

# EM Waves Uses And Dangers 1

**Q:1** (a) Mobile phones send digital signals using electromagnetic waves.

**(ii)** Which one of the following types of electromagnetic wave is used to carry information between masts in a mobile phone network?

Draw a ring around your answer.

light    microwave    radio

(1 mark)

**(b)** Some people worry that using a mobile phone may be bad for their health. Look at this information taken from a recent newspaper article.

- z        Scientists in Sweden found that the regular use of a mobile phone increases the risk of a cancerous growth between the ear and the brain.
  
- z        Some people who use mobile phones for a long time complain of headaches and tiredness. The same effect has not been noticed in laboratory tests.
  
- z        There is no reliable evidence to link using mobile phones with ill health.
  
- z        The waves from a mobile phone are not strong enough to cause long-term heat damage to cells in the body.

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

The evidence from different scientists doing the same investigation is reliable if

different

all the scientists get    identical    results.

random

(1 mark)

(ii) What information in the article supports the idea that mobile phones are bad for your health?

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(2 marks)

(iii) Some scientists say that using a mobile phone is totally safe. What information in the article supports this view?

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(2 marks)

**Q:2** A headline from a recent magazine article is shown below.



(a) Complete the following sentence.

Skin cancer can be caused by exposure to excess \_\_\_\_\_ rays from the Sun.

(1 mark)

**(b)** Sunscreen should be used to protect your skin from the damaging effects of the Sun. A thick layer of sunscreen should be applied 30 minutes before sunbathing and re-applied every hour.

The protection factor of a sunscreen lets you work out roughly how long you can stay in the Sun without causing damage to your skin. For example, a 'factor 10' sunscreen lets you stay in the Sun for up to ten times longer than if you were not using the sunscreen.

**(i)** Without sunscreen, a person with fair skin has found that she gets sunburn after 12 minutes of sunbathing.

What is the maximum time that she could sunbathe without burning if she used 'factor 30' sunscreen on her skin?

\_\_\_\_\_

Maximum time = \_\_\_\_\_

(1 mark)

**(ii)** Why does the protection factor give only a rough idea of how long you can sunbathe without getting sunburn?

\_\_\_\_\_  
\_\_\_\_\_

(1 mark)

**(iii)** Another person has naturally dark skin.

Suggest why he can sunbathe with less risk of getting skin cancer than a fair-skinned person.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2 marks)

(c) Most people know that sunbathing can cause skin cancer. But most holidaymakers still like to come home with a suntan.

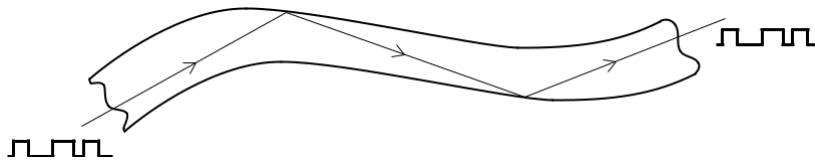
Why is it important that people understand that there are dangers involved in sunbathing?

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(1 mark)

**Q:3** (a) The diagram shows a signal and the path taken by the signal as it travels along an optical fibre.



(i) What name is given to the type of signal shown in the diagram?

(1 mark)

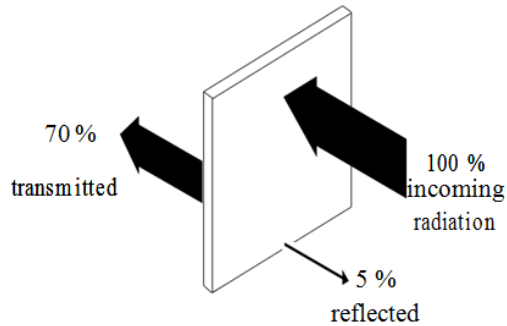
(ii) Name the two types of electromagnetic radiation that can be used to send signals along an optical fibre.

1 \_\_\_\_\_

2 \_\_\_\_\_

(2 marks)

(b) Infra red radiation can be reflected, absorbed and transmitted by glass.



(i) What percentage of infra red is absorbed by the glass?

\_\_\_\_\_

(1 mark)

(ii) Complete the following sentence by drawing a ring around the correct word or phrase.

The absorbed infra red 

increases
does not change
Decreases

 the temperature of the glass.

(1 mark)

(c) Two of the following statements are true. One of the statements is false. Tick ( ) the boxes next to the two true statements.

All objects absorb infra red radiation.

Black surfaces are poor emitters of infra red radiation.

A hot object emits more infra red than a cooler object.

(1 mark)

(d) The following statement is false.

Black surfaces are good reflectors of infra red radiation.

Change one word in this statement to make it true.

