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Paper 4 Theory (Extended)

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MARK SCHEME

Maximum Mark: 80

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This document consists of **8** printed pages.

Question	Answer	Marks
1(a)(i)	J	1
1(a)(ii)	E	1
1(a)(iii)	D	1
1(a)(iv)	J	1
1(a)(v)	L	1
1(a)(vi)	D	1
1(b)(i)	(atoms with) same number of protons / atomic number / of same element	1
	different number of neutrons / different mass number / different nucleon number	1
1(b)(ii)	E AND G	1
1(b)(iii)	they have the same number of electrons in their outer shell	1

Question	Answer	Marks
2(a)(i)	CH ₂	1
2(a)(ii)	initial colour: orange	1
	final colour: colourless / none	1
2(b)(i)	approximately horizontal line draw to right of and below the reagent line	1
	energy change shown starting level with the reactant energy AND finishing level with the product energy AND having only one (correct) arrow head AND labelled ΔH /energy change	1
2(b)(ii)	(energy required to break bonds =) 3624	1
	(energy given out when bonds made =) 3738	1
	–114 (kJ/mol)	1
2(c)	(attractive) forces between molecules	1
	(forces of attraction) are <u>stronger</u> in iodine	1

Question	Answer	Marks
3(a)	regular arrangement / lattice of positive ions / magnesium ions / Mg^{2+} ions	1
	sea of electrons OR delocalised electrons	1
	attraction between (positive) ions and (delocalised / sea of) electrons	1
3(b)	electrons	1
	move / flow (throughout / through the structure)	1
3(c)	layers (of atoms or ions)	1
	layers / atoms / ions can slide / slip / glide (over each other) (without breaking the metallic bonds)	1
3(d)(i)	magnesium shown as (2, 8) using crosses	1
	sulfide shown as (2, 8, 8), with the two gained electrons in the outer shell of sulfur shown as crosses and all other electrons on sulfur shown as dots	1
	magnesium ion charge as 2^+ AND sulfide charge as 2^-	1
3(d)(ii)	melt / fused	1
	ions can move OR are mobile	1

Question	Answer	Marks
4(a)	petroleum	1
4(b)(i)	<i>saturated</i> : only single bonds OR no double / multiple bonds (between carbon atoms)	1
	<i>hydrocarbon</i> : (compound that) contains carbon and hydrogen	1
	<i>hydrocarbon</i> : and no other elements / only	1
4(b)(ii)	alkane(s)	1
4(b)(iii)	any 2 from: • same / similar chemical properties • (same) general formula • (consecutive members) differ by CH₂ • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change / example of a physical property variation	2
4(b)(iv)	CO ₂ and H ₂ O on right-hand side and no other products / reagents	1
	11 (O ₂), 7 (CO ₂), 8 (H ₂ O)	1
4(c)(i)	acid rain	1

Question	Answer	Marks
4(c)(ii)	<i>carbon monoxide</i> : from incomplete combustion (of fuel)	1
	<i>oxides of nitrogen</i> : nitrogen (from the air) reacts with oxygen (from the air)	1
	<i>oxides of nitrogen</i> : at high temperatures (in engine) OR (electrical) spark (in the engine)	1
4(c)(iii)	poisonous / toxic / death	1
4(c)(iv)	any 3 from: - oxides of nitrogen are reduced / lose oxygen (to form nitrogen) - oxides of nitrogen form nitrogen (oxides of nitrogen) react with carbon monoxide - gases (adsorb / stick) on the catalyst's surface	3
4(d)(i)	butane	1
4(d)(ii)	(molecules with) the same molecular formula	1
	different structural formula / different displayed formula	1
4(d)(iii)	UV light / sunlight	1
	H–Cl	1
	any mono to deca chloro-substituted derivative of methyl propane	1

Question	Answer	Marks
5(a)(i)	loss (of electrons)	1
5(a)(ii)	$\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^-$	1
5(a)(iii)	goes down / gets less / decreases / lower / smaller	1
5(b)(i)	beryllium	1
	most negative voltage with any (named) metal OR biggest voltage with cobalt / nickel	1
5(b)(ii)	cobalt AND nickel	1
5(b)(iii)	– sign	1
	2.7	1
5(c)	(set up cell) using magnesium and beryllium (electrodes)	1
	voltage positive if magnesium is metal 2	1
	OR	
	(set up cells) using both magnesium and beryllium with the same metal as the other electrode	1
	larger (magnitude) voltages with magnesium	1
	OR	
	use magnesium with a different metal and compare to a reference value in a table	1
	value is more negative than with beryllium, if magnesium is metal 1	1

Question	Answer	Marks
6(a)(i)	$\text{BaCO}_3 \rightarrow \text{BaO} + \text{CO}_2$	1
6(a)(ii)	anything pH in the range pH 10 to pH 14	1
6(a)(iii)	nitrogen dioxide	1
	oxygen	1
6(b)(i)	$\text{Na}_2\text{CO}_3 + \text{Ba}(\text{NO}_3)_2 \rightarrow \text{BaCO}_3 + 2\text{NaNO}_3$ M1 formula of NaNO_3 M2 equation fully correct	2
6(b)(ii)	filter	1
	wash (the residue) using water	1
	dry the residue between filter papers / in a warm place	1
6(c)(i)	$M_r = 197$	1
	$(9.85 / 197 =) 0.05 \text{ (mol)}$	1
6(c)(ii)	0.05 (mol)	1
6(c)(iii)	$(0.05 \times 24) = 1.2 \text{ (dm}_3\text{)}$	1
6(c)(iv)	moles of HCl at the start = $(250 / 1000 \times 1.00) = 0.25$	1
	moles HCl in excess = $0.25 - (2 \times 0.05) = 0.15 \text{ (mol)}$	1