Question Number	Answer	Additional guidance	Mark
3(a)(i)	Atoms may form positive ions by **losing** electrons. (1) The electrons involved in forming positive ions are the **outer** electrons (1)	accept any clear indication that correct word is in gap	(2)

Question Number	Answer	Mark
3(a)(ii)	The only correct answer is **C gamma** A is not correct because alpha radiation is not electromagnetic B is not correct because beta minus radiation is not electromagnetic D is not correct because neutron radiation is not electromagnetic	(1)

Question Number	Answer	Mark
3(a)(iii)	The only correct answer is **A alpha** B is not correct because beta minus travels further in air than alpha C is not correct because beta plus travels further in air than alpha D is not correct because gamma travels further in air than alpha and beta	(1)

Question Number	Answer	Additional guidance	Mark
3(b)(i)	one from: (radiation from them) (can cause) cancer / tumours (1) radiation sickness / radiation poisoning (1) (radiation from them can) mutate / alter/ deform / damage / ionise / kill {cell OR DNA OR genes} (1) burns skin (1)	accept any named type of cancer accept birth defects OR sterilisation Ignore unqualified poisoning kills you skin damage	(1)

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	**neutron** (in the nucleus) (1) becomes a **proton** (and an electron) (1)	**down quark / d** (in the neutron) OR mass/nucleon number stays same becomes an **up quark / u** OR atomic/proton number increases by 1 n > p + e(-) scores 2 marks if no other mark scored allow for 1 mark (it) emits an electron OR beta (minus) is an electron OR energy is released OR loses a proton and gains a neutron IGNORE gaining/losing/becoming electron(s)	(2)

Question Number	Answer	Mark
3(c)	**B** 10^{-10} m	(1)

Question Number:	Answer	Additional guidance	Mark
3(d)	substitution (1) $\frac{1.6726 \text{ (x } 10^{-27})}{9.1094 \text{ (x } 10^{-31})}$ evaluation (1) 1836 evaluation to 2 sf (1) 1800	 Allow 1 mark for answers that round to 1.836 to any power of ten for this mark 1.836×10^3 OR 1.80×10^3 accept 1840 or any rounding of 1836.125 1.8×10^3 **any number** shown to 2 sf gets this mark award full marks for the correct answer without working	(3)

(Total for Question 3 = 11 marks)