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A Level Physics Summer Independent Learning Activity

Welcome to A Level Physics, please complete **ALL** of the following tasks ready for your first day at New College. You can either write on the document electronically, print the document out or write your notes and answers on paper to bring in for your first lesson in September.

The activity is split into 7 sections:

- **TASK 1:** GCSE Waves Review
- **TASK 2:** GCSE Waves Exam Questions
- **TASK 3:** Prefixes and Significant Figures
- **TASK 4:** Equations and Gradients
- **TASK 5:** Data Analysis
- **TASK 6:** A Level Waves Introduction
- **TASK 7:** A Level Waves Exam Questions

Please be aware that you will have an assessment on these topics shortly after beginning your A level Physics course and the knowledge covered is essential to understanding the subsequent content.

The following resources may be useful:

TASK 1: GCSE Waves Review

Part 1. Read through the Bitesize pages on Progressive waves.
https://www.bbc.co.uk/bitesize/guides/zgf97p3/revision/1

Part 2. Read through the notes on Longitudinal and Transverse waves.
https://www.bbc.co.uk/bitesize/guides/z9bw6yc/revision/1

Part 3. Complete the notes on wave basics.

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Wave Basics

All waves transfer ____

Waves are created by ____

There are two types of waves; transverse and longitudinal.

In a transverse wave the oscillations are ____ to the direction that the wave travels in.

In a longitudinal wave the oscillations are ____ to the direction that the wave travels in.

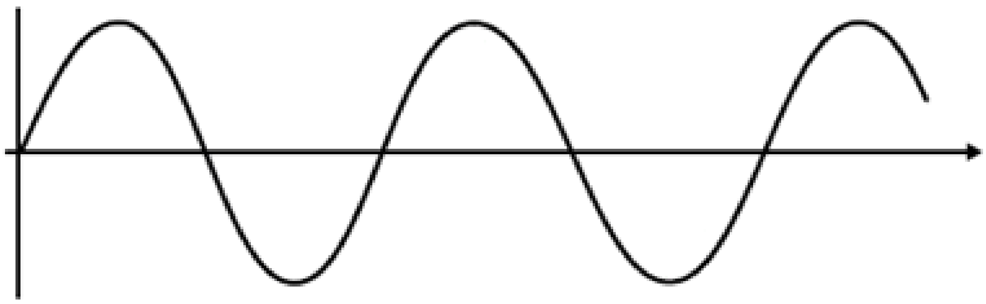
Examples of transverse waves are ____

____

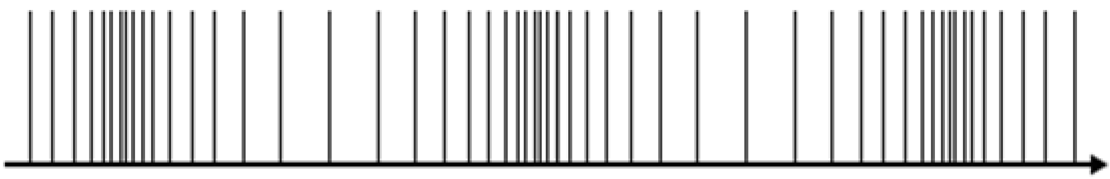
Examples of longitudinal waves are ____

____

The diagram below is an example of a ____ wave.



The diagram below is an example of a ____ wave.



What do the following terms mean? Add them to the appropriate diagram above (if possible).

Peak ____

Trough ____

Compression ____

Rarefaction ____

Wavelength ____

Amplitude ____

Frequency ____

Wave speed ____

$$v = f \times \lambda$$

Symbol	Quantity	Units	Unit Symbol
v			
f			
λ			

Complete this table by calculating the missing values.

v	f	λ
	3	1.2
	8	0.015
336		0.8
40		0.8
340	850	
300 000 000	500 000 000	

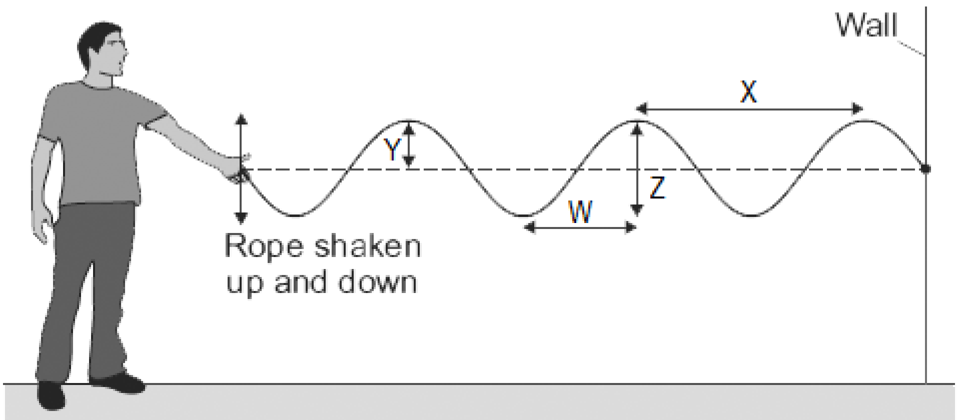
The diagram shows waves being produced on a rope. The waves are not reflected by the wall.

