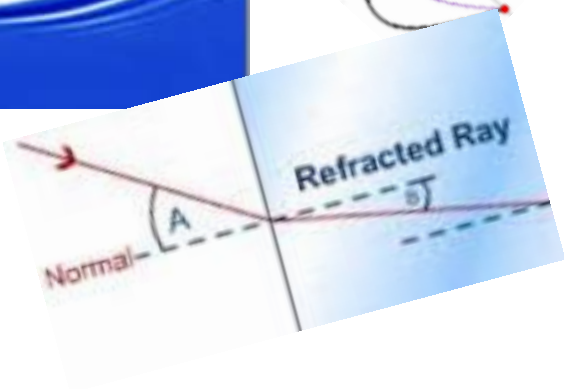
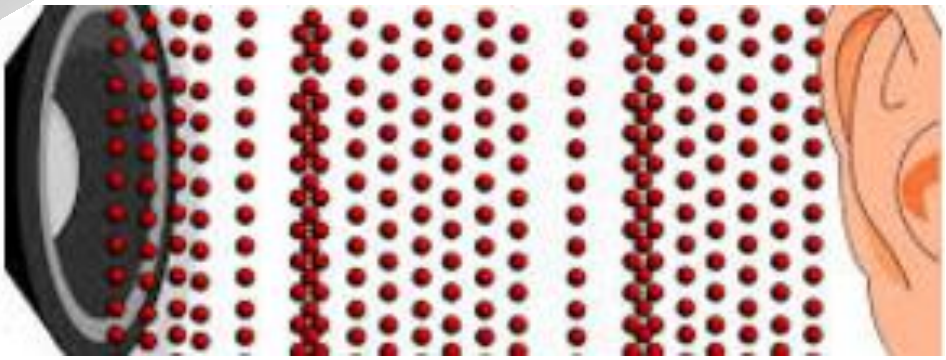
Name ……

Yr 10 Physics Intervention Pack: Waves and Electromagnetic Waves





Yr 10 Physics Intervention Pack: Waves and Electromagnetic Waves

Q1 perpendicular energy flow

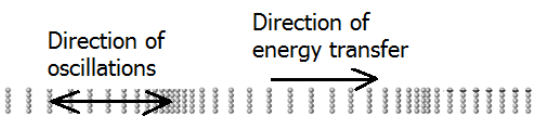
Waves transfer energy from one place to another.

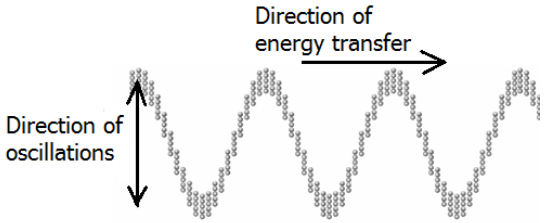
Waves may be mechanical (when matter oscillates eg water waves) or electromagnetic (eg visible light, radio waves).

Waves may transverse or longitudinal.

In a transverse wave the oscillations are …… to the energy flow.

In a longitudinal wave the oscillations are parallel to the …… .



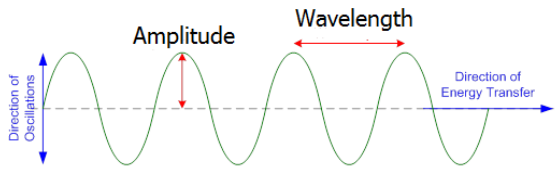


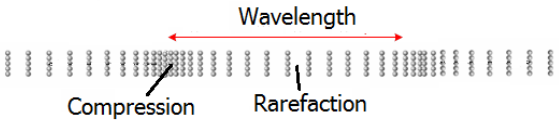
Q2 wavelength second maximum

The amplitude of a wave is the …… displacement of a point on a wave from the undisturbed position.

The ……..of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave.

The frequency is the number of waves passing a point each…… .





Q3 velocity transverse

Electromagnetic waves are …… waves that form a continuous spectrum.

All electromagnetic waves travel at the same ……..through a vacuum (space) or air.