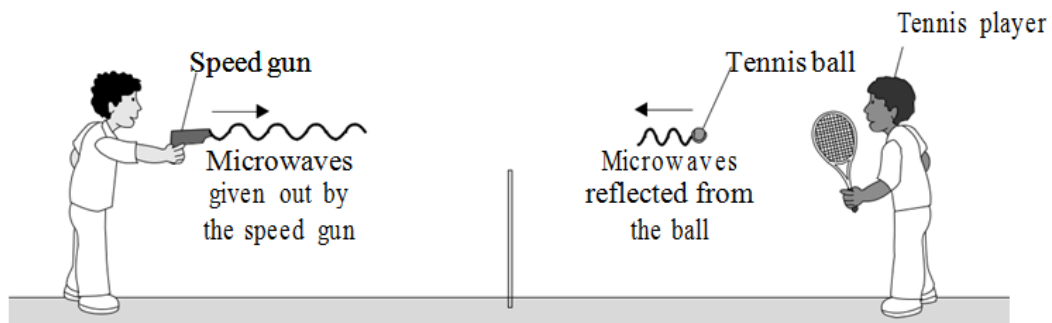
Write down your new statement.

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(1 mark)

Q:4 (a) The picture shows a speed gun being used to measure how fast a tennis player hits the ball.



Some of the microwaves from the speed gun are absorbed by the ball and some are reflected by the ball.

(a)(i) Complete the following sentence by choosing one of the phrases from the box.

longer than    the same as    shorter than

The wavelength of the microwaves reflected from the ball are \_\_\_\_\_ the wavelength of the microwave from the speed gun.

(1 mark)

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

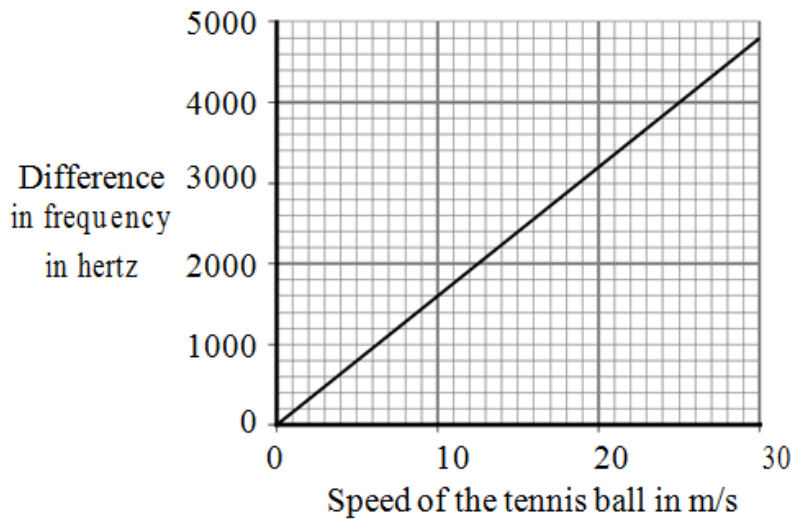
When the ball absorbs microwaves, its temperature will not change .

decrease slightly  
increase slightly

(1 mark)

**(b)** The microwaves reflected from the ball have a higher frequency than the microwaves from the speed gun.

The graph shows how the difference between the two frequencies depends on the speed of the ball.



**(b)(i)** Describe the pattern that links the difference between the two frequencies and the speed of the ball.

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(1 mark)

**(b)(ii)** The speed gun measures the difference between the two frequencies as 3200 Hz.

Use the graph to find the speed of the tennis ball. Show clearly on the graph how you obtain your answer.

Speed of the tennis ball = \_\_\_\_\_ m/s

(2 marks)

**(b)(iii)** Which one of the following gives the reason why the data has been shown as a line graph and not as a bar chart?

Put a tick (☑) in the box next to your choice.

Frequency and speed are both categoric variables.

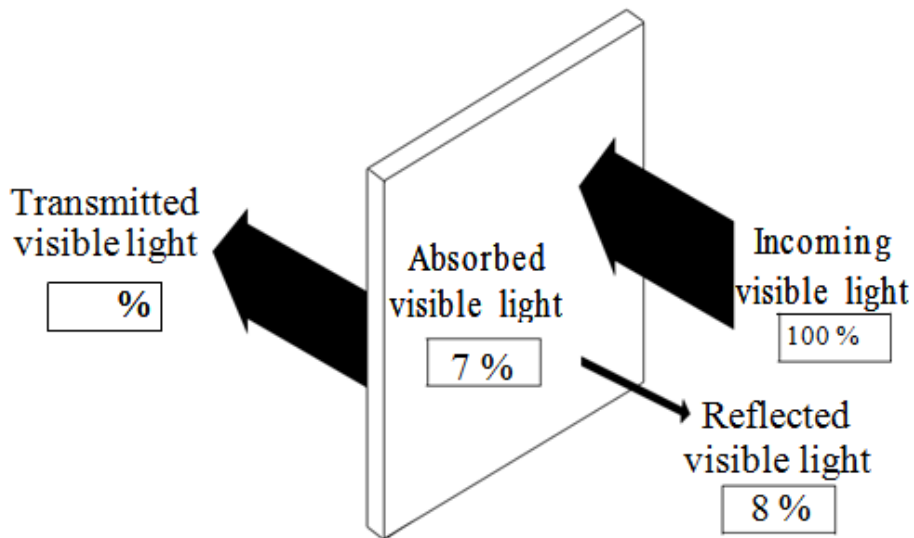
Frequency and speed are both continuous variables.