Draw an arrow on the diagram to show the direction in which the waves transfer energy.

Which of the labelled arrows show the:

Amplitude? __________

Wavelength? __________



State which type of wave is shown in the diagram and explain how you can tell?

____

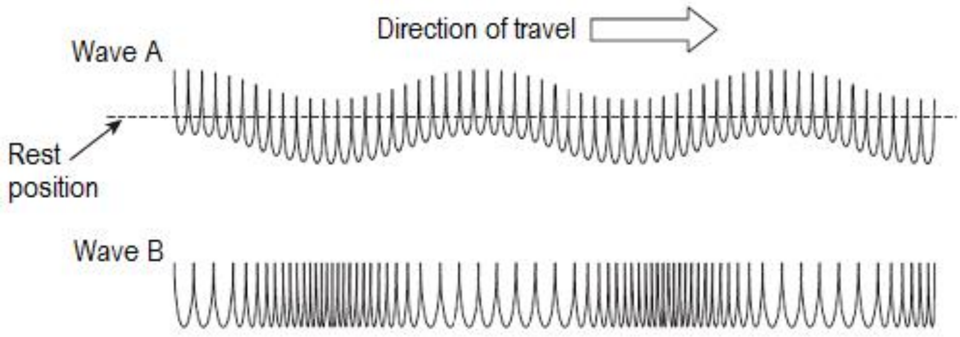
____

The diagram shows two ways in which a wave can travel along a slinky spring.

Clearly indicate and label the wavelength of Wave A and Wave B

Which a longitudinal wave? ________

Which is a transverse wave? ________



Complete the table by writing the initials of the waves of the EM spectrum and colours of the visible section into the correct boxes.

			Visible Light									
	X					G	Y					R

As we go from left to right in the table above the **wavelength** of the waves ______________________

As we go from left to right in the table above the **frequency** of the waves ______________________

As we go from left to right in the table above the **energy** of the waves ______________________

As we go from left to right in the table above the **speed** of the waves ______________________

Circle the correct values for the range of wavelengths of the electromagnetic spectrum.

The longest EM wavelength is around				The shortest EM wavelength is around			
10^{15} m	10^{4} m	10 m	10^{-6} m	10^{6} m	10 m	10^{-4} m	10^{-15} m

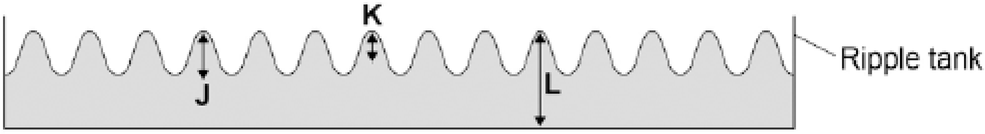
Use	EM Wave	Use	EM Wave
Sending a text from a mobile phone		To sterilise surgical equipment	
Taking a photograph of a tree		A medical tracer injected into a patient	
Killing cancerous cells inside a patient		Security ink used to mark your property	
Turning off a television with a remote control		Producing shadow images of bones	
Broadcasting a movie by satellite		Broadcasting a local radio show	
In sunbeds to give a sun tan		Turning a piece of bread into toast	
Taking a thermal photograph of a human		Cooking food in a microwave oven	

TASK 2: GCSE Waves Exam Questions

Wave Basics

Q1. Small water waves are created in a ripple tank by a wooden bar. The wooden bar vibrates up and down hitting the surface of the water.

The figure below shows a cross-section of the ripple tank and water.



Q1(a) Which letter shows the amplitude of a water wave? Tick **one** box.

J ☐

K ☐

L ☐

(1)

Q1(b) The speed of the wooden bar is changed so that the bar hits the water fewer times each second. What happens to the frequency of the waves produced? Tick one box.

Increases ☐

Does not change ☐

Decreases ☐

(1)

Q1(c) Describe how the wavelength of the water waves in a ripple tank can be measured accurately.

....

....

....

....

.... **(2)**

Q1(d) The water waves in a ripple tank have a wavelength of 1.2 cm and a frequency of 18.5 Hz. How does the speed of these water waves compare to the typical speed of a person walking?

....

....

....

....

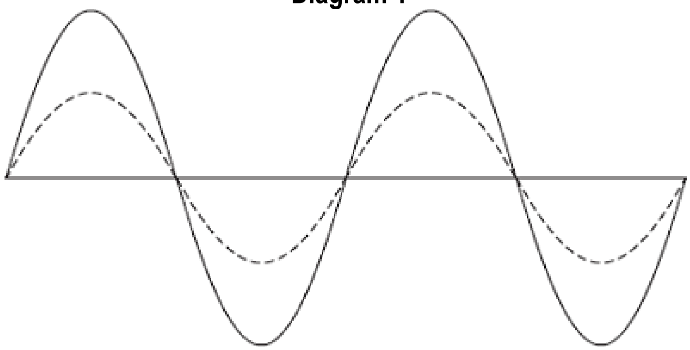
....

