AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.6.2 ELECTROMAGNETIC WAVES (PACK 5)

SCORE	PERCENTAGE
/164	%

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Q1.

The diagram below shows types of waves within the electromagnetic spectrum.

Some of the types of waves are represented by letters.

P	**microwaves**	**Q**	**visible light**	**R**	**S**	**gamma rays**

(a) Which letter shows the position of ultraviolet (UV) radiation within the electromagnetic spectrum?

Tick **one** box.

P ☐ **Q** ☐ **R** ☐ **S** ☐

(1)

(b) A special lamp can produce UV radiation.

Which **two** statements describe the electromagnetic waves emitted by a UV lamp?

Tick **two** boxes.

They have a higher frequency than X-rays. ☐

They have the same wave speed as visible light. ☐

They have a longer wavelength than microwaves. ☐

They have a lower frequency than gamma rays. ☐

They have a greater wave speed than radio waves. ☐

(2)

(c) UV radiation is used to treat a vitamin D deficiency.

People should **not** use a UV lamp for long periods of time.

State **two** risks of exposure to high levels of UV radiation.

1. _____

_____

2. _____

_____

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(2)

(d) Ionising radiation is used for some medical imaging.

Name **two** types of electromagnetic waves that are used.

1. _____

2. _____

(2)

(Total 7 marks)

Q2.

A car aerial receives radio waves from a radio transmitter.

Radio waves are transverse waves.

Sound waves are longitudinal waves.

(a) Describe the difference between transverse waves and longitudinal waves.

_____

_____

_____

_____

(2)

(b) The radio waves have a frequency of 4.8×10^9 Hz

Wave speed of electromagnetic waves = 3.0×10^8 m/s

Calculate the wavelength of the radio waves.

Give your answer to 2 significant figures.

_____

_____

_____

_____

Wavelength = _____ m

(3)

(c) Describe how the radio waves reaching the car aerial produce signals in the electrical circuit of the car radio.

_____

_____

_____

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_____

_____

_____

_____

_____

(3)

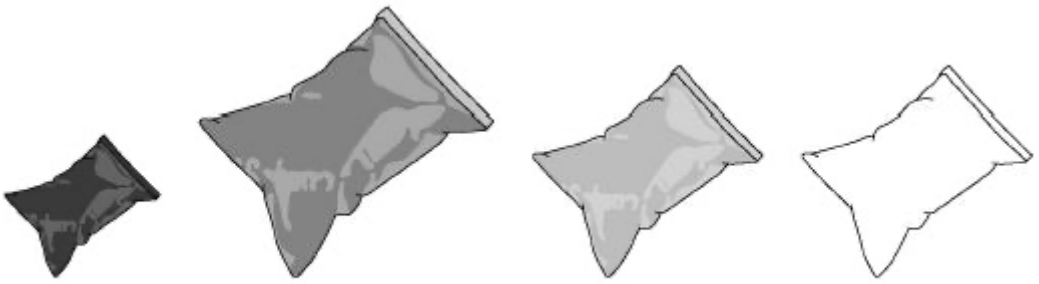
(Total 8 marks)

Q3.

A solar water bag can be used to heat water for an outdoor swimming pool.

A student wanted to find out if the colour of the solar water bag affects the temperature increase of the water inside the bag.

The diagram below shows some of the equipment used.



This is the method used.

1. Fill each bag with water.
2. Place the four bags on the ground outside.
3. After three hours, measure the temperature of the water inside each bag.
4. Repeat steps 1−3 on the next two days.

(a) Suggest three changes the student should make to this method to get valid results.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

The student repeated the investigation using an improved method.

The results obtained were valid.

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The table below shows the results.

Colour of bag	Temperature increase in °C			
	Day 1	Day 2	Day 3	Mean
Black	44.0	31.4	43.4	39.6
Pale blue	38.5	23.6	38.1	33.4
Pale green	37.9	23.7	37.7	33.1
White	25.3	23.4	24.2	**X**

(b) The student used a thermometer to measure the temperature of the water inside each bag.

What was the resolution of the thermometer?

Resolution = _____ °C

(1)

(c) Suggest **one** reason why the temperatures increased less on Day 2 than on Day 1 and Day 3.

_____

_____

(1)

(d) Calculate the mean temperature increase for the white bag.

_____

_____

Mean temperature increase = _____ °C

(1)

(e) Which colour of bag would be best to use to heat water?

Give a reason for your answer.

Colour _____

Reason _____

_____

_____

_____

(2)

(Total 8 marks)

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Q4.

(a) Complete the sentences.

Choose the answers from the box.

ionising	light	sound	transmitted	waves

X-rays travel at the speed of _____ .

X-rays can cause cancer because they are _____ .

(2)

(b) How do X-rays compare with gamma rays?

Tick **one** box.

X-rays have a longer wavelength and a higher frequency ☐

X-rays have a longer wavelength and a lower frequency ☐

X-rays have a shorter wavelength and a higher frequency ☐

X-rays have a shorter wavelength and a lower frequency ☐

(1)

A scientist measured the radiation dose that a person received at different distances from an X-ray machine.

The table shows the results.

Distance from machine in m	Dose in millisieverts/			Mean dose in millisieverts
	Test 1	Test 2	Test 3	
0.5	0.152	0.146	0.155	0.151
1.0	0.039	0.035	0.040	**X**
1.5	0.017	0.018	0.017	0.017
2.0	0.012	0.007	0.007	0.009
2.5	0.007	0.006	0.005	0.006

(c) Calculate value **X** in the table.

_____

_____

_____

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Mean dose = _____ millisieverts

(2)

(d) What conclusion can be made from the results in the table?

Tick **one** box.

The dose decreases if you stand further from the machine.	☐
The dose is directly proportional to the distance.	☐
The dose is the same at all distances from the machine.	☐
There is a linear relationship between dose and distance.	☐

(1)

(e) An X-ray gives a radiation dose of 0.180 millisieverts.

Natural sources give a dose of 0.012 millisieverts per day.

Calculate the time it would take for natural sources to give a dose of 0.180 millisieverts.

_____

_____

_____

Time = _____ days

(2)

(f) Suggest why doctors use X-rays even though this increases the risk of cancer to the patient.

_____

_____

(1)

(g) X-rays can also be used to treat cancer.

A patient receives a dose of 20 millisieverts from an X-ray.

Proton beam therapy delivers 40% of this dose.

Calculate the dose delivered by proton beam therapy.

_____

_____

_____

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Dose = _____ millisieverts

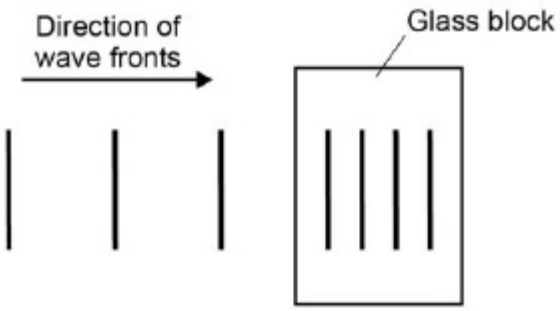
(2)

(Total 11 marks)

Q5.