Speed is a continuous variable and frequency is a categoric variable.

(1 mark)

**Q:5** Glass reflects, absorbs and transmits both infra red radiation and visible light.

**(a)** The diagram shows the percentages of visible light that are reflected and absorbed by one type of glass.



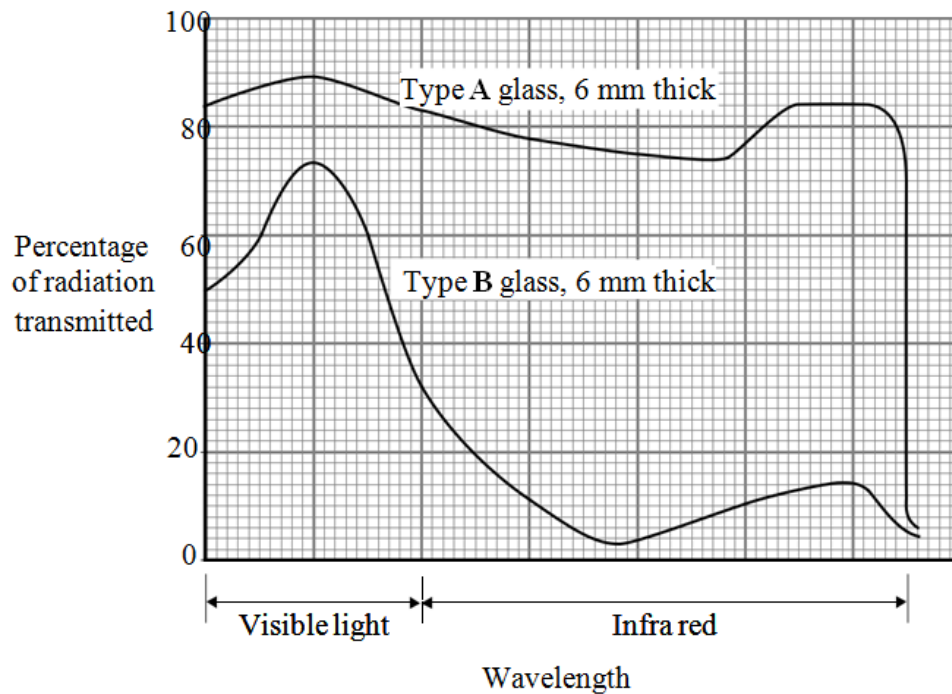
What percentage of visible light is transmitted by this type of glass?

\_\_\_\_\_ %

(1 mark)



(b) The amounts of infra red radiation and visible light transmitted by glass depend on the type and thickness of glass. The data obtained from tests on two different types of glass is displayed in the graph below.



(b) (i) To be able to compare the two types of glass, it was important to control one variable.

What variable was controlled in the tests?

(1 mark)

(b) (ii) A homeowner has a glass conservatory built on the back of the house. The homeowner tells the builder that the inside of the conservatory should stay as cool as possible throughout the summer.

Explain why the builder uses 'type B' glass for the conservatory.

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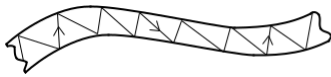
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(2 marks)

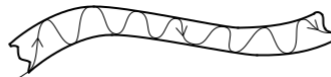
(c) Infra red and visible light can be used to send signals along an optical fibre.

Which one of the following diagrams, X, Y or Z, shows the path taken by a signal as it travels along an optical fibre?

Draw a ring around the correct diagram.



X



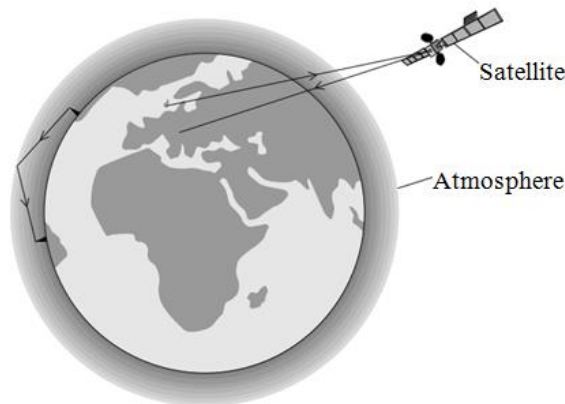
Y



Z

(1 mark)

**Q:6 (a)** Electromagnetic waves have many uses. The diagram shows two ways of sending information using electromagnetic waves.



