

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

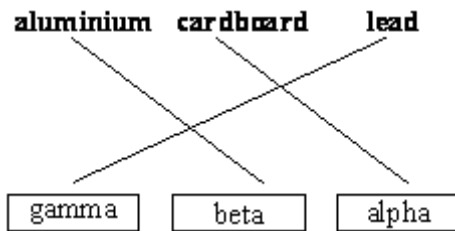
[5]

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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

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 ${}^4_2\text{He}$ 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]