Figure 1 is a wave front diagram showing light travelling through the air and into a glass block.

Figure 1

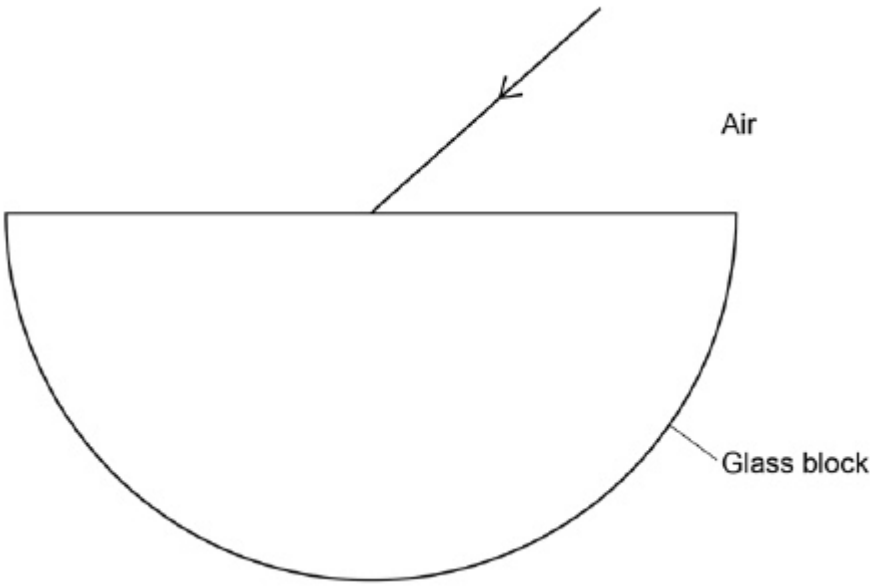


(a) Complete **Figure 1** by drawing wave fronts after they have left the glass block.

(1)

(b) **Figure 2** shows a ray of light incident on a semi-circular glass block.

Figure 2



Complete the ray diagram in **Figure 2**.

- Draw the ray of light passing through and leaving the glass block.
- Label the angle of refraction.

(4)

(c) Explain why the light is refracted.

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_____

_____

_____

_____

(2)

(d) A student investigated how different coloured light was refracted by glass.

The student aimed rays of different coloured light at a glass block.

She measured the angle of refraction for each colour.

Give **two** variables that the student should control.

1. _____

2. _____

(2)

The table shows the student's results.

Colour of light	**Angle of refraction in degrees**
Red	27.94
Orange	27.90
Yellow	27.82
Green	27.78
Blue	27.70

(e) Explain why these results could **not** have been obtained with a normal protractor.

_____

_____

_____

_____

(2)

(f) What conclusion can be made about the relationship between the wavelength of light and the angle of refraction?

_____

_____

(1)

(g) Glass does **not** transmit ultraviolet radiation.

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Suggest what happens to ultraviolet radiation when it is incident on glass.

_____

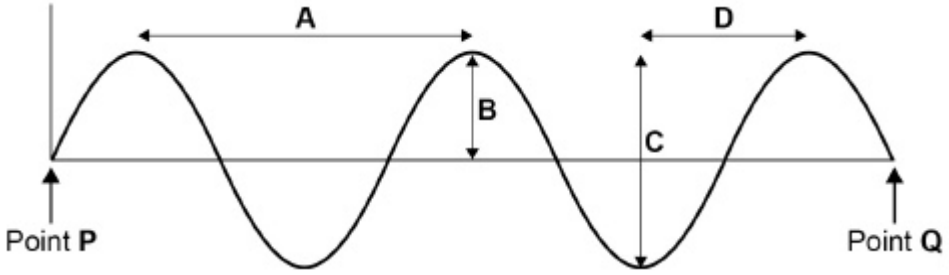
_____

(1)

(Total 13 marks)

Q6.

The diagram shows a wave.



(a) Which arrow shows the amplitude of the wave?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) Which arrow shows the wavelength of the wave?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) It takes 0.5 seconds for a wave in the diagram to travel from point **P** to point **Q**.

Calculate the frequency of the waves shown in the diagram.

_____

_____

_____

Frequency = _____ Hz

(2)

(d) What type of wave is sound?

Tick **one** box.

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Electromagnetic ☐

Longitudinal ☐

Transverse ☐

(1)

Two students carried out an experiment to determine the speed of sound.

This is the method used.

1. Student A stands 100 m away from Student B.
2. Student A bangs two blocks of wood together making a loud sound.
3. Student B starts a stopclock when he sees the blocks of wood bang together.
4. Student B stops the stopclock when he hears the sound and records the time.
5. The students repeat steps 2–4 several times.

The students calculated the speed of sound from their results.

(e) Suggest the most likely source of error in the experiment.

_____

_____

(1)

(f) The speed of sound calculated was lower than the true speed of sound in air.

Suggest **one** improvement to the students' method that would give a more accurate value for the speed of sound.

_____

_____

(1)

(g) A student compares the properties of visible light waves and radio waves.

Which **two** properties are the same for both visible light waves **and** radio waves?

Tick **two** boxes.

Both are transverse waves ☐

Both can travel through a vacuum ☐

Both have the same amplitude ☐

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Both have the same frequency ☐

Both have the same wavelength ☐

(2)

(Total 9 marks)

Q7.

A baby monitor has a sensor unit that transmits an image of the baby and the noises the baby makes to a monitor unit.

The monitor unit then displays an image of the baby and emits the noises the baby makes.

(a) Compare the properties of the waves that transmit images and noises from the monitor unit.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The sensor unit can detect infrared and visible light.

Suggest **one** advantage of being able to detect infrared.

_____

_____

(1)

(c) Write down the equation that links frequency, wave speed and wavelength.

Equation _____

(1)

(d) The signals for the monitor unit are transmitted as electromagnetic waves with a wavelength of 0.125 m.

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Wave speed of electromagnetic waves = 3×10^8 m / s

Calculate the frequency of the signal.

_____

_____

_____

_____

Frequency = _____ Hz

(3)

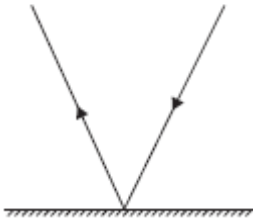
(Total 9 marks)

Q71.

Light rays can be reflected and refracted.

Figure 1 shows how a plane mirror reflects a ray of light.

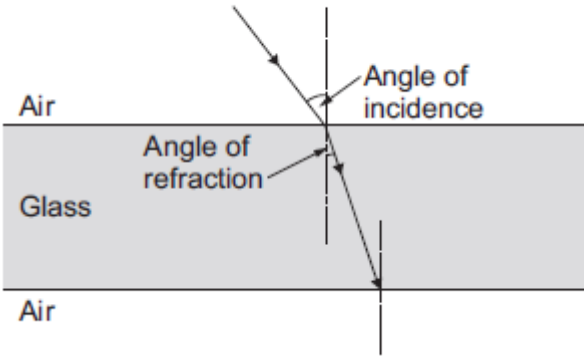
Figure 1



(a) Light is refracted when passing from air into glass.

