



Question	Answer	Mark
1(a)	83 protons 131 neutrons	B2
(b)	${}^0_1\beta$ Superscript 0 Subscript -1 ${}^{214}_{84}\text{Po}$	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) top bent down to R of layer [1]
middle straight on [1]
bottom deflected back to left [1]
- (b) (i) deflection greater than 90°/the bottom one [1]
(ii) positive ignore n [1]
(iii) nothing/vacuum/space/electrons [1]
- (c) 2 AND 2 [1]
- 3 (a) (nuclear) fusion B1
- (b) (i) charges are moving (and current is the (rate of) flow of charge) B1
(ii) $Q = It$ AND t is time B1
- (c) (i) 1. (they are) perpendicular OR at right angles OR at 90° B1
2. (they are) perpendicular OR at right angles OR at 90° B1
(ii) arrow (labelled F) perpendicular to direction AND pointing towards the bottom right of the page B1

[Total: 6]

- 4 (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]**
-
- 5 (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) atom 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]**

- 6 (a) Both have positive/same charge B1
- (b) A continues along original line B1
B deflected by any angle up to 135° (by eye) B1
C returns along same line OR deflected more than 135° (by eye) B1
- (c) Any two from: B2
- Atom is mostly empty space OR Nucleus is (very) much smaller than the atom OR Nucleus is very small
- Charge of nucleus is (very) concentrated / (very) dense
OR Nucleus contains all the positive charge of the atom
OR Nucleus has positive charge
- Nucleus contains most of the mass of the atom
OR Nucleus is (very) massive OR Nucleus is (very) dense

[Total: 6]

7 (a)

	hydrogen-1	deuterium	tritium
no. of protons	1		1
no. of neutrons	0		2
no. of electrons	1		1

proton line correct

neutron line correct, do not accept blank for 0

electron line correct

B1

B1

B1 [3]

(b) ignore any reference to background radiation throughout this part

(i) beta / fast moving electrons

B1 [1]

(ii) any two from:

beta stopped by 5 mm/thick Al / beta not stopped by 0.5 mm/thin Al

B1

alpha stopped by 0.5mm/thin Al

accept stopped by paper

B1 [2]

gamma not stopped by 5 mm or more/thick Al

ignore any reference to range in air

(c) (i) fusion / thermonuclear (reaction)

B1 [1]

(ii) (energy) released

B1 [1]

(d) fission

B1 [1]

[Total: 9]