a

Complete the gap fill:

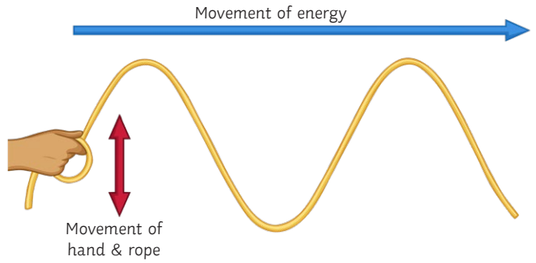
All waves transfer e_____ from one place to another, but the m_____ does not move. The particles oscillate (v_____) around a fixed point and pass e_____ onto the next particle and in turn they oscillate too.

b

State the two types of wave.

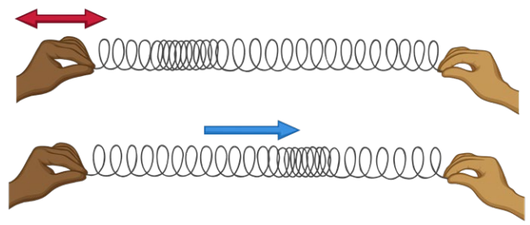
1. _____
2. _____

Which type of wave is represented in this picture?



_____

Which type of wave is represented in this picture?



_____

c

Which type of wave oscillates perpendicular (at right angles) to the direction of energy transfer?

_____

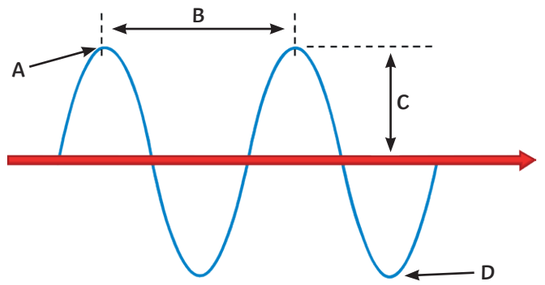
Which type of wave oscillates parallel to the direction of energy transfer?

_____

d

Which letter on the graph represents...

amplitude? _____
wavelength? _____
crest? _____
trough? _____



e

Match up the keyword to the correct definition:

frequency	The maximum displacement of a point on a wave away from its undisturbed position.
amplitude	The number of waves passing a point each second.
wavelength	The distance from a point on one wave to the equivalent point on the adjacent wave.

f

You are given the following equation in the exam: period = 1/frequency
What are the units for...

period (time)? _____
frequency? _____

g

What is the symbol equation linking wave speed, frequency and wavelength?

_____

Now complete the rest of the table:

Symbol in the Equation	What It Represents	Units
v		
	frequency	
		m

h

Calculate the speed of a wave with a wavelength of 42cm and a frequency of 11Hz.

i

A wave has a frequency of 54Hz and a speed of 330m/s. Calculate the wavelength.

j

Identifying the suitability of apparatus to measure wave speed, frequency, and wavelength was a required practical.

State a control variable in this practical:

_____

Why was it important to control this variable?

_____

What was the biggest source of error in your practical?

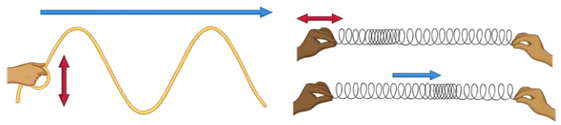
_____

How could you overcome this error?

_____

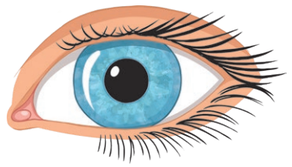
a

Which type of wave are electromagnetic (EM) waves - transverse or longitudinal?



_____

Which part of the EM spectrum can human eyes detect?



_____

b

Complete the gap fill by choosing from **some** of the following words:

velocity, magnetism, energy, spectrum, acceleration, absorber

Electromagnetic waves transfer _____ from the source of the waves to an _____. The waves form a continuous _____, and all types, travel at the same _____ through a vacuum (space) or air.