.... **(4)**

(Total 8 marks)

Q2(a) **Diagram 1** shows two waves.

Diagram 1



Q2(ai) Name **one** wave quantity that is the same for the two waves.

.... **(1)**

Q2(aii) Name **one** wave quantity that is different for the two waves.

.... **(1)**

Q2(aiii) The waves in **Diagram 1** are transverse.

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

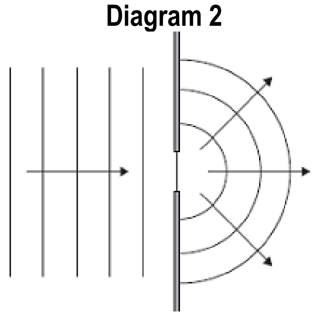
Draw a ring around the correct answer.

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

(1)

Q2(b) **Diagram 2** shows water waves in a ripple tank moving towards and passing through a gap in a barrier.

Diagram 2



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)**

Q2(c) Bats use the reflection of high pitched sound waves to determine the position of objects.
State the name given to reflected sound waves.

.... **(1)**

Q2(d) The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.
Calculate the speed of this sound wave.

....

....

....

Speed = ... m/s **(2)**

Q2(e) Sound waves are longitudinal. Describe a longitudinal sound wave.

....

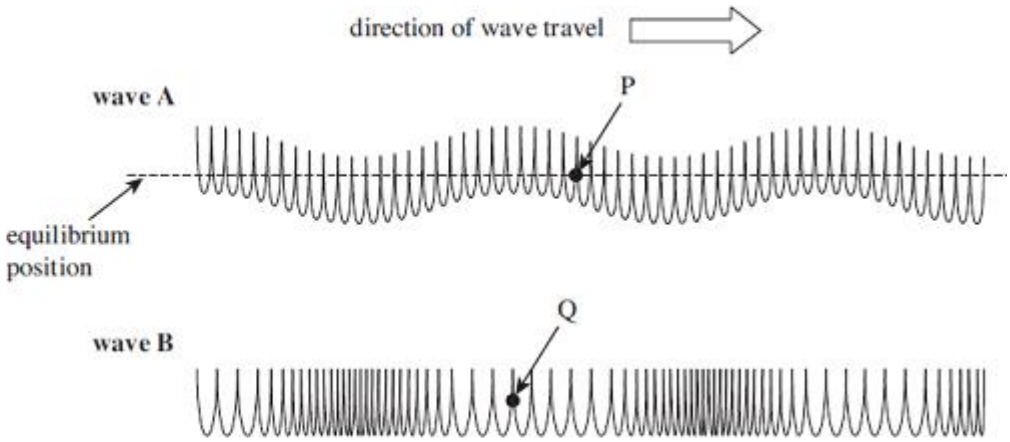
....

....

.... **(2)**

(Total 11 marks)

Q3. The figure below shows two ways in which a wave can travel along a slinky spring.



Q3(a) State and explain which wave is longitudinal.

....

....

.... **(2)**

Q3(b) On the figure above,

Q3(bi) clearly indicate and label the wavelength of **wave B** **(1)**

Q3(bii) use arrows to show the direction in which the points **P** and **Q** are about to move as each wave moves to the right. **(2)**

Q3(ci) State the difference between a longitudinal wave and a transverse wave.

....

....

....

.... **(2)**

Q3(cii) State an example of a transverse wave.

.... **(1)**

Q3(ciii) State an example of a longitudinal wave.

.... **(1)**

Q3(e) Sound with a frequency of 560 Hz travels through steel with a speed of 4800 m/s.
Calculate the wavelength of the sound wave.

....

....

.... **(2)**

(Total 11 marks)

The EM Spectrum

Q4. **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

Q4(a) The **four** types of electromagnetic wave named in **Diagram 1** above are used for communication.

Q4(ai) Which type of electromagnetic wave is used when a traffic signal communicates with a car driver?

.... **(1)**

Q4(aii) Which type of electromagnetic wave is used to communicate with a satellite in space?

.... **(1)**

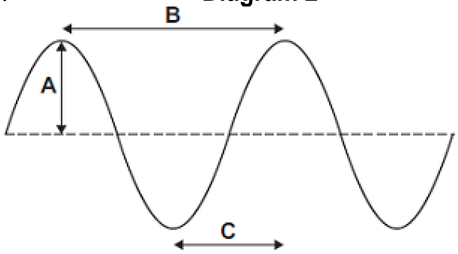
Q4(b) Gamma rays are part of the electromagnetic spectrum.
Which letter, **J**, **K** or **L**, shows the position of gamma rays in the electromagnetic spectrum?
Draw a ring around the correct answer.

