Wave Basics

Q1 Complete the sentence below by circling the correct word in each pair.

Waves transfer **energy / matter** without transferring any **energy / matter.**

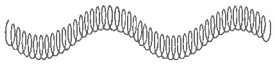
Q2 There are **two ways** in which you can make waves on a **slinky** spring.

a) Which diagram shows a **transverse** wave, and which one shows a **longitudinal** wave?

Transverse: .....

Longitudinal: .....

(1)



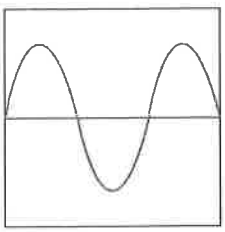
(2)

b) Write down one difference between these two types of wave.

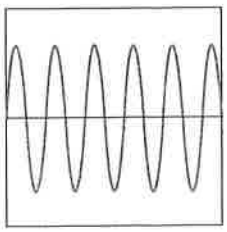
.....

.....

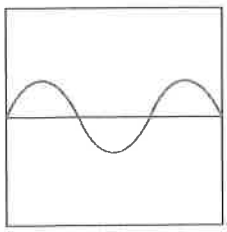
Q3 Diagrams **A**, **B** and **C** represent electromagnetic waves.



A



B



C

a) Which two diagrams show waves with the same **frequency**? ..... and .....

b) Which two diagrams show waves with the same **amplitude**? ..... and .....

c) Which two diagrams show waves with the same **wavelength**? ..... and .....

Q4 Which of the phrases below relate to **transverse** waves and which to **longitudinal**? Write '**T**' for transverse, and '**L**' for longitudinal.

☐ vibrations are at 90° to the direction of energy transfer

☐ electromagnetic radiation

☐ sound waves

☐ vibrations are along the same direction as the energy transfer

☐ produced by a slinky spring whose end is wiggled at 90° to the spring itself

☐ ripples on water

☐ produced by a slinky spring whose end is pushed and pulled towards and away from the rest of the spring

Wave Basics

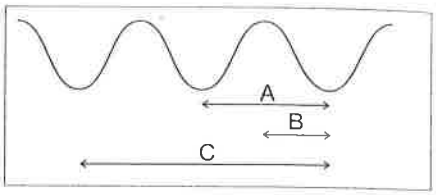
Q5 All waves have a **frequency** and a **wavelength**.

a) What units are used to measure wavelength? .....

b) What does it mean to say that "the frequency of a wave is 25 hertz"?

.....

c) The diagram shows a waveform.
Which of A, B or C is the length of one whole wave?



.....

Q6 There are six equations below, some of which are **incorrect**.
Draw a big thick line through the ones that are incorrect.

$\text{Frequency} = \text{Speed} \times \text{Wavelength}$

$\text{Frequency} = \frac{\text{Wavelength}}{\text{Speed}}$

$\text{Wavelength} = \frac{\text{Speed}}{\text{Frequency}}$

$\text{Speed} = \frac{\text{Frequency}}{\text{Wavelength}}$

$\text{Speed} = \text{Frequency} \times \text{Wavelength}$

$\text{Frequency} = \frac{\text{Speed}}{\text{Wavelength}}$

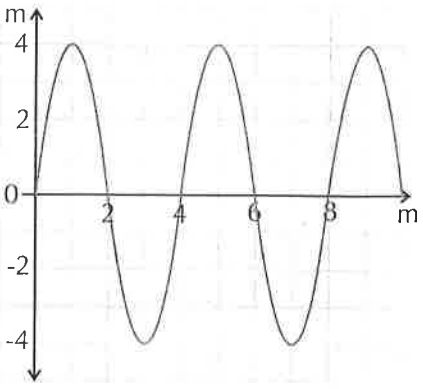
Q7 **Green light** travels at 3×10^8 m/s and has a wavelength of about 5×10^{-7} m.

Calculate the **frequency** of green light. Give the correct unit in your answer.

.....

.....

Q8 Jason draws the graph on the right to show a wave with an **amplitude** of **4 m** and a **wavelength** of **2 m**.



a) What has Jason done wrong?

.....

.....

b) On the same set of axes, draw a wave with a **wavelength** of **5 m** and an **amplitude** of **3 m**.

Q9 An ultraviolet wave has a frequency of 4.6×10^{15} Hz. It travels at a speed of 3×10^8 m/s.

Calculate the **wavelength** of the wave.

.....

.....

