<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 (a)</td><td><table><tr><th>Metal</th><th>Highest temperature</th></tr><tr><td>aluminium</td><td>42.0</td></tr><tr><td>copper</td><td>25.0</td></tr><tr><td>iron</td><td>29.0</td></tr><tr><td>magnesium</td><td>46.5</td></tr><tr><td>zinc</td><td>31.5</td></tr></table></td><td>M1 for magnesium and zinc
M2 and M3 for other 3 metals – 1 mark for 2 correct, 2 marks for all 3 correct

Penalise missing trailing 0 once only</td><td>3</td></tr>
<tr><td>(b) (i)</td><td>magnesium</td><td>mark csq on table in (a)</td><td>1</td></tr>
<tr><td>(ii)</td><td>it/copper does not react (with sulfuric acid)</td><td>ACCEPT there is no reaction / the (sulfuric) acid does not react (with copper)
IGNORE copper is unreactive</td><td>1</td></tr>
<tr><td>(c)</td><td>M1 (change/rise in temperature would be) less

M2 because there is a larger volume/mass of solution/liquid (to be heated)

OR

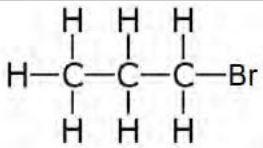
same (amount of) energy distributed to a larger number of particles</td><td>ACCEPT halved
IGNORE any quoted temperatures

ACCEPT there is more/twice as much solution/liquid to be heated

ALLOW acid for solution/liquid

REJECT the magnesium has to react with more acid

M2 dep on M1</td><td>2</td></tr>
</table>

Question number	Answer	Notes	Marks
2 (a)	propane		1
(b)	C_4H_{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_2C REJECT C_nH_{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)		ACCEPT bromine in any position ACCEPT multiple substitutions ACCEPT correct displayed formula given as a product of an equation IGNORE any structural formula eg $CH_3CH_2CH_2Br$ 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)	M1 (Fe) $\frac{36.8}{56}$ (Ti) $\frac{31.6}{48}$ (O) $\frac{31.6}{16}$ M2 0.66 0.66 1.98 M3 1 1 3 OR M1 calculation of M_r of $FeTiO_3$=152 M2 expression for % of <u>each</u> element e.g. Fe: 56 ÷ 152 x 100% M3 evaluation to show these equal 36.8% Fe, 31.6% Ti, 31.6% O	Division by atomic number scores 0 ACCEPT any number of sig figs except one ALLOW 0.65, 0.65, 1.97	3
(b)	M1 (element oxidised) – carbon / C M2 (reason) – (it has) gained/ combined with oxygen / forms carbon dioxide M2 dep on M1	IGNORE refs to electron loss ACCEPT oxidation state/ number increases ACCEPT oxidation state/ number changes from 0 to (+)4	2
(c) (i)	$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$ M1 all formulae correct M2 balanced	ACCEPT multiples and halves IGNORE state symbols even if incorrect	2 1
(ii)	titanium / Ti / magnesium / Mg reacts with oxygen OR titanium / Ti / magnesium / Mg reacts with nitrogen	IGNORE refs to oxidation ACCEPT forms an oxide ACCEPT forms a nitride	
(iii)	<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	IGNORE to speed up the reaction IGNORE refs to increasing surface area	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**NdF_3 + **3**Ca → **2**Nd + **3**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: ● good conductor <u>of heat</u> ● high melting point ● malleable Apply list principle			2
(ii)	**M1** – ductile			1
	M2 – good conductor <u>of electricity</u> Apply list principle Answers can be given in any order			1
(b) (i)	strong(er) IGNORE references to density and rusting	other correct descriptions		1
	lower density / resists corrosion			
(ii)	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	iron is less reactive		1
	M2 – (aluminium/it) displaces iron (from its oxide) M2 DEP on M1	replaces it/aluminium takes oxygen away from iron (oxide)		1

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

(Total marks for Question 5 = 12 marks)