J **K** **L**

(1)

Q4(c) **Diagram 2** shows an infrared wave.

Diagram 2



Q4(ci) 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)

Q4(cii) 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)

Q4(d) Mobile phone networks send signals using microwaves. Some people think the energy a person's head absorbs when using a mobile phone may be harmful to health.

Q4(di) Scientists have compared the health of people who use mobile phones with the health of people who do not use mobile phones. Which **one** of the following statements gives a reason why scientists have done this? Tick (✓) **one** box.

To find out if using a mobile phone is harmful to health. ☐

To find out if mobile phones give out radiation. ☐

To find out why some people are healthy. ☐

(1)

Q4(dii) The table gives the specific absorption rate (SAR) value for two different mobile phones.

The SAR value is a measure of the maximum energy a person's head absorbs when a mobile phone is used.

Mobile Phone	SAR value in W/kg
X	0.28
Y	1.35

A parent buys mobile phone **X** for her daughter.
Using the information in the table, suggest why buying mobile phone **X** was the best choice.

....

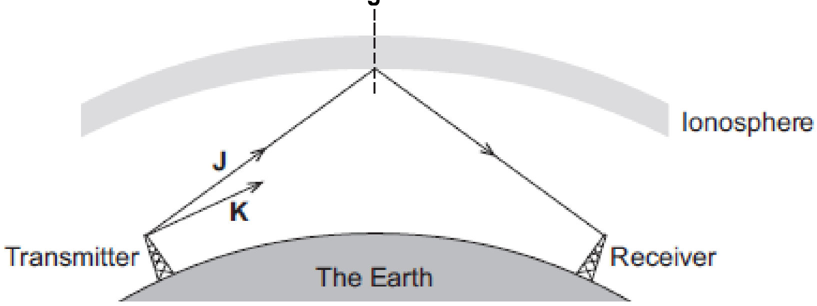
....

.... **(2)**

Q4(e) Different parts of the electromagnetic spectrum are useful for different methods of communication.

Figure 1 shows a transmitter emitting two electromagnetic waves, **J** and **K**.

Figure 1



Wave **J** is reflected by a layer in the atmosphere called the ionosphere.

Q4(ei) Wave **K** will also be reflected by the ionosphere.

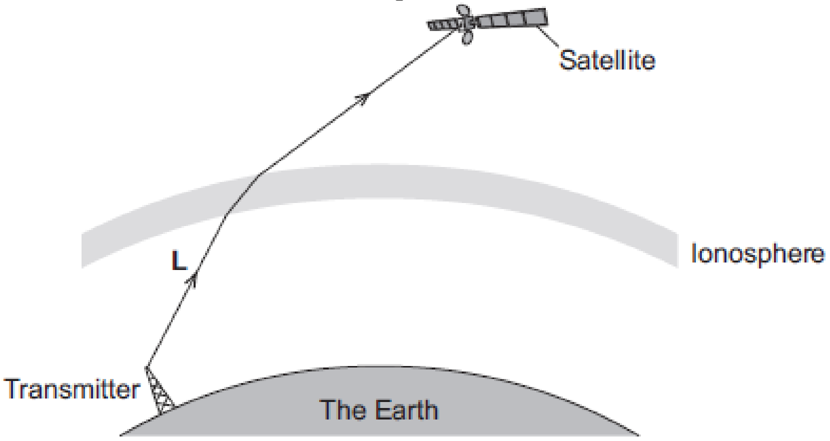
On **Figure 1**, draw the path of wave **K** to show that it **does not** reach the receiver. **(2)**

Q4(eii) What is the name given to the dashed line in **Figure 1**?

.... **(1)**

Q4(f) **Figure 2** shows a transmitter sending a signal to a satellite orbiting the Earth.

Figure 2



Q4(fi) Which type of electromagnetic wave is used to send a signal to a satellite?
Draw a ring around the correct answer.

gamma **microwave** **ultraviolet**

(1)

Q4(fii) What name is given to the process that occurs as wave **L** passes into the ionosphere?
Draw a ring around the correct answer.

diffraction **reflection** **refraction**

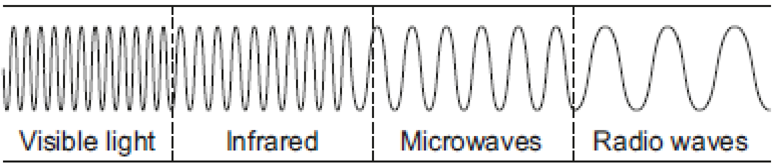
(1)

Q4(g) Waves **J**, **K** and **L** are electromagnetic waves.
What are **two** properties of **all** electromagnetic waves? Tick (✓) **two** boxes.