Wave Properties

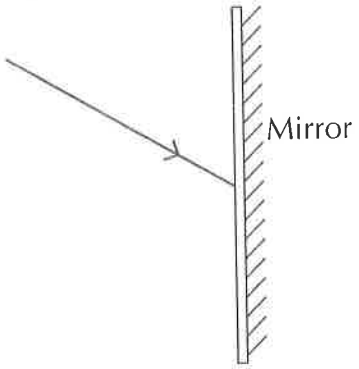
Q1 Harriet spends at least an hour looking at herself in a **mirror** every day. The image she sees is formed from light reflected by the mirror.

a) What is meant by a "normal" when talking about reflection?

.....

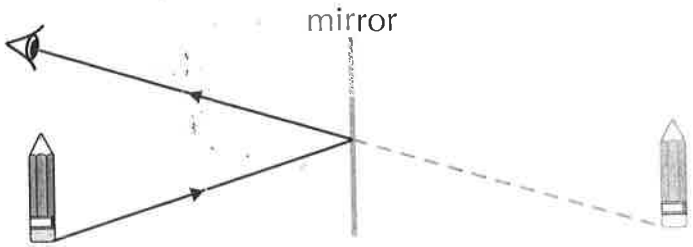
.....

b) Complete the diagram to show an incident ray of light being reflected by the mirror. Label the **angle of incidence**, **i**, the **normal**, and the **angle of reflection**, **r**.



Q2 The diagram below shows a pencil being reflected in a **plane mirror**. Some of the rays have already been drawn in.

a) On the diagram, draw in the rays showing how light is reflected to form an image of the **top** of the pencil.



b) Is the image in a plane mirror real or virtual? .....

c) Is the image inverted or upright? .....

d) The image of the pencil is **laterally inverted**. Explain what this means.

.....

.....

Top Tips: If you get asked a question about constructing ray diagrams, remember the important rule for drawing reflections in a plane mirror: **angle of incidence = angle of reflection**. Always use a **ruler** to draw your ray diagrams too — examiners love a line drawn with a ruler.

Refraction and Diffraction

Q1 Waves can be **diffracted.**

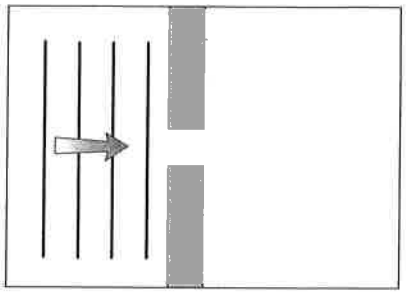
a) Explain what 'diffraction' means.

.....

.....

b) A ripple tank is used to study the behaviour of waves as they pass through gaps. The gap in diagram 1 is about the **same size** as the wavelength. The gap in diagram 2 is **much bigger**. Complete both diagrams to show what happens to the waves after they pass through the gaps.

1



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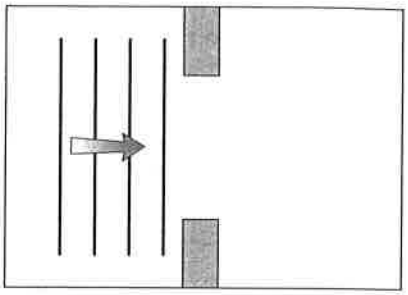
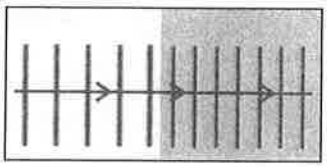
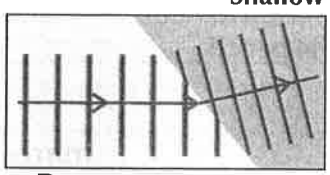


Q2 Diagrams A and B show plane **water waves** travelling from **deep** to **shallow** water in a ripple tank.

A



B



a) Which diagram shows the waves being **refracted**? .....

b) Why does refraction **not happen** in the other diagram?

.....

c) Write a definition of **refraction**.

.....

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Q3 Why do you not see **light** diffract as it passes through a **doorway**?

.....

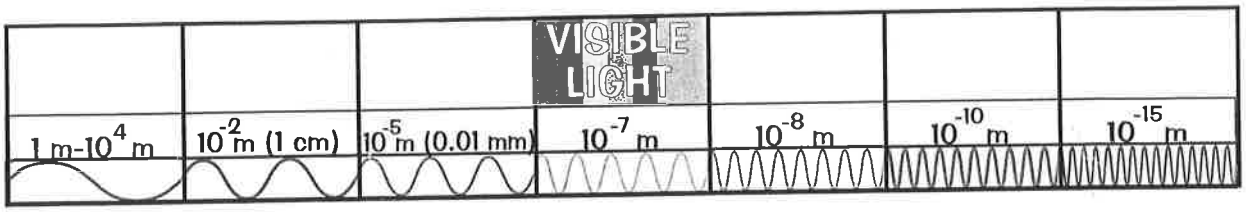
.....

