Question	Answer	Mark
1(a)	83 protons 131 neutrons	 **B2**
(b)	$^{0}_{1}\beta$ Superscript 0 Subscript –1 $^{214}_{84}$Po	 **B1** **B1** **B1**
(c)	(After 20 min count rate is) 360 / 2 or 180 (count / s) (After 40 min count rate is) 180 / 2 or 90 (counts / s) (After 60 min count rate is) 90 / 2 OR new count-rate = 360/(2 × 2 × 2) or 360 / 8 or 3 half-lives 45 (counts / s)	 **C1** **A1**

Question	Answer	Mark
1(d)	Any two points chosen from the lists below: (economic): high cost of storage / shielding / guarding / need to store for a long time OR reduction in tourism OR loss of farming produce / land OR reduction of land / property values (social): fear of cancer / causes cancer / genetic mutations / radiation sickness in people / animals OR local objections OR cause people to move away (environmental): crop mutations OR leakage into water supplies OR pollution <u>of atmosphere</u> / water supply	**B2**
		Total: 9

2 **(a)** different number of neutrons (in the nucleus) OR different neutron number B1

(b) **(** **1** letter Q at nucleon number = 208 B1
proton number = 81 B1

2 letter R at nucleon number = 212 B1
proton number = 84 B1

(ii) evidence of dividing original number by 2 C1
75 (counts) / min OR 1.25 (counts) / s OR 4500 (counts) / hr

[Total: 7]

3 **(a)** **(i)** number of / more neutrons B1
4 more neutrons B1

(ii) same number of protons / proton number / atomic number / chemical reactions / number of electrons (in neutral atom) B1

(b) any **two** lines from:
larger charge
slower moving
more massive
greater volume / more chance of collision
more energy B2

(c) **(i)** <u>atom</u> is mostly empty space OR nucleus very small OR mass concentrated at centre / nucleus OR greater distance between nuclei B1

(ii) charge concentrated at centre / nucleus B1

[Total: 7]

4 **(a)** **(i)** at least two lines (one left, one right) outside the coil of correct shape **or** at least two vertical lines inside the coil **or** two diverging and one central line at top and bottom C1
at least four lines (two left, two right) outside the coil of correct shape **or** at least two lines (one left, one right) outside the coil of correct shape) and at least two vertical lines inside the coil
(crossing or complete loops outside coil gains maximum of 1) A1 [2]

(ii) lines closer where field is stronger o.w.t.t.e. **or** vice versa **or** spacing of lines B1 [1]

(b) reduces (strength of) field B1
(increasing the resistance) reduces the current B1 [2]

(c) curved path upwards (might curve back to the left) B1
well-drawn curved path (no straight section and circular by eye) B1 [2]

(ii) curves in opposite direction to **(c)(i)** B1
magnetic field reversed B1 [2]

[Total: 9]

5 **(a)** number of protons 17 and 17 B1
number of neutrons 18 and 20 B1
number of electrons 17 and 17 B1

(b) alpha, beta, gamma words or symbols, any order NO B1

(c) (mark **(i)** and **(ii)** together)

(i) any correct use M1

(ii) simple correct explanation A1

[6]