(a)(i) What type of wave is used to send information to and from satellites?

\_\_\_\_\_

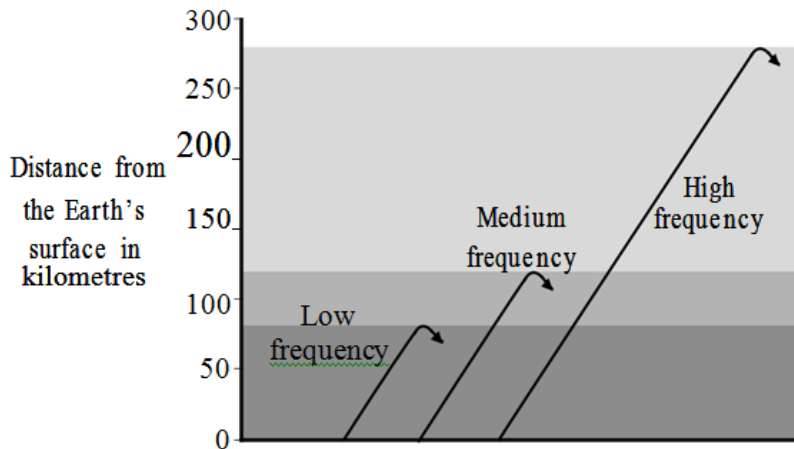
(1 mark)

(a)(ii) What property of this type of wave makes it suitable for satellite communications?

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(1 mark)

(b) Different frequency radio waves travel different distances through the atmosphere before being reflected.



Use the information in the diagram to describe the connection between the frequency of a radio wave and the distance the radio wave travels through the atmosphere before it is reflected.

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(1 mark)

(c) Electromagnetic waves travel at a speed of 300 000 000 m/s.

A radio station transmits waves with a wavelength of 20 metres.

Use the equation in the box to calculate the frequency, in kilohertz (kHz), of these waves.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$
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Show clearly how you work out your answer.

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Frequency = \_\_\_\_\_ kHz

(2 marks)

**Q:7** Small sailing boats can be fitted with a passive radar device. The device increases the chance that the small boat will be seen on the radar screen of a large ship. The radar transmitter on the large ship emits microwaves.

**(a)** Microwaves and radio waves are both part of the electromagnetic spectrum.

How are microwaves different from radio waves?

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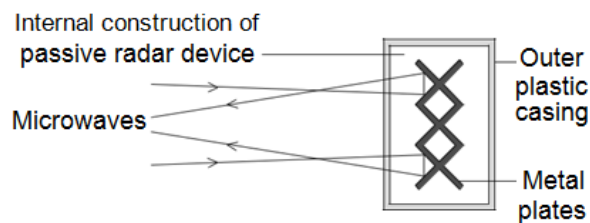
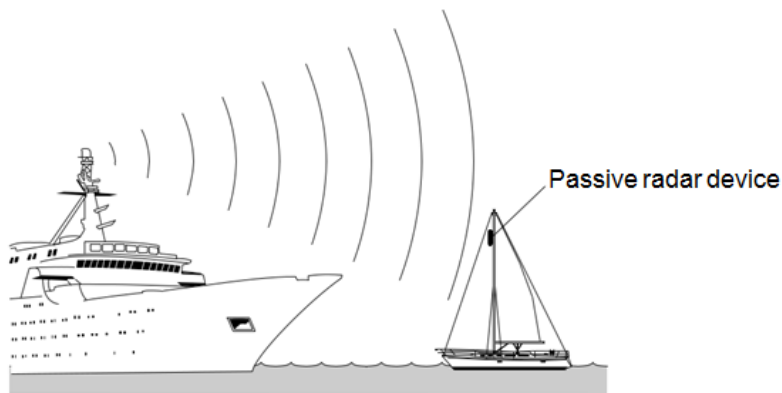
(1 mark)

**(b)** How fast do microwaves travel through the air or a vacuum compared to radio waves?

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(1 mark)

**(c)** The diagrams show the position of a passive radar device on a small boat and the internal construction of one type of passive radar device.



Microwaves can be absorbed, reflected or transmitted by different materials and types of surface. Explain what happens to the microwaves from the ship's transmitter when they reach the passive radar device.

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(2 marks)

**TOTAL MARKS=39**