Question	Marking Guidance	Mark	Comments
1(a)	(Total number of) protons and neutrons (in nucleus of atom)	1	(number of) nucleons
1(b)	Zn	1	Do not allow Zn^{-1} or Zn^{+1} or ZN Ignore numbers
1(c)(i)	P = ionise (sample) Q = accelerate (sample)	1 1	Allow removing an electron / forms (+) ions Allow speeds (ions) up Penalise molecules / atoms
1(c)(ii)	m/z (relative) abundance / (relative) intensity	1 1	Allow mass / charge QoL Allow M1 + M2 in any order
1(d)(i)	$\frac{206 + 207 + (208 \times 2)}{4} = \frac{(829)}{4}$ = 207.3	1 1 1	M1 = topline M2 = ÷ 4 Only 207.3 = 3 marks
1(d)(ii)	Lead/Pb	1	Not PB
1(d)(iii)	Same number of electrons (in outer shell) / same electronic configuration	1	Ignore electrons determine chemical properties Ignore reference to p and n if correct Penalise if incorrect

Question	Marking Guidance	Mark	Comments
2(a)(i)	Higher than P	1	
2(a)(ii)	$1s^2\ 2s^2 2p^6 3s^1$	1	Allow any order
2(a)(iii)	$Al^{+}(g) + e^{(-)} \longrightarrow Al^{2+}(g) + 2e^{(-)}$ *OR* $Al^{+}(g) \longrightarrow Al^{2+}(g) + e^{(-)}$ *OR* $Al^{+}(g) - e^{(-)} \longrightarrow Al^{2+}(g)$	1	
2(a)(iv)	Electron in Si (removed from) (3)p orbital / electron (removed) from higher energy orbital or sub-shell / electron in silicon is more shielded	1	Accept converse arguments relating to Al Penalise incorrect p-orbital
2(b)	Sodium / Na Electron (removed) from the 2nd shell / 2p (orbital)	1 1	Allow Na^{+} M2 is dependent on M1 Allow electron from shell nearer the nucleus (so more attraction)
2(c)	Silicon / Si	1	Not SI
2(d)	Heat or energy needed to overcome the attraction between the (negative) electron and the (positive) nucleus or protons Or words to that effect eg electron promoted to higher energy level (infinity) so energy must be supplied	1	Not breaking bonds QoL

Question	Marking Guidance	Mark	Comments
3(a)(i)	The power of an atom or nucleus to withdraw or attract electrons *OR* electron density *OR* a pair of electrons (towards itself)	1	Ignore retain
	In a covalent bond	1	
3(a)(ii)	More protons / bigger nuclear charge	1	
	Same or similar shielding / electrons in the same shell or principal energy level / atoms get smaller	1	Not same sub–shell Ignore more electrons
3(b)	Ionic	1	If not ionic then CE = 0/3 If blank lose M1 and mark on
	Strong or many or lots of (electrostatic) attractions (between ions)	1	If molecules / IMF / metallic / atoms lose M2 + M3, penalise incorrect ions by 1 mark
	Between + and – ions / between Li^+ and F^- ions / oppositely charged ions	1	Allow strong (ionic) bonds for max 1 out of M2 and M3
3(c)	Small electronegativity difference / difference = 0.5	1	Must be comparative Allow 2 non-metals
3(d)(i)	(simple) molecular	1	Ignore simple covalent
3(d)(ii)	$OF_2 + H_2O \longrightarrow O_2 + 2HF$	1	Ignore state symbols Allow multiples Allow OF_2 written as F_2O
3(d)(iii)	45.7% O	1	
	(O F) (45.7 54.3) (16 19)	1	If students get M2 upside down lose M2 + M3 Check that students who get correct answer divide by 16 and 19 (not 8 and 9). If dividing by 8 and 9 lose M2 and M3 but could allocate M4 ie max 2
	(2.85 2.85) (1 1)		
	EF = OF or FO	1	Calculation of OF by other correct method = 3 marks Penalise Fl by 1 mark
	MF (= 70.0/35) = O_2F_2 or F_2O_2	1	