EM Waves and Communication

Q1 The different types of **EM waves** form a spectrum.

a) Use the words below to complete the table to show the seven types of EM waves:

Infrared Gamma rays Ultraviolet
X-rays Radio waves Microwaves



b) In which direction does the **energy** of the electromagnetic radiation **increase** across the table? Tick the box next to the correct answer.

☐ The energy of the waves **increases** from **left to right** across the table.

☐ The energy of the waves **increases** from **right to left** across the table.

Q2 a) Tick the correct boxes to show whether each of the following statements is true or false.

	True	False
i) Visible light travels faster in a vacuum than both X-rays and radio waves.	☐	☐
ii) All EM waves transfer matter from place to place.	☐	☐
iii) Radio waves have the shortest wavelength of all EM waves.	☐	☐
iv) All EM waves can travel through space.	☐	☐

b) Write a correction for each false sentence.

.....

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.....

Q3 Circle the letter next to the statements below that are true.

A Long waves such as radio waves are good for transmitting information long distances.

B Some wavelengths of radio wave are reflected by the ionosphere and come back to Earth.

C Short-wave radio waves can be diffracted around hills.

D To receive TV signals, you must be in the direct line of sight of the transmitter.

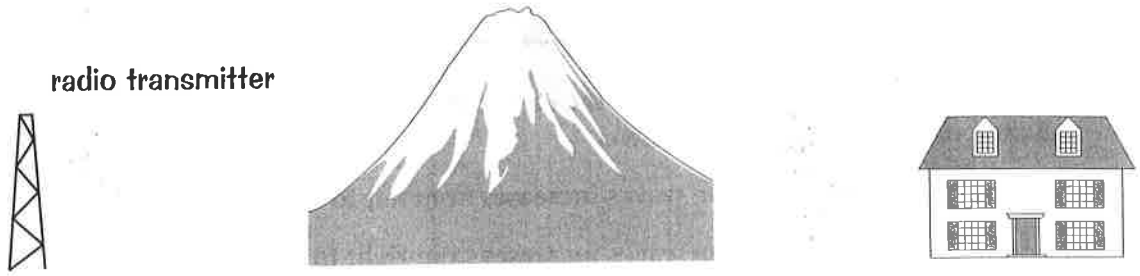
EM Waves and Communication

Q4 Complete the sentences below by circling the correct word in each pair.

EM waves with higher frequencies have **shorter / longer** wavelengths.

The **higher / lower** the frequency of an EM wave, the greater the energy of the wave.

Q5 The house shown below receives radio signals from a nearby transmitter, even though there is a mountain between the house and the transmitter.



Use the words below to fill in the blanks in the passage.

ionosphere **short-wave** **long-wave** **FM**

The house can receive ..... signals because they can diffract around the mountain. It also receives ..... signals because they are reflected by the ..... . However ..... signals are not received at the house as the transmitter is not in direct line of sight of the house.

Q6 Red and violet are at opposite ends of the spectrum of **visible** light. Describe two things they have in common and two ways in which they differ.

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Top Tips: You may have realised by now that radio waves are really important for communication. I don't want to panic you, but you're more than likely being hit by loads of radio waves right now, there's pretty much nowhere to hide. Luckily radio waves are harmless, and they'll only affect you if you can't remember all the uses for them in your exams. So get learning.

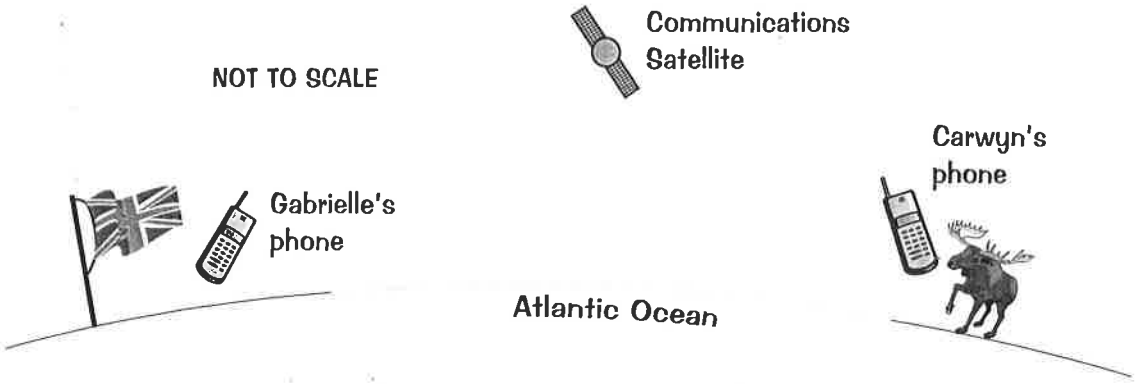
EM Waves and Their Uses

Q1 Television remote controls use EM waves to communicate with the TV.

