

Structured Questions

Diagnostic Methods in Medicine

Medical Tracers / Gamma Camera / PET Scans

| | |
|----------------------|------------|
| Easy (1 question) | /5 |
| Medium (3 questions) | /23 |
| Total Marks | /28 |

Scan here to return to the course
or visit [savemyexams.com](https://www.savemyexams.com)



Easy Questions

- 1 (a)** The medical tracer technetium-99m is used in imaging organs such as the brain.

Explain the advantages of using technetium-99m for this purpose.

[2]

(2 marks)

- (b)** A gamma-camera uses powerful computers and sophisticated software to produce three- dimensional images of the patient's organ.

Name and describe the remaining three main components of the gamma camera.

[3]

(3 marks)

Medium Questions

- 1 (a) Fluorine-18 is a common radioactive isotope used in positron emission tomography (PET). Fluorine-18 emits positrons. A patient is injected with a radiopharmaceutical containing fluorine-18.

Describe how a PET scanner is used to locate an area of increased activity within the patient.

[4]

(4 marks)

- (b) The half-life of fluorine-18 is 110 minutes.

Calculate the time t in minutes for the activity of the radiopharmaceutical to decrease to 30% of its initial activity.

$t = \dots\dots\dots$ minutes [3]

(3 marks)

- (c) PET scanners are not available in all hospitals. This is because fluorine-18 requires expensive on-site particle accelerators and fluorine-18 has a very small 'shelf-life'. Suggest the impact this may have on the treatment and diagnosis of patients in the country.

[1]

(1 mark)

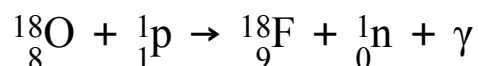
- 2 The medical tracer fluorine-18 is used in positron emission tomography (PET). Fluorine-18 is a beta-plus emitter with a short half-life.

Describe how the fluorine-18 nuclei are located in a patient using a PET scanner.

[4]

(4 marks)

- 3 (a)** The nuclear reaction below shows how the isotope of fluorine-18 ($^{18}_{9}\text{F}$) is made from the isotope of oxygen-18 ($^{18}_{8}\text{O}$).



The oxygen-18 nucleus is **stationary** and the proton has kinetic energy of $0.25 \times 10^{-11} \text{ J}$. The binding energy of the $^{18}_{8}\text{O}$ nucleus is $2.24 \times 10^{-11} \text{ J}$ and the binding energy of the $^{18}_{9}\text{F}$ nucleus is $2.20 \times 10^{-11} \text{ J}$. The proton and the neutron have zero binding energy.

- i) Explain why a high-speed proton is necessary to trigger the nuclear reaction shown above.

[2]

- ii) Estimate the minimum wavelength λ of the gamma ray photon (γ).

$\lambda = \dots\dots\dots \text{ m}$ [3]

- iii) Fluorine-18 is a positron emitter. Name a medical imaging technique that uses fluorine-18 and state one benefit of the technique.

[2]

.....

.....

.....

.....

.....

.....

.....

(7 marks)

- (b) Describe how the components of a computerised axial tomography (CAT) scanner can produce high-quality images of the internal structures of a patient.

[4]

(4 marks)