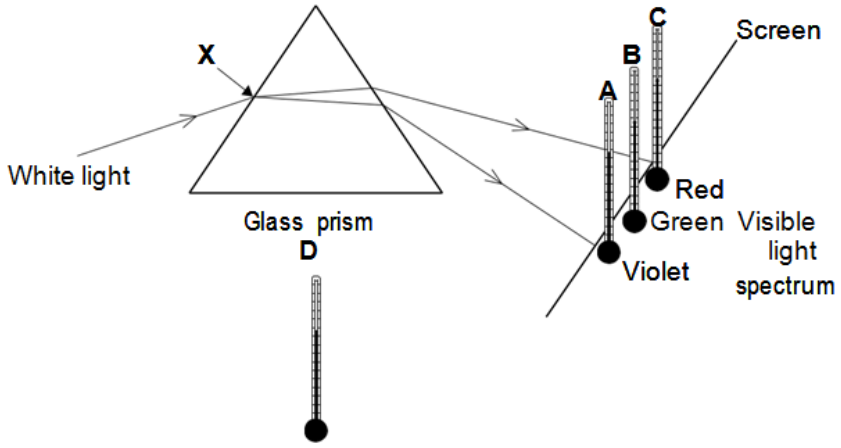
# Electromagnetic Waves Uses And Dangers 2

**Q:1** The diagram shows the apparatus that a student used to investigate the heating effect of different wavelengths of light.




**(a) (i)** What process happens at the point labelled X on the diagram?

_____

(1 mark)

**(a) (ii)** The student put thermometer D outside of the light spectrum.

Suggest why.

_____

_____

(1 mark)

**(a) (iii)** The table gives the position and reading of each thermometer 10 minutes after the investigation started.

| Thermometer | Position of thermometer | Temperature in °C |
|---|---|---|
| A | in violet light | 21 |
| B | in green light | 22 |
| C | in red light | 24 |
| D | outside the spectrum | 20 |

What should the student conclude from the data in the table?

_____

_____

_____

_____

(2 marks)

**(b)** A similar investigation completed in 1800 by the scientist Sir William Herschel led to the discovery of infrared radiation.Suggest how the student could show that the spectrum produced by the glass prism has an infrared region.

_____

_____

_____

_____

(2 marks)

**(c)** A person emits infrared radiation at a frequency of 3.2 1013 Hz. Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be 3.0 108 m/s.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Wavelength = _____ m

(2 marks)

**(d)** A thermal imaging camera detects infrared radiation. Electronic circuits inside the camera produce a visible image of the object emitting the infrared radiation.

At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

Thermal imaging cameras work better at night than during the day.Explain why.

(2 marks)

**Q:2** Galaxies emit all types of electromagnetic wave.

**(a) (i)** Which type of electromagnetic wave has the shortest wavelength?

(1 mark)

**(a) (ii)** State one difference between an ultraviolet wave and a visible light wave.

(1 mark)

**(b)** Electromagnetic waves travel through space at a speed of 3.0 108 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

_____

_____

_____

Frequency = _____

(3 marks)

**Q:3(a)** The new Tetra communications system to be used by the police transmits digital signals using microwaves of wavelength 75 cm.

The signals travel through the air at 300 000 000 m/s.

**(i)** What is a digital signal?

_____

(1 mark)

**(ii)** Use the following equation to calculate the frequency of the microwaves used by the Tetra system. Show clearly how you work out your answer.

| wave speed = frequency × wavelength |
|---|

_____

_____

Frequency = ..... hertz

(2 marks)

**(b)** Read the following extract from a newspaper and then answer the questions that follow.

Residents of Stag Hill Court, a luxury block of flats, are shocked at the plans to site a mobile phone mast on the roof of the flats. They oppose the mast on health grounds, quoting research in Germany that has found a possible increase in cases of cancer around mobile phone masts.

A spokesperson for the telecoms company said, 'The residents should not worry. The research carried out by our own scientists has found no link between ill health and mobile phone masts'.

This has not reassured the residents, who argue that new independent research is urgently needed.

**(i)** Explain why living near a mobile phone mast could cause ill health.

_____

_____

_____

_____

_____

(3 marks)

**(ii)** Suggest two reasons why the residents have not been reassured by the research carried out by the telecoms company.