Long wavelength → Short wavelength

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

Low frequency → High frequency

Q4 Microwaves X-rays

Electromagnetic wave	Application	**HT only** Appropriate property of electromagnetic wave
Radio waves	TV and radio broadcasting	(1) radio waves can be produced & detected relatively easily by electrical systems. (2) radio waves diffract around obstacles so there doesn't need to be a line of sight between the transmitter and receiver.
……..	(1) satellite communications (2) Cooking food	(1) can penetrate the ionosphere. (2) strongly absorbed by water molecules.
Infrared	(1) electrical heaters (2) cooking food (3) infrared cameras	(1) emitted by hot objects eg heater (2) emitted by hot objects eg grill (3) more is emitted by objects the warmer they are.
Visible light	Fibre optic communications	Can travel a long distance along glass fibres, reflecting from the sides of the fibre.
……..	(1) medical imaging (2) medical treatment	(1) penetrates low density materials but absorbed by dense materials eg bone. (2) can kill cancer cells.
Gamma rays	(1) medical imaging (2) medical treatment	(1) emitted by some substances that can be injected into the human body and used as tracers. (2) can kill cancer cells.

Time Period

The time for one whole wave to pass a point. period = $\frac{1}{\text{frequency}}$ $T = \frac{1}{f}$

The units for period are seconds (s). The units for frequency are hertz (Hz).

Wave speed equation

wave speed = frequency × wavelength $v = f\lambda$

Units for speed are metre per second (m/s), for frequency are hertz (Hz) and for wavelength are metre (m).

1 kHz => 1 000 Hz. 1 MHz => 1 000 000 Hz.
1 mm => 0.001 m. 1 km => 1 000 m.

Q5 Calculate the wave speed of radio waves of wavelength 4 km and frequency 75 kHz.

4 km => …… m. 75 kHz => …… Hz.

$v = f \lambda$

v = ……

v = 300 000 000 m/s $(3 \times 10^8$ m/s)

Gamma Rays, X-rays, Ultraviolet Waves and Risk

Gamma rays, X-rays and ultraviolet waves all cause ionisation of living cells which can cause health problems including cancer.

The more of the waves that are absorbed by the body the more risk there is of health problems being caused.

The amount of energy absorbed by the body from gamma, X-rays & ultraviolet is measured in sieverts or millisieverts. 1 mSv => 0.001 Sv.

Measuring the Speed of Sound in Air

One method involves making a loud noise in a way that can be observed from far away.

The observers time how long it takes from making the noise to them hearing it.

The speed is calculated using distance = speed × time or speed = $\frac{\text{distance}}{\text{time}}$

Q6 Put a circle around the correct phrase to complete this sentence correctly:

The advantage of using a long distance when using this method to measure the speed of sound is that …

… the time is longer the people have more time to get ready and react.

… the time is longer so the uncertainty in its measurement is a smaller percentage.

… the time is longer and larger measurements tend to be more accurate.

Refraction (Ray Diagram) (HT only)

Electromagnetic waves have different velocities in different substances.

This causes refraction when an electromagnetic wave crosses the boundary between two difference substances.

Q7 Add / label:

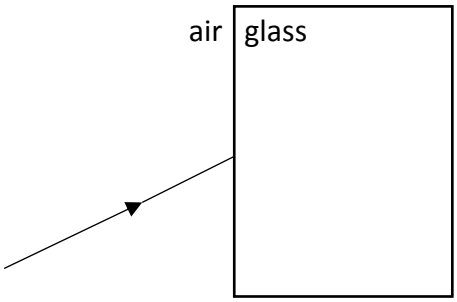
(1) incident ray

(2) normal

(3) refracted ray

(4) angle of incidence

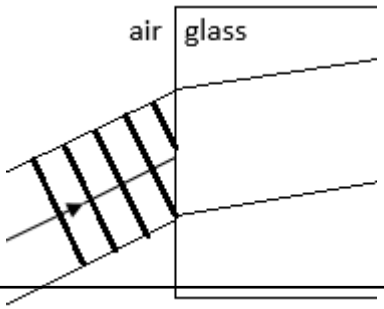
(5) angle of refraction



Refraction (Wavefront Diagram) (HT only)

Wavefronts are always at 90° to rays.

If the wavelength is less, the waves are slower and the wavefronts are closer together.



Q8

Complete the diagram to show the wavefronts crossing the air-glass boundary.

Radio Waves: Transmission & Reception (HT only)

Produced by electrons oscillating in metal wires.

When radio waves are absorbed by a metal wire (aerial) they make electrons in the metal wire oscillate at the same frequency as the radio waves (and the electrons in the transmitting aerial).

Q9 Label the diagram to show:

(1) electrons in the transmitting aerial oscillating.

(2) radio waves being transmitted.

