

Question number	Answer		Notes	Marks
1 (a)	Metal	Highest temperature	<p>M1 for magnesium and zinc</p> <p>M2 and M3 for other 3 metals – 1 mark for 2 correct, 2 marks for all 3 correct</p> <p>Penalise missing trailing 0 once only</p>	3
	aluminium	42.0		
	copper	25.0		
	iron	29.0		
	magnesium	46.5		
	zinc	31.5		
(b) (i)	magnesium		mark csq on table in (a)	1
(ii)	it/copper does not react (with sulfuric acid)		<p>ACCEPT there is no reaction / the (sulfuric) acid does not react (with copper)</p> <p>IGNORE copper is unreactive</p>	1
(c)	<p>M1 (change/rise in temperature would be) less</p> <p>M2 because there is a larger volume/mass of solution/liquid (to be heated)</p> <p>OR</p> <p>same (amount of) energy distributed to a larger number of particles</p>		<p>ACCEPT halved</p> <p>IGNORE any quoted temperatures</p> <p>ACCEPT there is more/twice as much solution/liquid to be heated</p> <p>ALLOW acid for solution/liquid</p> <p>REJECT the magnesium has to react with more acid</p> <p>M2 dep on M1</p>	2

Question number	Answer	Notes	Marks
2 (a)	propane		1
(b)	C ₄ H ₁₀	ACCEPT H ₁₀ C ₄ penalise incorrect use of symbols and subscripts REJECT structural and displayed formulae	1
(c)	W X Y	all three required	1
(d)	CH ₂	ACCEPT H ₂ C REJECT C _n H _{2n}	1
(e)	M1 (unsaturated) contains a (carbon to carbon) double bond M2 (hydrocarbon) (compound/molecule/substance) contains (the elements/atoms) hydrogen and carbon... M3 ...only	ACCEPT multiple bonds IGNORE refs to single bonds REJECT element/atom/mixture for compound/molecule/substance REJECT ions/molecules for elements/atoms M3 dep on mention of hydrogen & carbon in M2 ACCEPT other equivalents e.g. solely, just, exclusively	3
(f) (i)	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} - \text{Br} \\ & & & \\ & \text{H} & \text{H} & \text{H} \end{array} $	ACCEPT bromine in any position ACCEPT multiple substitutions ACCEPT correct displayed formula given as a product of an equation IGNORE any structural formula eg CH ₃ CH ₂ CH ₂ Br or molecular formula IGNORE H-Br	1 1
(ii)	UV / ultraviolet light/radiation	IGNORE references to heat / (high) temperature / (high) pressure	

Question number	Answer	Notes	Marks
3 (a)	<p>M1 (Fe) (Ti) (O) $\frac{36.8}{56}$ $\frac{31.6}{48}$ $\frac{31.6}{16}$</p> <p>M2 0.66 0.66 1.98</p> <p>M3 1 1 3</p> <p>OR</p> <p>M1 calculation of M_r of $\text{FeTiO}_3=152$</p> <p>M2 expression for % of <u>each</u> element e.g. Fe: $56 \div 152 \times 100\%$</p> <p>M3 evaluation to show these equal 36.8% Fe, 31.6% Ti, 31.6% O</p>	<p>Division by atomic number scores 0</p> <p>ACCEPT any number of sig figs except one ALLOW 0.65, 0.65, 1.97</p>	3
(b)	<p>M1 (element oxidised) – carbon / C</p> <p>M2 (reason) – (it has) gained/combined with oxygen / forms carbon dioxide</p> <p>M2 dep on M1</p>	<p>IGNORE refs to electron loss</p> <p>ACCEPT oxidation state/number increases</p> <p>ACCEPT oxidation state/number changes from 0 to (+)4</p>	2
(c) (i)	<p>$\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2$</p> <p>M1 all formulae correct</p> <p>M2 balanced</p>	<p>ACCEPT multiples and halves</p> <p>IGNORE state symbols even if incorrect</p>	2 1
(ii)	<p>titanium / Ti / magnesium / Mg reacts with oxygen</p> <p>OR</p> <p>titanium / Ti / magnesium / Mg reacts with nitrogen</p>	<p>IGNORE refs to oxidation</p> <p>ACCEPT forms an oxide</p> <p>ACCEPT forms a nitride</p>	
(iii)	<p><u>magnesium chloride</u> will dissolve more quickly / to help the <u>magnesium chloride</u> to dissolve / more of the <u>magnesium chloride</u> is in contact with the water</p>	<p>IGNORE to speed up the reaction</p> <p>IGNORE refs to increasing surface area</p>	1

(d) (i)	M1 positive ions/cations/nuclei and delocalised electrons M2 attract (one another) M2 dep on M1	IGNORE metal ions ALLOW sea of electrons IGNORE free electrons any refs to ionic bonding, covalent bonding or IMFs scores zero	2
(ii)	(delocalised) electrons can flow/move (through structure)/are mobile (when voltage/pd is applied)	IGNORE carry charge	1

Question number	Answer	Notes	Marks
4 a i	$2\text{NdF}_3 + 3\text{Ca} \rightarrow 2\text{Nd} + 3\text{CaF}_2$	Accept fractions and multiples	1
	ii calcium fluoride AND neodymium fluoride (in either order)	Accept formulae	1
	iii ionic	Accept electrovalent Ignore giant Ignore electron transfer Reject covalent bonding/ intermolecular forces	1
	iv Nd_2O_3	penalise incorrect use of symbols and subscripts	1

b	M1	(neodymium ions in) layers/rows/planes/sheets/OWTTE	Accept atoms/cations/particles for ions Reject molecules	4
	M2	slide/slip (over each other)	Allow OWTTE, eg flow/shift/roll/move M2 DEP on mention of EITHER layers or equivalent OR mention of ions or equivalent Do not award M2 if molecules/protons/electrons/nuclei in place of ions etc If reference to ionic bonding / covalent bonding / molecules / intermolecular forces, no marks	
	M3	delocalised electrons OR sea of electrons	Not just electrons Ignore free electrons	
	M4	(can) flow/travel/move (through structure) / are mobile (when voltage/pd is applied)	Ignore carry charge M4 DEP on M3 or near miss	

Question number	Answer	Accept	Reject	Marks
5 (a) (i)	Any two from: <ul style="list-style-type: none"> • good conductor <u>of heat</u> • high melting point • malleable Apply list principle			2
	(ii) M1 – ductile M2 – good conductor <u>of electricity</u> Apply list principle Answers can be given in any order			1 1
(b) (i)	strong(er) IGNORE references to density and rusting	other correct descriptions		1
	(ii) lower density / resists corrosion IGNORE lighter	does not rust greater strength to weight ratio		1
(c) (i)	heat / thermal energy / heat energy is given out OR transferred/lost to the surroundings IGNORE references to bond formation and breaking	produced produces an increase in temperature it gets hot		1
	(ii) M1 - (aluminium/it is) more reactive M2 – (aluminium/it) displaces iron (from its oxide) M2 DEP on M1	iron is less reactive replaces it/aluminium takes oxygen away from iron (oxide)		1 1

(iii)	M1 – aluminium	loses (three) electrons /oxidation number increases		1
	M2 – gains oxygen	combines with oxygen / forms aluminium oxide		1
	M2 DEP on M1 IGNORE references to magnesium			
(d)	temperature reached \geq m.pt of iron IGNORE exothermic / heat produced / lots of energy produced	<u>high</u> temperature reached / gets <u>very</u> hot		1

(Total marks for Question 5 = 12 marks)