1 _____

_____

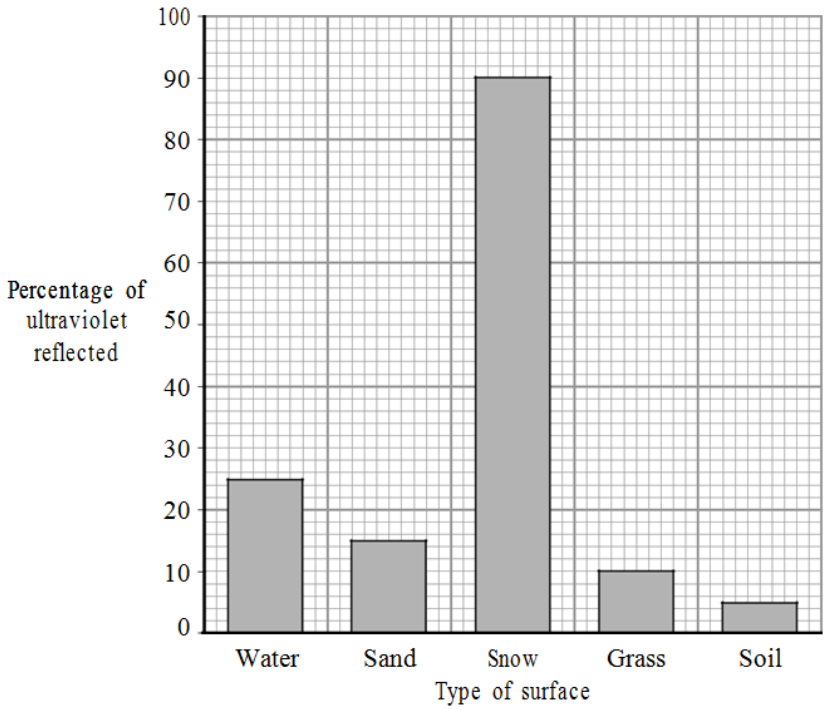
2 _____

_____

(2 marks)

**Q:4** **(a)** Ultraviolet (UV) radiation can be reflected or absorbed by a surface.

The percentage of ultraviolet radiation reflected by various surfaces is shown in the bar chart.




**(a)(i)** Which of these surfaces is the best absorber of ultraviolet radiation?

_____

(1 mark)

**(a)(ii)** Why has the data been shown as a bar chart rather than a line graph?

_____

_____

(1 mark)

**(a)(iii)** Who is likely to be exposed to more ultraviolet radiation, a skier or a golfer?Draw a ring around your answer.

skier golfer

Give a reason for your answer.

_____

(1 mark)

**a)(iv)** State one harmful effect that ultraviolet radiation has on skin.

_____

(1 mark)

