

MARK SCHEME

GCSE

PHYSICS

AQA - TRIPLE SCIENCE

P4 - TEST 4

ATOMIC STRUCTURE

Intermediate

Mark schemes

- 1.** (a) $\text{count rate} = \frac{819}{60}$ 1
- count rate = 13.65 1
- corrected count rate = 13.35 (per second)
- allow an answer of*
background = 0.30 × 60
= 18 (per minute)
corrected count rate
= 819 – 18
corrected count rate
= 801 per minute 1
- an answer of 13.35 (per second) scores 3 marks*
an answer of 13.95 (per second) scores 2 marks
an answer of 801 (per second) scores 2 marks
- (b) activity = 1250 × 180 1
- activity = 225 000 (Bq) 1
- an answer of 225 000 (Bq) scores 2 marks*
- (c) yearly dose = 0.003 × 365 1
- allow yearly dose = 1.095 (mSv)*
- which is << 100 (mSv)
- or**
- (well) below the lowest dose with evidence of causing cancer / harm 1
- (d) people are able to compare a radiation risk / dose / hazard to the radiation dose from (eating) bananas 1
- [8]**
- 2.** (a) (average) time taken for the amount / number of nuclei / atoms (of the isotope in a sample) to halve
- or**
- time taken for the count rate (from a sample containing the isotope) to fall to half
- accept (radio)activity for count rate* 1
- (b) 60 ±3 (days) 1
- indication on graph how value was obtained 1

(c) (i) cobalt(-60) 1

gamma not deflected by a magnetic field
or
gamma have no charge
dependent on first marking point
accept (only) emits gamma
gamma has no mass is insufficient
*do **not** accept any reference to half-life*

(ii) strontium(-90) 1

any **two** from:

- *only* has beta
- alpha would be absorbed
- gamma unaffected
- *beta penetration / absorption depends on thickness of paper*
if thorium(-232) or radium(-226) given, max 2 marks can be awarded

(iii) cobalt(-60) 1

shortest half-life
accept half-life is 5 years
dependent on first marking point

so activity / count rate will decrease quickest 1

(iv) americium(-241) / cobalt(-60) / radium(-226) 1

gamma emitter 1

(only gamma) can penetrate lead (*of this box*)
do not allow lead fully absorbs gamma

[14]

3.

(a) two half lives
gains 1 mark

but
 20 minutes
gains 2 marks

2

- (b) alphas will be stopped by skin / air **or** do not penetrate betas and gammas can reach / damage organs / cells

for 1 mark each

2

[4]

4.

- (a) X emits beta

accept β

1

Y emits alpha, beta, gamma

must have all three accept α , β , γ

1

- (b) gamma

accept beta and gamma

any mention of alpha loses first mark

1

radiation can penetrate (the plastic)

1

kills bacteria **or** microbes **or** micro-organisms **or** viruses

not germs

1

[5]

5.

- (a) suitable arrangement of source and GM tube ie fixed distance apart

accept 'detector' for GM tube and counter

1

suitable test

*eg introduce absorbing material **or** increase distance between source and GM tube*

1

suitable conclusion

*alpha that which gives a greatly reduced count with a paper absorber **or** alpha if count decreases rapidly when distance between source and GM tube exceeds 5cm(approx)*

the first two marks could be scored from a labelled diagram

1

- (b) (i) (changes to) background radiation

*do **not** accept the source is decaying if it is their only answer*

or

(beta) decay is random

accept decay is not constant

1

- (ii) thickness decreasing
accept it is thin 1
- increased count rate 1
- (means) less (beta) radiation absorbed
accept more (beta) radiation passes through 1
- (iii) changing thickness will not change count rate (significantly)
accept insufficient absorption of gamma radiation irrespective of thickness
*do **not** accept gamma rays too penetrating*
*do **not** accept answers in terms of speed* 1

[8]

- 6.** (a) one relevant point correctly plotted
gains 1 mark
- but** two relevant points correctly plotted
gains 2 marks
- but** three relevant points correctly plotted
gains 3 marks
- curved line drawn accurately through the points
for 1 further mark 4

- (b) age of igneous rock = 400 ± 100 million years 1

- (c) sandstone is a sedimentary rock
for 1 mark

there is likely to be some lead-207 present
or from the rocks from which the sandstone was formed
for 1 mark

(allow ^{207}Pb may not have come from this ^{235}U) 2

[7]

- 7.** (a) (i) 2.5 1
- (ii) The radiation dose from natural sources is much greater than from artificial sources. 1

(b) (i) other factors may be involved
accept a specific suggestion
eg they may be exposed to other types of radiation
accept cannot be sure (in many cases) that the cause of death is radon (poisoning)

1

(ii) any **one** from:

- different concentrations in different rooms
- to average out daily fluctuations
accept to find an average
accept to make the result (more) reliable / valid
*do **not** accept to make more accurate on its own*

1

(iii) average level (much) higher (in **C** and **D**)

accept converse

1

some homes have very high level (in **C** and **D**)

*accept maximum level in **A** and **B** is low*

or

maximum level in some homes (in **C** and **D**) is very high

*accept higher radiation levels (in **C** and **D**) for 1 mark*

1

[6]

8.

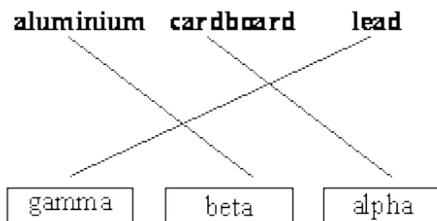
(a) (i) **P**

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]

9.

2 weeks

*if answer is incorrect 2 gains two marks weeks gains one mark
half of 68 or 34 gains one mark / allow working shown on graph*

[3]

10.

- (a) (i) (two) nuclei (of light elements) join
accept hydrogen atoms for nuclei

1

forming a larger / heavier nucleus / one
*accept comparative term equivalent to larger
accept forms a helium (nucleus / atom) this mark only scores if
fusion is in terms of hydrogen atoms*

1

- (ii) stars
*accept a named star
e.g. the Sun
accept nebula
mention of planets negates answer*

1

- (b) (i) any **one** from:
- (currently) only experimental
 - reaction does not last long enough
 - use more energy than they produce
*allow difficult to control
do **not** allow inefficient on its own*

1

(ii) any **one** from:

- will give another source of energy
- unlimited fuel supplies / energy
accept unlimited hydrogen
- would not produce any radioactive waste
accept less radioactive waste
accept nuclear for radioactive
*do **not** accept toxic waste*
- want to show that it can be done
accept any sensible suggestion
*do **not** accept answers only in terms of fossil fuels or carbon dioxide*

1

[5]

11.

(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]