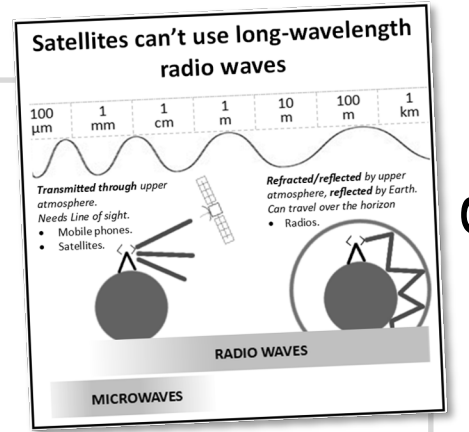




Section B

State and explain which type of electromagnetic wave needs to be used to successfully **transmit information between the surface of the Earth and satellites** in orbit above the Earth's atmosphere.

Draw one line from each device on the outside to the **electromagnetic wave used** on the inside (the electromagnetic waves can be used by more than one device. One has been done for you).

Television remote controls

Toasters and BBQ grills

Walkie-talkies

Mobile phones

Medical scanners that check for broken bones

Night-vision cameras

Devices that sterilise/disinfect water

R radio waves

M microwaves

IR infrared

V visible light

UV ultraviolet

X x-ray

G gamma

Microwave ovens

Thermal imaging cameras

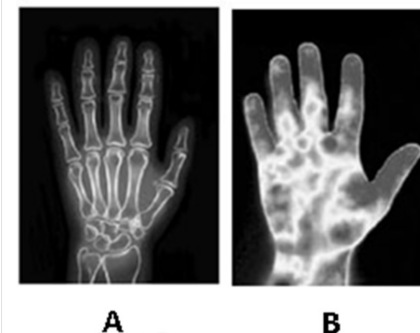
Speed cameras and police speed guns

Radiotherapy machines that destroy cancer cells

Special lights to detect forged bank notes

Movie cameras

Medical scanners that can look at organs in detail



A

B

This picture shows images of the same hand produced using two different electromagnetic waves.
The wave used to capture image A was
The wave used to capture image B was
Suggest what the differently-shaded parts of image B tell us about the hand?

Section A

1) Which of these is the same for all electromagnetic waves travelling in a vacuum?

- ☐ A: amplitude
- ☐ B: frequency
- ☐ C: speed
- ☐ D: wavelength

2) A satellite orbits the moon. Radio waves from this satellite transfer

- ☐ A: matter only
- ☐ B: energy and matter
- ☐ C: information and matter
- ☐ D: energy and information

3) How many different colours are there in visible light?

- ☐ A: five
- ☐ B: seven
- ☐ C: nine
- ☐ D: eleven

4) Three colours of the visible spectrum of light in the correct order are

- ☐ A: green, red, yellow
- ☐ B: blue, red, green
- ☐ C: red, orange, yellow
- ☐ D: violet, orange, green

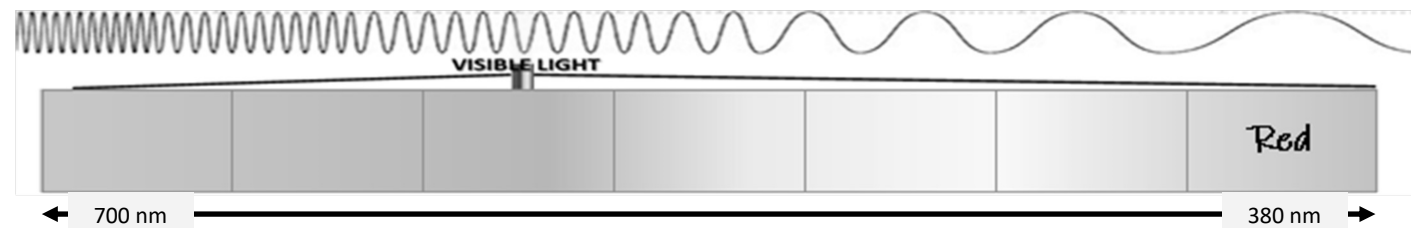
5) Which of these colours of light has the highest frequency?

