

MARK SCHEME

GCSE

PHYSICS

AQA - COMBINED SCIENCE

P4 - TEST 5

ATOMIC STRUCTURE

Advanced

Mark schemes

- 1.** (i) nucleus / neutron
do not accept shells or orbits 1
- (ii) neutron changes to a proton **or** number of neutrons goes down 1
and the number of protons goes up by 1
do not accept becomes positive 1
- [2]**
- 2.** (i) 7 **or** 8 1
- correct data extracted from graph e.g. takes 8 days to drop from 50 to 25
allow appropriate annotation of graph 1
- (ii) long enough to destroy cancer cells
do not accept dangerous unqualified 1
- but short enough to minimise damage to surrounding tissues 1
- [4]**
- 3.** (a) protons, electrons
both required, either order 1
- neutrons 1
- electron, nucleus
both required, this order 1
- (b) 2.7 (days)
allow 1 mark for showing correct use of the graph 2
- (c) put source into water at **one** point on bank
accept the idea of testing different parts of the river bank at different times 1

see if radiation is detected in polluted area

accept idea of tracing

or

put source into water at three points on bank (1)

see if radiation is detected downstream of factory **or** farmland **or** sewage treatment works (1)

1

[7]

4.

(a) beta

1

alpha: would not pass through (the aluminium / foil)

1

gamma: no change in count rate when thickness changes

must be a connection between detection / count rate / passing through and change in thickness

1

(b) foil thickness increases then decreases (then back to normal / correct thickness)

a description of count rate changes is insufficient

1

gap between rollers decreases, then increases (then back to correct size)

or

pressure from rollers increases then decreases

accept tightness for pressure

answers may link change in thickness and gap width for full credit

ie:

foil thickness increases so gap between rollers decreases (1)

foil thickness decreases so gap between rollers increases (1)

1

(c) 56 (years)

accept any value between 55-57 inclusive

allow 1 mark for correct calculation of mass remaining as 1.5 (micrograms)

allow 1 mark for a mass of 4.5 micrograms plus correct use of graph with an answer of 12

maximum of 1 compensation mark can be awarded

2

[7]

5.

(a) any **two** pairs from:

- nuclear model mass is concentrated at the centre / nucleus (1)
plum pudding model mass is evenly distributed (1)
accept the nuclear model has a nucleus/the plum pudding model does not have a nucleus for 1 mark
- nuclear model positive charge occupies only a small part of the atom (1)
plum pudding model positive charge spread throughout the atom (1)
accept electrons in shells/ orbits provided a valid comparison is made with the plum pudding model
*do **not** accept on its own*
*do **not** accept electrons at edge of plum pudding*
- nuclear model electrons orbit some distance from the centre / nucleus (1)
plum pudding electrons embedded in the (mass) of positive (charge) (1)
- nuclear model the atom mainly empty space (1)
plum pudding model is a 'solid' mass (1)
to gain credit it must be clear which model is being described
*do **not** accept simple descriptions on the diagram without comparison*

4

(b) nucleus must be positive to deflect/ repel alpha particles

answers in terms of electrons/negative charge causing deflection negates mark
answers in terms of reflection negates mark

1

nucleus (very) small so few alpha particles deflected backwards

accept most of atom empty space so most pass through

1

(c) many/ 100 000 measurements taken

accept results for measurements accept data valid / reliable

1

findings could not be explained by plum pudding model

accept a specific finding that could not be explained
eg some alpha particles were deflected backwards

1

[8]

6.

(a) (gamma emission) does not change the number of protons

1

(because gamma emission) is not a particle

allow (gamma emission) is an (electromagnetic) wave

1

- (b) prevents food poisoning 1
- (by) killing the bacteria / microorganisms / moulds 1
- that produce toxins
- ignore references to decay* 1
- (c) (only) gamma rays can pass (all the way) through packaging (to reach the food / bacteria)
- allow converse* 1
- (and also) gamma rays pass all the way through the food without damaging / ionising the food
- allow converse* 1
- ignore contamination*
- ignore no damage to food unqualified*
- (d) radioactive food contains a source of radiation
- or**
- radioactive food is emitting radiation 1
- (whereas)
- irradiated food has been exposed to (an external source of nuclear) radiation 1

[9]

- 7.** (a) 2 charged particles and 2 neutral particles 1
- (b) it is the type of radiation with a negative charge 1
- (c) it has a very long range in air 1

(d) risk / activity associated with iodine-131 has decreased by a large amount 1

because of short half-life

allow many half-lives have passed

allow half-life is only 8 days

2nd marking point dependent on 1st marking point

1

risk / activity associated with caesium-137 will not have decreased by much

allow activity has halved

1

because of long half-life

allow only one half-life has passed

4th marking point dependent on 3rd marking point

1

(e) 5 half-lives

allow any correct method

e.g. $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 1/32$

1

$5 \times 30 = 150$

1

$1986 + 150 = 2136$

1

any calculation using a value of 137 scores zero

an answer of 2136 scores 3 marks

[10]

8.

(a) half-life read from graph = 2 hours 1

time to fall to 1.56 is six half lives = $6 \times 2 = 12$ (hours)

1

(b)
$$\begin{array}{c} 210 \\ 82 \end{array} \text{Pb} \longrightarrow \begin{array}{c} 206 \\ 80 \end{array} \text{Hg} + \begin{array}{c} 4 \\ 2 \end{array} \text{He}$$

one mark for each correct element in the equation

3

(c) ionising radiation turns atoms into ions 1

which can break up molecules

1

this can change DNA

1

causing mutations to genes

1

which can cause cancer

1
[10]

9.

(a) (i) a helium nucleus

*accept ${}^4_2\text{He}$
accept 2 protons + 2 neutrons
do **not** accept He
do **not** accept helium atom*

1

(ii) nucleus

only answer, no alternative

1

(b) (i) each axis given a linear scale

*time axis must go up to 12 days
y-axis must go up to 40 000*

1

curve concave to axis drawn

1

curve shows correct half-life of four days

*do **not** accept a straight line must show one half-life
check first two plotted points correct to \pm half square
a curve drawn dot-to-dot scores a maximum of 1 mark*

1

(ii) 38 750

*no tolerance
allow 1 mark for 5 half-lives
allow 1 mark for showing that 1 250 are undecayed*

3

(c) (i) more radon enters shaft (through cracks in the rock face)

accept radon emitted from surroundings

1

(ii) (alpha) radiation will damage cell structure or ionise cells

accept kill cells

1

causing cancerous growth

*an answer in terms of the daughter product polonium being a solid
or lodging in the throat and also emitting alpha gains full credit*

1

[11]