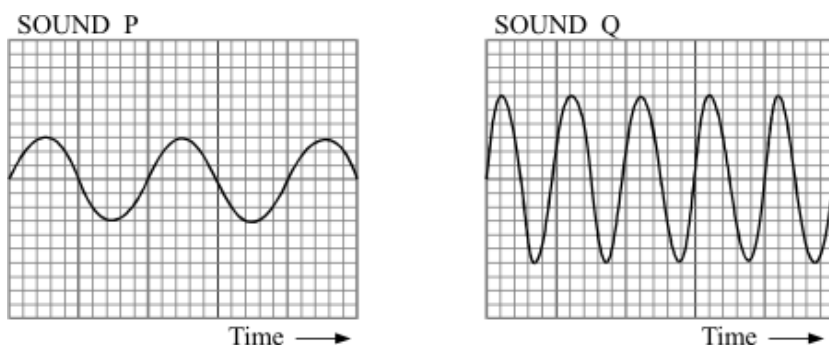


- Q1.** The diagram shows the oscilloscope traces of two different sounds P and Q. The oscilloscope setting is exactly the same in both cases.



P and Q **sound** different.  
Write down **two** differences in the way they sound.  
Explain your answers as fully as you can.

- 1 .....
- .....
- .....
- 2 .....
- .....
- .....

(Total 5 marks)

- Q2.** (i) Use the words frequency, wavelength and wave speed to write an equation which shows the relationship between them.

.....

(1)

- (ii) Calculate the speed of a sound wave with a frequency of 250 Hz and a wavelength of 1.3 m.

Show how you get to your answer and give the unit.

.....

.....

Speed = .....

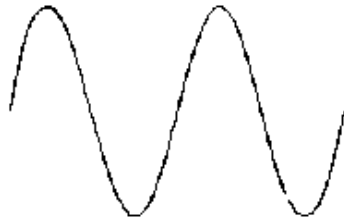
(2)

(Total 3 marks)

- Q3.** Some students made a small hand-turned a.c. generator, similar to a bicycle dynamo. They connected it to the Y plates of a cathode ray oscilloscope, CRO, and turned the generator slowly. The trace on the CRO looked like this:



They then turned the generator faster and the trace looked like this:



- (a) Why did the trace on the CRO show:

- (i) an increase in frequency;

.....

(1)

- (ii) a decrease in wavelength;

.....

(1)

- (iii) an increase in amplitude?

.....

(1)

- (b) One way to alter the output from the generator is to change the speed of turning. State **two** other ways to adapt parts of the generator to increase its output.

.....

.....

(2)

(Total 5 marks)

- Q4.** (a) The student is using a microphone connected to a cathode ray oscilloscope (CRO).



The CRO displays the sound waves as waves on its screen. What does the microphone do?

.....

.....

.....

(2)

- (b) The amplitude, the frequency and the wavelength of a sound wave can each be either increased or decreased.

- (i) What change, or changes, would make the sound quieter?

.....

(1)

- (ii) What change, or changes, would make the sound higher in pitch?

.....

(1)

(Total 4 marks)

**Q5.** Radio waves, ultra-violet, visible light and X-rays are all types of electromagnetic radiation.

(a) Choose wavelengths from the list below to complete the table.

$3 \times 10^{-8} \text{ m}$   $1 \times 10^{-11} \text{ m}$   $5 \times 10^{-7} \text{ m}$   $1500 \text{ m}$

TYPE OF RADIATION	WAVELENGTH (m)
Radio waves	
Ultra-violet	
Visible light	
X-rays	

(4)

(b) Microwaves are another type of electromagnetic radiation.

Calculate the frequency of microwaves of wavelength 3 cm.  
(The velocity of electromagnetic waves is  $3 \times 10^8 \text{ m/s}$ .)

.....

.....

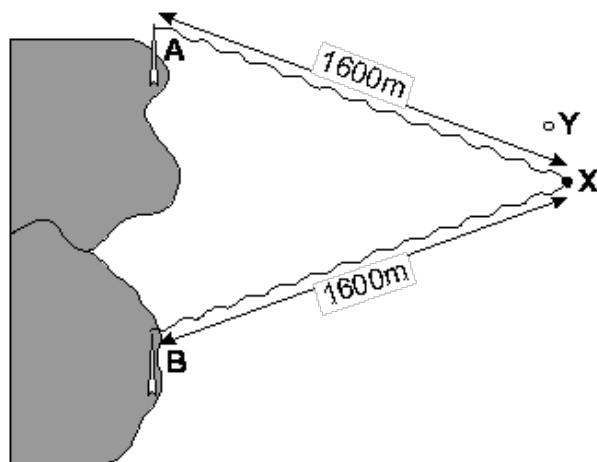
.....

