M1. (a) 1, 0
X, -l (X = negligible / very small / (1/1840) to (1/2000), but not nothing
2 for 4 correct
1 for 2/3 correct

2

(b) has a nucleus which is positive charge
negative charges (electrons) orbit nucleus
each for 1 mark

3

[5]

M2. (a) 90
for one mark

1

(b) (i) neutron
for one mark

1

(ii) nucleus
for one mark

1

(iii) electron
for one mark

1

(c) (i) 100
for one mark

1

(ii) 157
for one mark

1

[6]

M3. (a) **Y** and **Z**

1

they have the same number of protons **or** same atomic number

*accept they have the same number of electrons **or** same number of protons **and** electrons*
allow only different in number of neutrons N.B. independent marks

1

(b) **Quality of written communication**

*for correct use of terms underlined in B **or** C*
Q ✓ Q ✗

1

A – alpha particle passes straight through the empty space of the atom
or it is a long way from the nucleus

*describes 3 tracks correctly for **2** marks*
*describes 2 or 1 track correctly for **1** mark*

B – alpha particle deflected / repelled / repulsed by the (positive) nucleus

C – alpha particle heading straight for the nucleus is deflected / repelled / repulsed backwards

*do **not** accept hits the nucleus*
*do **not** accept answers referring to refraction*
*do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion*

mention of difference in charge on nucleus negates that track

max 2

[5]

]

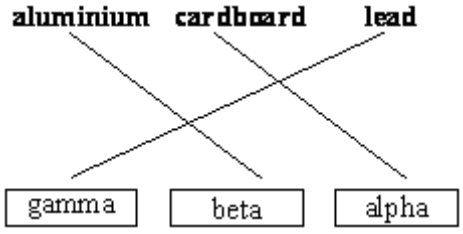
M5. (a) (i) **P**

1

(ii) **Q**

1

(b) 3 lines correct



*allow **1** mark for 1 correct line*
two lines drawn from any source or box – both incorrect

2

(c) (i) **K**

1

(ii) 56

accept 50 – 60 inclusive

1

(iii) **K**

1

(iv) to inject... tracer

1

[8]

M6. (a)

Particle	Relative Mass	Relative charge
Proton	1	
Neutron		0

accept one, accept +1
*do **not** accept –1*

1

accept zero
*do **not** accept no charge/ nothing/neutral unless given with 0*

1

(b) equal numbers/amounts of protons and electrons

1

protons and electrons have equal but opposite charge
accept protons charge +1 and electron charge –1
accept (charge) on proton
cancels/balances (charge) on electron
accept positive (charges) cancel out the negative(charges)
neutrons have no charge is neutral
*do **not** accept total charge of protons, electrons (and neutrons) is 0 unless qualified*

1

(c) (i) (3) fewer neutrons
accept lower/ smaller mass number
*do **not** accept different numbers of neutrons*
any mention of fewer/more protons/electrons negates mark
accept answers in terms of U-238 providing U-238 is specifically stated i.e. U-238 has (3) more neutrons

1

(ii) neutron

1

(iii) (nuclear) fission

accept fision

*do **not** accept any spelling that may be taken as fusion*

1

[7]

M7. (a) (i) **K** and **L**

both answers required either order

1

(ii) (1) same number of protons

accept same number of electrons

accept same atomic number

1

(2) different numbers of neutrons

1

(b) (i) 90

1

(ii) 140

1

(c) alpha (particle)

reason may score even if beta or gamma is chosen

1

mass number goes down by 4**or**
number of protons and neutrons goes down by 4
or
number of neutrons goes down by 2

*candidates that answer correctly in terms of why gamma **and** beta decay are not possible gain full credit*

1

atomic / proton number goes down by 2**or**
number of protons goes down by 2

*accept an alpha particle consists of 2 neutrons and 2 protons for **1** mark*

*accept alpha equals $^{4}_{2}He$ or $^{4}_{2}\alpha$ for **1** mark*

an alpha particle is a helium nucleus is insufficient for this mark

1

[8]

M8. (a) **L**

J

K

all 3 in correct order
*allow **1** mark for 1 correct*

2

(b) number of electrons = number of protons
accept amount for number

1

(c) neutrons
this answer only

1

(d) loses / gains electron(s)

1

[5]

M9. (a) (i) any **one** from:

- food / drink
- rocks / building materials
- cosmic rays / rays from space
  accept correctly named example

1

(ii) any **one** from:

- nuclear power / coal power (stations)
  accept nuclear waste
- nuclear accidents
  accept named accident eg Chernobyl
- nuclear weapons testing
  accept named medical procedure which involves a radioactive source
  accept radiotherapy
  nuclear activity / radiation is insufficient
  *do **not** accept CT scans*

1

(iii) different number of / fewer protons
accept does not have 86 protons
accept only has 84 protons
or different atomic number
*do **not** accept bottom number different*
reference to mass number negates this mark

1

(b) 168
accept 169 if clear, correct method is shown
*allow **1** mark for a correct dose ratio involving the spine*
eg 2:140 etc
***or** ratio of days to dose is 1.2*
***or** ratio of dose to days is 0.83*

2

(c) (i)

Group A	Group B
J M O	K L N

all correct

any order within each group

1

(ii) similar (number) / same (number) / large (number)

accept the same specific number in each group eg three

reference to other factors such as age is neutral

1

(iii) how many people in each group developed cancer

a clear comparison is required

1

(iv) *there are no marks for **Yes** or **No** the mark is for the reason*

Yes

the benefit of having the scan is greater than the risk **or** the risk is (very) small (compared to the chance from natural causes)

accept the risk is much greater from natural causes

No

no additional risk is acceptable

1

[9]