_____

_____

c

Which type of EM wave has the...

longest wavelength? _____

highest frequency? _____

shortest wavelength? _____

lowest frequency? _____

most energy? _____

least energy? _____

d

The amount of absorption, or radiation, of infrared by different surfaces was a required practical. What was the...

independent variable? _____

dependent variable? _____

control variable? _____

_____

hazard, the harm it could cause, and how you minimised the risk?

_____

_____

_____

e

Complete the boxes to show the order of the electromagnetic (EM) spectrum and state at least two uses of each type of EM wave.

EM Wave:							
Uses:							

f

The amount of absorption, or radiation, of infrared radiation by different surfaces was a required practical. Briefly outline a method for collecting valid results for this experiment.

_____

_____

_____

_____

_____

a

Next to each EM wave, place a tick or cross to indicate whether it can cause harm to the human body.

radio waves ☐

microwaves ☐

infrared waves ☐

visible light ☐

ultraviolet waves ☐

x-rays ☐

gamma rays ☐

b

Match up the EM wave to the description of the damage it does to the human body:

x-rays

UV waves

gamma rays

Causes skin to age prematurely and increases the risk of skin cancer.
Causes ionisation inside of cells, this damage leads to the cells dying.

c

Complete the gap fill:

Radiation dose is a measure of the risk of _____ resulting from exposure of the body to the _____.

It is measured in sieverts, and 1 sievert (Sv) is equivalent to _____ millisieverts (mSv).

Some types of radiation are more hazardous than others due to the amount of _____ in the wave and how penetrating it is.

d

State two factors that affect the amount of harm caused by certain EM waves:

1. _____

2. _____

e

State one advantage of using gamma rays to treat or detect cancer:

State one disadvantage of using gamma rays to treat or detect cancer:

f

State one advantage of using x-rays for medical imaging:

State one disadvantage of using x-rays for medical imaging:

g

Suggest why nurses wear lead lined aprons when performing x-ray examinations.

h

State two other precautions that nurses and healthcare professionals can undertake to reduce the harm of x-rays.

a

Complete the gap fill using the following words:
speed, 90, faster, medium, angle, ray, refracted

The _____ of a wave depends on the material (_____) it is travelling through. If a wave changes from one medium to another, the _____ changes too.

Waves are only refracted when they meet the boundary between two media at an _____.

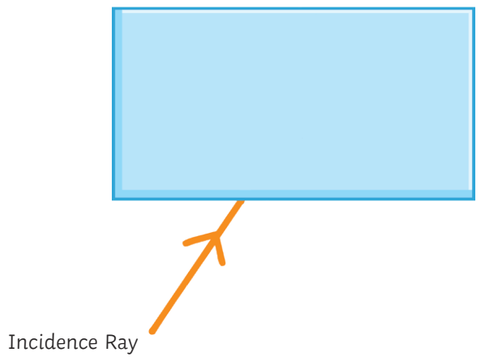
The more the _____ changes between the two media, the greater the direction of the wave changes.

However, a wave that meets the boundary at ___° (perpendicular) will not be _____.

Light waves travel _____ in air than in glass. The change in speed, and thus direction, between these two media can be shown using a _____ diagram.

b

Use a ruler to draw the path of the light ray as it travels through the glass block.



c

Choose the correct phrase to complete each statement to explain what is happening in your ray diagram on the left.

The light ray is travelling from air/glass with a low refractive index, into air/glass with a higher refractive index.

Upon entering the different medium, the average speed of the ray decreases/increases.

The ray is refracted away from/towards the normal.

As the light leaves the glass block and travels into the air, the speed of the ray increases/decreases.

