

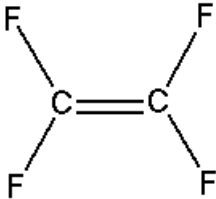
Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	proton / H^+ / hydrogen ion acceptor	1			
1(b)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ M1 $(NH_4)_2SO_4$ M2 equation completely correct	2			
2(a)	$4KI + 2CuSO_4 \rightarrow 2CuI + I_2 + 2K_2SO_4$ (2)	2			allow multiples / fractions
2(b)	1+ / +1	1			
2(c)	gains electron(s)	1			
2(d)	KI / potassium iodide / iodide (ions) / I^-	1			
3(a)(i)	M1 Ni / Nickel M2 (it) loses or donates electrons	2			
3(a)(ii)	redox	1			
3(b)	M1 $Pb \rightarrow Pb^{2+} + 2e^-$ M2 $Ag^+ + e^- \rightarrow Ag$	2			

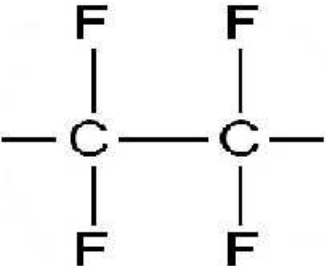
Question	Answer	Marks	AO Element	Notes	Guidance
3(c)	most reactive: nickel / Ni lead / Pb least reactive: silver / Ag	1			
4	roast zinc blende (in air) (1) $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$ (1) add / act with coke (1) $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$ OR $2\text{ZnO} + \text{C} \rightarrow 2\text{Zn} + \text{CO}_2$ (1) (zinc is) distilled (1)	5			
5	$\text{P}_4\text{O}_{10} + 12\text{NaOH} \rightarrow 4\text{Na}_3\text{PO}_4 + 6\text{H}_2\text{O}$ M1 Na_3PO_4 M2 equation completely correct	2			
6(a)	$\text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$ M1 all formulae correct M2 equation correctly balanced	2			
6(b)	redox / combustion	1			
7(a)	addition	1			

Question	Answer	Marks	AO Element	Notes	Guidance
7(b)	poly(but-1-ene)	1			
7(c)	M1 2 C atoms (only) with a single bond between them linked to the continuation bonds shown M2 correct repeat unit showing one C₂H₅ / CH₂CH₃ side chain attached to one of the C atoms in M1 M3 correct use of 'n'	3			
7(d)	CH ₂	1			
8(a)	Fe₂O₃ + 2H₃PO₄ → 2FePO₄ + 3H₂O M1 FePO₄ anywhere M2 whole equation correct	2			
8(b)	iron(III) phosphate acts as a barrier which prevents contact between iron and water or air / oxygen	1			
9(a)	gas / gaseous	1			

Question	Answer	Marks	AO Element	Notes	Guidance
9(b)	M1 1 shared pair of electrons M2 6 non-bonding electrons on each atom to complete an octet	2			
9(c)	$2\text{Na} + \text{F}_2 \rightarrow 2\text{NaF}$ M1 NaF anywhere M2 equation fully correct	2			
9(d)	chlorine less reactive than fluorine ORA	1			
10(a)	PbF_2	1			
10(b)	covalent	1			
10(c)	giant ionic lattice	1			

Question	Answer	Marks	AO Element	Notes	Guidance
10(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			
11(a)	2 (Mg) AND 2 (MgCl ₂)	1			
11(b)	TiCl ₄ + 4Na → Ti + 4NaCl	1			
11(c)	magnesium burns in air or oxygen OR reacts with air or oxygen / argon is unreactive or inert	1			

Question	Answer	Marks	AO Element	Notes	Guidance
12	M1 Suitable metal e.g. magnesium / any carbonate / any base M2 suitable observation e.g. insoluble base / insoluble carbonate / metal dissolve or disappear or metal / carbonate bubbles M3 balanced equation fully correct	3			
13(a)	not all the bonds are single bonds	1			
13(b)	M1 bromine / bromine water M2 turns colourless / decolourises	2			
13(c)		1			

