Question number	Answer		Mark
17(a)	• They are uncharged **Or** they do not cause ionisation	1	1
17 (b)(i)	$$^{220}_{86}\text{Rn} \rightarrow {}^{212}_{82}\text{Pb} + 2\ {}^{4}_{2}\alpha$$ • Nucleon numbers for Pb and α correct • Proton numbers for Rn and α and number of α correct	1 1	2
17(b)(ii)	• Momentum vectors in directions of track 1 and 2 shown tip to tail • Momentum vector for lead completes closed triangle	1 1	2
17(b)(iii)	• Use of $p = mv$ • Use of $p_h = p \cos \theta$ • Use of $p_v = p \sin \theta$ • Use of conservation of momentum • Use of Pythagoras (for momentum magnitude) • Velocity magnitude $= 5.8 \times 10^5$ m s^{-1} Example of calculation Momentum for 1st alpha $= 6.64 \times 10^{-27}$ kg $\times 1.74 \times 10^7$ m s^{-1} $= 1.155 \times 10^{-19}$ kg m s^{-1} Momentum for 2nd alpha $= 6.64 \times 10^{-27}$ kg $\times 1.81 \times 10^7$ m s^{-1} $= 1.20 \times 10^{-19}$ kg m s^{-1} 'vertical' component of 2nd alpha $= 1.20 \times 10^{-19}$ kg m s^{-1} $\times \cos 60° = 6.01 \times 10^{-20}$ kg m s^{-1} 'horizontal' component of 2nd alpha $= 1.04 \times 10^{-19}$ kg m s^{-1} Total 'vertical' component of lead momentum $= 1.17 \times 10^{-19}$ kg m s^{-1} $+ 6.01 \times 10^{-20}$ kg m s^{-1} $= 1.77 \times 10^{-19}$ kg m s^{-1} $(p_{Pb})^2 = (1.77 \times 10^{-19}$ kg m s$^{-1})^2 + (1.04 \times 10^{-19}$ kg m s$^{-1})^2$ $p_{Pb} = 2.04 \times 10^{-19}$ kg m s^{-1} $v = 2.04 \times 10^{-19}$ kg m s^{-1} $/ 3.52 \times 10^{-25}$ kg $v = 5.80 \times 10^5$ m s^{-1}	1 1 1 1 1 1	6
17 (c)	• There is a gap between the start of the two tracks • The atom/ion/nucleus produced after alpha decay would recoil in the opposite direction before emitting the next alpha • So we can tell that the track on the right was produced by the first alpha **Or** • The track on the right is thicker (than the track on the left) • This means that the track has had a longer time in which to disperse • So we can tell that the track on the right was produced by the first alpha	1 1 1 1 1 1	3
	Total for question 17		14