

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.

a

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?

c

You are given the following equation in the exam:  $\text{period} = 1/\text{frequency}$   
What are the units for...

period (time)? \_\_\_\_\_  
frequency? \_\_\_\_\_

f

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

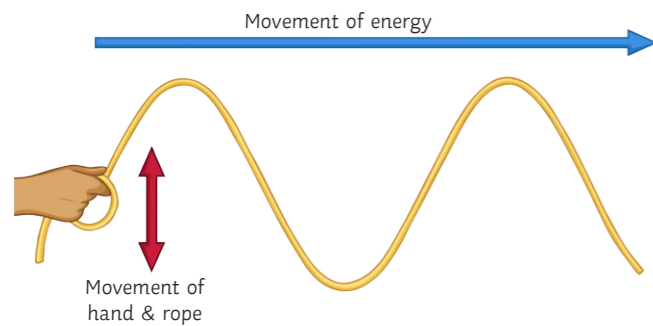
i

State the two types of wave.

- \_\_\_\_\_
- \_\_\_\_\_

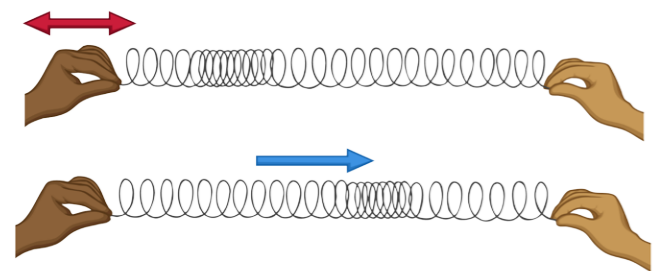
b

Which type of wave is represented in this picture?



\_\_\_\_\_

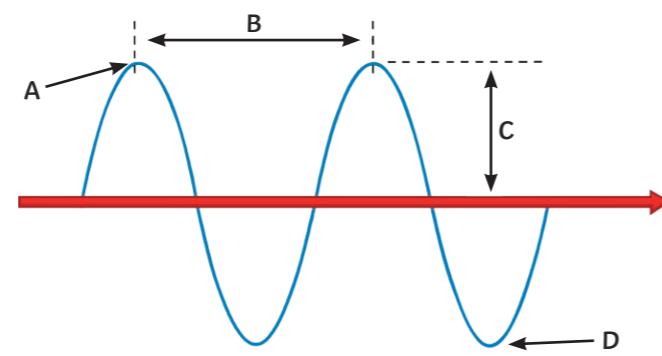
Which type of wave is represented in this picture?



\_\_\_\_\_

Which letter on the graph represents...

amplitude? \_\_\_\_\_  
wavelength? \_\_\_\_\_  
crest? \_\_\_\_\_  
trough? \_\_\_\_\_



d

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     |

g

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?

\_\_\_\_\_

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.

e

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

\_\_\_\_\_

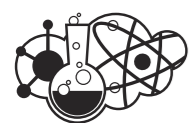
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

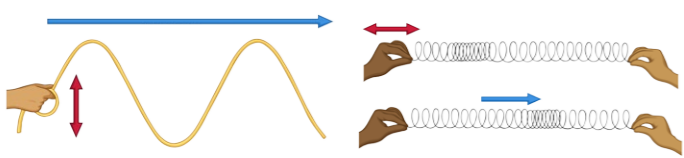
\_\_\_\_\_

h



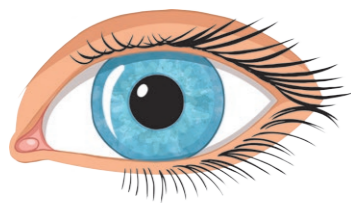
**a**

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

**d**

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

1. \_\_\_\_\_

2. \_\_\_\_\_

**g**

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**b**

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

|            |  |
|------------|--|
| x-rays     | Causes skin to age prematurely and increases the risk of skin cancer.    |
| UV waves   | Causes ionisation inside of cells, this damage leads to the cells dying. |
| gamma rays |  |

**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:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**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.

**f**

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**h**

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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.

