules Aluminium oxide is ionic Strong electrostatic forces between oppositely charged ions More energy needed to separate the ions		1 1 1 1 1	3.1.3.4 3.2.1.2 AO1 AO3
08.6	It is a covalent molecules No free electrons/ions to carry charge/flow		1 1	3.1.3.4 3.2.1.2 AO1

A Level AQA Chemistry
Chapter 3 – answers

Skills Boxes answers

		$AlCl_4^-$	PCl_4^+	PCl_6^-	IF_5	NH_4^+	OF_2	IF_3	NH_2^-	SO_4^{2-}
Step 1	central atom	3	5	5	7	5	6	7	5	6
Step 2	outer atoms	4 × 1	4 × 1	6 × 1	5 × 1	4 × 1	2 × 1	3 × 1	2 × 1	4 × 2
Step 3	charge?	+ 1	–1	+1	0	–1	0	0	+1	+2
Step 4	total e⁻	8	8	12	12	8	8	10	8	16
	e⁻ pairs	4	4	6	6	4	4	5	4	8
Step 5	double/ triple bond	0	0	0	0	0	0	0	0	4 (S=O)
Step 6	lone pairs	0	0	0	1	0	2	2	2	0
Answer	a) drawing									
	b) shape	tetrahedral	tetrahedral	octahedral	square pyramidal	tetrahedral	non-linear	trigonal planar	non-linear	tetrahedral
	c) angle / °	109.5	109.5	90	82	109.5	104.5	120	104.5	109.5