Property	**Tick (✓)**
All electromagnetic waves are longitudinal.	
All electromagnetic waves are transverse.	
All electromagnetic waves are mechanical.	
All electromagnetic waves have the same speed in a vacuum.	
All electromagnetic waves have the same frequency.	

(2)
(Total 15 marks)

Q5. Infrared and microwaves are two types of electromagnetic radiation.
The diagram below shows the positions of the two types of radiation within part of the electromagnetic spectrum.



Q5(a) Name **one** type of electromagnetic radiation which has more energy than infrared.

.... **(1)**

Q5(b) Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

greater than	less than	the same as

The wavelength of infrared is .... the wavelength of microwaves.

The frequency of microwaves is .... the frequency of infrared.

The speed of microwaves in a vacuum is .... the speed of infrared in a vacuum. **(3)**

Q5(c) Some scientists think that there is a link between using a mobile phone and some types of illness. Other scientists disagree. They say that the evidence is limited and unreliable.

Q5(ci) Suggest what scientists could do to show a link between using a mobile phone and illness.

....

.... **(1)**

Q5(cii) How could scientists improve the reliability of the evidence?

....

.... **(1)**

Q5(ciii) Complete the following passage by drawing a ring around the word in the box that is correct.

There has been little or no experimental research into the health of children who use mobile phones.

This is partly because of the [economic / environmental / ethical] issues involved in using children in scientific research.

(1)

Q5(d) Before being sold, new mobile phones must be tested and given a SAR value.

The SAR value is a measure of the energy absorbed by the head while a mobile phone is being used.

The table gives the SAR value for three mobile phones made by different companies.

To be sold in the UK, a mobile phone must have a SAR value lower than 2.0 W/kg.

Mobile phone	SAR value in W/kg
J	0.18
K	0.86
L	1.40

Q5(di) All companies use the same test to measure a SAR value.

Why is using the same test important?

....

.... **(1)**

Q5(dii) Would the companies that make the mobile phones, **J**, **K** and **L**, be correct to claim that these three phones are totally safe to use?

Answer yes or no. ....

Give a reason for your answer.

....

.... (1)

Q5(e) Devices designed to protect a mobile phone user from microwave radiation are now available.
Why is it important that these devices are tested by scientists who are **not** working for the company that makes the devices?

....

.... (1)

(Total 10 marks)

Q6(a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

Q6(ai) Give **two** properties that are common to both visible light and microwaves.

....

....

.... (2)

Q6(aii) Name **two** more types of electromagnetic wave that can be used for communications.

.... and .... (1)

Q6(b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.
Calculate the frequency of the microwaves used to link the computer to the router.
Show clearly how you work out your answer and give the unit.

....

....

....

Frequency = ... (3)

Q6(c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.
A politician commented on the increasing use of WiFi. He said: 'I believe that these systems may be harmful to children.'
However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

Q6(ci) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

....

.... (1)

Q6(cii) Why did the group of scientists suggest that there is a need for further research?

....

.... (1)

(Total 8 marks)

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TASK 3: Prefixes and Significant Figures

In Physics we have to deal with quantities from the very large to the very small. A prefix is something that goes in front of a unit and acts as a multiplier. This sheet will give you practice at converting figures between prefixes.

Symbol	Name	What it means	
P	peta	$\times10^{15}$	1000000000000000
T	tera	$\times10^{12}$	1000000000000
G	giga	$\times10^{9}$	1000000000
M	mega	$\times10^{6}$	1000000
k	kilo	$\times10^{3}$	1000
			1
m	milli	$\times10^{-3}$	0.001
μ	micro	$\times10^{-6}$	0.000001
n	nano	$\times10^{-9}$	0.000000001
p	pico	$\times10^{-12}$	0.000000000001
f	femto	$\times10^{-15}$	0.000000000000001

Convert the figures into the prefixes required

s	ms	µs	ns	ps
134.6				
96.21				
0.773				

m	km	mm	Mm	Gm
12873				
0.295				
57.23				

A	mA	µA	nA	kA
0.000678				
3.56				
0.00092				

For each value state how many significant figures it is stated to

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2		1066		1800.45		0.07	
2.0		82.42		2.483×10^4		69324.8	
2.00		750000		2.483		0.0063	
0.136		310		5906.4291		9.81×10^4	
0.34		3.10×10^2		200000		6717	
54.1		3.1×10^2		12.711		0.91	

Add the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Value 3	Total Value	Total to correct sig figs
51.4	1.67	3.23		
7146	–32.54	12.8		
20.8	18.72	0.851		
1.4693	10.18	–1.062		
9.07	0.56	3.14		
739762	26017	2.058		
8.15	0.002	106		
132.303	4.123	53800		
152	0.8	0.55		
0.1142	4922388	132000		

Multiply the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Total Value	Total to correct sig figs
0.91	1.23		
8.764	7.63		
2.6	31.7		
937	40.01		
0.722	634.23		

TASK 4: Equations and Gradients

Select the correct versions of these equations covered in GCSE Physics.