- ☐ A: blue
- ☐ B: green
- ☐ C: orange
- ☐ D: yellow

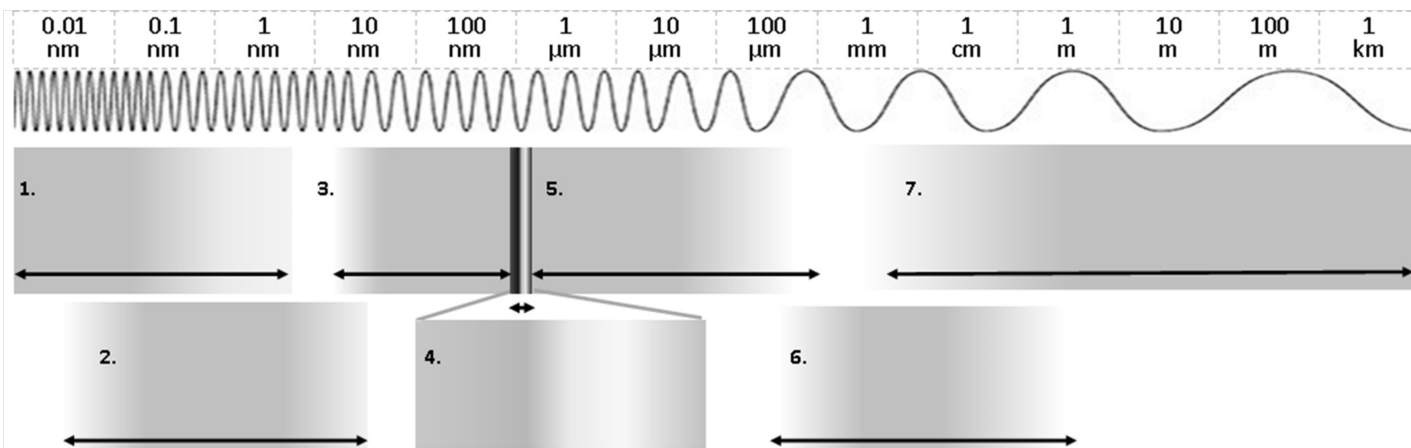
6) X-rays that have the most energy have the

- ☐ A: greatest mass
- ☐ B: highest frequency
- ☐ C: highest speed
- ☐ D: longest wavelength

Visible light is made of 7 colours. The **colour of visible light** depends on its wavelength. Write in the names of the colours of visible light in the empty boxes on the diagram below.

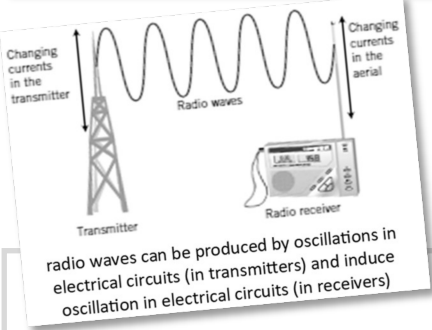
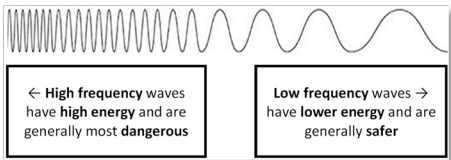


The **electromagnetic spectrum** is also divided into 7 parts. The name we give to an electromagnetic wave depends on its wavelength. Write the names of the electromagnetic waves in the empty boxes on the diagram below.



All seven different types of electromagnetic waves are emitted by the Sun.
Explain why all of these waves take the same time to travel to the Earth from the Sun.

Section C



Which electromagnetic wave has the **highest frequency**?

Which electromagnetic wave is **most dangerous** to humans?

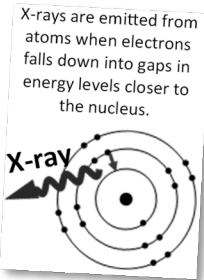
Which electromagnetic wave has the **highest energy**?

Which electromagnetic wave has the **lowest frequency**?

Which electromagnetic wave is **least dangerous** to humans?

Which electromagnetic wave has the **lowest energy**?

Three electromagnetic waves have so much energy that they can knock electrons off of atoms.



Because of this the waves are called **ionising radiation**. Which three electromagnetic waves are ionising?