Figure 2 shows a ray of light as it passes from air into a glass block.

Figure 2



(i) Draw a line on **Figure 2** to show the path of the ray as it leaves the glass block.

(1)

(ii) Name the dashed lines drawn at 90° to the glass in **Figure 2**.

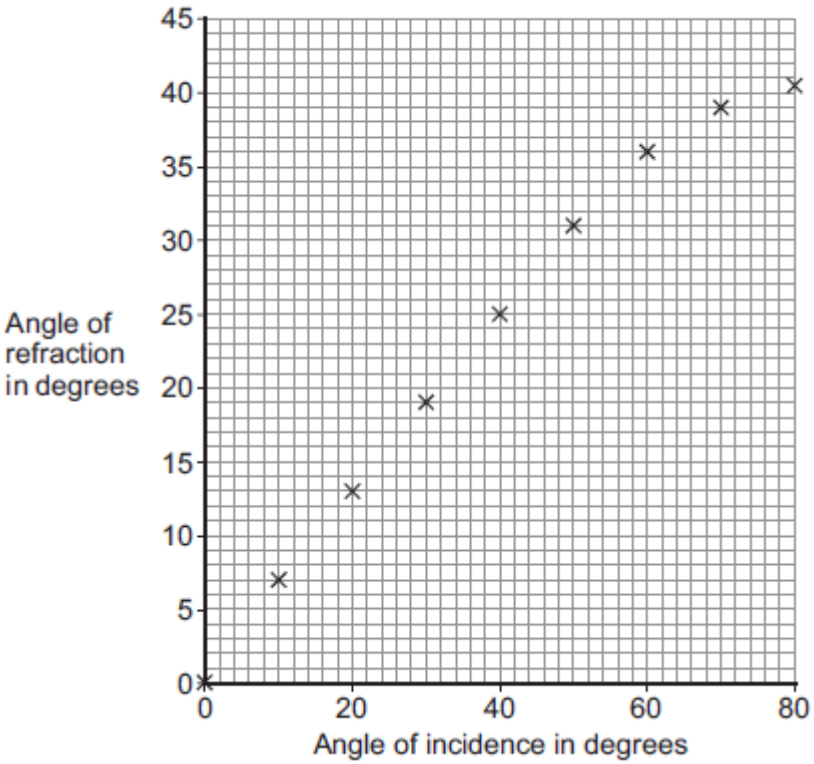
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(1)

(b) A student investigated the relationship between the angle of incidence and the angle of refraction as light passes from air into glass. Her results are shown in **Figure 3**.

Figure 3



(i) Draw a line of best fit on **Figure 3**.

(1)

(ii) Use **Figure 3** to describe the relationship between the angle of incidence and the angle of refraction.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q72.

Electromagnetic waves can be diffracted, reflected and refracted.

Infrared, microwaves, radio waves and visible light can all be used for communication.

Draw **one** line from each part of the electromagnetic spectrum to its use.

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Part	Use
Microwaves	Photography
Radio waves	Remote controls
Visible light	Mobile phones
	TV broadcasts

(Total 3 marks)

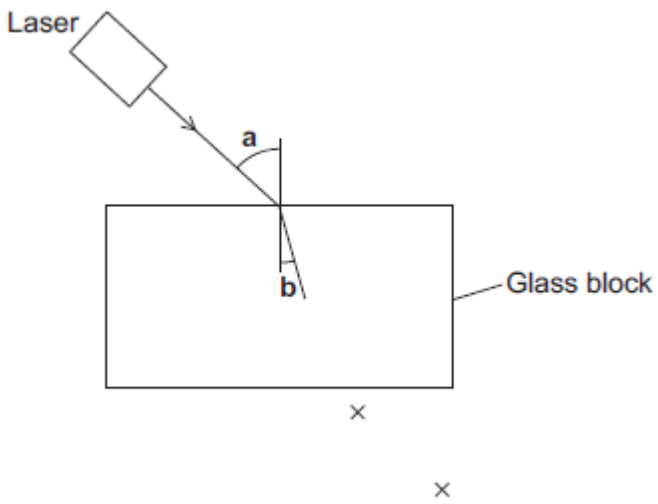
Q73.

A student used a laser to investigate the change of direction of light as it entered a glass block.

The apparatus is shown in **Figure 1**.

The path of a ray of light as it enters the glass block is shown.

Figure 1



(a) The student marked crosses to show the path of the ray of light that left the glass block.

Use a ruler to help you to draw the path of the ray of light through and out of the glass block.

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(2)

(b) Light from lasers can damage your eyes.

Suggest **one** safety precaution that the student should have taken during his investigation.

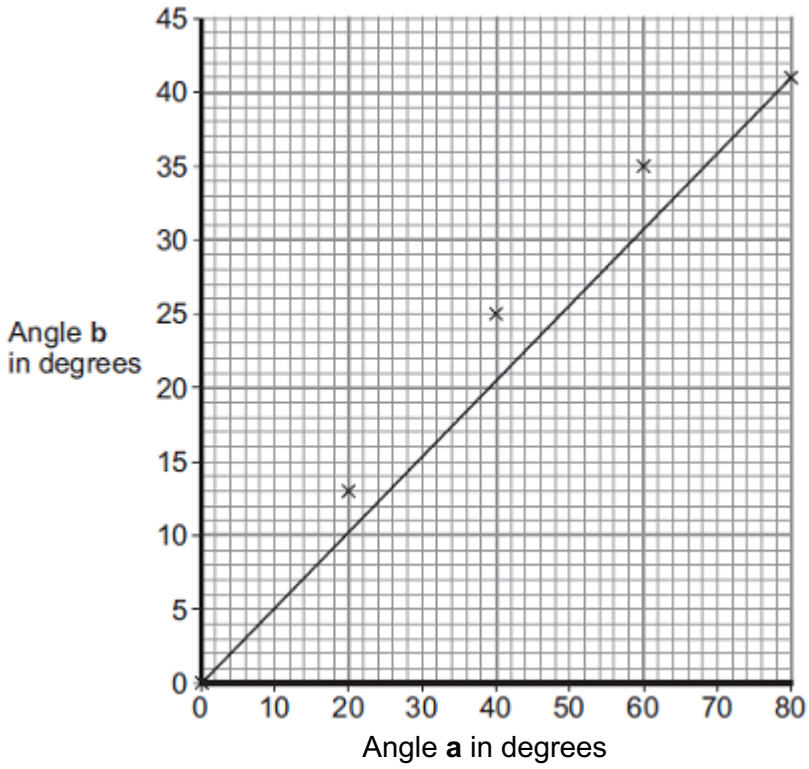
_____

_____

(1)

(c) The student measured **angle a** and **angle b** when the ray of light was incident at 5 different angles. He measured each set of values once. The student's results are shown in **Figure 2**.

Figure 2



(i) The student's line of best fit is **incorrect**.

Give **one** reason why.

_____

_____

(1)

(ii) The student measured 5 different values of **angle a** in his investigation.

Suggest **two** ways the student could improve his investigation.

_____

_____

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_____

_____

(2)

(Total 6 marks)

Q74.

