

Time allowed: 45 minutes

This task is out of 33 marks

Mark obtained: \_\_\_\_\_ / 33

**Instructions:** Write your answers using a pen in the spaces provided. If you need additional space to answer a question, use the blank space at the end of the paper and clearly indicate that this has been done.

1. Contrast soft and hard x-rays.

.....

.....

1M

2. This image shows an X-ray image of human femur (the large upper-leg bone). (H8)



Describe two properties of X-rays allow such an image to be produced.

.....

.....

.....

.....

.....

.....

2M

3. Outline the role of the following components of an endoscope that is used to conduct a biopsy within the body.....
  - (a) Coherent bundle

.....

.....

3M

- (b) Incoherent bundle

.....

.....

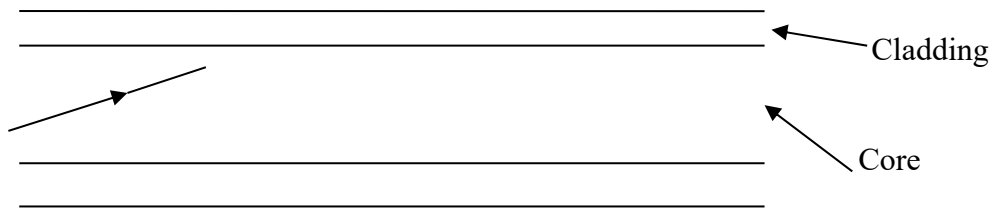
- (c) Surgical instruments

.....

.....

4. Complete the following diagram to show the movement of the ray of light in this optic fibre

2M



5. With the aid of a diagram, explain the process used to produce a CAT scan.

.....

.....

.....

.....

.....

.....

4M

6. The following images show an x-ray and a CAT scan of the human chest. Compare the information shown in the two images.



Fig (I)

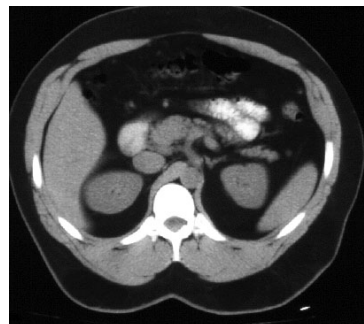


Fig (II)

.....

.....

.....

.....

.....

.....

4M

7. The following questions refer to the images shown below.



Fig. (I)

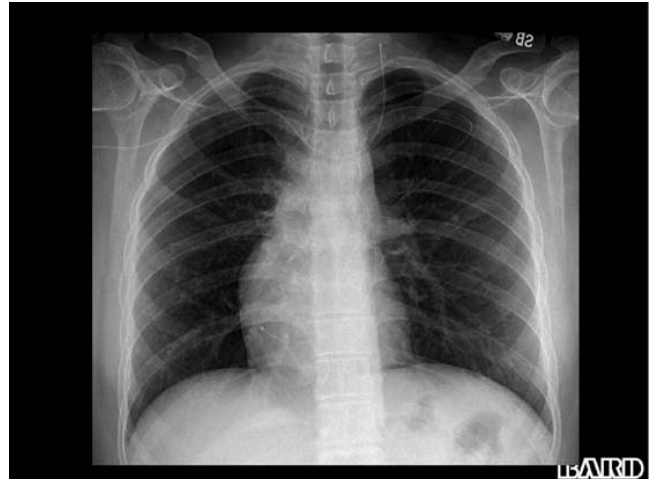


Fig (II)

(a) Identify the medical imaging technology use to produce the images in Fig(I)

1M

(b) With reference to the type of information that the images provide, explain why a doctor might choose the imaging technology that produced the image in Fig. (I) rather than the imaging technology that produced the image in Fig. (II).

2M

.....

.....

.....

.....

8. (a) An alpha-emitting radioactive isotope has a half-life of 20 seconds. Calculate the amount of the isotope remaining after 1 minute, if the initial sample had a mass of 1.6 kg.

1M

.....

.....

.....

(b) Would you consider the above isotope to be suitable for use in medical diagnosis? Justify your answer.

2M

.....

.....

.....

(c) Explain how an isotope can be used to target a specific part of the body for medical imaging purposes.

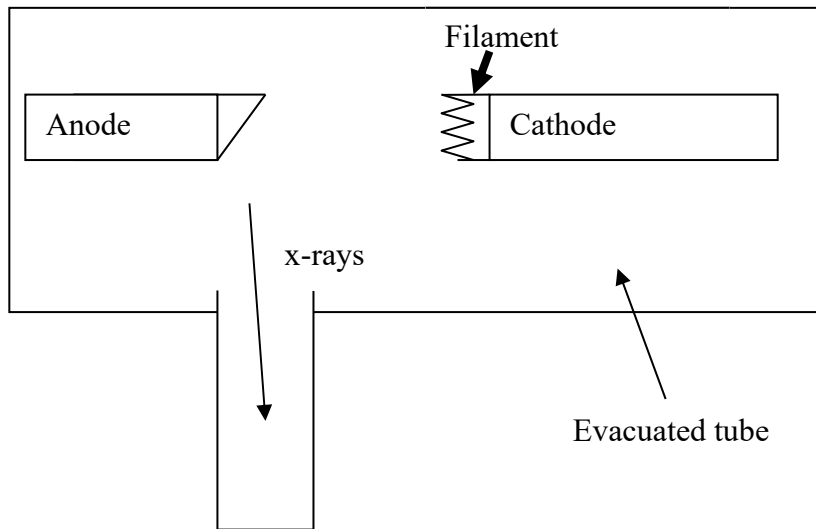
2M

.....

