Gamma rays are not particles, but bursts of energy released after alpha or beta particles are emitted. Gamma rays travel at the speed of light and are highly penetrating. They can cause serious and permanent damage to living tissue and can be stopped only by a thick shield of lead or concrete. The symbol given to gamma rays is $\gamma$.

**SCIFACTS**

Henri Becquerel accidentally discovered radioactivity while investigating the fluorescence of uranium salts. When he developed a photographic plate that had been in a drawer near his bench top, he found that it had been fogged up by rays from the uranium salts. The ‘fogging’ of the film in this device measures the amount of radioactivity to which they have been exposed. This effect of radioactivity is now used in a protective device worn by people who work with radioactivity.

## Activities

### Remember

1. How are isotopes of the same element different from each other?
2. Why are the isotopes of some elements radioactive?
3. Write down one or two words that describe the following statements:
   (a) a radioactive particle that has the same size and mass as an electron
   (b) a radioactive particle that is made up of two protons and two neutrons
   (c) the type of radiation that can penetrate the human body and can be stopped only by a thick shield of lead or concrete
   (d) a radioactive particle that can travel almost at the speed of light.

### Using data

A scientist wished to determine the type of radiation emitted by a radioisotope. She had three materials (paper, plastic and lead) and an instrument called a Geiger counter, which detects nuclear radiation. She covered the radioisotope with each of the three materials and measured the radiation that passed through each material. The results of her experiment are shown in the table below.

**Results of radioactivity experiment**

<table>
<thead>
<tr>
<th>Material</th>
<th>Effect on Geiger counter readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>paper</td>
<td>no effect on readings</td>
</tr>
<tr>
<td>plastic</td>
<td>readings fell by two-thirds</td>
</tr>
<tr>
<td>lead</td>
<td>large fall in readings</td>
</tr>
</tbody>
</table>

What type of nuclear radiation does this radioisotope emit? Explain your answer.

### Think

1. About 0.01 per cent of the potassium in your body is the radioisotope $^{40}_{19}$K. 
   (a) How many protons and neutrons are in each atom of this radioisotope?
   (b) The stable nuclei of potassium atoms have one less neutron than the nuclei of potassium's unstable radioisotope. Write down the complete symbol for the stable isotope of potassium.

2. Are the atoms $^{230}_{93}$X and $^{239}_{94}$Y isotopes of the same element? Explain.

3. An atom of uranium-238 ($^{238}_{92}$U) decays by emitting a single radioactive particle. The atom formed as a result of the decay is thorium-234 ($^{234}_{90}$Th). What type of radioactive particle is emitted? Explain your answer.