SCIENCE FOUNDATIONS

Atomic and nuclear physics

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you explain radioactivity, from the radiation used to treat cancer to the energy released inside a nuclear power plant. A hospital uses controlled radiation to target a tumour, and a power plant uses the energy released when atoms split to make electricity. A smoke detector in your home uses a tiny amount of radiation to sense smoke, and archaeologists use the steady decay of carbon to date old bones. The same physics explains all of these, from a life saving treatment to the power on your street.



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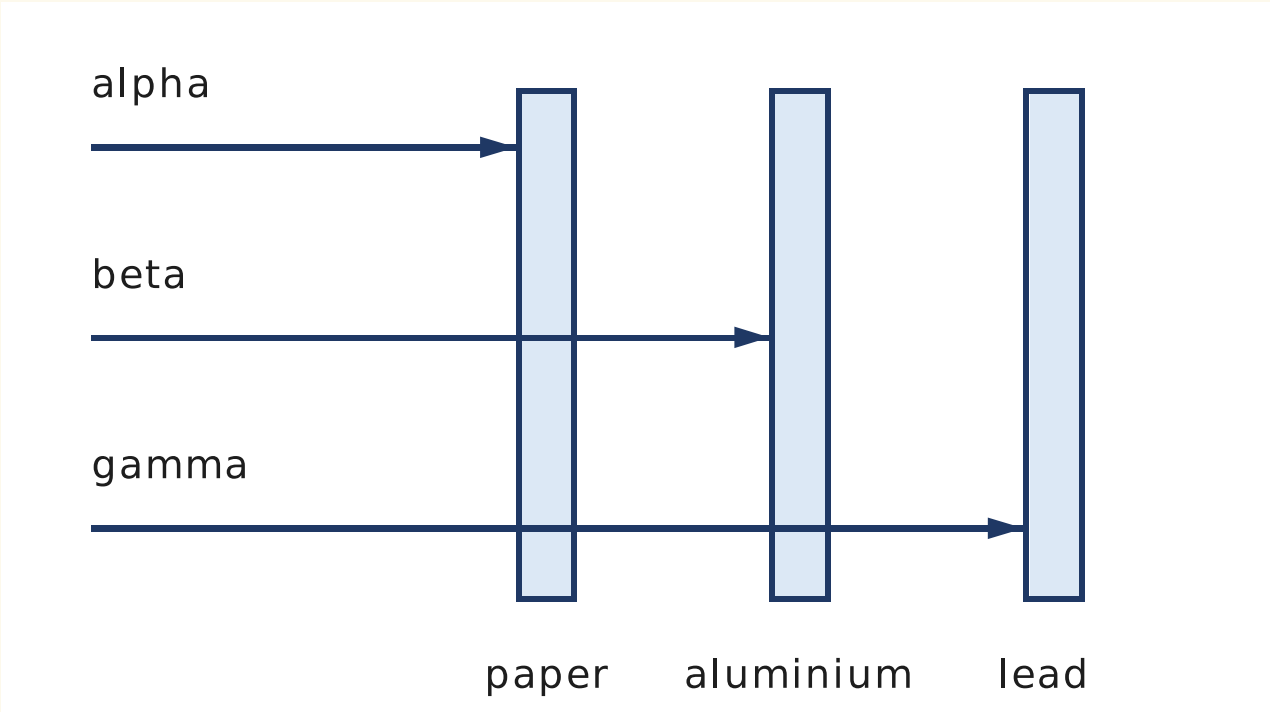
Worked examples

EXAMPLE 1

Q In what order, from least to most penetrating, do alpha, beta, and gamma radiation rank?



SOLUTION

Recall stopping materials: paper stops alpha, aluminium stops beta, lead is needed for gamma.

Least penetrating is stopped most easily: alpha.

Order from least to most penetrating.

The result is alpha least, then beta, then gamma most.