.....

(4)

(Total 8 marks)

**Q6.** In the diagram below A and B are two radio navigation beacons. They both transmit at 1.5 MHz. The waves from both A and B have the same amplitude and they are in phase with each other. A ship is at point X, 1600 m away from each beacon.



- (i) Calculate the wavelength of the radio waves.

(The speed of radio waves is  $3 \times 10^8$  m/s.)

.....  
.....  
.....

(3)

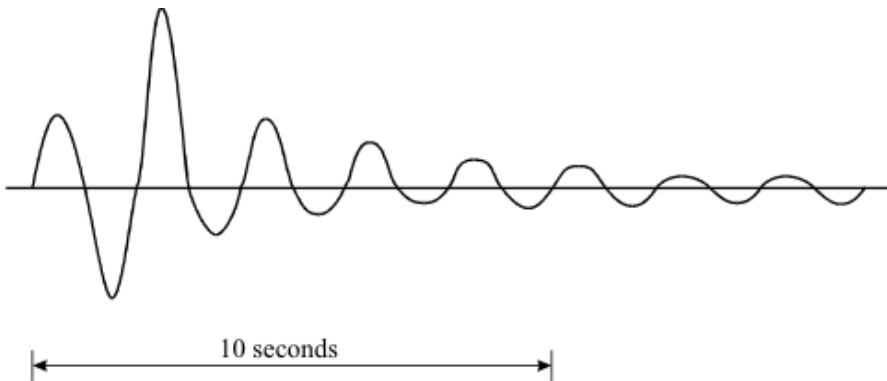
- (ii) Calculate the number of wavelengths which is equal to the distance between A and X.

.....  
.....

(1)

(Total 4 marks)

- Q7.** The vibration caused by a P wave travelling at 7.6 km/s has been recorded on a seismic chart.



- (i) How many waves are produced in one second?

.....

(1)

- (ii) Write down the equation which links frequency, wavelength and wave speed.

.....

(1)

- (iii) Calculate the wavelength of the P wave. Show clearly how you work out your answer and give the unit.

.....  
.....  
.....

Wavelength = .....

(2)  
(Total 4 marks)

**Q8.** Microwaves are used to transmit signals to the satellite. The microwaves have a wavelength of 0.6 metres (m) and travel through space at a speed of 300 000 000 metres per second (m/s).

- (i) Write down the equation which links frequency, wavelength and wave speed.

.....

(1)

- (ii) Calculate the frequency of the microwaves. Show clearly how you work out your answer and give the unit.

.....  
.....  
.....

Frequency = .....

(3)  
(Total 4 marks)

**Q9.** All radio waves travel at 300 000 000 m/s in air.

- (i) Give the equation that links the frequency, speed and wavelength of a wave.

.....

(1)

- (ii) Calculate the wavelength, in metres, of a radio wave which is broadcast at a frequency of 909 kHz. Show clearly how you work out your answer.

.....  
 .....  
 .....

Wavelength = ..... metres

(2)

(Total 3 marks)

- Q10.** (a) The new Tetra communications system to be used by the police transmits *digital signals* using microwaves of wavelength 75 cm.

- (i) 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  $\times$  wavelength

.....  
 .....

Frequency = ..... hertz

(2)

- (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)

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

1 .....

.....

2 .....

.....

(2)

(Total 7 marks)

- Q11.** (a) A student listens to the sound waves produced by a car siren. When the car is stationary, the student hears a constant frequency sound.

Describe how the wavelength and frequency of the sound waves heard by the student change when the car is driven away from the student.

.....

.....

.....

.....

(2)

- (b) Satellites fitted with various telescopes orbit the Earth. These telescopes detect different types of electromagnetic radiation.

Why are telescopes that detect different types of electromagnetic waves used to observe the Universe?

.....

.....

(1)

- (c) In 2005 a space telescope detected a star that exploded 13 billion years ago. The light from the star shows the biggest *red-shift* ever measured.

