Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

(a) State the purpose of the magnetic field in a magnetic resonance scanner.

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(1)

(b) Describe the role of the radio frequency pulses in a magnetic resonance scanner.

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(2)
(Total 3 marks)

Q2.

A patient has calcium kidney stones.
Three types of scan are available to investigate the condition:

- a magnetic resonance (MR) scan
- a CT scan
- an ultrasound scan.

Calcium kidney stones contain no water and appear similar to bone in each of the scans.

Discuss the advantages and disadvantages of each option.
In your answer you should

- refer to the relevant quality of the image obtained from each scan
- identify other factors that should be considered
- justify the type of scan you would recommend.

(Total 6 marks)

Q3.

A hospital uses the radioactive isotope technetium-99m as a tracer. Technetium-99m is produced using a Molybdenum-Technetium generator on site at the hospital.

(a) Explain why the value of the half-life of technetium-99m:

- makes it suitable for use as a tracer
- means that it must be produced in a generator on site.

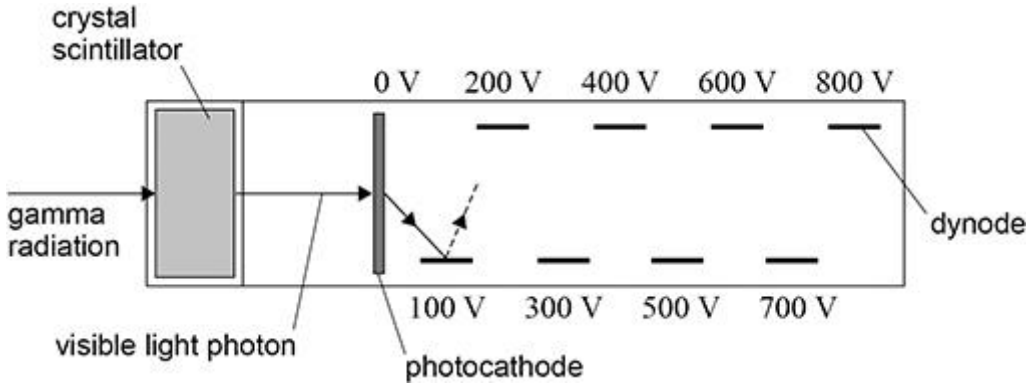
(4)

(b) Technetium-99m emits **only** gamma rays.

Explain why this makes technetium-99m suitable for use as a tracer.

(4)

(c) A gamma camera can be used to form images when using a tracer. The figure below shows a photomultiplier tube from a gamma camera.



At the crystal scintillator, each photon of gamma radiation leads to the emission of one visible light photon.

Describe how the current produced by the photocathode is amplified in the photomultiplier tube.

(3)

(d) Iodine-131 is a medical tracer that can be detected using a gamma camera.

Iodine-131 has a physical half-life of 8.0 days.

A patient is injected with iodine-131 that has an initial activity of 3.2 GBq. For this patient, the

biological half-life is 66 days. For safety reasons, the patient cannot be discharged from hospital until the activity due to the iodine in the patient's body drops to 1.1 GBq.

Determine whether the patient can be safely released from hospital after 10 days.

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(4)

(Total 15 marks)