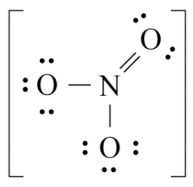
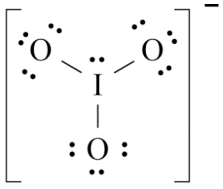
Assessment Schedule – 2005

Chemistry: Describe selected atomic, molecular and ionic properties (90697)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
1(a)	Trend in radius: it increases Trend in 1st IE: it decreases Reason: Going down the group, electrons are added and valence electrons are in energy levels further from the nucleus, resulting in the increased radius. Despite the increased nuclear charge (and more **inner** levels of electrons providing shielding), there is a decrease in electrostatic attraction. This means the energy required to remove an electron decreases.	BOTH trends correct. **OR** links ONE trend to number of electron shells / levels NOT orbitals.	Answer links increased radius and decreased IE to electron arrangement and also decreased electrostatic attraction / ease of removal of electron.	
1(b) (i)	F $1s^2 2s^2 2p^5$ F^- $1s^2 2s^2 2p^6$ Na^+ $1s^2 2s^2 2p^6$	All correct.		
1(b) (ii)	F^- and F atom both have the same nuclear charge but the additional valence electron in the F^- ion results in increased electrostatic repulsion between the valence electrons and hence an increased radius.	Correctly describes relative sizes of F and F^- **AND** relative sizes of F^- and Na^+.	Correctly describes relative sizes of both AND discussion shows clear understanding of how relative sizes are linked to electron configuration and charge on nucleus for **ONE** of the pairs.	Discussion shows clear understanding of how relative sizes are linked to electron configuration and charge on nucleus for both pairs.
1(b) (iii)	F^- and Na^+ have same electron configuration but Na^+ has more protons in the nucleus. This results in increased electrostatic attraction between nucleus and valence electrons so radius of Na^+ is smaller than F^-.			
2(a) (i)	 24 e's  26 e's	Correct number of valence electrons in both structures **AND** one structure correct. *May not include brackets around Lewis diagram and charges. Iodate ion may have expanded octet on central atom*	Both Lewis structures correct. Must include brackets around each Lewis diagram and must show charge.	
2(a) (ii)	Nitrate ion is trigonal planar while iodate ion is a trigonal pyramid. This is because the nitrate ion has only 3 regions of electron density around the central atom and repulsion between these 3 results in a 120° bond angle. The iodate has 4 regions of negative charge around the I atom and these point towards the corner of a tetrahedron. With only 3 of these regions being bonded pairs of electrons, the shape of the molecule is a trigonal pyramid with bond angles of approximately 109°.	Correct identification of BOTH shapes – must be consistent with Lewis diagram drawn.	Correct identification of both shapes and explanation in terms of regions of electron density (*not bonds*) around the central atom.	
2(b)	The Cl atom is more electronegative than the P	Description correctly	Partial discussion that	Correct and full

	atom so each of the P–Cl bonds is polar. In PCl_5, these P–Cl bonds are symmetrically arranged around the central P atom so that the polarity of the bonds cancels out and overall the molecule is non-polar. In comparison the presence of the nonbonding pair of electrons on the P atom of PCl_3 means that there is not a symmetrical arrangement of charge around the P atom and the molecule is polar.	refers to relative electronegativity of the atoms **OR** Correctly identifies the polarity of **BOTH** PCl_3 and PCl_5.	relates correct shape of molecule to polarity **AND** description correctly refers to the relative electro-negativities of the atoms. .	discussion in relation to BOTH polar nature of PCl_3 and non-polar nature of PCl_5.
3(a)	(i) $^{32}P \rightarrow {}^{32}S + \beta$ (ii) $^{236}U \rightarrow {}^{90}Kr + {}^{144}Ba + 2\,{}^{1}n$	Has correct mass numbers for species in both eqns **OR** correctly identifies element formed in both eqns.	Both equations correct.	
3(b)	28 650 years is 5 half-lives, so fraction remaining is 1/32 (0.03125) of carbon-14.	Correct number of half-lives.	Correct fraction remaining showing understanding of term half-life.	
4(a)	$Mn^{2+}(aq)$ colourless / pale pink $MnO_4^{2-}(aq)$ green $Cr^{3+}(aq)$ green or blue	TWO correct.		
(b)	(i) The pale orange solution of Fe^{3+} turns red due to the presence of the $[FeSCN]^{2+}$ ion. $Fe^{3+} + SCN^- \rightarrow [FeSCN]^{2+}$ (ii) The blue solution of copper sulfate turns green / yellow as the complex $[CuCl_4]^{2-}$, which is yellow, forms: $[Cu(H_2O)_6]^{2+} + 4HCl \rightarrow [CuCl_4]^{2-} + 4H_3O^+ + 2H_2O$ or correct alternative with H^+ as product or including only Cl^- on left rather than HCl.	ONE correct observation clearly stating a colour <u>change</u> **OR** Correctly identifies 1 complex ion using a formula.	For ONE of the reactions clearly links the colours observed to the species involved, with correct formula for at least one of the complex ions **OR** 2 correctly balanced equations.	Correctly links observations to species present for BOTH reactions, **AND** at least one balanced equation correct.

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
SIX opportunities answered at Achievement level or higher. 6 × A	SEVEN opportunities answered with at least FIVE at Merit level or higher. 5 × M *plus* 2 × A	EIGHT opportunities answered with at least TWO at Excellence level and FOUR at Merit level. 2 × E *plus* 4 × M *plus* 2 × A