During the day, the Sun transfers energy to an outdoor swimming pool.



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(a) By which method of energy transfer does the pool receive energy from the Sun?

_____

(1)

(b) (i) The mass of water in the pool is 5000 kg. The specific heat capacity of water is 4200 J/kg°C.

Calculate how much energy needs to be supplied to increase the water temperature by 5°C and state the correct unit.

Use the correct equation from the Physics Equations Sheet.

Give the unit.

_____

_____

_____

Energy = _____

(3)

(ii) The Sun supplies energy to the water in the pool at a rate of 16 kJ every second.

Calculate how much time it would take for energy from the Sun to raise the water temperature by 5 °C.

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You will need to use your answer to **(b)(i)** and the correct equation from the Physics Equations Sheet.

_____

_____

_____

Time = _____ seconds

(3)

(iii) On one day, the temperature of the pool is 7 °C lower than the air temperature.

The time it takes for the pool temperature to rise by 5 °C is less than the answer to part **(b)(ii)**.

Suggest a reason why.

_____

_____

(1)

(Total 8 marks)

Q75.

The electromagnetic spectrum is made up of electromagnetic waves.

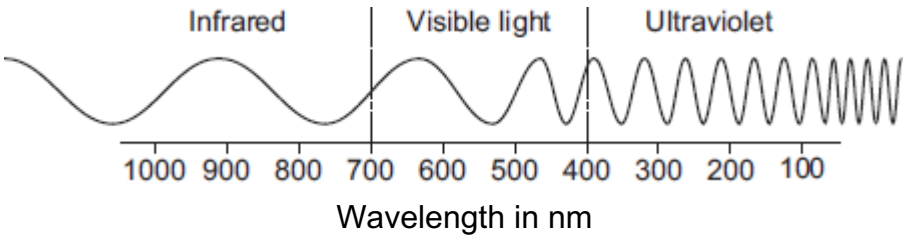
The electromagnetic waves form a continuous spectrum of different wavelengths.

(a) Draw a ring around the correct answer to complete the sentence.

All electromagnetic waves are | longitudinal / mechanical / transverse | waves.

(1)

(b) Part of the electromagnetic spectrum is shown in the diagram.



(i) What is the range of wavelengths the human eye can detect?

The range is from _____ nm to _____ nm.

(2)

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(ii) Draw a ring around the correct answer to complete the sentence.

As the frequency of the waves in the electromagnetic spectrum increases,

the wave speed	decreases. increases. stays the same.

(1)

(Total 4 marks)

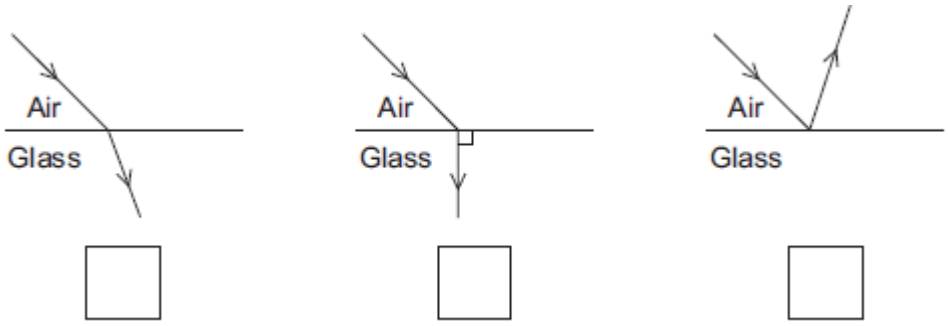
Q76.

This question is about the properties of light.

(a) Which diagram, **1**, **2** or **3**, shows the path a ray of light takes when travelling from air **into** glass?

Tick (✓) the box under the correct diagram.

Diagram 1 **Diagram 2** **Diagram 3**

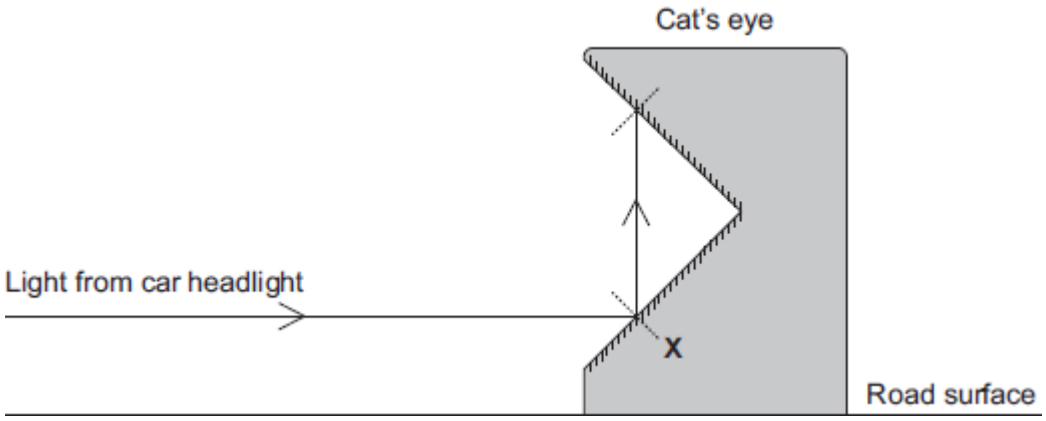


(1)

(b) 'Cat's eyes' are used on roads as markers. They reflect light from car headlights.

Diagram 4 shows the path of a ray of light entering a 'cat's eye'.

Diagram 4



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(i) Continue the path of the ray of light on **Diagram 4**.

Show the direction of the ray.

(2)

(ii) What is the name given to the dotted line on **Diagram 4** labelled **X**?

_____

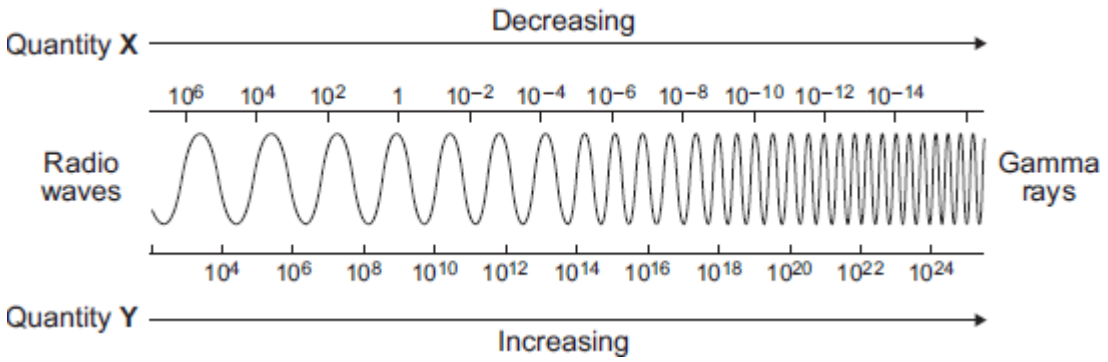
(1)

(Total 4 marks)

Q77.

The electromagnetic spectrum is shown in the diagram below.

Diagram 1



(a) Name quantities **X** and **Y**, and state the units they are measured in.