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13(d)	 M1 C-C M2 each C bonded to 2 F and no other atoms + extension bonds	2			
13(e)	M1 CF₂ M2 CF₂	2			
14(a)	4NO ₂	1			
	2CuO	1		M1 CuO as a product (1) M2 rest fully correct (1)	
14(b)	nitrogen dioxide is acidic OR nitrogen dioxide reacts with sodium hydroxide	1			

Question	Answer	Marks	AO Element	Notes	Guidance
15(a)	measuring cylinder	1			
15(b)	no more fizzing (1) (ZnCO ₃) stops dissolving or a (white) solid remains/is visible	2			
15(c)	to use up all the acid / H ⁺ ions	1			
15(d)	a solution that can hold no more solute (1) at the specified temperature (1)	2			
15(e)	(aq)	1			
15(f)	zinc oxide or zinc hydroxide	1			
15(g)	barium sulfate is insoluble	1			
16	Ag ⁺ (aq) + Cl ⁻ (aq) → AgCl(s) species (1) states (1)	2			
17(a)	hydrogen	1			
17(b)	hydroxide / OH ⁻	1			

Question	Answer	Marks	AO Element	Notes	Guidance
17(c)	$7 < \text{pH} \leq 12$	1			
17(d)	$\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$ Ca(OH)_2 (1) rest of equation (1)	1			
18(a)	$\text{CuCO}_3 + 2\text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O}$ M1 carbon dioxide and water as products M2 rest correct	2			
18(b)	respiration	1			
18(c)	photosynthesis	1			
19(a)	$\text{Mg(OH)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + 2\text{H}_2\text{O}$ M1 formula of both Mg(OH)_2 and MgSO_4 M2 equation fully correct	2			
19(b)	$\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$ M1 formula of ZnSO_4 M2 equation fully correct	2			

Question	Answer	Marks	AO Element	Notes	Guidance
19(c)	$\text{Na}_2\text{CO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{CO}_2 + \text{H}_2\text{O}$ M1 formulae of both Na_2CO_3 and Na_2SO_4 M2 equation fully correct	2			
20(a)	$2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ M1 Balanced equation M2 reversible arrow	2			
20(b)	450 °C (units required) (1) 1–5 atmospheres (units required) (1) vanadium(V) oxide or vanadium pentoxide or V_2O_5 (1)	3			A 723 K A 100–500 kPa
20(c)	SO_3 added to (concentrated) H_2SO_4 (1) (oleum) diluted with / added to water (1)	2			
21	$\text{SnO}_2 + 2\text{C} \rightarrow \text{Sn} + 2\text{CO}$ M1 all formulae correct M2 equation fully correct	2			
22(a)	$[(64 \times 2) + 56 + 119 + (32 \times 4) =] 431$	1			

Question	Answer	Marks	AO Element	Notes	Guidance
22(b)	$[(119/151) \times 100 =] 78.8 \%$	1			
22(c)	SnO ₂ because the percentage of tin is larger in SnO ₂ or answer to (b) > 27.6 %	1			
23	(→) Fe ²⁺ + Sn OR 2Fe + 3Sn ²⁺ → 2Fe ³⁺ + 3Sn (→) Sn ²⁺ + Cu OR Sn + 2Cu ²⁺ → Sn ⁴⁺ + 2Cu	2			
24(a)	glowing splint (1) relights/rekindles (1)	2			
24(b)	nitrogen dioxide / nitrogen(IV) oxide (1) brown (gas) (1)	2			
24(c)	2Cu(NO ₃) ₂ → 2CuO + 4NO ₂ + O ₂	1			allow multiples / fractions
25(a)	proton donor	1			
25(b)	→ ClO ₃ ⁻ + H ₃ O ⁺	1			

