

Name of the Student: _____

Max. Marks : 21 Marks

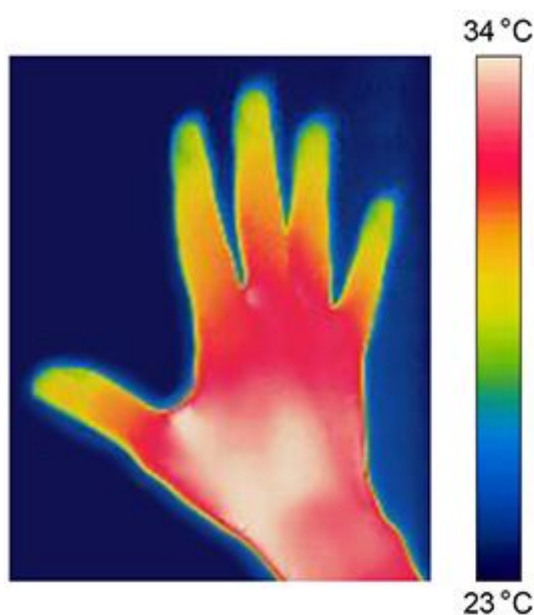
Time : 21 Minutes

Q1.

Different parts of the electromagnetic spectrum are used in medical imaging.

Figure 1 shows an Figure of a person's hand taken with an infrared camera.

Figure 1



- (a) Explain why the infrared camera is able to show that parts of the hand are at different temperatures.

(2)

- (b) Infrared has a range of wavelengths from 700 nm to 1 mm.

Which part of the electromagnetic spectrum would have waves with a wavelength of 6.5×10^{-7} m?

Tick (✓) **one** box.

Infrared

☐

Microwaves

☐

Radio waves

☐

Visible light

☐

(1)

(c) **Figure 2** shows X-rays and gamma rays being used for medical imaging.

Figure 2



To use X-rays for medical imaging, a machine produces a very brief burst of X-rays.

To use gamma rays for medical imaging, a radioactive isotope is injected into the patient's blood. The isotope is circulated around the body in the blood. The isotope emits gamma rays.

Compare the potential risks to a patient of using X-rays and gamma rays for medical imaging.

(4)

X-rays are produced by colliding high-energy electrons into a metal target.

The electrons have high energy because they are accelerated to high speeds.

Only a small proportion of the kinetic energy of an electron is converted into an X-ray when it collides with the metal target.

- (d) An electron is accelerated through a distance of 15 mm.

The work done on the electron is 1.2×10^{-13} J.

Calculate the force on the electron.

Force = _____ N

(3)

- (e) The metal target is made from tungsten.

Tungsten has the highest melting point of any metal.

Explain why using tungsten as the metal target enables the X-ray machine to be more powerful.

(3)

(Total 13 marks)

Q2.

X-rays form part of the electromagnetic spectrum.

Radiographers use X-rays to produce images of bones inside the body.

- (a) Explain why X-rays can be used to produce images of the bones inside the body.

- (b) The table below shows the effect of exposure to different doses of radiation.

Dose in mSv	Effect on the human body
100	slightly increased risk of cancer
1000	5% increased risk of cancer
5000	high risk of death

During an X-ray a person receives a dose of 0.5 mSv

The radiographer takes many X-ray images each day.

Explain why the radiographer stands behind a protective screen when taking an X-ray image.

(3)

- (c) Radio waves form part of the electromagnetic spectrum.

The diagram below shows one use of radio waves.



Explain how electrical signals in the transmitter produce a signal in the receiver.

(3)

(Total 8 marks)