Quantity **X**: _____ Unit for Quantity **X**: _____

Quantity **Y**: _____ Unit for Quantity **Y**: _____

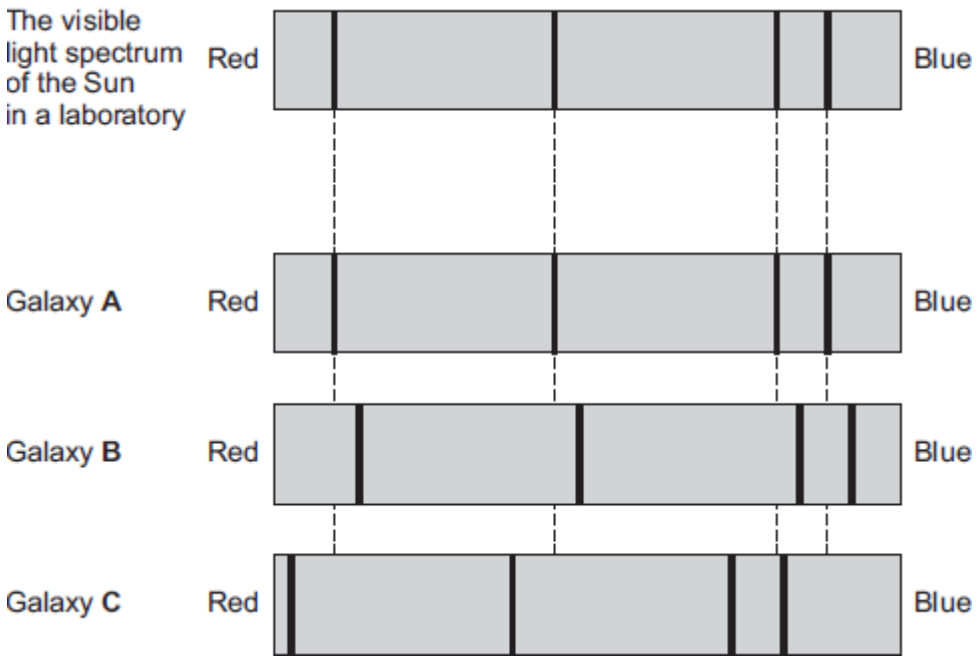
(3)

(b) The visible part of the electromagnetic spectrum from stars includes dark lines. These lines are at specific wavelengths.

Diagram 2 shows the visible light spectra for three galaxies, **A**, **B** and **C**, compared to the visible light spectrum of the Sun as seen in a laboratory.

Diagram 2

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(i) Using evidence from the spectra, what conclusions can be made about the movement of galaxies **A**, **B** and **C** relative to the Earth?

(3)

(ii) Compare the speed of galaxy **B** with the speed of galaxy **C** relative to the observer.

(1)

(iii) Explain why it is **not** valid to make conclusions about all galaxies in the Universe from these spectra.

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(2)

(Total 9 marks)

Q78.

A student investigates the infrared radiation being emitted by different coloured surfaces to the surroundings.

(a) Draw a ring around each correct answer to complete the sentences.

(i) All objects emit and | absorb / conduct / insulate | infrared radiation.

(1)

(ii) Compared with cooler objects, hotter objects emit | less / the same amount of / more | infrared radiation.

(1)

(b) The student pours 300 cm^3 of hot water into each of 3 metal cubes and seals the top of each cube.

(i) Draw a ring around the correct answer to complete the sentence.

Energy is transferred through the sides of the metal cubes by | conduction. / convection. / radiation.

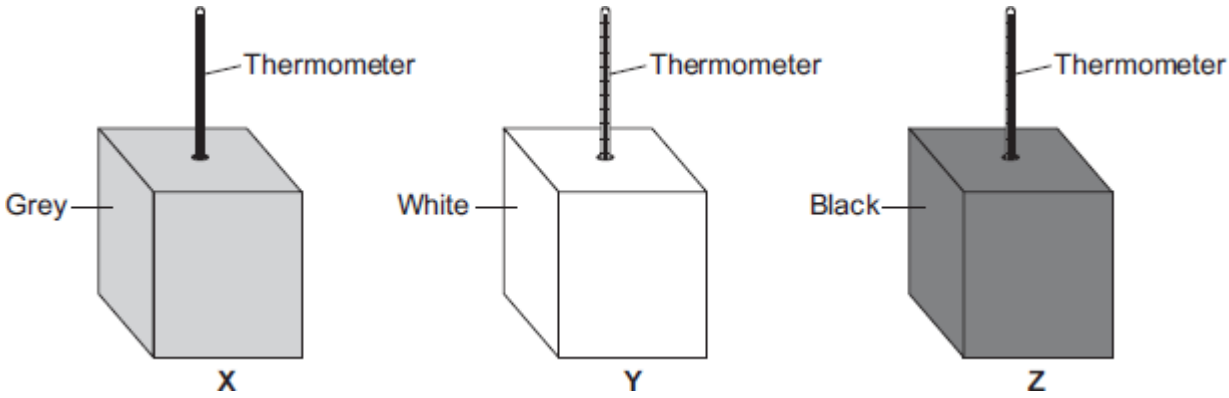
(1)

Each cube has the same volume.

Each cube is a different colour.

The temperature of each cube is recorded over 10 minutes.

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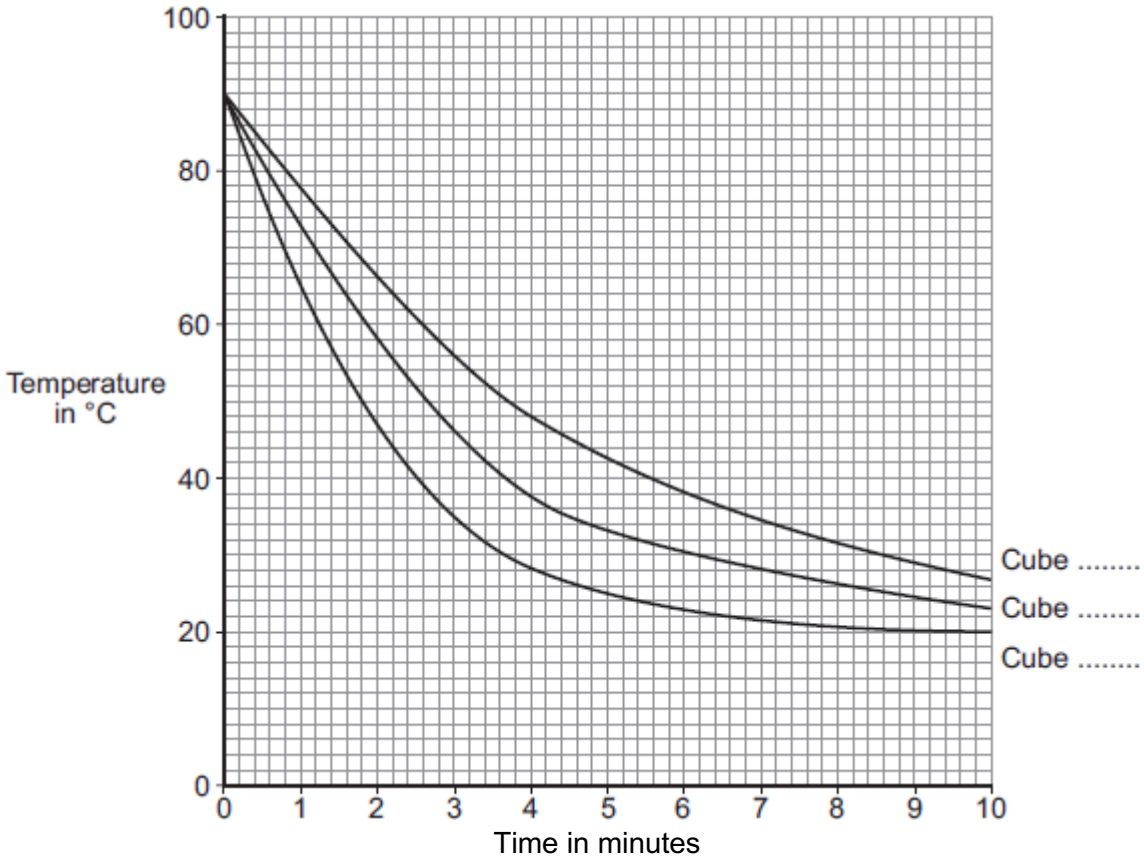