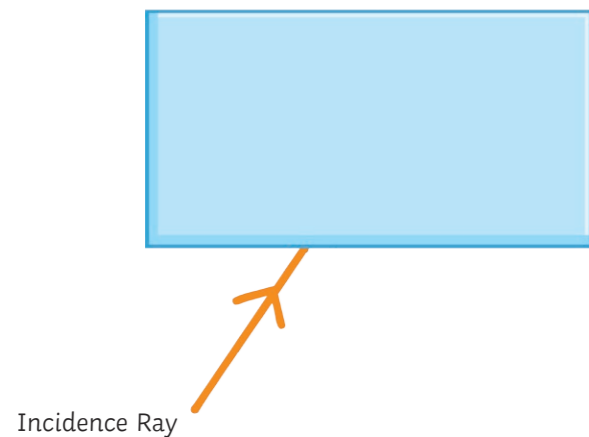
Waves are only refracted when they meet the boundary between two media at an \_\_\_\_\_.

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.

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



a

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.

c

The refractive index of a medium is the extent to which the light is refracted when it enters the medium. Look at the table of data:

| Medium  | Refractive Index |
|---------|------------------|
| air     | 1                |
| glass   | 1.5              |
| water   | 1.3              |
| diamond | 2.4              |

What conclusions can be drawn from the data?

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d

Complete the gap fill:

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

a

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**

c

You are given the following equation in the exam:  $\text{period} = 1/\text{frequency}$   
What are the units for...

period (time)? **seconds (s)**

frequency? **hertz (Hz)**

f

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

**Rearrange the equation to make wavelength the subject:**

$$\lambda = v/f$$

**Substitute the numbers into the equation:**

$$330\text{m/s} \div 54\text{Hz} = 6.12\text{m}$$

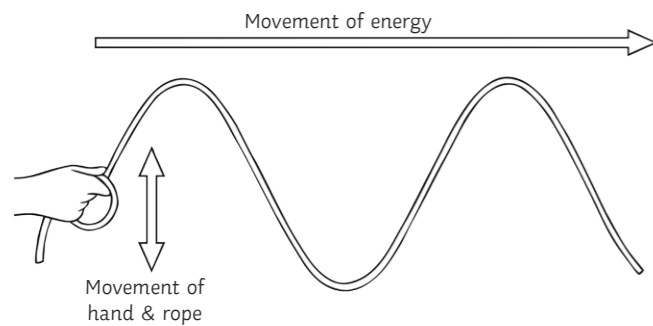
i

State the two types of wave.

- transverse**
- longitudinal**

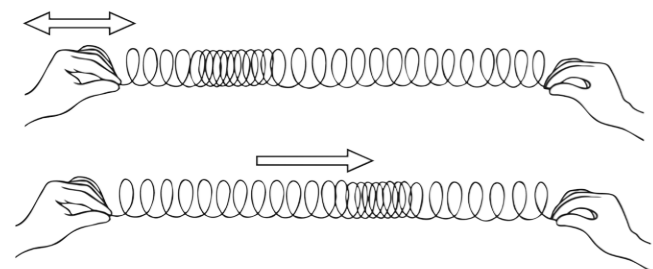
b

Which type of wave is represented in this picture?



**transverse**

Which type of wave is represented in this picture?



**longitudinal**

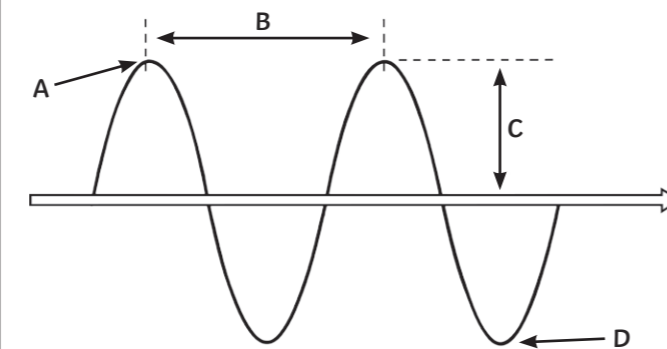
Which letter on the graph represents...

amplitude? **C**

wavelength? **B**

crest? **A**

trough? **D**



d

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

$$v = f \lambda$$

Now complete the rest of the table:

| Symbol in the Equation | What It Represents | Units      |
|------------------------|--------------------|------------|
| $v$                    | <b>wave speed</b>  | <b>m/s</b> |
| $f$                    | frequency          | <b>Hz</b>  |
| $\lambda$              | <b>wavelength</b>  | <b>m</b>   |

g

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.**

j

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.

