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| **P3 Topic 3** |
| **Production, uses and risks of ionising radiation from radioactive sources** |

**Questions**

**Q1.**

Ionising radiations are emitted by unstable nuclei.

(i) Which particle has the same mass as but opposite charge to a β+ particle?

     Put a cross (  ) in the box next to your answer.

**(1)**

    **A**   electron

    **B**   positron

    **C**   proton

    **D**   neutron

 (ii) Suggest why a beta particle will travel further in air than an alpha particle.

**(2)**

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**Q2.**

Ionising radiations are emitted by unstable nuclei.

(a) (i) Which particle has the same mass as but opposite charge to a β+ particle?

Put a cross (  ) in the box next to your answer.

**(1)**

    **A**   electron

    **B**   positron

    **C**   proton

    **D**   neutron

 (ii) Suggest why a beta particle will travel further in air than an alpha particle.

**(2)**

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(b) Complete the sentence by putting a cross (  ) in the box next to your answer.

 Following the radioactive decay of a nucleus, the nucleus might undergo some rearrangement, losing energy as

**(1)**

    **A**   gamma radiation

    **B**   a proton

    **C**   a neutron

    **D**   an X-ray

(c) Some unstable nuclei decay by emitting β− radiation.

 (i) Describe the process of β− emission.

**(3)**

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(ii) Explain what happens to the mass number and the atomic number of a nucleus when β− emission occurs.

**(3)**

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**(Total for Question = 10 marks)**

**Q3.**

Ionising radiations are emitted by unstable nuclei.

Complete the sentence by putting a cross (  ) in the box next to your answer.

 Following the radioactive decay of a nucleus, the nucleus might undergo some rearrangement, losing energy as

**(1)**

    **A**   gamma radiation

    **B**   a proton

    **C**   a neutron

    **D**   an X-ray

**Q4.**

Ionising radiations are emitted by unstable nuclei.

Some unstable nuclei decay by emitting β− radiation.

 (i) Describe the process of β− emission.

**(3)**

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(ii) Explain what happens to the mass number and the atomic number of a nucleus when β− emission occurs.

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**Mark Scheme**

Q1.

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|    | **Answer**  | **Acceptable answers**  | **Mark**  |
| **(i)**  |    **A** electron  |    | **(1)**  |
|  **(ii)** | suggestion to include **two** of  the ionisation is different (1)  correct difference in ionisation (1)  the masses are different (1)  alpha is bigger than beta (1)  alpha hits more (air) particles (1)  alpha loses its energy in shorter distance (1)  |   alpha more ionising (than beta) scores 2 marks   RA (heavier for bigger) RA RA IGNORE references to penetration  | **(2)** |

**Q2.**

|  |  |  |  |
| --- | --- | --- | --- |
|    | **Answer** | **Acceptable answers** | **Mark** |
| **(a)(i)** |    **A** electron  |    | **(1)**  |
| **(a) (ii)** | suggestion to include **two** of  the ionisation is different (1)  correct difference in ionisation (1)  the masses are different (1)  alpha is bigger than beta (1)  alpha hits more (air) particles (1)  alpha loses its energy in shorter distance (1)  |   alpha more ionising (than beta) scores 2 marks   RA (heavier for bigger) RA RA IGNORE references to penetration  | **(2)** |
| **(b)** |  **A**  gamma radiation  |    | **(1)** |
| **(c)(i)** | A description linking the following:  neutron decays / changes / becomes (1)  (neutron) into proton (1)  (plus an) electron (1)  |   quark changes (quark changes) from down to up / d to u e- (do not accept β- ) accept n and p for neutron and proton n > p + e- scores 3 marks IGNORE references to atomic and mass numbers; unstable nuclei; too many neutrons; gamma emitted  | **(3)** |
| **(c)(ii)** | An explanation linking **three** of the following:  mass number doesn't change (1)  (because) same number of nucleons / quarks (1)  atomic number goes up by one (1)  (because) there is an extra proton (1)  |     emitted electron mass is negligible proton and neutron have same mass   a neutron has (decayed in)to a proton  | **(3)** |

**Q3.**

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|    | **Answer** | **Acceptable answers** | **Mark** |
|    |  **A**  gamma radiation  |    | **(1)** |

**Q4.**

|  |  |  |  |
| --- | --- | --- | --- |
|    | **Answer** | **Acceptable answers** | **Mark** |
| **(i)** | A description linking the following:  neutron decays / changes / becomes (1)  (neutron) into proton (1)  (plus an) electron (1)  |   quark changes (quark changes) from down to up / d to u e- (do not accept β- ) accept n and p for neutron and proton n > p + e- scores 3 marks IGNORE references to atomic and mass numbers; unstable nuclei; too many neutrons; gamma emitted  | **(3)** |
| **(ii)** | An explanation linking **three** of the following:  mass number doesn't change (1)  (because) same number of nucleons / quarks (1)  atomic number goes up by one (1)  (because) there is an extra proton (1)  |     emitted electron mass is negligible proton and neutron have same mass   a neutron has (decayed in)to a proton  | **(3)** |

**Examiner's Report**

Q1.

***(ii)***

Examiners were looking for responses to mention relative ionising ability or mass.



**Results Plus: Examiner Comments**

This scores both marks for saying that beta particles are less ionising than alpha particles.

**Q2.**

***(a)(ii)***

Examiners were looking for responses to mention relative ionising ability or mass.



**Results Plus: Examiner Comments**

This scores both marks for saying that beta particles are less ionising than alpha particles.

***(c)(i)***

Responses in terms of a proton decaying into a neutron or quarks changing flavour were acceptable. Some candidates who tried both explanations contradicted themselves so lost some, if not all the marks.



**Results Plus: Examiner Comments**

Both strands are correct here and the beta minus particle identified as an electron.

***(c)(ii)***

Here candidates had to explain that the mass number did not change but the atomic number increased by 1.



**Results Plus: Examiner Comments**

An acceptable response for all 3 marks.

**Q3.**No Examiner's Report available for this question

**Q4.**

***(i)***

Responses in terms of a proton decaying into a neutron or quarks changing flavour were acceptable. Some candidates who tried both explanations contradicted themselves so lost some, if not all the marks.



**Results Plus: Examiner Comments**

Both strands are correct here and the beta minus particle identified as an electron.

***(ii)***

Here candidates had to explain that the mass number did not change but the atomic number increased by 1.



**Results Plus: Examiner Comments**

An acceptable response for all 3 marks.