



Question	Answer	Marks	AO Element	Notes	Guidance
1(a)(i)	A (1) H (1)	2			
1(a)(ii)	B	1			
1(a)(iii)	D	1			
1(a)(iv)	C and G OR C and E	1			
1(b)	F (1) third / outer shell is being filled before second shell is full; second shell has 6 electrons: it should have 8 electrons (1)	2			
1(c)	12	1			
1(d)(i)	H ⁻	1			
1(d)(ii)	aluminium / Al	1			
2	ethanol: (forces of attraction) between molecules (1) sodium chloride: (force of attraction) between positive and negative ions/ionic bonding (1)	2			

Question	Answer	Marks	AO Element	Notes	Guidance
3	same number of electrons same electronic configuration	2			
4	Mg octet of eight dots O octet of six crosses and two dots correct charges on both ions	3			
5(a)	functional group	1			
5(b)	M1 4 × C–H dot cross bonds and 1 C–C dot cross bond M2 1 × C=O dot cross bond M3 non-bonding electrons on O	3			
6(a)	magnesium 2.8 (all crosses) (1) fluorine 2.8 (seven dots and one cross in outer shell) (1) Mg ²⁺ and F ⁻ (1)	3			
6(b)	MgF ₂	1			
7	two single bonds (1) one double bond (1) six non-bonding electrons on both F atoms and four non-bonding electrons on O atom to complete the octet in each case (1)	3			

Question	Answer	Marks	AO Element	Notes	Guidance
8	Ca has 2 and Cl has 7 outer electrons (1) Ca (atoms) lose electrons (1) Cl (atoms) gain electrons (1) Ca ²⁺ (ions) (1) Cl ⁻ (ions) (1)	5			
9	oppositely charged ions (ions) are attracted	2			
10(a)	any number in the range 72–129 °C	1			
10(b)	attraction increase (1) between molecules (1)	2			
11	3 P–Cl dot cross bonds (1) 2 (only) non-bonding electrons to make an octet on P (1) 6 (only) non-bonding electrons to make an octet on each Cl (1)	3			

Question	Answer	Marks	AO Element	Notes	Guidance
12	all bonding pairs correct (1) H atoms have 2 electrons and C and O atoms have 8 electrons (1)	2			
13(a)	F	1			
13(b)	I (1)	1			
13(c)	F (1) H (1) I (1)	3			
13(d)	G (1) good conductor when solid (1)	2			
13(e)	D (1) high melting point (1) non-conductor of electricity when solid or liquid (1)	3			
13(f)	E (1) only conducts when liquid / conducts when liquid but not when solid (1)	2			

Question	Answer	Marks	AO Element	Notes	Guidance
14(a)	$P_4 + 6Cl_2 \rightarrow 4PCl_3$ formulae correct (1) equation balanced (1)	2			
14(b)	3 bonding pairs and 1 lone pair on P (1) six non-bonding electrons on 3 chlorine atoms (1)	2			
15	electrons (1) electrons (1) Cu^{2+} (ions) (1) Br^- (ions) (1)	4			
16	4 electrons in double bond between C and O (1) all single bonds correct (1) C and O each have 8 electrons in outer shell, all H have 2 electrons in outer shell (1)	3			

Question	Answer	Marks	AO Element	Notes	Guidance																
17	<table><tr><td>number of electrons</td><td>number of neutrons</td><td>number of protons</td><td>symbol</td></tr><tr><td>M1 13</td><td></td><td></td><td></td></tr><tr><td>M2 10</td><td>M3 13</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td>M4 19 9 M5 F M6 –</td></tr></table>	number of electrons	number of neutrons	number of protons	symbol	M1 13				M2 10	M3 13						M4 19 9 M5 F M6 –	6			
number of electrons	number of neutrons	number of protons	symbol																		
M1 13																					
M2 10	M3 13																				
			M4 19 9 M5 F M6 –																		
18(a)	4KI + 2CuSO ₄ → 2CuI + I ₂ + 2K ₂ SO ₄ (2)	2			allow multiples / fractions																
18(b)	1+ / +1	1																			
18(c)	gains electron(s)	1																			
18(d)	KI / potassium iodide / iodide (ions) / I [–]	1																			
19	⁹ ₄ Be any element symbol with a single negative charge (1) use of Cl (1) use of ³⁷ ₁₇ (1)	4																			