Equation	1	2	3	4	5	6	7	8	9
1	$d = s \times t$	$d = \frac{s}{t}$	$d = \frac{t}{s}$	$s = d \times t$	$s = \frac{d}{t}$	$s = \frac{t}{d}$	$t = d \times s$	$t = \frac{d}{s}$	$t = \frac{s}{d}$
2	$a = \Delta v \times t$	$a = \frac{t}{\Delta v}$	$a = \frac{\Delta v}{t}$	$t = a \times \Delta v$	$t = \frac{a}{\Delta v}$	$t = \frac{\Delta v}{a}$	$\Delta v = a \times t$	$\Delta v = \frac{a}{t}$	$\Delta v = \frac{t}{a}$
3	$a = F \times m$	$a = \frac{F}{m}$	$a = \frac{m}{F}$	$F = m \times a$	$F = \frac{a}{m}$	$F = \frac{m}{a}$	$m = F \times a$	$m = \frac{a}{F}$	$m = \frac{F}{a}$
4	$g = m \times W$	$g = \frac{m}{W}$	$g = \frac{W}{m}$	$m = g \times W$	$m = \frac{g}{W}$	$m = \frac{W}{g}$	$W = m \times g$	$W = \frac{g}{m}$	$W = \frac{m}{g}$
5	$m = p \times v$	$m = \frac{p}{v}$	$m = \frac{v}{p}$	$p = m \times v$	$p = \frac{m}{v}$	$p = \frac{v}{m}$	$v = m \times p$	$v = \frac{m}{p}$	$v = \frac{p}{m}$
6	$E = mg \times h$	$E = \frac{h}{mg}$	$E = \frac{mg}{h}$	$h = E \times mg$	$h = \frac{E}{mg}$	$h = \frac{mg}{E}$	$mg = E \times h$	$mg = \frac{E}{h}$	$mg = \frac{h}{E}$
7	$f = v \times \lambda$	$f = \frac{v}{\lambda}$	$f = \frac{\lambda}{v}$	$v = f \times \lambda$	$v = \frac{f}{\lambda}$	$v = \frac{\lambda}{f}$	$\lambda = f \times v$	$\lambda = \frac{f}{v}$	$\lambda = \frac{v}{f}$
8	$d = F \times W$	$d = \frac{F}{W}$	$d = \frac{W}{F}$	$F = d \times W$	$F = \frac{d}{W}$	$F = \frac{W}{d}$	$W = F \times d$	$W = \frac{d}{F}$	$W = \frac{F}{d}$
9	$E = P \times t$	$E = \frac{P}{t}$	$E = \frac{t}{P}$	$P = E \times t$	$P = \frac{E}{t}$	$P = \frac{t}{E}$	$t = E \times P$	$t = \frac{E}{P}$	$t = \frac{P}{E}$
10	$E = Q \times V$	$E = \frac{Q}{V}$	$E = \frac{V}{Q}$	$Q = E \times V$	$Q = \frac{E}{V}$	$Q = \frac{V}{E}$	$V = E \times Q$	$V = \frac{E}{Q}$	$V = \frac{Q}{E}$
11	$I = Q \times t$	$I = \frac{t}{Q}$	$I = \frac{Q}{t}$	$Q = I \times t$	$Q = \frac{I}{t}$	$Q = \frac{t}{I}$	$t = I \times Q$	$t = \frac{I}{Q}$	$t = \frac{Q}{I}$
12	$I = R \times V$	$I = \frac{R}{V}$	$I = \frac{V}{R}$	$R = I \times V$	$R = \frac{I}{V}$	$R = \frac{V}{I}$	$V = I \times R$	$V = \frac{I}{R}$	$V = \frac{R}{I}$
13	$I = P \times V$	$I = \frac{P}{V}$	$I = \frac{V}{P}$	$P = I \times V$	$P = \frac{I}{V}$	$P = \frac{V}{I}$	$V = I \times P$	$V = \frac{I}{P}$	$V = \frac{P}{I}$
14	$m = \rho \times V$	$m = \frac{\rho}{V}$	$m = \frac{V}{\rho}$	$\rho = m \times V$	$\rho = \frac{m}{V}$	$\rho = \frac{V}{m}$	$V = \rho \times m$	$V = \frac{m}{\rho}$	$V = \frac{\rho}{m}$
15	$e = F \times k$	$e = \frac{F}{k}$	$e = \frac{k}{F}$	$F = k \times e$	$F = \frac{e}{k}$	$F = \frac{k}{e}$	$k = F \times e$	$k = \frac{e}{F}$	$k = \frac{F}{e}$

