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0 6 A smoke detector contains a source of alpha radiation in a plastic case.

0 6 . 1 A source of beta radiation in a smoke detector would be more hazardous than a source of alpha radiation.

Explain why.

[2 marks]

0 6 . 2 Actinium (Ac) is one source of alpha radiation.

An actinium (Ac) nucleus emits an alpha particle (α) and turns into a francium (Fr) nucleus.

This can be represented as:

$$^{A}_{Z}\mathrm{Ac} \longrightarrow {}^{223}_{87}\mathrm{Fr} + \alpha$$

Determine the values of **A** and **Z**.

[2 marks]

A = _____

Z = _____

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0 6 . 3 A teacher wanted to find out what nuclear radiation is emitted from a source.

The teacher placed different barriers between the source and a detector.

The teacher recorded the count for 30 seconds after each barrier was put in place.

Table 2 shows the results.

Table 2

Barrier	Thickness in millimetres	Count after 30 seconds
None		985
Paper	0.1	149
Aluminium	5.0	0
Lead	20.0	0

Explain what nuclear radiation was emitted by the source.

[4 marks]

Question 6 continues on the next page

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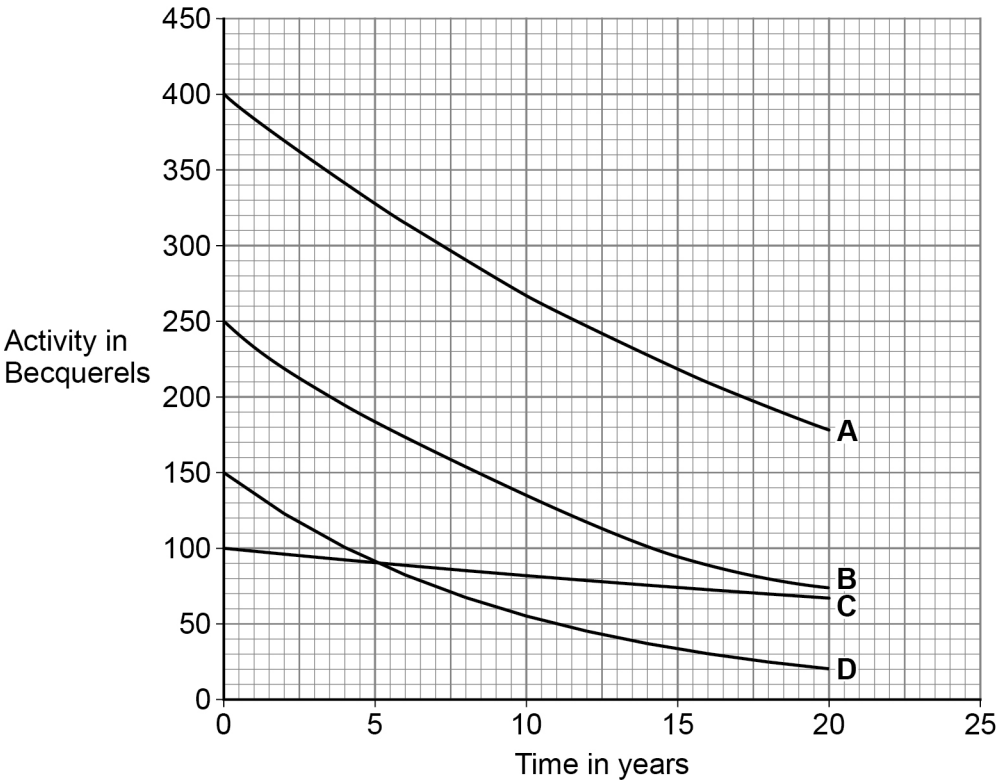
0 6 . 4 **Figure 11** shows how the activity of four different radioactive isotopes, **A**, **B**, **C** and **D**, changes over time.

Figure 11



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Write the isotopes **A**, **B**, **C** and **D** in order of increasing stability of their nuclei.

Explain your answer.

[3 marks]

Least stable **Most stable**

_____ _____ _____ _____

Explanation _____

_____

_____

_____

_____

_____

11

END OF QUESTIONS

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	beta radiation is more penetrating (than alpha radiation)	allow beta radiation can pass through the case (but alpha radiation cannot) allow beta radiation can travel further (in air than alpha radiation) do **not** allow beta radiation is more ionising	1	AO1 6.4.2.1 6.4.2.4
	so beta radiation could irradiate people passing near the smoke detector	allow beta radiation can pass through skin	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	A = 227 Z = 89		1 1	AO1 AO2 6.4.2.2 6.4.2.1 6.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(some) radiation is stopped by paper		1	AO3 6.4.2.1
	so the source emits alpha radiation	MP2 dependent on MP1	1	
	and (some) radiation passes through paper but is stopped by aluminium		1	
	so the source emits beta radiation (but does not emit gamma)	MP4 dependent on MP3	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	D B A C	all four letters must be in the correct order explanation only scores if correct order given	1	AO3 6.4.2.1 6.4.2.3
	explanation			
	a substance with a longer half-life has more stable nuclei	allow the more stable a nucleus, the less likely it is to decay (in a given time)	1	
	so answers are in order of increasing half-life		1	

Total Question 6		**11**