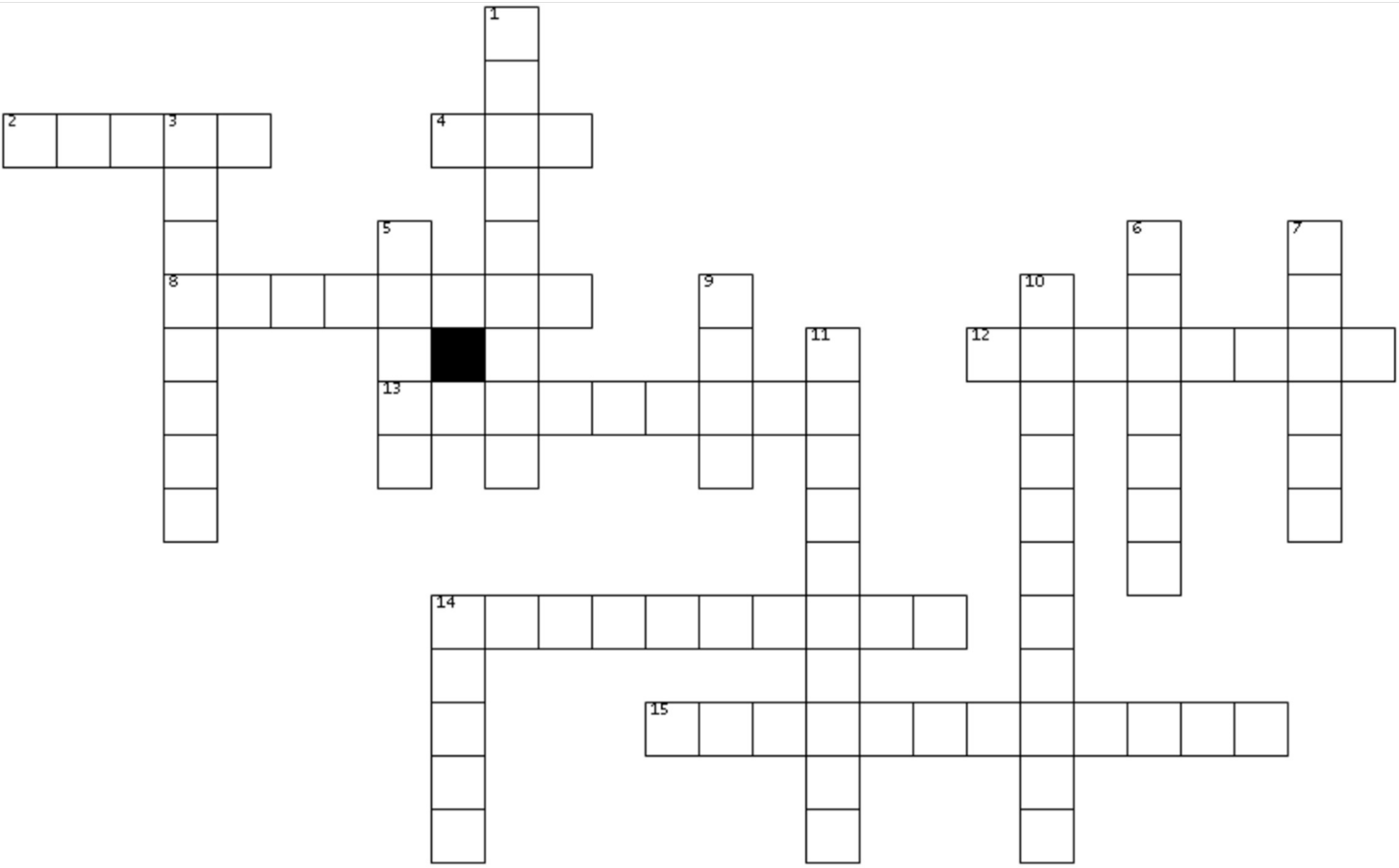
Draw **at least** one line from each box at the side to match it to the electromagnetic wave or waves to which it applies

No known danger to humans	R radio waves	Causes internal heating (of body cells)
Produced by an oscillating electrical current inside a transmitter	M microwaves	Can be generated by devices called magnetrons
Can damage the retina in eyes even at low intensity	IR infrared	Can be produced by passing an electric current through some gases (e.g. in tanning bed lamps)
Causes sunburn	V visible light	Only harmful at very high intensity when it can cause blindness
Ionising radiation - damages living cells can cause mutations/cancer	UV ultraviolet	Emitted by all hot objects
Emitted when the energy level an electron occupies inside an atom changes.	X x-ray	Causes skin burns
	G gamma	Emitted when the nucleus of a radioactive atom changes

Section D

There are two different equations that can be used to calculate the speed of an electromagnetic wave. State both of these equations.

- 1. Wave speed =
- 2. Wave speed =



ACROSS

- 2. the type of EM wave with the longest wavelength (5)
- 4. the colour of visible light with the lowest frequency (3)
- 8. an EM wave that is used in night-vision cameras (8)
- 12. the part of an atom that must change for Xrays to be emitted (8)
- 13. the type of EM wave used to communicate with satellites (9)
- 14. a disease that exposure to ultraviolet radiation increases your risk of developing (4,6)
- 15. an EM wave that can be split into seven colours (7,5)

DOWN

- 1. the feature of a wave that is related to its energy (and so also its danger) (9)
- 3. the word used to describe high frequency electromagnetic waves that have enough energy to remove electrons from atoms (8)
- 5. an EM wave that can cure cancer as well as cause it (5)
- 6. the part of an atom that must change for gamma rays to be emitted (7)
- 7. the colour of visible light with the shortest wavelength (6)
- 9. an EM wave used in medical scanners (4)
- 10. an EM wave used to detect forged bank notes (11)
- 11. when a wave changes direction as it passes the boundary between different media (10)
- 14. the number of types of electromagnetic waves there are (5)