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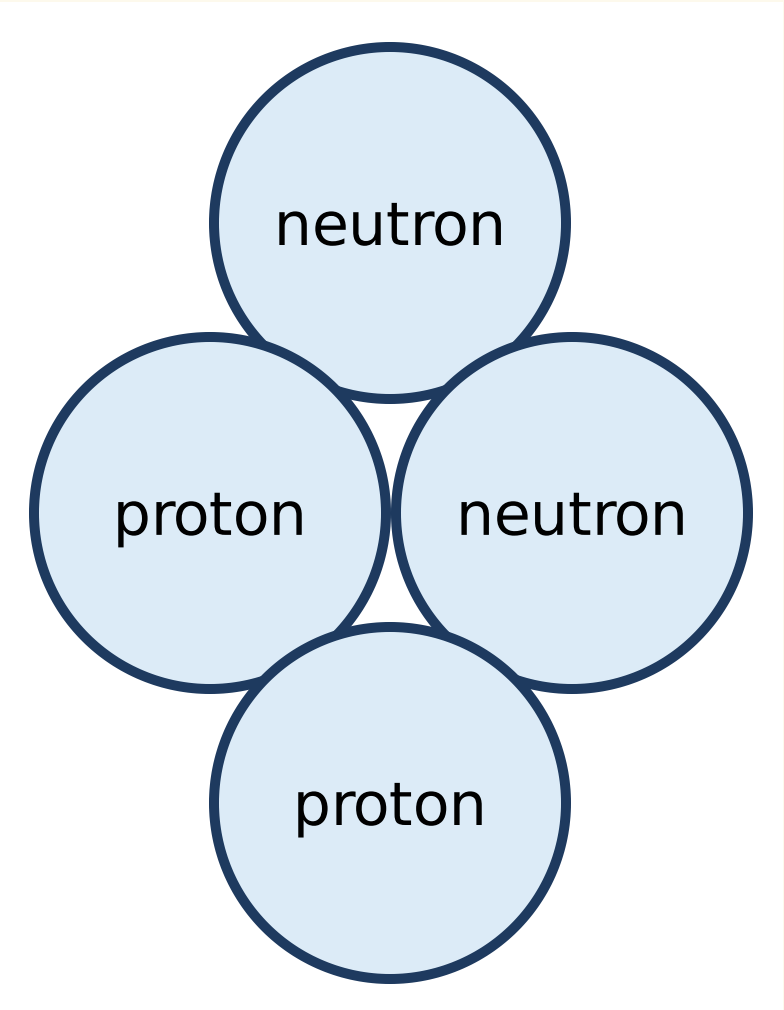
EXAMPLE 2

Q Which radiation is a helium nucleus?



SOLUTION

Check the definitions: alpha is a helium nucleus.

Beta is an electron, gamma is light.

Label it alpha.

The result is alpha radiation.

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Practice questions

1 Which type of radiation has the greatest mass: alpha, beta, or gamma?

- A Alpha
- B Beta
- C Gamma
- D Neutron

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2 Which type of radiation travels at the speed of light?

- A Alpha
- B Beta
- C Gamma
- D Neutron

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3 **An alpha particle is a helium nucleus. How many protons does it contain?**

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4 **Stopped by paper: which type of radiation?**

A Alpha

B Beta

C Gamma

D Neutron

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5 Beta radiation is what?

A A helium nucleus

B A fast electron

C High-energy light

D A proton

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6 Gamma radiation is what?

A A fast electron

B A helium nucleus

C A neutron

D High-energy light

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7 A beta source is placed behind a sheet of paper. What happens to the beta radiation?

- **A** It is stopped by the paper
- **B** It passes through the paper
- **C** It turns into gamma radiation
- **D** It is absorbed by the air

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8 A doctor needs radiation that can reach a tumour deep inside the body. Which type should be used, and why?

- **A** Alpha, because it has the greatest mass
- **B** Beta, because it is stopped by skin
- **C** Gamma, because it penetrates the deepest
- **D** Alpha, because it travels the fastest

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9 Nuclear or chemical: which changes the nucleus?

- A Nuclear
- B Chemical
- C Both
- D Neither

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10 Is gamma radiation a particle?

- A Yes
- B No

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ANSWER KEY

1. Alpha

2. Gamma

3. 2

4. Alpha

5. A fast electron

6. High-energy light

7. It passes through the paper

8. Gamma, because it penetrates the deepest

9. Nuclear

10. No

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