Question number	Answer	Notes	Marks
1 (a) M1	76 (cm^3)		1
M2	35 (cm^3)	Award 1 mark for M1 and M2 transposed	1
M3	41 (cm^3)	M3 CQ on M1 and M2 No penalty for use of values to 1 dp	1
(b) (i)	all points correctly plotted	Award marks for points plotted to the nearest gridline (or better) Deduct 1 mark for each error Award M1 + M2 if points not visible but line correct	2
	<u>straight</u> line of best fit	Line does not have to continue beyond points Allow <u>straight</u> line of best fit CQ on points plotted Line must not go to origin	1
(ii)	point circled at 165, 25		1
(c)	(blank 1) decreased (blank 2) decreased (blank 3) no change		1 1 1
(d)	$\frac{(140 - 111) \times 100}{140} = 20.7\ (\%)$	Award M1 for (140 – 111) or 29 Award M2 for correct final answer to 1 dp Correct final answer with no working scores 2 marks 20% / 21% with no working scores 0 79.3% scores 0 but could then be used to calculate 20.7, in which case 2 marks can be awarded	1 1

Total 12 marks

Question number	Answer	Notes	Marks
2 (a)	**M1** coke **M2** limestone accept answers in either order	ignore 'carbon' / 'charcoal' ignore 'calcium carbonate' ignore formulae	2
(b) (i)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ **M1** all formulae correct **M2** balanced	 **M2** dep on **M1**	2
(ii)	**M1** iron / Fe **M2** (it has) lost oxygen	 **M2** dep on **M1**or near miss eg Fe_2O_3 accept 'iron (III) ions / Fe^{3+} has gained electrons' accept 'oxidation number of iron decreases / oxidation number of iron changes from +3 to 0'	2
(c) (i)	$C + O_2 \rightarrow CO_2$		1
(ii)	C (neutralisation)		1

(d)	(i)	**M1** oxygen **M2** water	accept 'air' accept 'moisture' / 'water vapour' ignore 'steam' accept answers in either order	2
	(ii)	prevents oxygen/water from coming into contact with the iron	accept refs to acting as a barrier	1
(e)	(i)	galvanising	ignore 'sacrificial protection'	1
	(ii)	**M1** zinc is more reactive than iron / loses electrons more readily **M2** (and therefore) corrodes in preference (to the iron)	ignore 'sacrificial protection' accept 'reacts (with oxygen/water) in preference (to the iron)' accept refs to zinc converting iron(II) ions to iron (atoms) reject 'zinc rusts' for **M2**	2
(f)	(i)	(aluminium/it) is too reactive / more reactive than carbon / <u>above</u> carbon in the reactivity series	accept 'carbon is less reactive than aluminium' accept 'the temperature required is too high' ignore refs to carbon monoxide	1
	(ii)	energy costs are too great / electricity is expensive	allow 'it is cheaper to use the blast furnace' ignore refs to iron being below carbon in the reactivity series	1

Question number	Answer	Accept	Reject	Marks
3 (a)	oxidised AND gain of oxygen IGNORE reference to loss of electrons	increase in oxidation number	gain of electrons	1
(b)	**M1** it/magnesium is more reactive than titanium **M2** it/magnesium has displaced titanium **M2** dep on **M1**	reverse argument replaced		1 1
(c)	it/magnesium chloride has a different/lower boiling point **IGNORE** references to melting point	more volatile reverse argument		1
(d)	**M1** (aircraft engines) – high strength-to-weight ratio **M2** (hip replacements) – non-toxic **M3** (propellers) – corrosion resistant **NO USE CAN BE GIVEN TWICE**	high m.pt / corrosion resistant high strength-to-weight ratio / corrosion resistant	not corrosive not corrosive	1 1 1
			Total	**7**

Question number				Answer	Notes	Marks
4	a	i	M1	(hydrated) iron(III) oxide / Fe_2O_3	Allow (hydrated) iron oxide and $Fe_2O_3.xH_2O$	1
		ii	M1	oxygen / O_2	Allow air Do not accept O	1
			M2	water / H_2O	Accept poorly written formulae such as H2O and O^2 Accept phonetic spellings Answers can be in either order Reject salt / acid - eg salt water does not score	1
	b		M1	cross in box 4 (oxidation)		1
	c	i	M1	Zinc / Zn	Accept phonetic spellings	1
		ii	M1	cross in box 2 (Bucket)		1
	d		M1 M2	oiling / greasing / painting / covering with plastic / coating with tin or named metal (aluminium or below) in reactivity series / attaching magnesium or zinc blocks (to ships)	Any two for 1 each Ignore sacrificial protection and galvanising and alloying	2

Total 8 marks

Question number				Answer	Notes	Marks
5	a	i	M1	layers / sheets / planes / rows of (positive) ions	Allow atoms/ particles in place of positive ions Reject molecules / protons / electrons	1
			M2	slide (over each other)	Allow slip / flow / move in place of slide Accept explanation in terms of non-directional bonding Do not award M2 if protons / electrons Do not award M2 if no mention of layers or equivalent	1
		ii	M1	delocalised electrons / sea of electrons	Ignore free electrons	1
			M2	move / flow (through structure) / mobile (when voltage/potential difference applied)	M2 needs mention of electrons Any mention of ions moving = 0/2	1

Question number				Answer	Notes	Marks
5		i	M1	green precipitate	Accept solid / suspension Ignore qualifiers such as pale / light / dark / muddy / dirty Ignore grey Ignore references to <u>turning</u> brown Reject bubbles or equivalent Do not penalise wrong identity of precipitate	1
			M2	brown precipitate	Accept solid / suspension Accept orange / orange-brown / red-brown Ignore qualifiers such as pale / light / dark Reject bubbles or equivalent Do not penalise wrong identity of precipitate Award 1 for both colours correct but precipitate missing	1
		ii	M1	$FeSO_4 + 2NaOH \rightarrow Fe(OH)_2 + Na_2SO_4$	Correct formulae = 1	1
			M2		Balancing = 1	1

Total 8 marks