Solutions

Each answer shows the steps, then the **result**.

2.1

- a substance containing **radioactive nuclei** introduced into the body and **taken up** by the tissue being studied

2.2

- β^+ **(positron)** decay

2.3

- when a particle meets its **antiparticle**, they are destroyed
- and their **mass becomes energy** (electromagnetic radiation)

2.4

- 511 keV ($= m_e c^2$)

3.1 B

- the two photons travel **in opposite directions**

3.2

- total rest energy $= 2m_e c^2$, shared by two photons, so each $E = m_e c^2$

$$E = (9.11 \times 10^{-31}\ \text{kg})(3.0 \times 10^{8}\ \text{m s}^{-1})^2 = \mathbf{8.2 \times 10^{-14}}\ \text{J}$$

  ($= 511$ keV)

3.3

- momentum must be **conserved**
- the pair's total momentum is ≈ 0, so the photons must go in **opposite directions** with equal momentum (a single photon could not conserve momentum)

3.4

- both photons are detected (almost simultaneously) on **opposite sides** of the ring
- the annihilation lies on the **straight line** joining the two detectors — combining many such lines builds the image