Question	Answer	Marks	AO Element	Notes	Guidance
20(a)	M1 magnesium ion second shell shown containing 8 electrons shown as X M2 oxide ion second shell shown containing 8 electrons, two as X and six as ● M3 charges: magnesium ion as 2+ and oxide as 2-	3			
20(b)	strong forces of attraction (between oppositely charged ions)	1			
20(c)	ions / Mg^{2+} and O^{2-} / anions and cations can move (throughout the structure)	1			
21(a)	M1 same number of electrons M2 (same number of) electrons in outer shell	2			
21(b)	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ M1 MgCl_2 as product M2 fully correct equation	2			

Question	Answer	Marks	AO Element	Notes	Guidance
21(c)	M1 test: lighted / burning splint M2 result: (squeaky) pop	2			
22	M1 (lattice of) positive ions / cations M2 (delocalised / sea of) electrons M3 attraction / attract between positive and negative	3			
23(a)	covalent	1			
23(b)	forces of attraction between molecules AND are weak / need a small amount of energy to break	1			
23(c)	no moving or flowing or mobile charged particles or ions or electrons	1			
24(a)	PbF_2	1			
24(b)	covalent	1			
24(c)	giant ionic lattice	1			

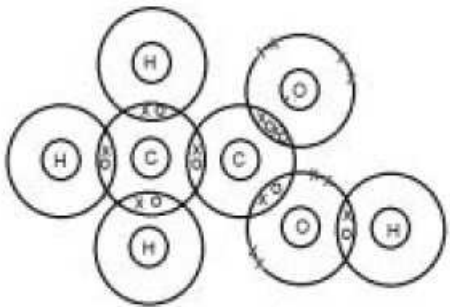
Question	Answer	Marks	AO Element	Notes	Guidance
24(d)	M1 (It or lead(II) fluoride) forces of attraction between ions / ionic bonds M2 (tetrafluoromethane) forces of attraction between molecules M3 ionic bonds stronger than attractive forces between molecules / ionic bonds need more energy to break than attractive forces between molecules	3			
25(a)	gas / gaseous	1			
25(b)	M1 1 shared pair of electrons M2 6 non-bonding electrons on each atom to complete an octet	2			
25(c)	$2\text{Na} + \text{F}_2 \rightarrow 2\text{NaF}$ M1 NaF anywhere M2 equation fully correct	2			
25(d)	chlorine less reactive than fluorine ORA	1			
26(a)	(oxidation is) loss of electrons	1			

Question	Answer	Marks	AO Element	Notes	Guidance
26(b)	one shared pair between each H and S (1) four unpaired electrons on S giving S a total of 8 outer shell electrons and no other unpaired electrons (1)	2			
26(c)	weak (attractive) forces OR (attractive) forces need little energy to overcome (1) forces between molecules / intermolecular (1)	2			
27	Mg shown with new outer shell with 8 crosses (1) Both Cl with a new outer shell with 7 dots and 1 cross (1) '2+' charge on Mg and '-' charge on each Cl (1)	3			A 8 dots
28	nucleons: 27 (1) neutrons: 14 (1) electrons: 10 (1)	3			

Question	Answer	Marks	AO Element	Notes	Guidance
29	(potassium bromide): ionic bonds / attraction between ions (1) (iodine monochloride): intermolecular forces / forces between molecules / named intermolecular forces, e.g. van der Waals / London forces / dispersion forces / dipole-dipole (1) bonds in KBr are stronger / need more energy to break bonds / ORA (1)	3			
30(a)	a shared pair of electrons (between two atoms) M1 shared electrons M2 pair of / two electrons	2			
30(b)	M1 three correct bonding pairs from one N atom to each of three F atoms M2 (3 pairs of) non-bonding electrons on each of three F atoms to complete an octet M3 (1 pair of) non-bonding electrons on N atom to complete an octet	3			