- (i) What is *red-shift*?

.....

.....

(1)

- (ii) What does the measurement of its red-shift tell scientists about this star?

.....

.....

(1)



(d) Red-shift provides evidence for the 'big bang' theory.

(i) Describe the 'big bang' theory.

.....

.....

.....

.....

(2)

(ii) Suggest what scientists should do if new evidence were found that did not support the 'big bang' theory.

.....

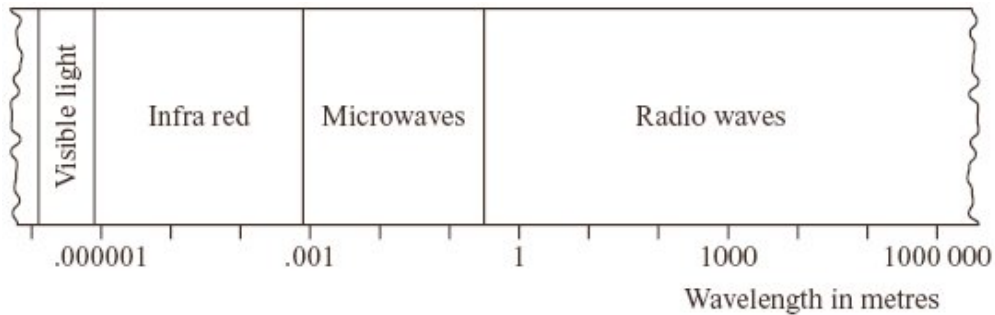
.....

.....

(1)

(Total 8 marks)

**Q12.** The diagram represents part of the electromagnetic spectrum.



(i) Visible light travels through air at 300 000 000 m/s.

Why can we assume that radio waves travel through air at the same speed as light?

.....

(1)

- (ii) A radio station broadcasts at a frequency of 200 kHz.

Use the following equation to calculate the wavelength of the waves broadcast by this radio station. Show clearly how you work out your answer.

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

.....

.....

$$\text{Wavelength} = \dots\dots\dots \text{ m}$$

(2)

- (iii) Draw a vertical line on the diagram above to show the position of this radio wave in the electromagnetic spectrum.

(1)

(Total 4 marks)

##

- (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave? .....

(1)

- (b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Show clearly how you work out your answer.

.....

.....

$$\text{Wavelength} = \dots\dots\dots \text{ m}$$

(2)

- (c) What happens when a metal aerial absorbs radio waves?

.....

.....

.....

.....

(2)

- (d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth not be able to detect X-rays emitted from distant stars?

.....

.....

(1)

(Total 6 marks)

**Q14.**

- (a) Microwaves are one type of electromagnetic wave.

- (i) Which type of electromagnetic wave has a lower frequency than microwaves?

.....

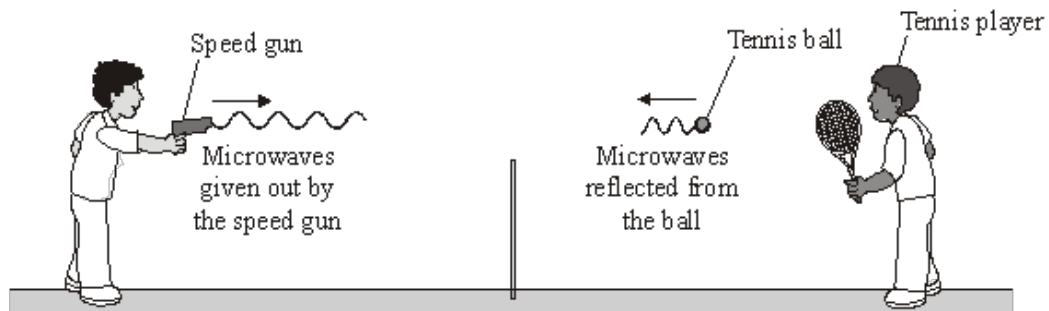
(1)

- (ii) What do all types of electromagnetic wave transfer from one place to another?

.....

(1)

- (b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



- (i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the microwaves emitted from the speed gun.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$
---

Show clearly how you work out your answer.

.....  
 .....

Wavelength = ..... m

(2)

- (ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

.....  
 .....

(1)

- (iii) Some of the microwaves transmitted by the speed gun are reflected from the moving ball back towards the speed gun.

