



**General Certificate of Education**

**Chemistry 1421**

**CHEM1      Foundation Chemistry**

**Mark Scheme**

*2009 examination - January series*

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Question	Part	Sub Part	Marking Guidance	Mark	Comments									
1	(a)		<table border="1"> <thead> <tr> <th>Particle</th> <th>Relative Charge</th> <th>Relative mass</th> </tr> </thead> <tbody> <tr> <td>Proton</td> <td><u>+1</u></td> <td>1</td> </tr> <tr> <td>Neutron</td> <td>0</td> <td>1</td> </tr> </tbody> </table>	Particle	Relative Charge	Relative mass	Proton	<u>+1</u>	1	Neutron	0	1	1	Need +1 for proton
		Particle	Relative Charge	Relative mass										
Proton	<u>+1</u>	1												
Neutron	0	1												
				1										
1	(b)		d block/ D block;	1	Or D or d									
1	(c)	(i)	74;	1	Not 74.0									
1	(c)	(ii)	112;	1	Not 112.0									
1	(d)	(i)	To accelerate/ make go faster;	1	Any order Not just attract to negative plate									
			To deflect/ to bend the beam;	1										
1	(d)	(ii)	Electromagnet / magnet / electric field /accelerating potential or voltage;	1	Not electric current Not electronic field									
1	(e)		None/ nothing;	1	If blank mark on. If incorrect CE = 0									
			Same number of electrons (in outer orbital/shell)/ both have 74 electrons/ same electron configuration;	1	Not just electrons determine chemical properties Ignore protons and neutrons unless wrong statement.									
1	(f)		$\frac{(182 \times 26.4) + (183 \times 14.3) + (184 \times 30.7) + (186 \times 28.6)}{100}$	1	If transcription error then M1 = AE = -1 and mark M2 consequentially									
			= 183.90; allow range from 183.90 – 184.00;	1										

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	(a)		Ability/power of an atom/element/nucleus to withdraw electron density or electron cloud or a pair of electrons (towards itself);	1	Not withdraw an electron If ref to ionic, metallic, imf etc then CE = 0
			From a <u>covalent bond</u> or from a shared pair of electrons;	1	Not distort Not remove electrons
2	(b)		Van der Waals/ vdw/London/ <u>temporary</u> (induced) dipole/ dispersion forces;	1	
			Hydrogen bonds/H bonds;	1	Not just hydrogen
2	(c)		(Large) electronegativity difference between N + H/ difference of 0.9/ N very electronegative;	1	Insufficient to say N= 3.1 and H = 2.1
			Forms N $\delta^-$ / H $\delta^+$ or dipole explained in words;	1	Not N becomes (fully) negative or vice versa
			<u>Lone pair on N</u> attracts/forms weak bonds with H ( $\delta^+$ );	1	QWC Can score M2 and 3 from a diagram
2	(d)		Co-ordinate/dative;	1	If not correct then CE = 0. If covalent/blank mark on.
			Both electrons/ lone pair (on P/PH <sub>3</sub> )	1	Not lone pair on hydrogen
			Shares/donated from P(H <sub>3</sub> )/ to H( $\delta^+$ );	1	
2	(e)		3 bonds and 1 lp attached to As;	1	Must label H and As atoms Accept distorted tetrahedral not bent tetrahedral
			Pyramidal/tetrahedral/ trigonal pyramidal;	1	Not bipyramidal/triangular
2	(f)		(Only) weak Van der Waals forces between molecules /AsH <sub>3</sub> has weaker IMF /ammonia has hydrogen bonding/ more energy needed to break IMF's in ammonia/ Van der Waals weaker than H bonds;	1	Accept has no H bonds . Ignore dp-dp in AsH <sub>3</sub> provided ammonia has stronger IMF. If between atoms mentioned CE=0 Break bonds CE = 0

2	(g)	$4\text{AsCl}_3 + 3\text{NaBH}_4 \rightarrow 4\text{AsH}_3 + 3\text{NaCl} + 3\text{BCl}_3$ ;	1	Accept multiples
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Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)	(i)	$\frac{79.9 \times 100}{225.9}$	1	Whole expression Ignore >3 sig figs
			= 35.37(%) allow 35.0 – 35.4%;	1	Allow 35% Allow 2 marks if correct %
3	(a)	(ii)	Sell the HCl or sell the other product or sell the acid (formed in the reaction);	1	Need a financial gain
3	(b)	(i)	$\frac{165}{189.9} = 0.869$ ; allow 0.86 – 0.87;;	2	One mark for $M_r = 189.9$ Ignore units
			0.869	1	Accept same value as in (i)
3	(b)	(iii)	$0.869 \times 79.9 = 69.4$ ; Allow 68.7 – 70;	1	Accept answer to (ii) $\times 79.9$
			$\frac{63}{69.4} \times 100$ ; = 90.75%; Accept 90.6 to 92%;	1	Accept 63 x 100 /answer to (iii) If > 100% lose this mark