So the ray is refracted away from/towards the normal.

a

Complete the gap fill:

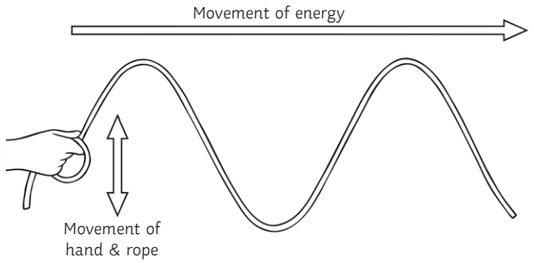
All waves transfer e**nergy** from one place to another, but the m**atter** does not move. The particles oscillate (v**ibrate**) around a fixed point and pass e**nergy** onto the next particle and in turn they oscillate too.

b

State the two types of wave.

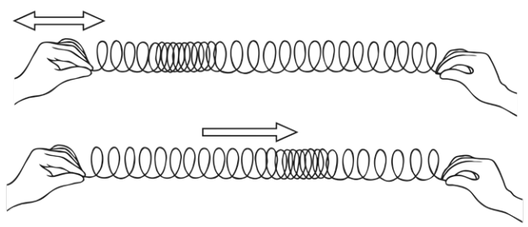
1. **transverse**
2. **longitudinal**

Which type of wave is represented in this picture?



transverse

Which type of wave is represented in this picture?



longitudinal

c

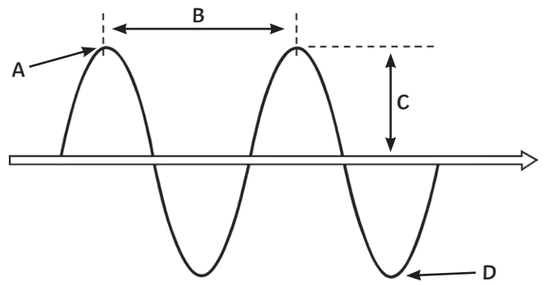
Which type of wave oscillates perpendicular (at right angles) to the direction of energy transfer?
transverse

Which type of wave oscillates parallel to the direction of energy transfer?
longitudinal

d

Which letter on the graph represents...

amplitude? **C**
wavelength? **B**
crest? **A**
trough? **D**



e

Match up the keyword to the correct definition:

frequency	The maximum displacement of a point on a wave away from its undisturbed position.
amplitude	The number of waves passing a point each second.
wavelength	The distance from a point on one wave to the equivalent point on the adjacent wave.

f

You are given the following equation in the exam: period = 1/frequency
What are the units for...

period (time)? **seconds (s)**
frequency? **hertz (Hz)**

g

What is the symbol equation linking wave speed, frequency and wavelength?
v = f λ

Now complete the rest of the table:

Symbol in the Equation	What It Represents	Units
v	**wave speed**	**m/s**
f	frequency	**Hz**
λ	**wavelength**	m

h

Calculate the speed of a wave with a wavelength of 42cm and a frequency of 11Hz.

***v* = *f* λ**
convert cm into m = 0.42m
Substitute the numbers into the equation:
11Hz x 0.42m = 4.62m/s

i

A wave has a frequency of 54Hz and a speed of 330m/s. Calculate the wavelength.
Rearrange the equation to make wavelength the subject:
λ = *v*/*f*
Substitute the numbers into the equation:
330m/s ÷ 54Hz = 6.12m

j

Identifying the suitability of apparatus to measure wave speed, frequency, and wavelength was a required practical.

State a control variable in this practical:
The volume of water in the tank.

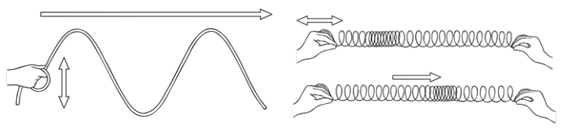
Why was it important to control this variable?
The depth of the water will affect the speed and wavelength.

What was the biggest source of error in your practical?
Counting the waves by eye.

How could you overcome this error?
Use a stroboscope.