Complete the table below about graphs and gradients

Equation	Graph	Rearrange Equation	Gradient	Intercept
$y = mx + c$	y plotted on the y axis x plotted on the x axis	$y = mx + c$	m	c
$V = IR$	y axis = V x axis = I	$V = RI$	R	0
$I = \frac{Q}{t}$	y axis = t x axis = Q			
$\rho = \frac{RA}{l}$	y axis = l x axis = R			
$\varepsilon = V + Ir$	y axis = V x axis = I			
$E = VIt$	y axis = E/t x axis = V			
$hf = \phi + E_K$	y axis = E_K x axis = f			
$\lambda = \frac{h}{mv}$	y axis = $1/v$ x axis = m			
$E_P = mgh$	y axis = mg x axis = E_P			
$E = \frac{1}{2}Fe$	y axis = e x axis = $1/F$			
$c = f\lambda$	y axis = $1/\lambda$ x axis = f			
$v = u + at$	y axis = a x axis = $1/t$			
$v^2 = u^2 + 2as$	y axis = v^2 x axis = s			
$s = \frac{(u+v)}{2}t$	y axis = v x axis = s			

TASK 5: Data Analysis

Write a conclusion for each case study below

Case Study A

Length of tuning fork (cm)	Frequency of sound produced (Hz)	Note
18.0	261	C
16.5	294	D
15.0	329	E
13.5	349	F
12.0	392	G

Case Study B

Type of metal used	Frequency of sound produced for each length (Hz)			
	10 cm	11 cm	12 cm	13 cm
Aluminium	400	375	350	325
Brass	515	500	485	470
Chrome	466	429	392	355
Steel Alloy 1	492	450	408	366
Steel Alloy 2	402	378	354	330

Case Study C

Age (years)	Highest frequency that could be heard (kHz)			
	Trial 1	Trial 2	Trial 3	Mean
10	24	24	24	24
20	20	22	21	21
30	18	17	18	18
40	14	16	16	15
50	12	12	12	12

Case Study D

Age group (years)	Range of hearing (Hz)	
	Male	Female
10-19	20 to 24000	20 to 24000
20-29	20 to 20000	20 to 20000
30-39	20 to 17000	20 to 18500
40-49	20 to 14000	20 to 16000
50-59	20 to 11000	20 to 13500

TASK 6: A Level Waves Introduction

Part 1. Read through the notes on Progressive waves and then watch and make extra notes on the video linked below – '14 – Progressive Waves':
https://www.youtube.com/watch?v=MngDwyyrPpw

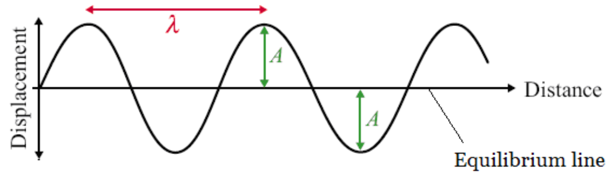
Part 2. Read through the notes on Longitudinal and Transverse waves and then watch and make extra notes on the video linked below – `15 – Longitudinal and Transverse waves':
https://www.youtube.com/watch?v=mP2xDykybPE

Both tasks, 1 and 2, should take a minimum of 1 hour each. You will be tested on the content in September so pause / rewind / repeat the video as many time as you need to ensure you know the content.

1 - Progressive Waves

Waves

All waves are caused by oscillations and all transfer energy without transferring matter. This means that a water wave can transfer energy to you sitting on the shore without the water particles far out to sea moving to the beach.



Here is a diagram of a wave; it is one type of wave called a transverse wave. A wave consists of something (usually particles) oscillating from an equilibrium point. The wave can be described as progressive; this means it is moving outwards from the source.

We will now look at some basic measurements and characteristics of waves.

Amplitude, A, measured in metres, m

The amplitude of a wave is the maximum displacement of the particles from the equilibrium position.

Wavelength, λ, measured in metres, m

The wavelength of a wave is the minimum distance between 2 points which are in phase. It can be measured between two adjacent peaks, troughs or any point on a wave and the same point one wave later.

Time Period, T, measured in seconds, s

This is simply the time is takes for one complete oscillation to happen. Like wavelength it can be measured as the time it takes between two adjacent peaks, troughs or to get back to the same point on the wave.

Frequency, f , measured in Hertz, Hz

Frequency is a measure of how often something happens, in this case how many complete waves occur in every second. It is linked to time period of the wave by the following equations: $T = \frac{1}{f}$ and $\boxed{f = \frac{1}{T}}$

Wave Speed, c, measured in metres per second, m s^{-1}

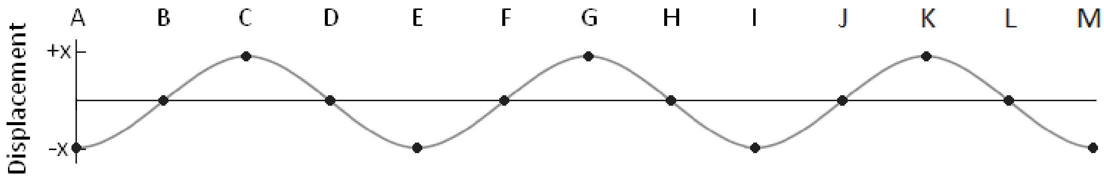
The speed of a wave can be calculated using the following equations: $\boxed{c = f\lambda}$

Here c represents the speed of the wave, f the frequency and λ the wavelength.