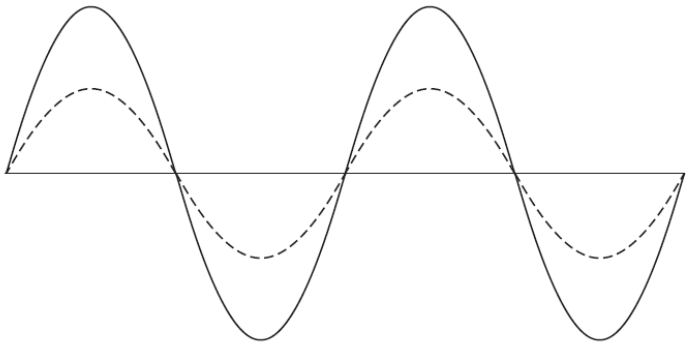
(3) electrons in the receiving aerial oscillating.

GCSE Questions

Q10 PH1FP Jan 13 q4

(a) **Diagram 1** shows two waves.

Diagram 1



(a) (i) Name **one** wave quantity that is the same for the two waves.

.....

(1 mark)

(a) (ii) Name **one** wave quantity that is different for the two waves.

.....

(1 mark)

(a) (iii) The waves in **Diagram 1** are transverse.

Which **one** of the following types of wave is **not** a transverse wave?

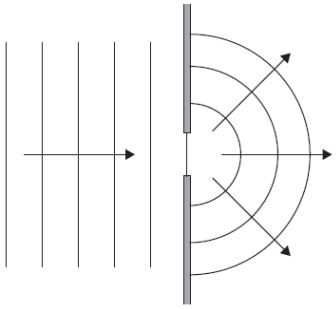
Draw a ring around the correct answer.

gamma rays **sound** **visible light**

(1 mark)

(b) **Diagram 2** shows water waves in a ripple tank moving towards and passing through a gap in a barrier.

Diagram 2



(b) (ii) Every second, 8 waves pass through the gap in the barrier. The waves have a wavelength of 0.015 metres.

Calculate the speed of the water waves and give the unit.

.....

.....

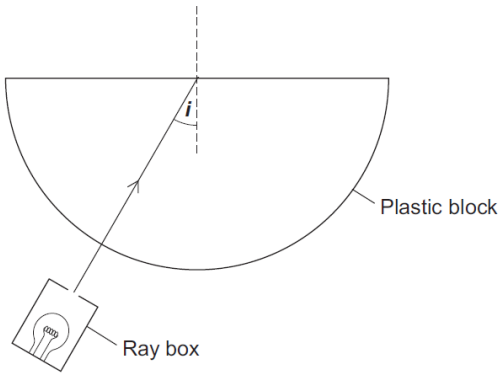
.....

Speed = ...

(3 marks)

Q11 PH1FP Jan '13 q6 ish

A student invetigated the refraction of light as it passed out of a clear plastic block into the air.
Diagram 1 shows the apparatus the student used.



(a) Complete the diagram to show the refracted ray emerging from the block.
Label the angle of refraction "r". (2 mks)

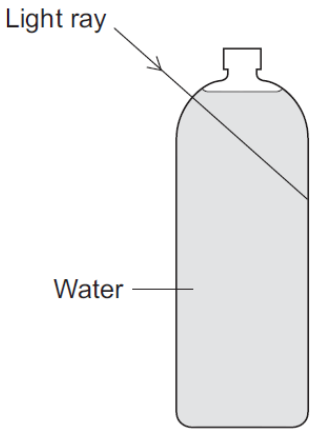
(b)

Light travelling from water into air is refracted in the same way as when light travels from plastic into air.

Diagram 2 shows a large bottle, filled with water. The bottle is made from clear plastic.

Draw on **Diagram 2** the path of the light ray as it passes out of the bottle into the air.

Diagram 2



(2 marks)

Q12 PH1FP June 13 q2

(a)

Diagram 1 shows four of the seven types of wave in the electromagnetic spectrum.

Diagram 1

J	K	L	Visible light	Infrared	Microwaves	Radio waves

Gamma rays are part of the electromagnetic spectrum.

Which letter, **J**, **K** or **L**, shows the position of gamma rays in the electromagnetic spectrum?

Draw a ring around the correct answer.

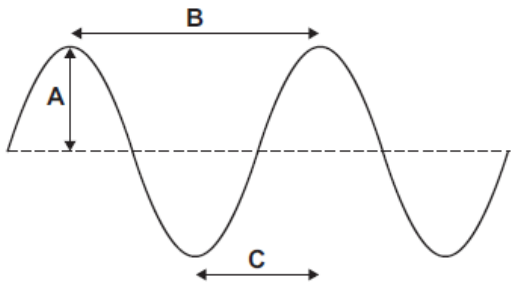
J **K** **L**

(1 mark)

(b)

Diagram 2 shows an infrared wave.

