

GCSE Knowledge Organiser

Unit 1 – Waves

SCIENCE

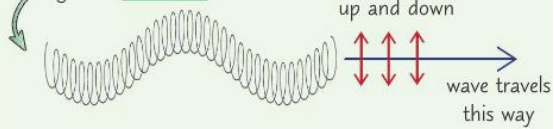
ONE

Transverse Wave

The oscillations (vibrations) are perpendicular (at 90°) to the direction of energy transfer

Most waves are transverse, including all electromagnetic (EM) waves e.g. light, ripples and waves in water and waves on a string

A spring wiggled up and down gives a transverse wave. vibrations go up and down



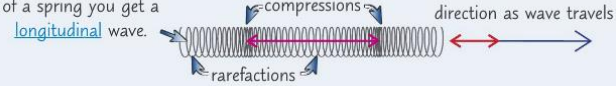
wave travels this way

Longitudinal Wave

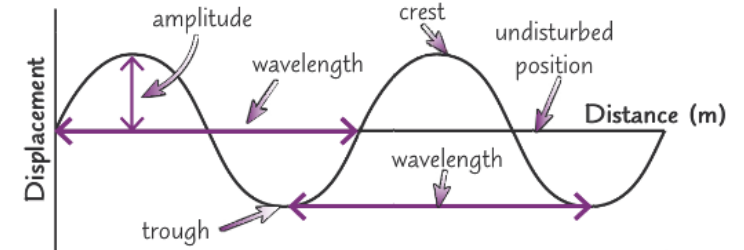
The oscillations (vibrations) are parallel to the direction of energy transfer.

An example is sound waves in air

If you push the end of a spring you get a longitudinal wave. vibrations in the same direction as wave travels



TWO



Keyword	Definition
Amplitude	The maximum displacement of a point on the wave from its undisturbed position
Wavelength	The distance between the same point on two adjacent waves
Frequency	The number of complete waves passing a certain point per second. It is measured in Hertz (Hz)
Wave speed	The speed at which the energy is transferred (or the wave moves) through the medium

THREE

Speed of sound in air = 330 m/s

$$T = \frac{1}{f}$$

Period (s) Frequency (Hz)

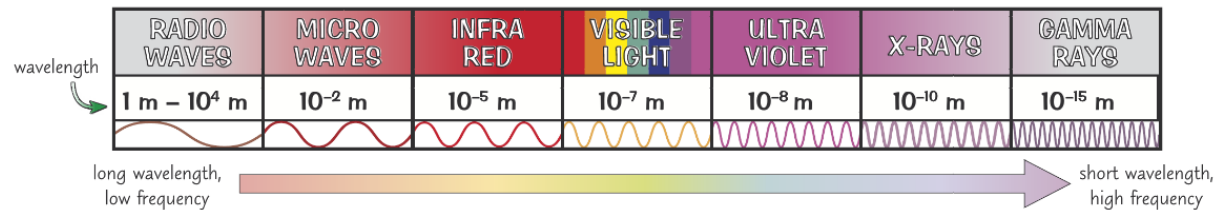
$$v = f\lambda$$

Wave speed (m/s) Wavelength (m) Frequency (Hz)

When a wave meets a boundary between two materials, three things can happen:

Absorption	The wave transfers energy to the material's energy stores (often thermal energy store = heating)
Transmission	The wave carries on travelling through the new material. This leads to refraction.
Reflection	The incoming ray is neither absorbed or transmitted, it is 'sent back' away from the second material

FOUR



- Electromagnetic (EM) waves are transverse waves
- They transfer energy from a source to an absorber
- All EM waves travel at the same speed through air or a vacuum (space)
- They are vibrations of electric and magnetic fields (not particles)
- EM waves travel at different speeds in different materials (which can lead to refraction)
- We group EM waves based on their frequency and wavelength (see the spectrum above)
- Our eyes can only detect a small section of the EM waves – visible light
- EM waves are generated by different changes in the atoms of their nuclei