(ii) What is the independent variable in the investigation?

_____

(1)

The results of the investigation are shown on the graph.



(iii) Write the correct letter for each cube, **X**, **Y** or **Z**, next to the lines shown on the graph.

(2)

(iv) All three cubes had the same starting temperature. This was important in the investigation.

Suggest why.

_____

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_____

(1)

(v) Some variables are kept the same in an investigation.

What name is given to these variables?

_____

(1)

(Total 8 marks)

Q79.

An athlete runs in a marathon race. As he runs, his body gets hotter.

His body produces sweat to help him cool down.

(a) Explain in terms of particles, how sweating helps the athlete to cool down.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) At the end of the race, the athlete is covered with a 'space blanket' made from shiny foil to prevent him from cooling too quickly.

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He wraps the space blanket around his body to reduce energy transfer to the surroundings.

How does the space blanket reduce energy transfer to the surroundings?

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q80.

Electromagnetic waves form a continuous spectrum.

Three parts of the electromagnetic spectrum are:

- gamma rays
- infrared
- visible light.

(a) Place the parts in order of increasing energy.

Increasing energy

_____ _____ _____

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(2)

(b) The parts of the electromagnetic spectrum all have different properties.

Draw a ring around the correct answer to complete each sentence.

(i) The number of waves passing a point in 1 second is called the

frequency.
speed.
wavelength.

(1)

(ii) All parts of the electromagnetic spectrum travel at the same speed

through

a vacuum.
glass.
water.

(1)

(c) The different parts of the electromagnetic spectrum are used for different methods of communication.

Complete the table by giving an example of a use of each part of the electromagnetic spectrum for communication.

Part of electromagnetic spectrum	**Use for communication**
Infrared	
Microwave	
Radio wave	
Visible light	

(4)

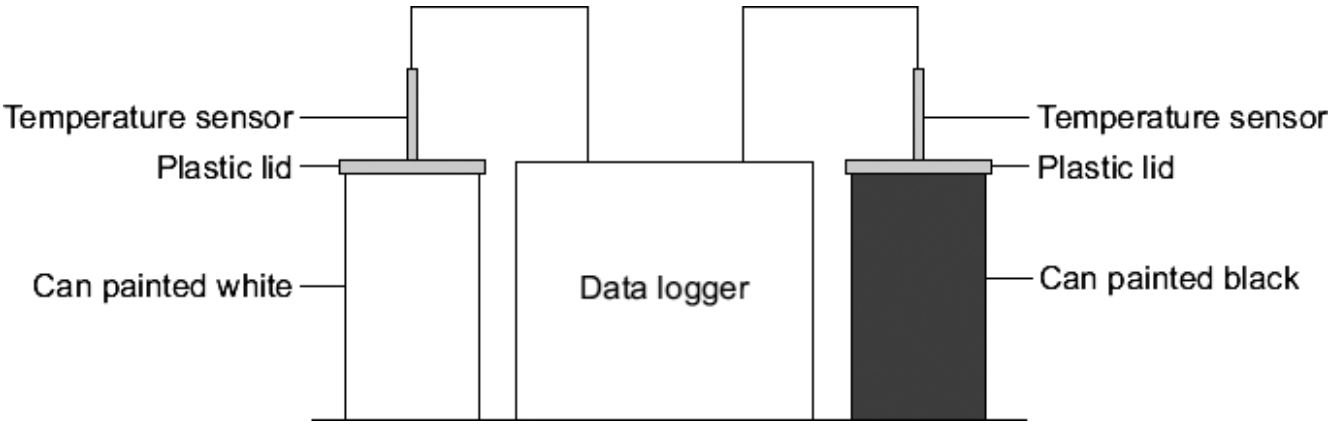
(Total 8 marks)

Q81.

A student investigated the emission of infrared radiation from two cans.

- The two cans were the same size.
- One can was painted white and the other can was painted black.
- The student poured the same volume of boiling water into each can.
- A data logger recorded the temperature in each can for the next 14 minutes.

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(a) Draw a ring around the correct answer in the box to complete the sentence.

The plastic lids prevent energy loss by

conduction.
convection.
infrared radiation.

(1)

(b) The data logger takes two temperature readings each second, and then plots a graph for the student.

The student could have used a thermometer to measure the temperature.