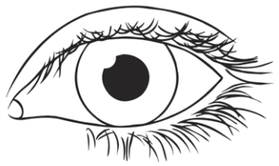
a

Which type of wave are electromagnetic (EM) waves - transverse or longitudinal?



transverse

Which part of the EM spectrum can human eyes detect?



Visible light only.

b

Complete the gap fill by choosing from **some** of the following words:

velocity, magnetism, energy, spectrum, acceleration, absorber

Electromagnetic waves transfer **energy** from the source of the waves to an **absorber**. The waves form a continuous **spectrum**, and all types, travel at the same **velocity** through a vacuum (space) or air.

The words acceleration and magnetism should not be used.

c

Which type of EM wave has the...

longest wavelength? **radio waves**

highest frequency? **gamma rays**

shortest wavelength? **gamma rays**

lowest frequency? **radio waves**

most energy? **gamma rays**

least energy? **radio waves**

d

The amount of absorption, or radiation, of infrared by different surfaces was a required practical. What was the...

independent variable? **type of surface**

dependent variable? **temperature (°C)**

control variable? **Volume of water or start temperature of the water.**

hazard, the harm it could cause, and how you minimised the risk?
The hot water could scald skin, so we used test tube racks and ensured the floor was clear of trip hazards.

e

Complete the boxes to show the order of the electromagnetic (EM) spectrum and state at least two uses of each type of EM wave.

EM Wave:	radio waves	microwaves	infrared waves	visible light	ultraviolet waves	x-rays	gamma rays
Uses:	Television, radio and Bluetooth.	Satellite communication and cooking food.	Remote controls, infrared cameras and heaters.	Optical fibres and photography (cameras).	Security marking, energy efficient lamps and sunbeds.	Medical imaging and medical treatment for cancer.	Medical treatments for cancer and sterilising food.

f

The amount of absorption, or radiation, of infrared radiation by different surfaces was a required practical. Briefly outline a method for collecting valid results for this experiment.

Cover four boiling tubes in different materials to create different surfaces: matt black, shiny black, white and silver (the independent variable). Pour the same volume of the same start temperature of hot water into the tubes (these control variable ensures validity). Measure the temperature of each tube every minute (the dependent variable). The tube that cools the fastest emits infrared energy the fastest.

a

Next to each EM wave, place a tick or cross to indicate whether it can cause harm to the human body.

radio waves ☒

microwaves ☒

infrared waves ☒

visible light ☒

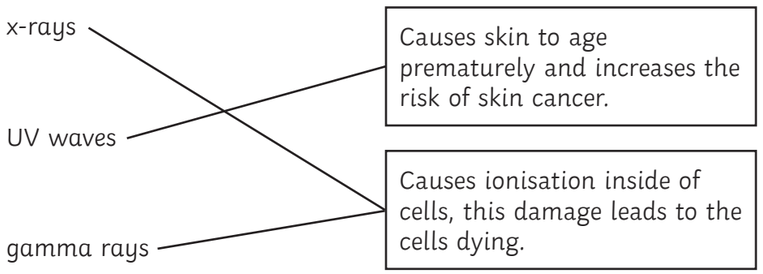
ultraviolet waves ☑

x-rays ☑

gamma rays ☑

b

Match up the EM wave to the description of the damage it does to the human body:



c

Complete the gap fill:

Radiation dose is a measure of the risk of **harm** resulting from exposure of the body to the **radiation**.

It is measured in sieverts, and 1 sievert (Sv) is equivalent to **1000** millisieverts (mSv).

Some types of radiation are more hazardous than others due to the amount of **energy** in the wave and how penetrating it is.

d

State two factors that affect the amount of harm caused by certain EM waves:

1. **Type of radiation.**
2. **Amount of exposure.**

e

State one advantage of using gamma rays to treat or detect cancer:

Gamma rays can be used to detect cancer by ingesting or injecting a radioactive source as a tracer. This is beneficial as it means early treatment can commence, and the outcome is therefore more likely to be positive in terms of life-expectancy. Gamma rays can be used to treat cancer without invasive surgery - a high focused beam causes the cancer cells to mutate further, resulting in them dying.