**(b)** This is a label from a pair of sunglasses.

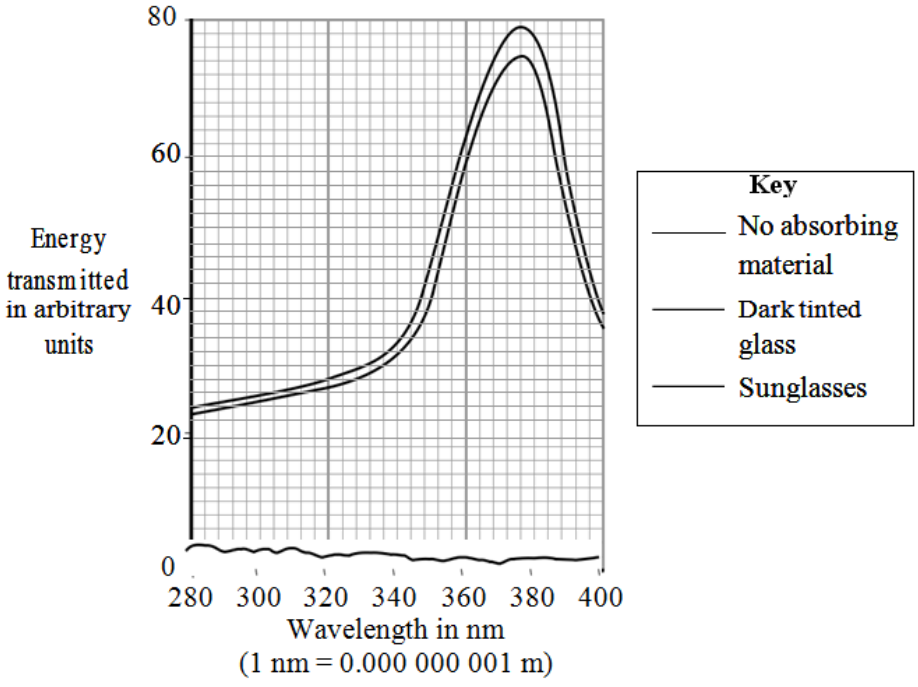
Sportswear Budget £5

- plastic lenses
- blocks 95% of ultraviolet rays
- UV absorbing up to wavelengths of 400 nm

A student tested the sunglasses by measuring the energy transmitted by the lenses for ultraviolet waves with a range of different wavelengths.

For comparison, the student also measured the transmission of ultraviolet waves through a piece of dark tinted glass.

The results of the tests are shown in the graph.



**(b)** **(i)** Explain how the student's results support the claims made on the label.

_____

_____

_____

_____

(2 marks)

**b)** **(ii)** Ultraviolet radiation can cause permanent eye damage.

Why should the lenses for sunglasses not be made from the dark tinted glass used in the student's tests?

_____

_____

(1 mark)

**(c)** An eye care charity predicts that within 10 years, everyone, when outside, will wear UV protection sunglasses most of the time. This is because the potential damage from ultraviolet radiation is so serious.

**(c) (i)** Which one of the following statements is the most likely reason for the prediction made by the eye care charity?

Put a tick (☒) in the box next to your answer. ☐

Publicity and education will make people aware of the dangers. ☐

The price of UV blocking sunglasses will fall dramatically. ☐

The level of UV in the atmosphere will increase. ☐

(1 mark)

**(c) (ii)** Several manufacturers of sunglasses have said that the research they have carried out supports the view of the eye care charity.

Suggest why the research conducted by the manufacturers could be biased.

_____

_____

(1 mark)

**Q:5 (a)** Mobile phone networks send digital signals using microwaves.

Give one other use of microwaves.

_____

_____

(1 mark)

**(b)** Some scientists think that there is a link between using a mobile phone and some types of illness. Other scientists disagree. They say that the evidence is limited and unreliable.

**(b)(i)** Suggest what scientists could do to show a link between using a mobile phone and illness.

_____

_____

(1 mark)

**(b)(ii)** How could scientists improve the reliability of the evidence?

_____

_____

(1 mark)

**(b) (iii)** Complete the following passage by drawing a ring around the word in the box that is correct.

There has been little or no experimental research into the health of children who use mobile phones.

This is partly because of the

| |
|---|
| economic |
| environmental |
| ethical |

issues involved in using children in scientific research.

(1 mark)

**(c)** Before being sold, new mobile phones must be tested and given a SAR value.

The SAR value is a measure of the energy absorbed by the head while a mobile phone is being used.

The table gives the SAR value for three mobile phones made by different companies.

To be sold in the UK, a mobile phone must have a SAR value lower than 2.0 W/kg.

| Mobile phone | SAR value in W/kg |
|---|---|
| J | 0.18 |
| K | 0.86 |
| L | 1.40 |

**(c)(i)** All companies use the same test to measure a SAR value. Why is using the same test important?

_____

_____

(1 mark)

**(c) (ii)** Would the companies that make the mobile phones, J, K and L, be correct to claim that these three phones are totally safe to use?

Answer yes or no _____

Give a reason for your answer.

