

M1. (a) 1, 0
X, -1 (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

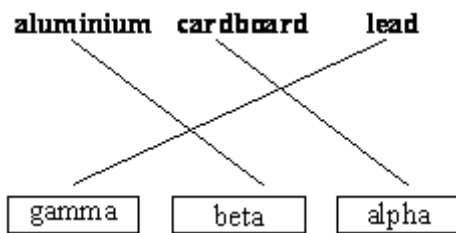
[5]

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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

cancel/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 ${}^4_2\text{He}$ 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) (

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]