AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.4.1 ATOMS AND ISOTOPES (PACK 2)

SCORE	PERCENTAGE
/106	%

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Mark schemes

Q1.

(a) (i) helium nuclei

1

or

two protons and two neutrons or $^{4}_{2}$He

*do **not** accept it is a particle emitted by an unstable nucleus of Californium -241*

(ii) time taken for the activity **or** count rate **or** number of nuclei **or** number of atoms **or** number of radioactive particles to decrease to half

1

(iii) Technetium-99

*this mark **cannot** score without Technetium- 99*

1

any **two** of the following:

- suitable short half-life or activity quickly reduced to a safe level or it doesn't stay in the body long
  *this mark **can** score if Cobalt -60 is given*
- (gamma emitter so) it can be <u>detected</u> outside the body
- less (ionising) damage to cells **or** tissue
  *this mark **can** score if Cobalt -60 is given*

2

(b) any **three** of the following:

- transport of waste into the area
- possibility of accident or leakage from transport
- safe levels not reached for hundreds or thousands of years
- Possible leakage **or** contamination of land **or** water **or** increase in background radiation
- increased risk of (radiation linked) illness **or** cancer

3

[8]

Q2.

(a) (i) a helium nucleus

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accept $^{4}_{2}He$
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 ± 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]

Q3.

(a) (i) electron
neutron
proton
nucleus
1 mark for each correct label

4

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(ii) H-1 has no neutrons
H-3 has 2 neutrons

more neutrons gets 1 mark

2

(iii) nucleus unstable

2

(b) lead/concrete
lead/concrete needed to stop gamma rays

2

[10]

Q4.

(a) 1.
-1

2

for 1 mark each

(b) (i) 19p,
20n,
19e

all correct for 2 marks
2 correct for 1 mark

2

(ii) K40 has an extra neutron/different number of neutrons/
it has more neutrons/21 neutrons

for 1 mark
NOT fewer neutrons

1

(iii) radioactive/unstable nucleus/ nucleus disintegrates/
emits radiation/it has too many neutrons

for 1 mark

1

(iv) calcium/Ca

for 1 mark

1

(v) 1 (e) in outer shell/same number of electrons/outer electron
same distance from the nucleus

for 1 mark

1

(c) (i) Geiger-Muller tube (photographic) film

for 1 mark

1

(ii) cancer, leukaemia, radiation sickness etc.

for 1 mark

1

[10]

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Q5.

(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]

Q6.

(a) nucleus positive charge / protons in nucleus electrons / negative charges orbit nucleus

each for 1 mark

3

(b) (i) positive dough repels positive alpha particles **or** 2 positive charges repel forces small

each for 1 mark

2

(ii) large force needed + ves in plum pudding spread out – *may appear in (i)*

positive charge must be concentrated / in nucleus
(ignore references to electrons)

for 1 mark each

3

(c) 1, 0
X,–l (X = negligible / very small/(1/1840) (1/2000),but not nothing)

each row for 1 mark

2

(d) (i) 4

for 1 mark

1

(ii) B and C have the same number of protons / atomic number
but different number of neutrons / mass number

each for 1 mark

3

[14]

Q7.

(a) 90

for one mark

1

(b) (i) neutron

for one mark

1

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(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]

Q8.

(a) (i) B

for one mark

2

(ii) has a different number of electrons (protons)

for one mark

(b) (i) A and C

for one mark

1

(ii) same number of protons / electrons, same nuclear charge
different number of neutrons / nuclear masses different

for 1 mark each

2

[5]

Q9.

(a) (i) beta and gamma (*any* order)

for one mark

1

(ii) gamma

for one mark

1

(b) (i) particles / atoms / molecules become charged / gain / lose electrons

for one mark

1

(ii) e.g. to kill cancer cells (*allow* any use of alpha, beta or gamma or X^- radiation)

for one mark

1

(c) (i) time taken for no. of atoms / no. of nuclei / mass of U238 / activity to halve – ***not*** radioactivity

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or
time taken for count rate to halve
for one mark

1

(ii) atoms with unstable nuclei which emit radiation
(*not* definition of isotope but isotope which is radioactive gets 1 mark)
for 1 mark each

2

(d) (i) 1 / 4 *accept* 25% or 0.25
for one mark

1

(ii) 2 × half life or 2 × 4500 million years (independent of (i))
gains *1 mark*
but

9000 million years ecf only if answer to (i) is $\frac{1}{2}, \frac{1}{8}, \frac{1}{16}$, etc.
gains 2 marks

2

[10]

Q10.

(a) (i) B
for one mark

1

(ii) has 4 electrons / protons others only 3; B has a different no. of electrons / protons - *not* A and C have same no. of protons / electrons
for one mark

1

(b) (i) A and C
for one mark

1

(ii) same no. of protons / electrons different no. of neutrons
or
nuclei have the same charge but different mass
for 1 mark each

2

(c) (i) 

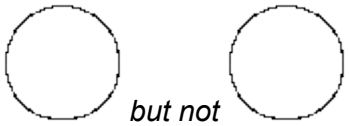
(ii) 

(iii) 
for 1 mark each

3

(d) 2p.2n 

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allow *but not*

(i.e. no mark if electrons shown)

for one mark

1

[9]

Q11.

(i) 86

1

(ii) 222

1

[2]

Q12.

(a) radium

accept Ra

1

(b) different numbers of protons

accept one has 91 protons, one has 92
or *Pa has 91 protons, U has 92*
do ***not*** *credit they have different atomic numbers*
reject different numbers of protons and neutrons

1

(c) alpha

1

(d) neutron changes into proton

accept electron lost / beta radiation
accept singular or plural answers

1

[4]

Q13.

(a) (i) cannot penetrate aluminium

allow can only pass through air / paper too weak is neutral

1

(ii) gamma rays not affected (by aluminium)

allow all / most (gamma rays) to pass through

too strong is neutral
danger is neutral

1

(b) (i) (nuclei) unstable

1

(ii) causes harm / damage to body / cells

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allow radiation sickness

1

detail e.g., causes mutations / causes cancer / damages DNA / damages chromosomes

allow two effects for 2 marks

1

[5]

Q14.

(a) protons

1

protons

accept electrons

1

neutrons

1

(b) protons

reject mass

1

[4]

Q15.

neutron becomes proton / neutron emits electron / neutron emits beta particle

gains proton neutral

[1]

Q16.

- 4
- 9

each for 1 mark

[2]

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