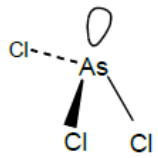
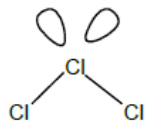
4)

estion	Marking Guidance	Mark	Comments
5(a)	P = 100 000 Pa and T = 298 K	1	Wrong conversion of V or incorrect conversion of P/T lose M1 + M3
	$n = \frac{PV}{RT}$ or $\frac{100\,000 \times 4.31}{8.31 \times 298}$	1	If not rearranged correctly then cannot score M2 and M3
	n(total) = 174(.044)	1	
	n (NO) = 69.6	1	Allow student's M3 x 4/10 but must be to 3 significant figures
(b)(i)	$\frac{3000}{17}$	1	Allow answer to 2 significant figures or more
	176.5	1	Allow 176–177 But if answer = 0.176 – 0.18 (from 3/17) then allow 1 mark

b)(ii)	176.47 x 46 = 8117.62 8117.62 x $\frac{80}{100}$ (= 6494 g) $\frac{6494}{1000}$ = 6.5 *OR* If 163 mol used: 163 x 46 = 7498 (1) 7498 x $\frac{80}{100}$ = 5998.4 g (1) 6.00 kg (1)	1 1 1	M1 is for the answer to (b)(i) x 46. But lose this mark if 46 ÷ 2 at any stage However if 92 ÷ 2 allow M1 M2 is for M1 x 80/100 M3 is for the answer to M2 ÷ 1000 to min 2 significant figures (kg)

(c)	0.543 x $\frac{2}{3}$ (= 0.362) 0.362 x $\frac{1000}{250}$ = 1.45 (mol dm^{-3})	1 1	If not x $\frac{2}{3}$ CE = 0/2 Allow 1.447-1.5 (mol dm^{-3}) for 2 marks
(d)	NO_2 contributes to acid rain / is an acid gas / forms HNO_3 / NO_2 is toxic / photochemical smog	1	Ignore references to water, breathing problems and ozone layer. Not greenhouse gas
(e)	Ensure the ammonia is used up / ensure complete reaction or combustion *OR* Maximise the yield of nitric acid or products	1	
(f)	Neutralisation	1	Allow acid vs alkali or acid base reaction

5)

stion	Marking Guidance	Mark	Comments
a)		1	Mark is for 3 As-Cl bonds and 1 lone pair
	(Trigonal) pyramid(al) / tetrahedral	1	Allow triangular pyramid
		1	Mark is for 2 Cl-Cl bonds and 2 lone pairs Do not penalise if + not shown
	Bent / V-shaped / triangular	1	Not trigonal
b)	There are 4 bonds or 4 pairs of electrons (around As) (Electron pairs / bonds) repel equally	1 1	Can show in a diagram. If lone pair included in shape, CE = 0/2 QoL

6)

Q	Part	Sub Part	Marking Guidance	Mark	Comments
8	a	i	$2CuFeS_2 + 2SiO_2 + 4O_2 \longrightarrow Cu_2S + 2FeSiO_3 + 3SO_2$	1	
8	a	ii	Acid rain *OR* an effect either from acid rain or from an acidic gas in the atmosphere	1	
8	a	iii	SO_2 could be used to make H_2SO_4 *OR* to make gypsum / plaster or $CaSO_4(xH_2O)$	1	
8	b		$Cu_2S + 2O_2 \longrightarrow 2CuO + SO_2$	1	Or multiples Ignore state symbols
8	c		$2CuO + C \longrightarrow 2Cu + CO_2$ *OR* $CuO + C \longrightarrow Cu + CO$	1	Or multiples Ignore state symbols
8	d	i	*Any one from the following two ONLY* • (Scrap) iron is cheap • Low energy requirement	1	Apply the list principle Not "less energy"
8	d	ii	$Fe + Cu^{2+} \longrightarrow Fe^{2+} + Cu$	1	Or multiples Ignore state symbols