

Diagram illustrating the electromagnetic spectrum with four boxes labeled 1 to 4. Box 1: Radio waves. Box 2: Name it. Box 3: Name it. Box 4: Visible light. Below the boxes is a horizontal axis with an arrow pointing left labeled 'towards radio waves' and an arrow pointing right labeled 'frequency'. The axis is labeled 'wavelength' and 'frequency'.

- 1 They all travel at the same _____ in a vacuum: _____ m/s
- 2 They can all be _____ and _____
- 3 They are all _____ waves and transfer energy

[illegible]

broadcasting radio and TV cooking food satellite communication mobile phones heaters and grills
 night-vision cameras remote controls photography optical fibres fluorescent lamps security marking
 sterilising water seeing broken bones airport security scanners sterilising surgical instruments treating cancer

Name it

5

Name it

6

Name it

7

Gamma rays

KEY WORDS TO USE

☐ wavelength
 ☐ frequency
 ☐ increases
 ☐ decreases



Ionising radiation — ultraviolet, X-rays and gamma rays

[illegible]

HAZARDS — SUGGESTIONS TO CHOOSE FROM

internal heating of body tissue skin burns damage to the retina skin cancer blindness mutates cells cancer

burns (high doses) very low risk

The Electromagnetic Spectrum

One **challenge question** on the whole electromagnetic spectrum (4.6.2.1–4.6.2.4). Work through it on your own — **show all your working**, watch the **unit prefixes**, and be **specific**: “used in hospitals” is not a use.

Question 1

[15 marks]

The table shows the main groups of the electromagnetic spectrum. Two groups are missing.

Radio		Infrared	Visible		X-rays	Gamma rays
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(a) Write the names of the two missing groups in the table. (2)

(b) The arrow below the table shows the direction of (1)

- ☐ A increasing wavelength
 ☐ B increasing frequency
- ☐ C increasing wave speed
 ☐ D decreasing energy

(c) State **two** properties that **all** electromagnetic waves have in common. (2)

1

2

(d) A satellite TV signal is carried by microwaves with a frequency of **12 GHz**. The speed of electromagnetic waves is 3.0×10^8 m/s. (3)
 Calculate the wavelength of the microwaves.

A large grid area for working out the calculation for the wavelength of the microwaves.

wavelength = _____ m

(e) A hospital uses both X-rays and gamma rays.

(i) Give **one** use of gamma rays in a hospital. (1)

(ii) A radiographer takes X-ray images of patients every day. Explain why the radiographer stands behind a lead screen while each image is taken. (2)

(f) Microwaves and infrared can both be used to cook food. Describe how the harm that each one can do to the human body is **different**. (2)

(g) A distant star gives out a burst of gamma rays and a burst of radio waves at the same moment. Both travel through space to a telescope on a satellite. State which burst arrives first, if either. Give a reason for your answer. (2)

(Total for Question 1 = 15 marks)