FIVE

Refraction

- When a wave crosses a boundary of a different material, it changes speed
- If the wave is travelling along the normal it will change speed but is **not** refracted
- If the wave hits the boundary at an angle it changes direction, it is refracted
- As the wave travels into the second material, it slows down and bends **towards** the normal
- As the wave leaves the material, it speeds up and bends **away** from the normal
- The higher the density of material, the more the wave is refracted (the more the wave slows down)
- The wavelength of the wave changes when it is refracted, but the frequency stays the same

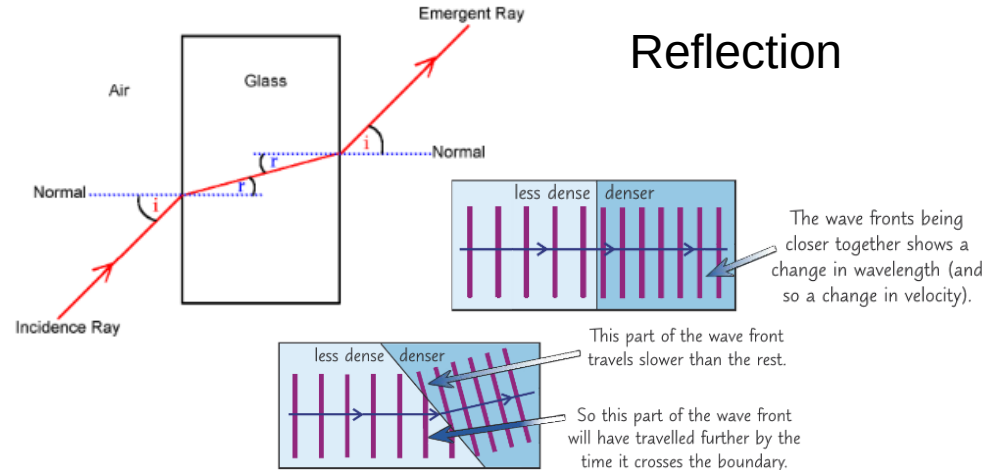
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SIX

Reflection



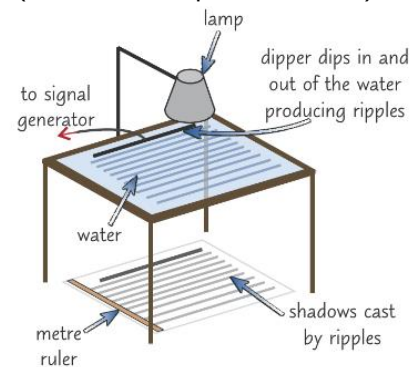
SEVEN

EM Wave	Uses	Dangers
Radio waves	Television, radio, radio telescopes	Isn't absorbed by the soft tissue – passes through without damage
Microwaves	Satellite communications, cooking food	
Infrared	Electric heaters, cooking food, infrared cameras	
Visible light	Fibre optic communications	
Ultraviolet	Fluorescent lamps, sun tanning	Damage surface cells (sunburn, premature ageing of skin), blindness and increased risk of skin cancer
X-rays	Medical imaging and treatments	Ionising radiation – causes gene mutation or cell destruction, and cancer
Gamma rays	Sterilising surgical instruments, treatment of cancer	Ionising radiation – causes gene mutation or cell destruction, and cancer

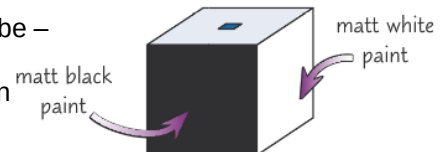
EIGHT

Required Practicals

Ripple tank – waves in a liquid (calculate the speed of waves)

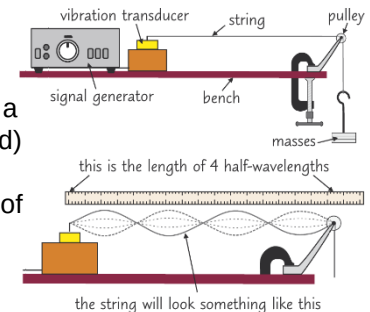


Leslie Cube – Infrared absorption



A Leslie cube is a hollow, watertight, metal cube made of e.g. aluminium, whose four vertical faces have different surfaces (e.g. matt black, shiny metal) – to investigate IR emission