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	(a)	(i)	Energy/enthalpy (change)/ $\Delta H$ / needed to remove 1 mole of electrons;  From 1 mol of gaseous atoms;	1	Allow 1 electron Not heat alone  From 1 gaseous atom Not mix and match moles and one electron. Allow 1 for balanced eq with ss
				1	
4	(a)	(ii)	Increase;  Increasing nuclear charge/ increasing number of protons;  Same or similar shielding /same number of shells or energy levels/ (atomic) radius decreases/electron closer to nucleus;	1 1 1	If blank mark on If incorrect CE = 0 Not increasing atomic number  Not same distance from nucleus.
				1	
				1	
4	(a)	(iii)	Aluminium/Al;  <u>E</u> lectron in higher energy /p or 3p orbital;  Less energy needed to lose electron/ electron more easily lost/ ionisation energy less;	1 1 1	If incorrect CE = 0  Not 2p Ignore shielding
				1	
				1	
4	(b)		Silicon/Si;  Macromolecular/ Giant molecular or atomic or covalent;  Many or strong <u>covalent</u> bonds need to be <u>broken</u> / lots of energy needed to <u>break the covalent</u> bonds;	1 1 1	If incorrect CE = 0 If silicone, silica Si <sub>8</sub> , Si <sub>4</sub> mark on. If IMF or ionic or metallic in Silicon then CE = 0 for explanation Not loosened bonds
				1	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	(a)	(i)	0.013;	1	
5	(a)	(ii)	0.0065;	1	Answer to (i) ÷ 2
5	(a)	(iii)	$\frac{0.548}{0.0065} = 84.3$ ;	1	Allow 0.548 ÷ answer to (ii) Allow 84.1 – 84.4
5	(b)		84.3 – 60 = 24.3;  Mg;  If 147.6 used the answer is 87.6 (1) And this is Sr (1)	1  1	1 mark for -60  Allow consequential metal from their calculated A Answer has got to be a metal to score M2

Question	Part	Sub Part	Marking Guidance	Mark	Comments	
6	(a)		Single bonds <u>only</u> /no double or multiple bonds;	1	C and H <u>only</u> not C and H molecules	
			Contains carbon and hydrogen <u>only</u> ;	1		
			Alkanes;	1		
6	(b)		(1) Fractions or hydrocarbons or compounds have different boiling points/ separation depends on bp;	1	Ignore mp and vdw If refer to bond breaking/ cracking/ blast furnace/ oxygen/air 2 max QWC	
			(2) bp depends on size/ $M_r$ chain length;	1		
			(3) Temp gradient in <u>tower or column</u> / cooler at top of <u>column</u> or vice versa;	1		
			(4) Higher bp / larger or heavier molecules at bottom (of column) or vice versa;	1		Not increasing size of fraction Not gases at top
6	(c)		<u>Large</u> molecules or compounds or long chain hydrocarbons (broken) into <u>smaller</u> molecules or compounds or smaller chain hydrocarbons;	1	QWC	
			Zeolite or aluminosilicate (catalyst);	1		
			$C_{14}H_{30} \rightarrow C_8H_{18} + C_6H_{12}$ ;	1		Only
			Smaller chain molecules are in more demand or have higher value or vice versa;	1		Insufficient to say more useful/ have more uses
6	(d)		$C_8H_{18} + 8\frac{1}{2} O_2 \rightarrow 8CO + 9H_2O$ ;	1	Allow multiples Penalise contradiction of name and symbol Allow multiples	
			Rh/ Pd/Pt/Ir or in words;	1		
			$2CO + 2NO \rightarrow 2CO_2 + N_2 / 2CO + O_2 \rightarrow 2CO_2$ ;	1		
			Greenhouse gas/ absorbs infrared radiation;	1		

6	(e)	car less powerful/ car stops/ reduced performance/ won't run smoothly/ can't accelerate; Test it (before sale) /Quality control etc;	1 1	Not incomplete combustion or bad effect on engine Not doesn't go as far.
6	(f)	(compounds with) same molecular formula / same no and type of atoms; And different structure/ structural formula; 2,2,4-trimethylpentane;	1 1 1	Not atoms/elements with same molecular formula. If same <u>chemical</u> formula, can allow M2 M2 consequential on M1 Allow displayed formula for M2 Only (but allow numbers in any order)