Underline the type of radiation used in wireless remote controls.

Gamma **UV** **Infrared** **X-ray**

Q2 Gabrielle in Britain and Carwyn in Canada are talking by mobile phone.



a) Suggest why the satellite needs to be high above the Earth.

.....

.....

b) Why are radio waves not used to communicate with satellites?

.....

c) What type of electromagnetic waves are used to communicate with satellites?

.....

Q3 A **cable TV** company uses a large dish to collect TV signals from a satellite in space. It then sends these signals to houses along **optical fibres**.

a) What type(s) of EM waves could be used to send the signals along the optical fibres?

.....

b) Describe how the EM radiation is transmitted down the optical fibre.

.....

EM Waves and Their Uses

Q4 Explain how a microwave camera on a remote-sensing satellite can 'see' through clouds.

.....

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.....

Q5 It has been suggested that using **mobile phones** could cause **brain tumours**. However, at the moment there is **no reliable evidence** to prove that this is or isn't the case.

a) What type of radiation is used by mobile phones?

.....

b) What could happen to the **brain cells** of people who use mobile phones?

.....

.....

c) Why do people still **take the risk** by using mobile phones?

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.....

.....

Q6 Visible light is used for photography.

Briefly describe how a camera uses visible light to take a photo.

.....

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Top Tips: There are four main types of electromagnetic radiation used in communications technology — microwaves, radio waves, visible light and infrared radiation. Make sure you know the uses of each. Then as a reward, practice using infrared radiation by channel hopping with your remote.

Sound Waves

Q1 Sound waves are caused by **vibrations**.

Put the following sentences in the correct order to describe how the sound of a drumbeat is made and reaches our ears.

A The vibration of the drum sets the air molecules next to it vibrating too.

B We hear the sound when the vibrations in the air reach our ears.

C When someone beats a drum, the skin on top of the drum vibrates.

D A series of compressions and decompressions travel outwards through the air (or other medium) as a longitudinal wave.

Correct order: ....., ..., ..., ...

Q2 Choose from the words below to fill in the spaces in the passage.

high **low** **vibrate**

A sound wave makes air molecules ..... . If there are many vibrations per second the frequency or pitch of the sound is ..... . If there are only a few vibrations per second the pitch of the sound is ..... .

Q3 Complete the sentences below by circling the correct word in each pair.

The bigger the **amplitude / frequency** of a sound wave, the **louder / quieter** the sound.

Q4 A bell is vibrating with a frequency of 2 kHz. How many times a second is it vibrating?

.....

Q5 Most humans can hear sounds in the frequency range 20 Hz to 20 000 Hz.

a) What is the frequency of a sound wave that has 30 compressions in one second?

.....

b) Put the following frequencies in order, from the lowest frequency to the highest.

3 MHz, 8 kHz, 630 Hz, 400 kHz, 5 Hz, 21 kHz

.....

Sound Waves

Q6 Mina sings in her school choir. She practises both in her bedroom and in an empty practice room at school. She hears a difference in the sound of her voice, caused by a difference in echo.

a) What is an echo?

.....

.....

b) Why were there lots of echoes in the unfurnished practice room but not in her bedroom at home?

.....

.....

c) Why is there a delay before you hear an echo?

.....

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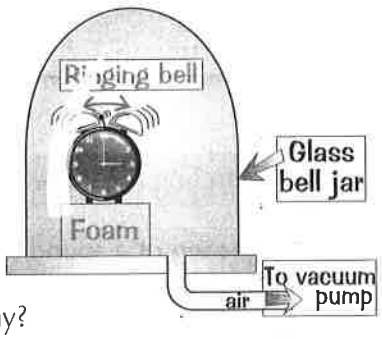
Q7 In an experiment, a ringing alarm clock is placed in a glass bell jar. Air is sucked out of the jar by a vacuum pump.



a) What happens to the sound and why?

.....

.....

b) Why does the experiment work better if the alarm clock is placed on top of a block of foam?

.....

.....

Top Tips: I know what you're thinking — it's an outrage what these alarm clocks have to go through in the name of science. Why not calm yourself though, by making sure you know all the stuff about sound off the last two pages, like what an echo is and how pitch is determined by frequency.