T5 Light and the EM Spectrum HIGHER

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

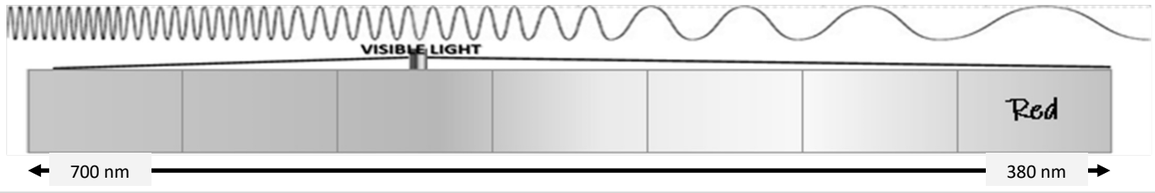
3) How many different colours are there in visible light?
- ☐ **A:** five
- ☐ **B:** seven
- ☐ **C:** nine
- ☐ **D:** eleven

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

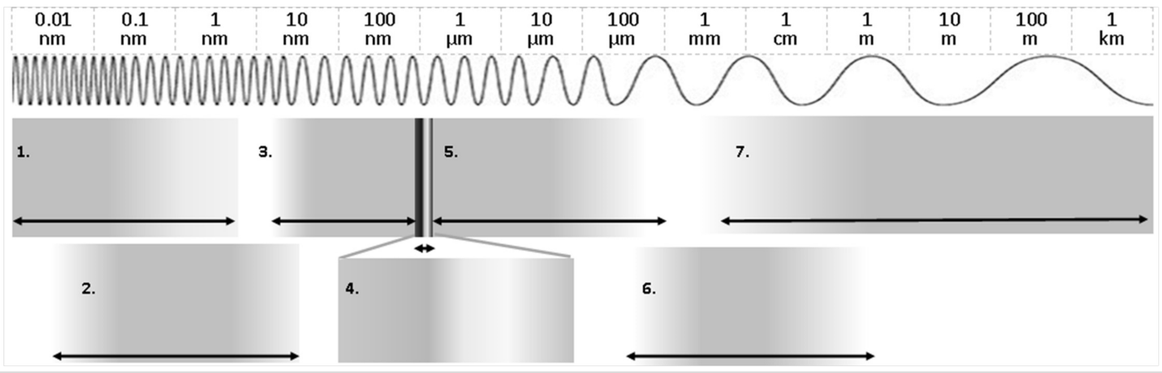
5) Which of these colours of light has the highest frequency?
- ☐ **A:** blue
- ☐ **B:** green
- ☐ **C:** orange
- ☐ **D:** yellow

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.

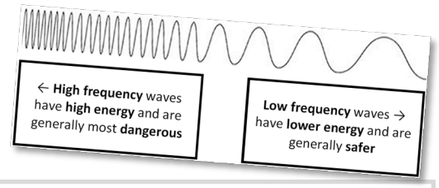


The **electromagnetic spectrum** is also divided into 7 parts. The name we give to an electromagnetic wave depends on its wavelength. Write the names of the electromagnetic waves in the empty boxes on the diagram below.



All electromagnetic waves travel at the same speed in a vacuum.
Use the fact that light takes 500 seconds to travel 1.50×10^{11} m from the Sun to the Earth to calculate the speed of electromagnetic waves in a vacuum.

Section B



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

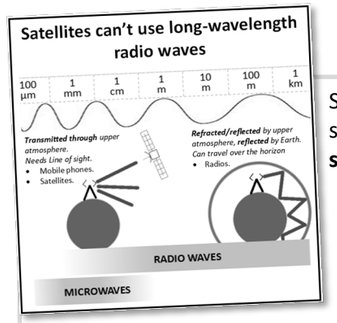
Which electromagnetic wave is **most dangerous** to humans?

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

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

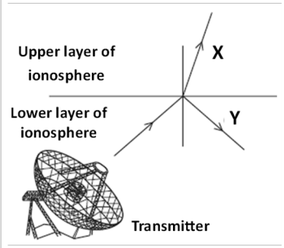
Which electromagnetic wave is **least dangerous** to humans?

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

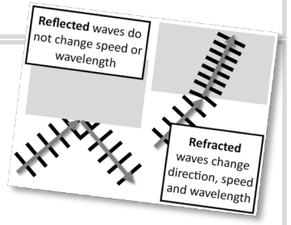


State and explain which type of electromagnetic wave needs to be used to successfully **transmit information between the surface of the Earth and satellites** in orbit above the Earth's atmosphere.

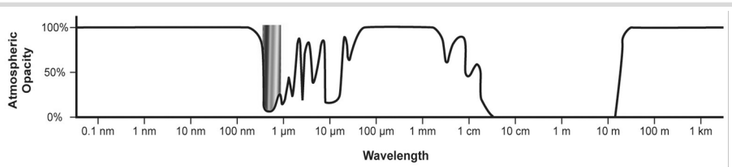
Shown below is a simplified diagram to show electromagnetic waves from a transmitter moving upwards, then meeting a boundary between lower and upper layers of the atmosphere.