.....

.....

9. Pictured below is a simple X-ray tube. Complete the questions that follow the diagram



(a) Why is a filament required at the cathode?

1M

.....  
.....

(b) Explain how energy transformations result in the production of X-rays. In your answer, you should refer to two different methods by which X-radiation is produced.

4M

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

10. Explain how positrons emitted by radiopharmaceutical can be used to produce an image.

4M

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



## Marking Scheme

Q.1	Criteria	Mark
	Any contrasting statement. E.g. Soft X-rays have a longer wavelength than hard X-rays	1

Q.2	Criteria	Mark
	States two of the following : X-rays can penetrate soft tissues more readily than bone. X-rays change the colour of photographic film. X-rays have a very high frequency allowing for contrast of small object.	2
	States ONE of the above	1

Q.3	Criteria	Mark
	Outlines the function of each component of the endoscope.	3
	Outlines the function of two components of the endoscope.	2
	Outlines the function of one component of the endoscope.	1

Q.4	Criteria	Mark
	Ray of light reflects at the boundary of core and cladding Ray of light has equal angles of incidence and reflection	2
	One of the above	1

Q.5	Criteria	Mark
	A suitable diagram which labels the ring of detectors and x-ray tube. A description of the process which includes passing x-rays through the body at different angles and the computer analysis of the data to produce a tomographic (2D slice) image. Answer is well structured and uses scientific language.	4
	Demonstrates a sound understanding of the process without a diagram OR Uses the correct diagram with a partial explanation of the process	2-3
	Demonstrates a limited understanding of the process discussed)	1

Q.6	Criteria	Mark
	Four similarities/differences between the information shown by each scan using comparative statements.	4
	Three similarities/differences between the information shown by each scan using comparative statements.	3
	Answer demonstrates some understanding of the differences between the information shown in the scans but does not use comparative statements.	1-2

Q.7(a)	Criteria	Mark
	Identifies the type of scan (bone scan, PET) or a relevant technology (eg gamma ray camera)	1

Q.7(b)	Criteria	Mark
	Response states that the technology produces information about the body's metabolism not structure and relates this to a specific example (eg tumours are regions of high metabolic activity and therefore are more easily identified using a bone scan – soft tissue does not show up clearly using an X-ray	2
	Response states that the technology produces information about the body's metabolism not structure	1

Q.8(a)	Criteria	Mark
	0.2 kg or 200 g	1

Q.8(b)	Criteria	Mark
	Identifies that the statement is incorrect and outlines one relevant specific reason for this (eg alpha particles do not penetrate tissue and therefore cannot be detected in order to construct an image)	2
	Identifies that the statement is incorrect but does not provide a valid reason (reason must be attempted for a mark)	1



Q.8(c) Criteria	Mark
Response outlines that an isotope can be attached to a pharmaceutical that is used by that specific body part and will accumulate there (or that the isotope is an element that is a normal part of the organ's metabolism) and describes a specific example (eg Iodine-131 for imaging thyroid) OR provides a more thorough explanation of the accumulation and imaging process.	2
Response outlines that an isotope can be attached to a pharmaceutical that is used by that specific body part and will accumulate there (or that the isotope is an element that is a normal part of the organ's metabolism)	1

Q.9 a Criteria	Mark
Filament is the source of electrons which are released via thermionic emission	1

Q.9b Criteria	Mark
Correctly states that KE of electrons is transformed into electromagnetic radiation (x-radiation) and provides a thorough explanation of the production of * characteristic radiation (k shell electrons knocked out of their shell by cathode ray electrons; X rays emitted as electrons from higher energy levels move into that shell) * Bremsstrahlung radiation (production of X rays by the rapid deceleration of cathode ray electrons)	4
Provides a thorough explanation of the production of X rays for both techniques, OR Identifies the energy transformation but does not thoroughly explain both techniques	3
Provides a reasonable explanation of the production of X rays for both techniques, OR Identifies the energy transformation and provides a reasonable explanation of the production of X rays for one technique.	2
Provides a reasonable explanation of the production of X rays for one technique OR Identifies the energy transformation	1

Q.10 Criteria	Mark
Thorough, well-structured response which includes <ul style="list-style-type: none"> <li>• Positron-electron annihilation produces a pair of gamma ray photons which travel in opposite directions</li> <li>• A ring of detectors (gamma ray cameras) around the body detect the gamma rays</li> <li>• The time of arrival and intensity of the gamma rays is recorded</li> <li>• The image is constructed from the line-of-response / intensity information using a computer</li> </ul>	3-4
Response contains at least two correct relevant pieces of information but is poorly structured and/or contains incorrect information	1-2