State one disadvantage of using gamma rays to treat or detect cancer:

Normal cells nearby are also affected during treatment and undergo ionisation, resulting in the patient feeling unwell.

f

State one advantage of using x-rays for medical imaging:

X-rays can be used to detect broken bones, visualise dental issues, treat cancer cells and as part of CT scans.

State one disadvantage of using x-rays for medical imaging:

X-rays can cause ionisation in cells and increase the chance of mutation, therefore leading to rapidly growing and dividing cells (a tumour).

g

Suggest why nurses wear lead lined aprons when performing x-ray examinations.

Nurses wear lead lined aprons due to two factors: they are exposed to harmful x-rays towards the upper end of the EM spectrum on a regular basis. The x-rays themselves are highly ionising and can cause damage to body cells, resulting in mutations and potentially leading to uncontrolled cell growth (a tumour). Therefore, nurses can reduce their radiation dose by wearing a lead lined apron which blocks the rays.

h

State two other precautions that nurses and healthcare professionals can undertake to reduce the harm of x-rays.

1. **Work from a distance/step into another room/stand behind a glass window.**
2. **Wear a radiation badge/dosimeter to measure and record exposure.**

a

Complete the gap fill using the following words:
speed, 90, faster, medium, angle, ray, refracted

The **speed** of a wave depends on the material (**medium**) it is travelling through. If a wave changes from one medium to another, the **speed** changes too.

Waves are only refracted when they meet the boundary between two media at an **angle**.

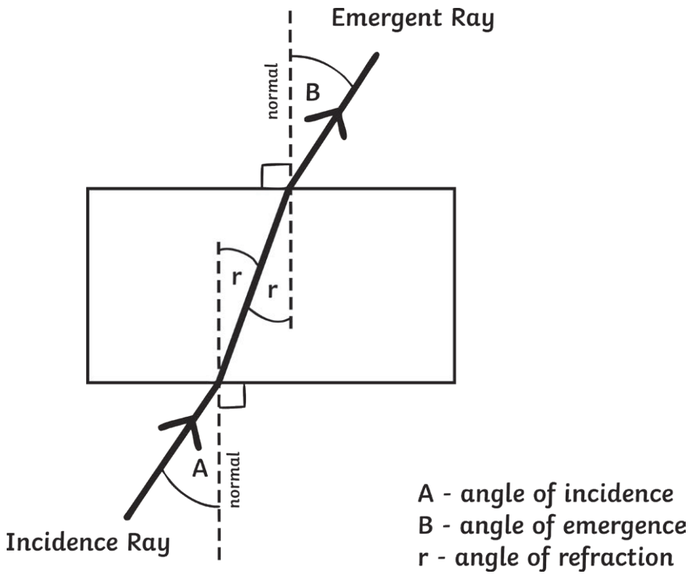
The more the **speed** changes between the two media, the greater the direction of the wave changes.

However, a wave that meets the boundary at **90°** (perpendicular) will not be **refracted**.

Light waves travel **faster** in air than in glass. The change in speed, and thus direction, between these two media can be shown using a **ray** diagram.

b

Use a ruler to draw the path of the light ray as it travels through the glass block.



c

Choose the correct phrase to complete each statement to explain what is happening in your ray diagram on the left.

The light ray is travelling from **air**/glass with a low refractive index, into air/**glass** with a higher refractive index.

Upon entering the different medium, the average speed of the ray **decreases**/increases.

The ray is refracted **away from**/towards the normal.

As the light leaves the glass block and travels into the air, the speed of the ray **increases**/decreases.

So the ray is refracted away from/**towards** the normal.