



General Certificate of Education

Chemistry 1421

CHEM1 Foundation Chemistry

Mark Scheme

2009 examination - January series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	(a)		Particle	1	Need +1 for proton
			Proton		
			Neutron		
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
			To deflect/ to bend the beam;	1	Not just attract to negative plate
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.
			Same number of electrons (in outer orbital/shell)/ both have 74 electrons/ same electron configuration;	1	If incorrect CE = 0 Not just electrons determine chemical properties Ignore protons and neutrons unless wrong statement.
1	(f)		$\frac{(182 \times 26.4) + (183 \times 14.3) + (184 \times 30.7) + (186 \times 28.6)}{100}$ = 183.90; allow range from 183.90 – 184.00;	1	If transcription error then M1 = AE = -1 and mark M2 consequentially

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 δ^- / H δ^+ 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 (δ^+);	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 ₃)	1	Not lone pair on hydrogen
			Shares/donated from P(H ₃)/ to H(δ^+);	1	
2	(e)		3 bonds and 1 lp attached to As;	1	Must label H and As atoms
			Pyramidal/tetrahedral/ trigonal pyramidal;	1	Accept distorted tetrahedral not bent tetrahedral Not bipyramidal/triangular
2	(f)		(Only) weak Van der Waals forces between molecules /AsH ₃ 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 ₃ 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)	$\frac{79.9 \times 100}{225.9}$ = 35.37(%) allow 35.0 – 35.4%;	1	Whole expression Ignore >3 sig figs Allow 35% Allow 2 marks if correct %
				1	
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
3	(b)	(ii)	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) $\times 79.9$
3	(b)	(iv)	$\frac{63}{69.4} \times 100$; = 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)/ ΔH / needed to remove 1 mole of electrons;	1	Allow 1 electron Not heat alone
			From 1 mol of gaseous atoms;	1	From 1 gaseous atom Not mix and match moles and one electron. Allow 1 for balanced eq with ss
4	(a)	(ii)	Increase;	1	If blank mark on If incorrect CE = 0
			Increasing nuclear charge/ increasing number of protons;	1	Not increasing atomic number
			Same or similar shielding /same number of shells or energy levels/ (atomic) radius decreases/electron closer to nucleus;	1	Not same distance from nucleus.
4	(a)	(iii)	Aluminium/Al;	1	If incorrect CE = 0
			<u>Electron</u> in higher energy /p or 3p orbital;	1	Not 2p Ignore shielding
			Less energy needed to lose electron/ electron more easily lost/ ionisation energy less;	1	
4	(b)		Silicon/Si;	1	If incorrect CE = 0 If silicone, silica Si ₈ , Si ₄ mark on.
			Macromolecular/ Giant molecular or atomic or covalent;	1	If IMFor ionic or metallic in Silicon then CE = 0 for explanation
			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	Not loosened bonds

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	(a)		Single bonds <u>only</u> / no double or multiple bonds;	1	
			Contains carbon and hydrogen <u>only</u> ;	1	C and H <u>only</u> not C and H molecules
			Alkanes;	1	
6	(b)		(1) Fractions or hydrocarbons or compounds have different boiling points/ separation depends on bp;	1	Ignore mp and vdw
			(2) bp depends on size/ M_r chain length;	1	If refer to bond breaking/ cracking/ blast furnace/ oxygen/air 2 max QWC
			(3) Temp gradient in <u>tower</u> or <u>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
			Rh/ Pd/Pt/Ir or in words;	1	Penalise contradiction of name and symbol Allow multiples
			$2CO + 2NO \rightarrow 2CO_2 + N_2 / 2CO + O_2 \rightarrow 2CO_2$;	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)