Give **two advantages** of using a data logger instead of the thermometer

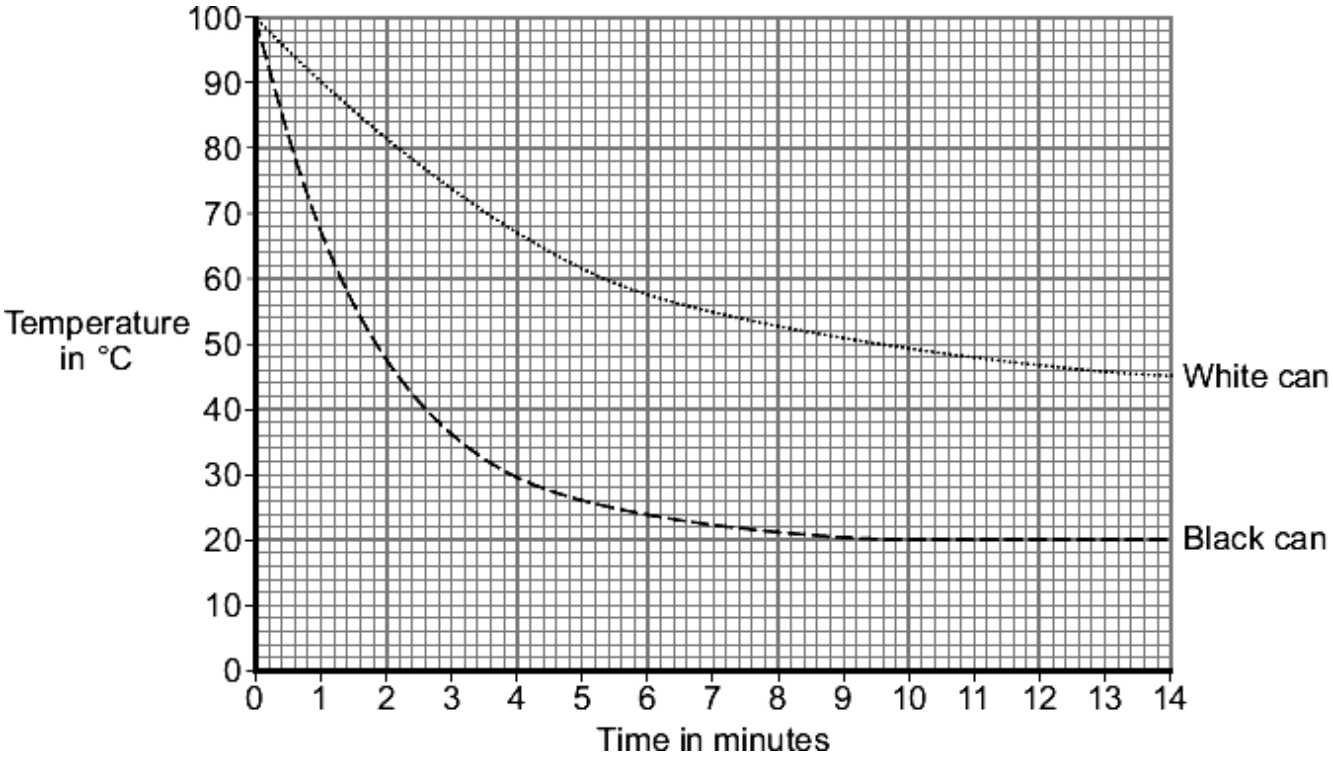
1. _____

2. _____

(2)

(c) The graph shows the student's results.

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(i) Explain the difference in temperature between the water in the two cans after 14 minutes.

_____

_____

_____

_____

(2)

(ii) The student decided to repeat the investigation using a can painted grey.

On the graph, draw a line for the results you would expect for the can painted grey.

(2)

(Total 7 marks)

Q82.

Waves have many different properties.

(a) Draw a ring around the correct answer in the boxes to complete each sentence.

Light waves	are longitudinal. are transverse. may be either longitudinal or transverse.

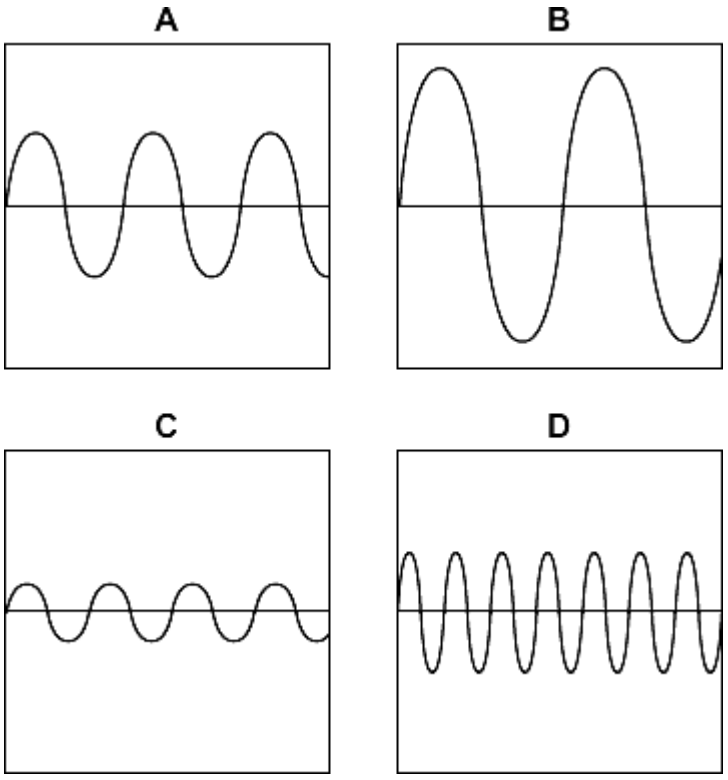
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Sound waves	are longitudinal. are transverse. may be either longitudinal or transverse.

(2)

(b) Diagrams **A**, **B**, **C** and **D** show oscilloscope traces of four different sound waves.

The oscilloscope settings are the same each time.



(i) Give the letter of the loudest sound. ☐

(1)

(ii) Give the letter of the highest pitch sound. ☐

(1)

(Total 4 marks)

Q83.

(a) The diagram shows the electromagnetic spectrum.

Two types of wave have been missed out.

Write the names of the missing waves in the empty boxes.

	X-rays	Ultraviolet rays		Infrared rays	Microwave	Radio waves

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(2)

(b) Different types of waves are used by different types of communications equipment.

Draw **one** line from each situation in **List A** to the wave used to communicate in **List B**.

List A Situation	**List B Wave used to communicate**
TV remote control	Microwave
Satellite TV	Infrared rays
Terrestrial TV	Radio waves
	Ultraviolet rays

(3)

(Total 5 marks)

Q84.

Electromagnetic waves behave differently in different situations.

Electromagnetic waves travel at a speed of 3×10^8 m/s in a vacuum.

Microwave radiation has a wavelength of 2 cm.

Calculate the frequency of microwave radiation.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

_____

_____

Frequency = _____ hertz

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(Total 2 marks)

Q85.

The different parts of the electromagnetic spectrum are shown below.

Gamma rays	X-rays	Ultraviolet	Visible light	Infrared	Microwaves	Radio waves

(a) Name a part of the electromagnetic spectrum with:

(i) a longer wavelength than microwaves: _____

(1)

(ii) greater energy than X-rays: _____

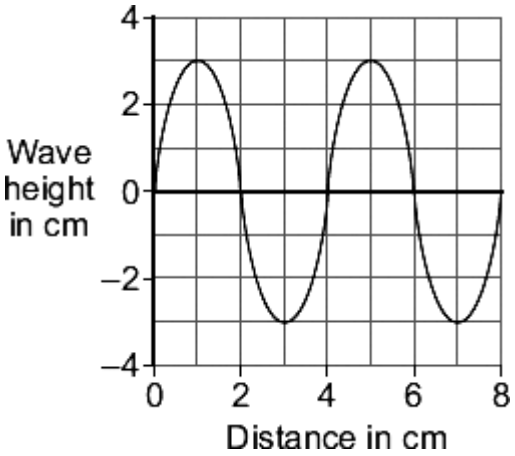
(1)

(iii) a higher frequency than ultraviolet: _____

(1)

(b) The properties of water waves can be measured easily in a school lab.

The diagram shows information about waves.



(i) How many complete waves are shown in the diagram?

_____

(1)

(ii) What is the wavelength of each wave in the diagram?

_____ cm

(1)

(iii) What is the amplitude of the waves?

_____ cm

(1)

(iv) Complete the sentence below.

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The oscillations of the waves in the diagram are perpendicular to the direction of energy transfer. They are called _____ waves.