Diagram 2



(i) Which **one** of the arrows, labelled **A**, **B** or **C**, shows the wavelength of the wave?

Write the correct answer, **A**, **B** or **C**, in the box. ☐

(1 mark)

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

The wavelength of infrared waves is [shorter than / the same as / longer than] the wavelength of radio waves.

(1 mark)

Q13 PH1FP June 13 q5

(a) A lorry has an air horn. The air horn produces sound waves in the air.

(a) (i) Use **one** word to complete the following sentence.

Sound waves cause air particles to ..... .

(1 mark)

(a)(ii) The air horn produces sound waves with a frequency of 420 Hz.
The speed of sound in air is 330 m/s/
Calculate the wavelength of the sound waves.

Wavelength = ... Unit: ..... [

Q14 PH1HP Jan '13 q5

Galaxies emit all types of electromagnetic wave.

(a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1 mark)

(a) (ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1 mark)

(b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Frequency = ...

(3 marks)

Q15 Explain what is meant by a “transverse wave” and how it is different from a longitudinal wave.

……

……

……

……

…… .[2]

Q16 Calculate the frequency of an electromagnetic wave that has a speed of 3.00×10^8 m/s and a wavelength of 2 **mm**.

Frequency = …… Unit: …….. [2]

Answers:

Q1 parallel energy flow

Q2 maximum wavelength second

Q3 transverse velocity

Q4 Microwaves

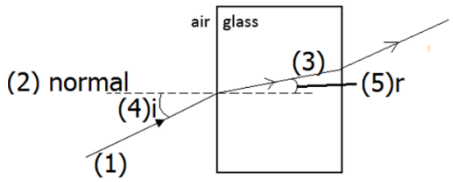
X-rays

Q5 4km => 4 000 m 75 kHz => 75 000 Hz

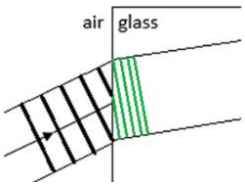
v = 4 000 × 75 000

Q6 *… the time is longer so the uncertainty in its measurement is a smaller percentage.*

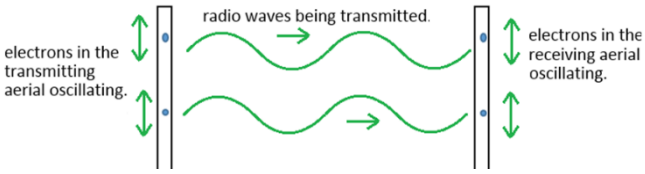
Q7



Q8



Q9



Q10ai Wavelength (or "frequency")

Q10aii Amplitude

Q10aiii Sound

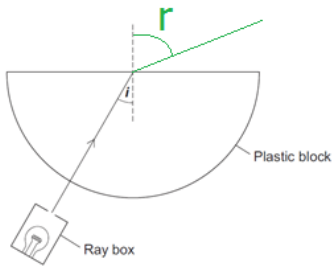
Q10b v = fλ

"Every second, 8 waves pass through …" => frequency = 8 Hz

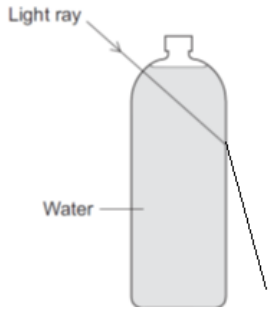
v = 8 × 0.015

v = 0.12 m/s

Q11a



Q11b



Q12a J

Q12bi B

Q12bii shorter than

Q13ai vibrate / oscillate

Q13aii $v = f \lambda$

$330 = 420 \times \lambda$

$\lambda = {}^{330}/_{420}$

$\lambda = 0.79$ m

Q14ai Gamma (rays)

Q14aii visible light has longer wavelength / higher frequency
[OR "ultraviolet has shorter wavelength / lower frequency"]

Q14b $v = f \lambda$

$3 \times 10^8 = f \times 25$

$f = {}^{3\times10^8}/_{25}$

$f = 12\,000\,000$ Hz (or 12 MHz)

Q15 (transverse =>) <u>oscillations</u> are <u>perpendicular to</u> <u>energy flow</u>,
(whereas in a longitudinal wave the) <u>oscillations</u> are <u>parallel to</u> the <u>energy flow</u>.

Q16 $\lambda = 2$ mm => $\lambda = 0.002$ m

$v = f \lambda$

$3\times10^8 = f \times 0.002$

$f = \frac{3 \times 10^8}{0.002}$

$f = 1.5 \times 10^{11}$ Hz