Describe how the wavelength and frequency of the microwaves change as they are reflected from the moving ball.

.....  
 .....  
 .....  
 .....

(2)

(Total 7 marks)

**Q15.**

- (a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

- (i) Give **two** properties that are common to both visible light and microwaves.

1 .....  
 .....  
 2 .....  
 .....

(2)

- (ii) Name **two** more types of electromagnetic wave that can be used for communications.

..... and .....

(1)

- (b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the frequency of the microwaves used to link the computer to the router.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$
---

Show clearly how you work out your answer and give the unit.

.....  
.....  
.....

Frequency = .....

(3)

- (c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.

A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

- (i) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

.....  
.....

(1)

- (ii) Why did the group of scientists suggest that there is a need for further research?

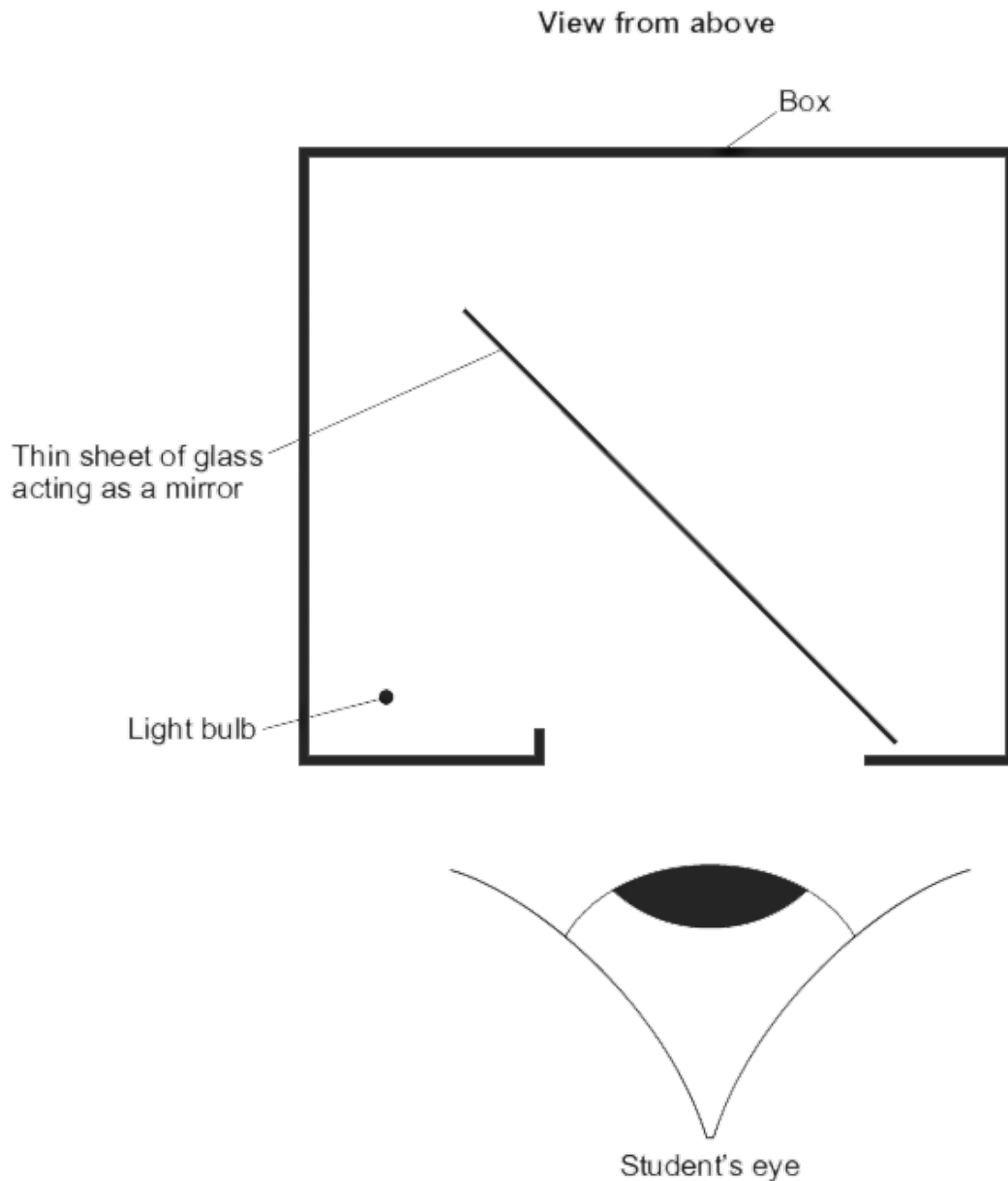
.....  
.....