Question	Answer	Marks	AO Element	Notes	Guidance
26	$\text{C}_3\text{H}_6\text{O}_2 + 3\frac{1}{2}\text{O}_2 \rightarrow 3\text{CO}_2 + 3\text{H}_2\text{O}$ 1 mark for all formulae correct 1 mark for correct balancing	2			
27(a)	heat it	1			
27(b)	$\text{Ca}(\text{ClO}_3)_2 \rightarrow \text{CaCl}_2 + 3\text{O}_2$ 1 mark for O_2 as product 1 mark for the rest correct and balanced	2			
28	$2\text{K}(\text{s}) + \text{Br}_2(\text{l}) \rightarrow 2\text{KBr}(\text{s})$ 1 mark for formulae all correct 1 mark for balancing 1 mark for state symbols	3			
29(a)	$\text{Cl}_2 + 2\text{e}^{(-)} \rightarrow 2\text{Cl}^{-}$	1			
29(b)	(bromide ions) lose electrons / donate electrons / are oxidised	1			
30	ethanoic acid + copper carbonate → copper ethanoate + carbon dioxide + water	1			

Question	Answer	Marks	AO Element	Notes	Guidance
31(a)	M1 steam M2 catalyst	2			
31(b)	$2\text{C}_3\text{H}_7\text{OH} + 9\text{O}_2 \rightarrow 6\text{CO}_2 + 8\text{H}_2\text{O}$ M1 species M2 fully correct equation	2			
32(a)	circle around COOH group	1			
32(b)	$\text{C}_3\text{H}_6\text{O}_3$	1			
33(a)	more than enough oxygen to react with all of the hydrocarbon	1			
33(b)	125 (cm ³)	1			
33(c)	1:5:3	1			
33(d)	C_3H_8 If full credit is not awarded, allow 1 mark for $\text{C}_x\text{H}_y(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{l})$	2			

Question	Answer	Marks	AO Element	Notes	Guidance
34(a)	the breakdown (into elements) (1) of an (ionic) compound by (the passage of) electricity (1)	2			
34(b)(i)	oxygen	1			
34(b)(ii)	glowing splint (1) relights (1)	2			
34(b)(iii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ M1 gain of electrons by H^+ M2 rest of equation	1			
34(c)	<i>the wires</i> : electrons (1) <i>the electrolyte</i> : ions (1)	2			
34(d)	any two from: • green gas at positive electrode • bulb is brighter • rate of bubbles increases	2			
35(a)	oxygen / O_2 (1) sodium nitrite / sodium nitrate(III) / NaNO_2 (1)	2			

Question	Answer	Marks	AO Element	Notes	Guidance
35(b)	$2\text{Cu}(\text{NO}_3)_2 \rightarrow 2\text{CuO} + \text{O}_2 + 4\text{NO}_2$ M1 CuO M2 rest of equation fully correct	2			allow multiples or fractions
36(a)	$\rightarrow 2(\text{C}_2\text{H}_5\text{OH}) + 2\text{CO}_2$ M1 carbon dioxide made as product M2 balanced	2			
36(b)	any 2 from: • 37 °C • anaerobic • glucose is aqueous • yeast	2			
37	$3\text{Mg} + \text{Fe}_2\text{O}_3 \rightarrow 3\text{MgO} + 2\text{Fe}$ M1 Fe ₂ O ₃ AND MgO M2 fully correct	2			
38(a)	<i>the wires:</i> electrons (1) <i>the electrolyte:</i> ions (1)	2			

Question	Answer	Marks	AO Element	Notes	Guidance
38(b)	any 2 from: • increases conductivity • as a solvent • lowers the operating temperature	2			
38(c)	$Al^{3+} + 3e^{-} \rightarrow Al$	1			
38(d)	oxygen is made at the anode (1) the anodes are made of carbon (1) oxygen (made) reacts with carbon (1)	3			
39	2 / 2 / 4 / 1	1			allow multiples and fractions
40(a)	cracking	1			
40(b)	$C_{12}H_{26} \rightarrow 3C_2H_4 + C_6H_{14}$ M1 $C_{12}H_{26}$ M2 rest of equation	2			
40(c)	phosphoric acid (1) heat (1)	2			

Question	Answer	Marks	AO Element	Notes	Guidance
40(d)	addition / hydration	1			
40(e)	measure its boiling temperature (1) compare to (known) data (1)	2			
[Total: 167]					