Waves on a string (solid) (calculate the speed of waves)



Knowledge Organise Quiz Boxes 1 & 2

1. What is the definition of 'Frequency'?
2. What does 'oscillation' mean?
3. In which type of wave are the oscillations perpendicular to the direction of energy transfer?
4. What is being described? - *'The maximum displacement of a point on the wave from its undisturbed position'*
5. What type of wave is a sound wave?
6. What type of wave is light?
7. What is the definition of 'Wavelength'?
8. What is the definition of 'Wave Speed'?
9. In which type of wave are the oscillations parallel to the direction of energy transfer?
10. Name 2 different parts of a wave.

Knowledge Organiser Quiz Boxes 1 & 2 - Answers

1. What is the definition of 'Frequency'?

- The number of waves passing a certain point each second

2. What does 'oscillation' mean?

- The vibrations that create a wave

3. In which type of wave are the oscillations perpendicular to the direction of energy transfer?

- Transverse

4. What is being described? - *'The maximum displacement of a point on the wave from its undisturbed position'*

- Amplitude

5. What type of wave is a sound wave?

- Longitudinal

Knowledge Organiser Quiz Boxes 1 & 2 - Answers

6. What type of wave is light?

- Transverse

7. What is the definition of 'Wavelength'?

- The distance between the same point on two adjacent waves

8. What is the definition of 'Wave Speed'?

- The speed at which the energy (or the wave moves) through the medium

9. In which type of wave are the oscillations parallel to the direction of energy transfer?

- Longitudinal

10. Name 2 different parts of a wave.

- Peak, Trough, Rarefaction, Compression

Knowledge Organiser Quiz Box 3

1. The speed of sound in air is?
2. How would you calculate the Period of a wave?
3. What does absorption mean?
4. The unit for wave speed is?
5. Frequency is measured in?
6. What does transmission of a wave mean?
7. What is the equation to calculate wave speed?
8. The unit for a Period of a wave is?
9. What happens to a wave that experiences reflection?
10. The unit for wavelength is?

Knowledge Organiser Quiz Box 3

1. The speed of sound in air is? **330 m/s**
2. How would you calculate the Period of a wave?
 $1 \div \text{frequency}$

3. What does absorption mean?

The wave transfers energy to the material's energy stores

4. The unit for wave speed is? **Metres per second (m/s)**
5. Frequency is measured in? **Hertz (Hz)**
6. What does transmission of a wave mean?

The wave carries on travelling through the new material

7. What is the equation to calculate wave speed?
Frequency x wavelength or $f \times \lambda$

8. The unit for a Period of a wave is? **Seconds (s)**
9. What happens to a wave that experiences reflection?

The incoming ray is 'sent back' away from the second material

10. The unit for wavelength is? **metres (m)**

Knowledge Organiser Quiz Box 4

1. EM waves transfer energy from to
2. What type of waves of EM waves?
3. How are EM waves grouped?
4. How are EM waves generated?
5. Which section of the EM spectrum can be detected by our eyes?
6. What is the wavelength of Gamma rays?
7. Which EM wave has the longest wavelength?
8. Which EM wave has the highest frequency?
9. What is the wavelength of Ultraviolet rays?
10. All EM waves travel at the same speed through...

Knowledge Organiser Quiz Box 4

1. EM waves transfer energy from **a source to an absorber**
2. What type of waves of EM waves? **Transverse**
3. How are EM waves grouped? **By wavelength and frequency**
4. How are EM waves generated? **Changes in atoms of their nuclei**
5. Which section of the EM spectrum can be detected by our eyes? **Visible light**
6. What is the wavelength of Gamma rays? **10^{-15}m**
7. Which EM wave has the longest wavelength? **Radio waves**
8. Which EM wave has the highest frequency? **Gamma rays**
9. What is the wavelength of Ultraviolet rays? **10^{-8}m**
10. All EM waves travel at the same speed through **air or a vacuum**