(1)

**(Total 8 marks)**

**Q16.** The diagram shows a model used to demonstrate an illusion known as 'Pepper's Ghost'.

A small light bulb and thin sheet of glass are put inside a box. The thin sheet of glass acts as a mirror. Although the light bulb is switched on, a student looking into the box cannot see the bulb. What the student does see is a virtual image of the bulb.



- (a) Use a ruler to complete a ray diagram to show how the image of the light bulb is formed. Mark and label the position of the image.

(4)

- (b) The image seen by the student is virtual.

Why?

.....  
.....

(1)  
(Total 5 marks)

**Q17.** Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

- (a) Give **two** more properties that are the same for both radio waves and microwaves.

1 .....  
.....  
2 .....  
.....

(2)

- (b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

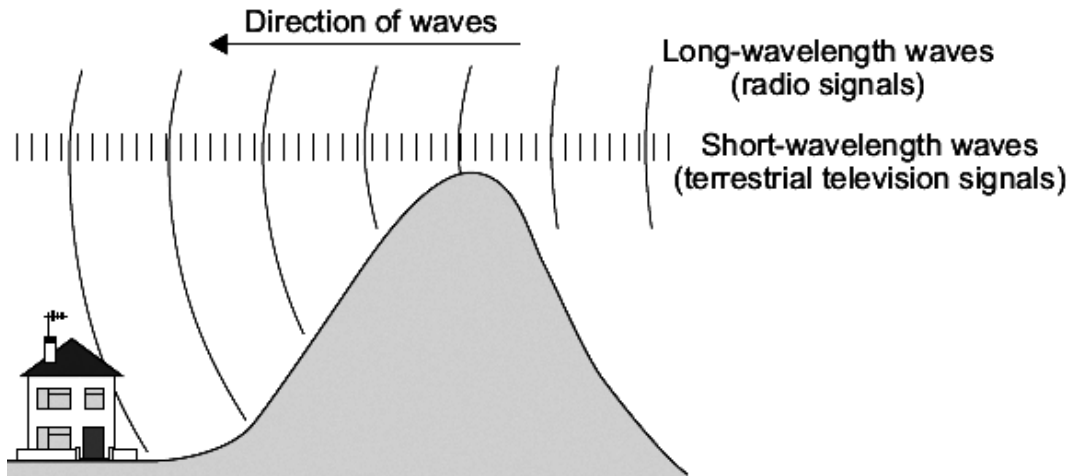
.....  
.....

(1)

- (c) Terrestrial television does not use satellites.

Terrestrial television signals and radio signals both use radio waves.

Radio signals are transmitted at a longer wavelength than terrestrial television signals.



My Revision Notes AQA GCSE Physics for A\* – C, Steve Witney, © Philip Allan UK

In hilly areas it may be possible to receive radio signals but not receive terrestrial television signals.

Explain why.

.....

.....

.....

.....

.....

.....

(3)



- (d) Electromagnetic waves travel at a speed of  $3.0 \times 10^8$  m/s.

A radio station transmits waves with a wavelength of  $2.5 \times 10^2$  m.

Calculate the frequency of the radio waves.

Use the correct equation from the Physics Equations Sheet.