_____

_____

(1 mark)

**(d)** Devices designed to protect a mobile phone user from microwave radiation are now available.

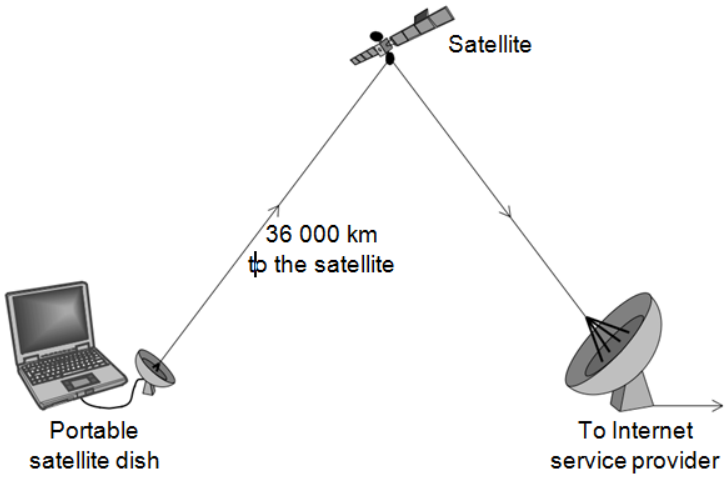
Why is it important that these devices are tested by scientists who are not working for the company that makes the devices?

_____

_____

(1 mark)

**Q:6(a)** The diagram shows a computer connected to the Internet using a satellite link.




**(a) (i)** Which one of the following types of electromagnetic wave is used to send information to the satellite?

Draw a ring around your answer.

microwave radio visible light

**(b)** Since 2009, people in some parts of Kenya have been able to connect to the Internet using signals sent through an optical fibre cable rather than via a satellite link.

**(b) (i)** Complete the following sentence by drawing a ring around the correct line in the box.

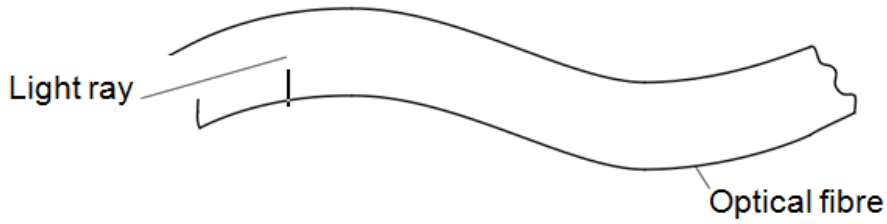
Visible light and

| |
|---|
| infra red |
| radio |
| ultraviolet |

can be used to send signals along an optical fibre.

(1 mark)

**(b) (ii)** The diagram shows part of an optical fibre.

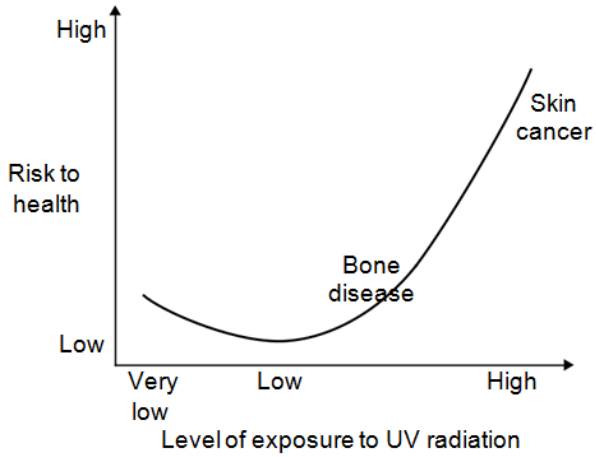



Complete the diagram to show how the light ray travels through the optical fibre.

(2 marks)

**Q:7** Exposure to ultraviolet (UV) radiation can harm a person's health.

The graph shows how the risk to health depends on the level of exposure to UV.




**(a)** What level of exposure to UV radiation gives the highest health risk?

Draw a ring around your answer.

very low low high

(1 mark)

**(b)** The body needs vitamin D to prevent bone disease. The ultraviolet radiation in sunlight enables the body to produce vitamin D. Some people hardly ever go outside into direct sunlight.

**(b) (i)** Complete the following sentence by drawing a ring around the line in the box that is correct.

Staying inside will

| |
|---|
| Reduce |
| not affect |
| increase |

the risk of developing skin cancer.

(1 mark)

**(b) (ii)** How will staying inside affect the risk of developing bone disease?

_____

Give a reason for your answer.

_____

_____

(2 marks)

**TOTAL MARKS=47**