e

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

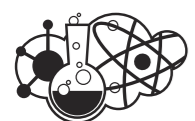
$$v = f \lambda$$

**convert cm into m = 0.42m**

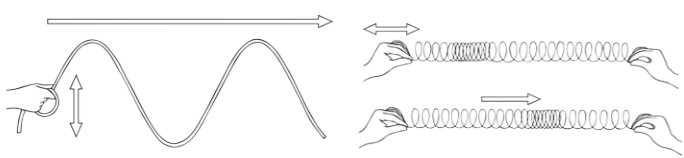
**Substitute the numbers into the equation:**

$$11\text{Hz} \times 0.42\text{m} = 4.62\text{m/s}$$

h

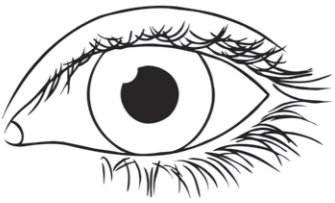


Which type of wave are electromagnetic (EM) waves - transverse or longitudinal?



**transverse**

Which part of the EM spectrum can human eyes detect?



**Visible light only.**

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.**

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**

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.**

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

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.**

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

|                   |                                     |
|-------------------|-------------------------------------|
| radio waves       | <input type="checkbox"/>            |
| microwaves        | <input type="checkbox"/>            |
| infrared waves    | <input type="checkbox"/>            |
| visible light     | <input type="checkbox"/>            |
| ultraviolet waves | <input checked="" type="checkbox"/> |
| x-rays            | <input checked="" type="checkbox"/> |
| gamma rays        | <input checked="" type="checkbox"/> |

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

|            |  |
|------------|--|
| x-rays     | Causes skin to age prematurely and increases the risk of skin cancer.    |
| UV waves   | Causes ionisation inside of cells, this damage leads to the cells dying. |
| gamma rays |  |

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.

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

- Type of radiation.**
- Amount of exposure.**

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.**

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).**

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.**

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

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

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.

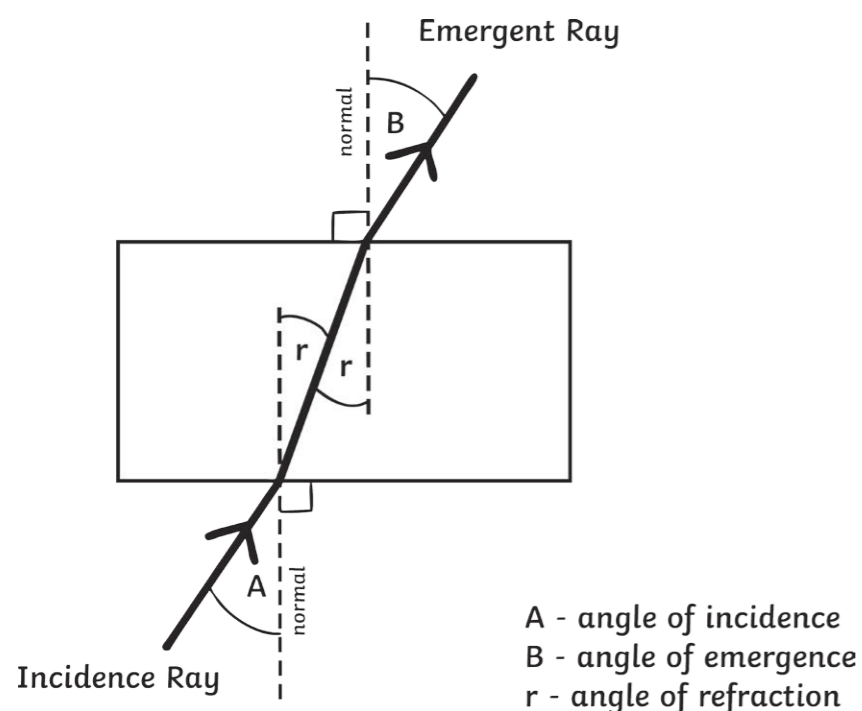
Waves are only refracted when they meet the boundary between two media at an **angle**.

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.

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



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.

The refractive index of a medium is the extent to which the light is refracted when it enters the medium. Look at the table of data:

| Medium  | Refractive Index |
|---------|------------------|
| air     | 1                |
| glass   | 1.5              |
| water   | 1.3              |
| diamond | 2.4              |

What conclusions can be drawn from the data?

**Air has the lowest refractive index, a value of 1, and diamond has the highest refractive index of 2.4.**

**Air is a gas and has the lowest refractive index. The refractive index increases in liquids (water), and increases further in solids (glass and diamond).**