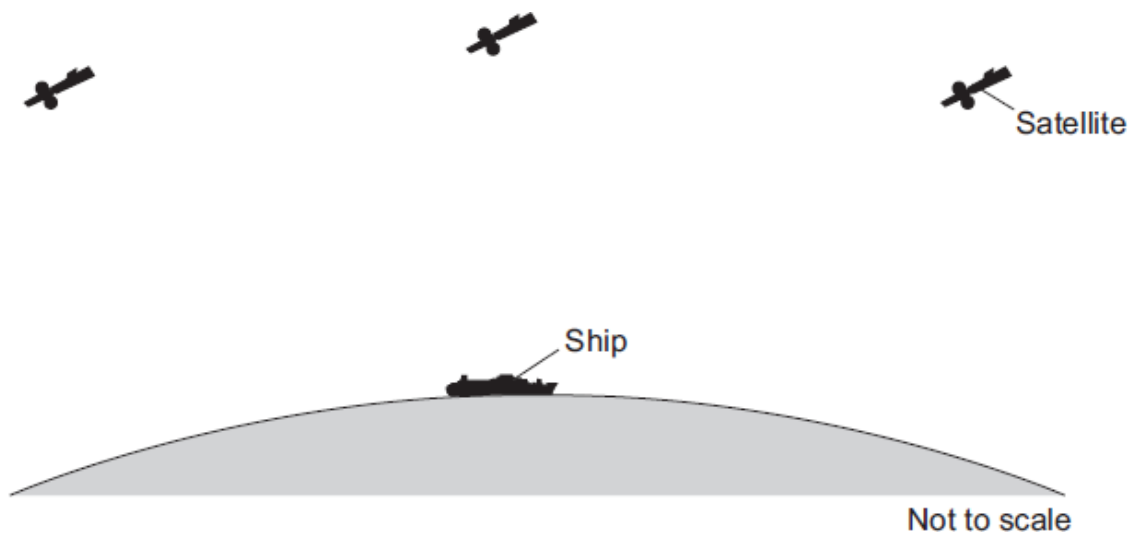
Show clearly how you work out your answer and give the unit.

.....  
.....  
.....

Frequency = .....

(3)  
(Total 9 marks)

- Q18.** The ship in the diagram is fitted with a navigation system. The navigation system works out the location of the ship by timing the microwave signals transmitted from at least three satellites.



- (a) Microwaves are one type of electromagnetic wave.

Give **two** properties that all electromagnetic waves have.

1 .....  
.....  
2 .....  
.....

(2)

- (b) The microwaves used in the navigation system are transmitted at a frequency of 1575 MHz.

Use the equation and information in the box to calculate the wavelength of the microwaves used in the navigation system.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$ $\text{microwaves travel at } 300\,000\,000 \text{ m/s}$ $1 \text{ MHz} = 1\,000\,000 \text{ Hz}$
---

Show clearly how you work out your answer.

.....

.....

.....

.....

Wavelength = ..... m

(3)

- (c) The ship is fitted with a metal aerial that receives the microwave signals from the satellites.

For the navigation system to work, what effect must the microwave signals have on the aerial?

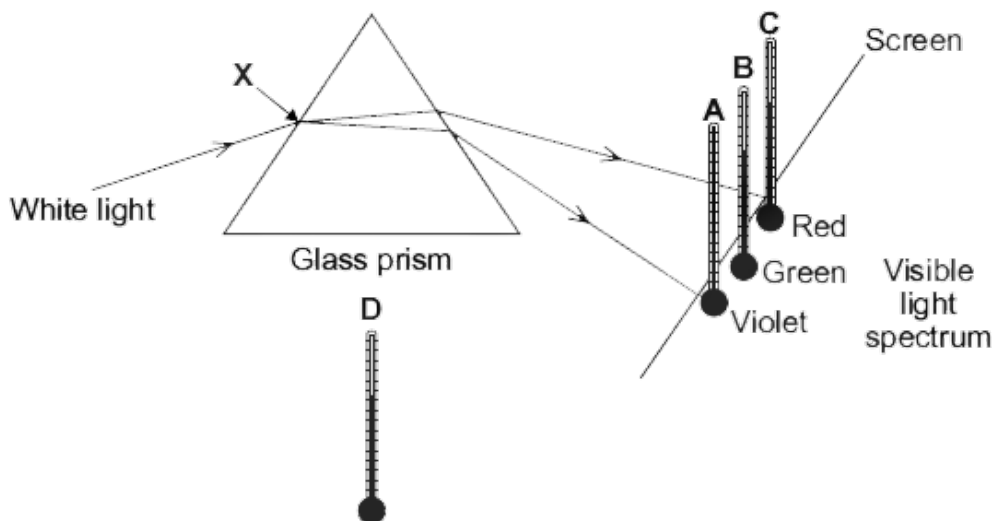
.....

.....

(1)

(Total 6 marks)

- Q19.** 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)

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

Suggest why.

.....

.....

