Worksheet 4.4.2: Alpha, Beta and Gamma Radiation PhysicsSheets

Specification: GCSE Physics (AQA 4.4.2 / Edexcel SP15)

Alpha (α) Radiation: A helium nucleus ($^4_2$He). Highly ionising, low penetration (stopped by paper/skin).
Beta (β) Radiation: A high-speed electron ($^0_{-1}$e). Moderately ionising, medium penetration (stopped by aluminium).
Gamma (γ) Radiation: An electromagnetic wave. Weakly ionising, high penetration (stopped by thick lead/concrete).
Ionisation: The process of removing electrons from atoms, creating ions.
Contamination: When unwanted radioactive material gets onto or into an object or person.
Irradiation: The process of being exposed to radiation from an external radioactive source.

Section A: Key Terms & Properties

1. Match the description to the correct type of radiation (Alpha, Beta, or Gamma).

a) A high-speed electron emitted from an unstable nucleus. _____

b) An electromagnetic wave emitted from an unstable nucleus. _____

c) A helium nucleus emitted from an unstable nucleus. _____

d) The process of removing electrons from atoms, creating ions. _____

2. Figure 1 shows three types of radiation passing through different materials. Label the paths for Alpha (α), Beta (β), and Gamma (γ) radiation.

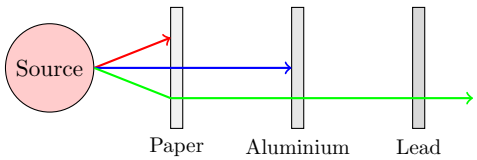

Figure 1: Penetration of Radiation

3. Complete the sentences below using the most appropriate scientific term:

a) Alpha radiation has the _____ ionising power.

b) Gamma radiation is an _____ wave and has no mass or charge.

c) Beta particles are deflected by electric and magnetic fields in the _____ direction to alpha particles.

d) _____ radiation has the longest range in air.

Section B: Core Concepts & Explanations

4. Answer the following questions, providing clear scientific explanations:

a) Explain why alpha particles are considered to be highly ionising.

b) Describe the changes that occur within an unstable nucleus during beta decay.

c) Compare and contrast the penetration power of alpha, beta, and gamma radiation.

d) Explain how a strong magnetic field affects the paths of alpha, beta, and gamma radiation.

Section C: Exam Application & Extended Writing

5. A radioactive source emits alpha, beta, and gamma radiation. The properties of these radiations are summarised in the table below:

Radiation Type	Nature	Charge	Range in Air	Shielding Required
Alpha (α)	Helium nucleus	+2	Few cm	Paper
Beta (β)	High-speed electron	-1	Few m	Aluminium
Gamma (γ)	Electromagnetic wave	0	Unlimited (reduces intensity)	Thick Lead/Concrete

a) A scientist is working with this source and wants to block only the alpha radiation, allowing beta and gamma to pass through. What material should they use, and why is it effective for this purpose?

b) Explain the difference between radioactive irradiation and radioactive contamination. Describe the precautions that should be taken to protect against each of these hazards. (6 marks)