(1)

(Total 7 marks)

Q86.

(a) Sound and light are different types of waves.

Give **two** similarities and **two** differences between sound waves and light waves.

_____

_____

_____

_____

_____

_____

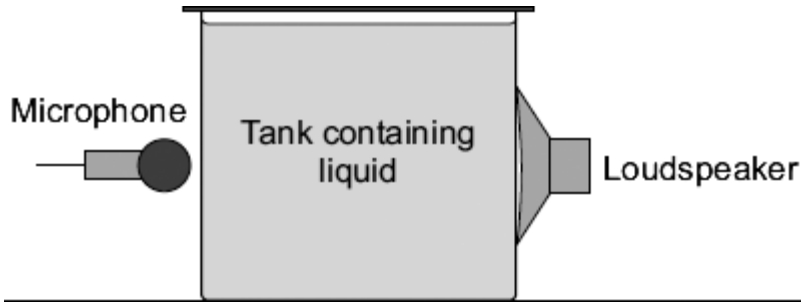
_____

_____

(4)

(b) A student does an experiment to investigate the speed of sound in different liquids.

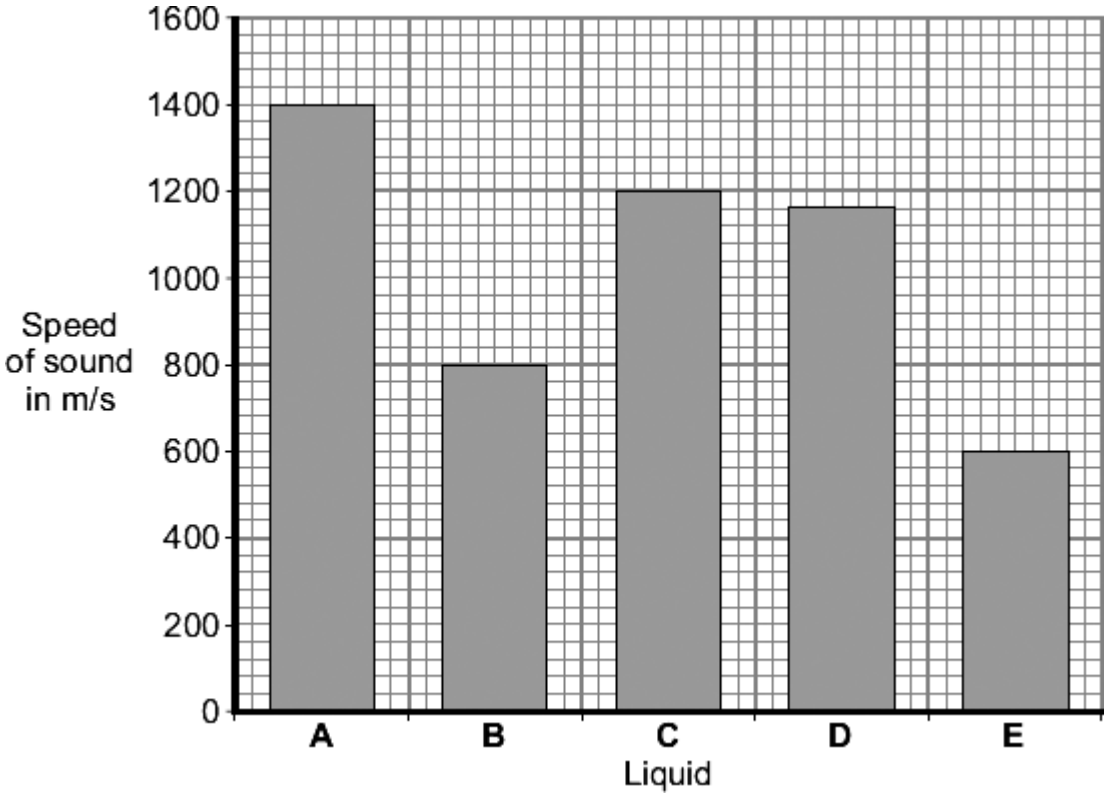
The student uses the apparatus shown.



A loudspeaker makes a sound wave. The sound wave travels through the liquid in the tank. The time it takes to travel this distance is used to calculate the speed of sound.

The bar chart shows the student's results.

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(i) When a sound wave with a frequency of 4800 hertz passes through one of the liquids, it has a wavelength of 0.25 m.

Calculate the speed of the wave and identify the liquid used.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

_____

_____

_____

Speed = _____ m/s

The liquid used was _____

(3)

(ii) The student's hypothesis was:
'There is a link between the density of a liquid and the speed of sound in the same liquid.'

Liquid	Density in g/cm^3	Speed of sound in m/s
Ethoxyethane	0.71	985

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Ethanol	0.80	1150
Kerosene	0.82	1300
Water	1.00	1500
Mercury	13.50	1450

Use the information in the table to decide whether the student's hypothesis was completely correct or not.

Was the student's hypothesis completely correct?

Draw a ring around your answer. **Yes** / **No**

Give reasons for your answer.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q87.

Some TV signals are transmitted to a satellite in space and back to Earth. A satellite dish is fixed to a house. The satellite dish receives the TV signal. Microwaves are used for satellite TV transmission.

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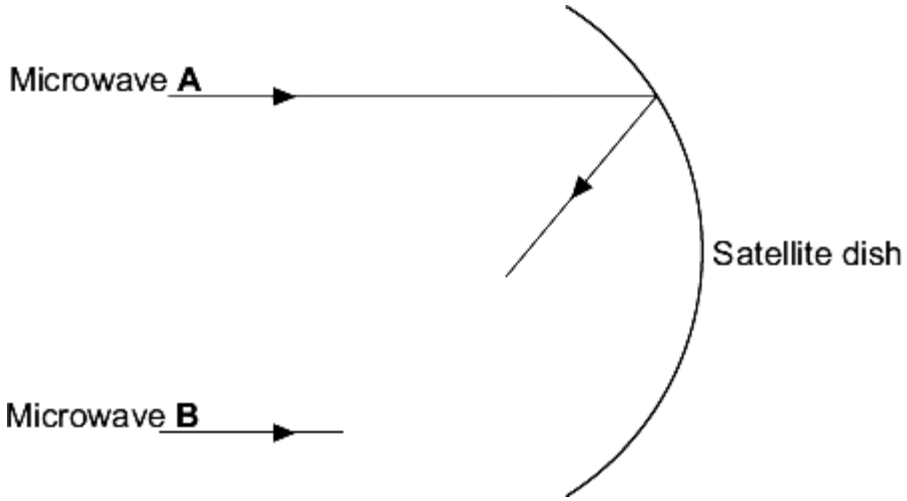
(a) Why are microwaves used, rather than radio waves, to transmit TV signals to and from satellites in space?

_____

_____

(1)

(b) The shape of the satellite dish allows microwaves to be focused at the receiver. The diagram shows how microwave **A** is reflected by the satellite dish.



(i) Complete the diagram to show how microwave **B** is reflected by the satellite dish.

(1)

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(ii) Draw on the diagram where the receiver should be placed.

For the receiver, use this symbol: 

(1)

(Total 3 marks)

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