(1)

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

Thermometer	Position of thermometer	Temperature in °C
<b>A</b>	in violet light	21
<b>B</b>	in green light	22
<b>C</b>	in red light	24
<b>D</b>	outside the spectrum	20

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

.....

.....

.....

.....

(2)

- (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)

- (c) A person emits infrared radiation at a frequency of  $3.2 \times 10^{13}$  Hz.

Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be  $3.0 \times 10^8$  m/s.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

.....

Wavelength = ..... m

(2)

- (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)

(Total 10 marks)

**Q20.** (a) Water waves are transverse waves. Sound waves are longitudinal waves.

(i) Explain the difference between a transverse wave and a longitudinal wave.

You may include labelled diagrams in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(ii) Name **one** type of wave that may be either transverse or longitudinal.

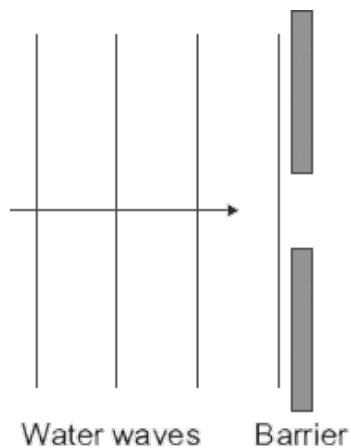
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(1)

(b) The diagram shows water waves in a ripple tank moving towards a gap in a barrier.

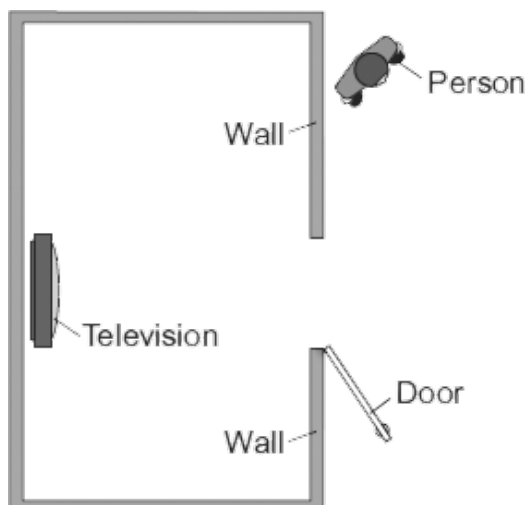
The water waves diffract as they pass through the gap.

Complete the diagram to show the diffracted water waves.



(1)

- (c) A television is switched on inside a room. A person outside the room can hear the television, but only when the door is open.



When the door is open, the person can hear the sound but cannot see the television.

Explain why.

.....

.....

.....

.....

(2)  
(Total 7 marks)

- Q21.** (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B**, or **C**, is an infra red wave?

.....

(1)

- (b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$
---

Show clearly how you work out your answer.

.....  
 .....

Wavelength = ..... m

(2)

- (c) What happens when a metal aerial absorbs radio waves?

.....  
 .....  
 .....  
 .....

(2)

- (d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth **not** be able to detect X-rays emitted from distant stars?

.....  
 .....

(1)

(Total 6 marks)

**Q22.** Galaxies emit all types of electromagnetic wave.

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

.....

(1)

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

.....  
 .....

(1)

- (b) Electromagnetic waves travel through space at a speed of  $3.0 \times 10^8$  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)

- (c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part (b) as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

- (i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

.....  
.....

(1)

- (ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....  
.....  
.....  
.....

(2)

- (iii) What does the observation of red-shift suggest is happening to the Universe?

.....  
.....

(1)

(Total 9 marks)



**Q23.** (a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

$10^{-15}$  metres to  $10^4$  metres

☐

$10^{-4}$  metres to  $10^{15}$  metres

☐

$10^{-6}$  metres to  $10^6$  metres

☐

(1)

(b) Infrared waves and microwaves are used for communications.

(i) Give **one** example of infrared waves being used for communication.

.....  
.....

(1)

(ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of  $1.8 \times 10^9$  Hz and travel at a speed of  $3.0 \times 10^8$  m/s.

Calculate the wavelength of the microwaves.

Use the correct equation from the Physics Equations Sheet.

Give your answer to **two** significant figures.

.....  
.....  
.....

Wavelength = ..... m

(3)

- (c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	Sperm count in millions of sperm cells per cm <sup>3</sup> of semen
0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

.....

(1)  
(Total 6 marks)