Question	Answer	Marks	AO Element	Notes	Guidance
31(a)	two (or more) substances not chemically combined	1			
31(b)	21 (%)	1			
31(c)	M1 air is made into a liquid M2 (allow air to) boil or evaporate M3 condense the vapours / collect the vapours in order (of evaporation) fractional distillation gets M2 and M3	3			
31(d)	boiling points	1			
32(a)	diffusion	1			
32(b)	silicon(IV) oxide is a solid, whereas carbon dioxide is a gas	1			

Question	Answer	Marks	AO Element	Notes	Guidance
32(c)	photosynthesis (1) chlorophyll / chloroplasts (1) sunlight / UV (light) (1) $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ (2) M1 species correct M2 balanced	5			
33	SCl_2 has intermolecular forces (of attraction) (1) LiCl has (electrostatic) forces (of attraction) between ions (1) intermolecular forces are weaker / less energy is needed to break intermolecular forces (1)	3			
34	Li shown as having one shell with 2 electrons OR no electrons OR no outer shell (1) Cl shown as having an outer shell of 7 electrons of one type, plus one different electron which matches Li electrons (1) '+' charge on Li AND '-' charge on Cl (1)	3			

Question	Answer	Marks	AO Element	Notes	Guidance
35(a)	(acidified) potassium manganate(VII) OR potassium (di)chromate(VI)	1			
35(b)	 M1 all shared pairs of electrons correct for single bonds M2 2 shared pairs of electrons for the C=O bond M3 total of 8 electrons on each O including 4 non-bonding electrons and no additional non-bonding electrons	3			
36	two shared pairs of electrons (1) both Cl with complete outer shells (1) S with complete outer shell (1)	3			

Question	Answer	Marks	AO Element	Notes	Guidance
37(a)	positive ions / cations (1) sea of electrons / mobile electrons / delocalised electrons / moving electrons / flowing electrons (1) attraction between positive ions and electrons (1)	3			
37(b)	layers / rows / sheets of ions (1) slide / slip / shift (over each other or past each other) (1)	2			
37(c)	particles have different sizes / radii (1) layers cannot slide / slip / shift (1)	2			
38(a)	soft because weak forces between layers/sheets/rows	1			
	layers can slip/slide	1			
	good conductor because electrons can move/mobile	1			
38(b)	it is soft: pencils or lubricant or polish	1			

Question	Answer	Marks	AO Element	Notes	Guidance																																
	good conductor: electrodes or brushes (in electric motors)	1																																			
39(a)	6Li + N ₂ = 2Li ₃ N species (1) balancing (1)	2																																			
39(b)	N ³⁻ ion drawn correctly	1																																			
	charges correct (minimum 1 × Li ion and 1 nitride ion)	1																																			
40(a)	<table border="1"><tr><td>group number</td><td>I</td><td>II</td><td>III</td><td>IV</td><td>V</td><td>VI</td><td>VII</td></tr><tr><td>symbol</td><td>Na</td><td>Mg</td><td>Al</td><td>Si</td><td>P</td><td>S</td><td>Cl</td></tr><tr><td>number of valency electrons</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>valency</td><td>1</td><td>2</td><td>3</td><td>4</td><td>3</td><td>2</td><td>1</td></tr></table> (1) for each line	group number	I	II	III	IV	V	VI	VII	symbol	Na	Mg	Al	Si	P	S	Cl	number of valency electrons	1	2	3	4	5	6	7	valency	1	2	3	4	3	2	1	2			
group number	I	II	III	IV	V	VI	VII																														
symbol	Na	Mg	Al	Si	P	S	Cl																														
number of valency electrons	1	2	3	4	5	6	7																														
valency	1	2	3	4	3	2	1																														
40(b)	number of valency electrons = the group number	1																																			

Question	Answer	Marks	AO Element	Notes	Guidance
40(c)	for Na to Al the valency is the same as the number of valency (outer) electrons (1) (because) this is the number of electrons lost (for full energy level) (1)	2			
	for P to Cl the valency is 8 – [number of valency (outer) electrons] or valency + valency electrons = 8 (1) (because) this is number of electrons needed (or to be gained) (for full energy level) (1)	2			
[Total: 178]					