Explain what happens to the waves after they meet the boundary between the lower and upper layers as shown in the diagram.
Your explanation should refer to changes in direction and speed of the waves.



Use information in diagram to answer the questions below



Name at least two EM waves absorbed by the atmosphere.

Name at least two EM waves transmitted through the atmosphere.

combined sciences text book pages 339-352

Link to BBC Bitesize

Section C

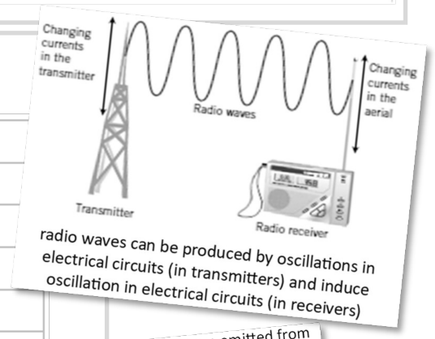
Draw ***at least*** one line from each box at the side to match it to the electromagnetic wave or waves to which it applies

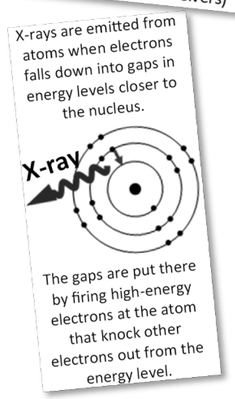
R	radio waves
M	microwaves
IR	infrared
V	visible light
UV	ultraviolet
X	x-ray
G	gamma

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

Match electromagnetic waves to their **uses**. You can use letters for the waves to save on space and you can use waves once, more than once or not at all.

Medical scanners that see inside bodies	
Cooking	
Radiotherapy (treating cancer)	
Communicating with different countries	
TV remote controls	
Detecting security markings/forged bank notes	
Disinfecting water	
Sterilising food and medical equipment	
Photography	
Communicating with satellites	
Security scanners that see inside luggage and vehicles	
Thermal imaging and night-vision cameras	
Speed cameras and speed guns	

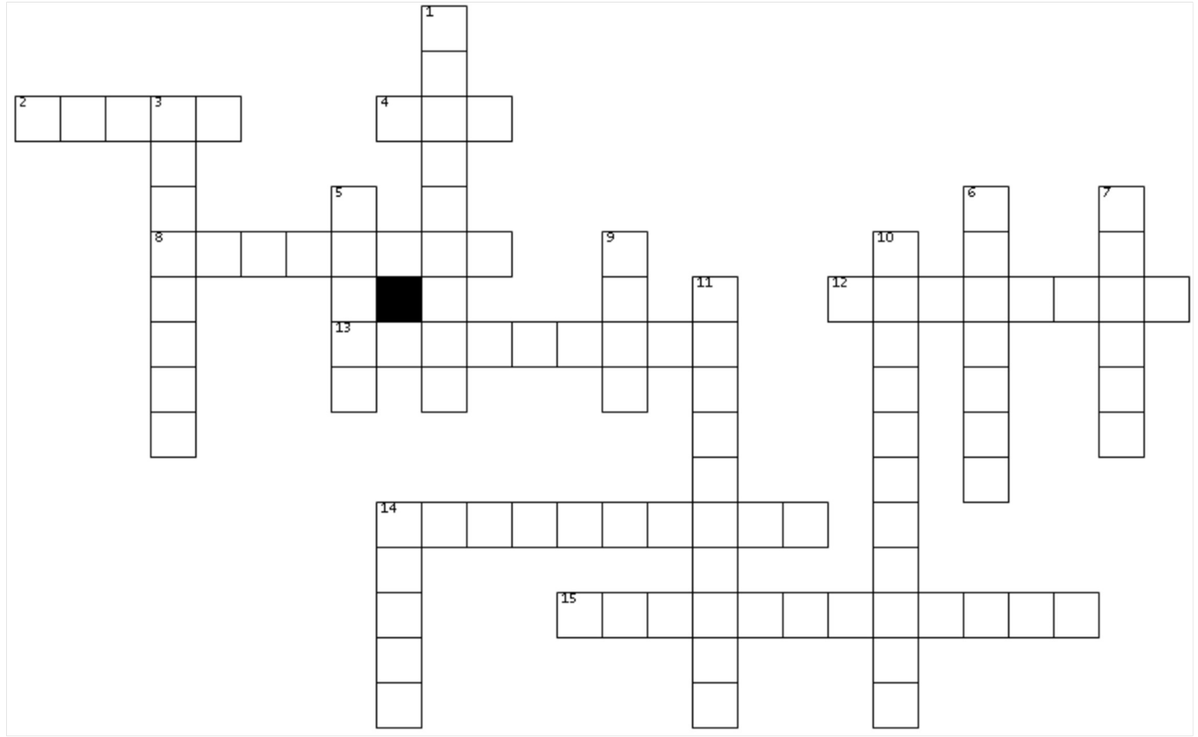




Section D

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)