Phase Difference is measured in degrees, °

If we look at two particles a wavelength apart (such as C and G) we would see that they are oscillating in time with each other. We say that they are *completely in phase*. Two points half a wavelength apart (such as I and K) we would see that they are always moving in opposite directions. We say that they are *completely out of phase*.

The phase difference between two points depends on what fraction of a wavelength lies between them



	B	C	D	E	F	G	H	I	J	K	L	M
Phase Difference from A (degrees)	90	180	270	360	450	540	630	720	810	900	990	1080

Path Difference is measured in wavelengths, λ

If two light waves leave a bulb and hit a screen the difference in how far the waves have travelled is called the path difference. Path difference is measured in terms of wavelengths.

	B	C	D	E	F	G	H	I	J	K	L	M
Path Difference from A	¼λ	½λ	¾λ	1λ	1¼λ	1½λ	1¾λ	2λ	2¼λ	2½λ	2¾λ	3λ

So two waves leaving A with one making it to F and the other to J will have a path difference of 1 wavelength (1λ).

My notes on Progressive Waves	
Questions (2. After writing your notes, what questions could you be asked?)	My notes (1. write your notes here)
Summary (definitions I must learn, key ideas I must remember).	

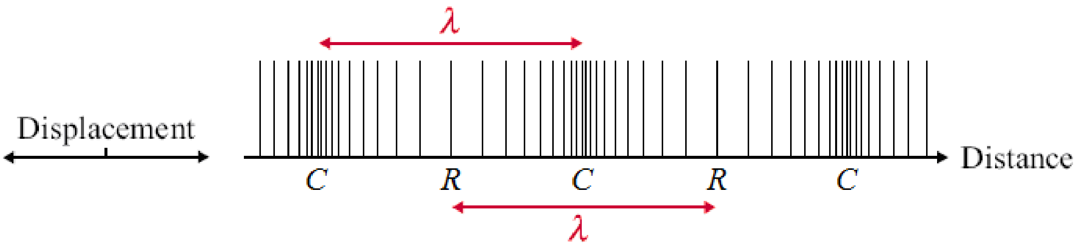
2 - Longitudinal and Transverse waves.

Waves

All waves are caused by oscillations and all transfer energy without transferring matter. This means that a sound wave can transfer energy to your eardrum from a far speaker without the air particles by the speaker moving into your ear. We will now look at the two types of waves and how they are different

Longitudinal Waves

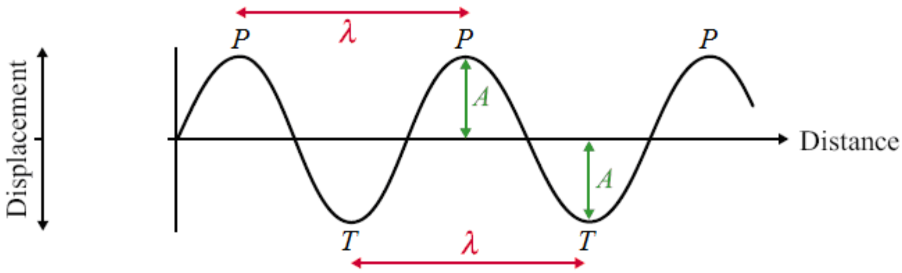
Here is a longitudinal wave; the oscillations are parallel to the direction of propagation (travel).
Where the particles are close together we call a compression and where they are spread we call a rarefaction.
The wavelength is the distance from one compression or rarefaction to the next.
The amplitude is the maximum distance the particle moves from its equilibrium position to the right of left.



<u>Example</u>: sound waves

Transverse Waves

Here is a transverse wave; the oscillations are perpendicular to the direction of propagation.
Where the particles are displaced above the equilibrium position we call a peak and below we call a trough.
The wavelength is the distance from one peak or trough to the next.
The amplitude is the maximum distance the particle moves from its equilibrium position up or down.

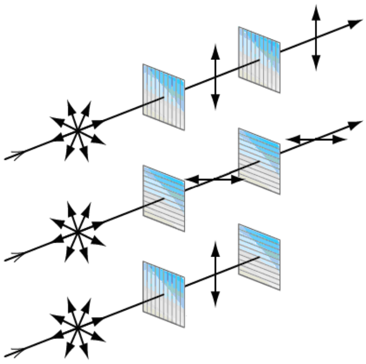


<u>Examples</u>: water waves,Mexican waves and waves of the EM spectrum

EM waves are produced from varying electric and magnetic field.

Polarisation

Polarisation restricts the oscillations of a wave to one plane. In the diagrams the light is initially oscillating in all directions. A piece of Polaroid only allows light to oscillate in the same direction as it.



- In the top diagram the light passes through a vertical plane Polaroid and becomes polarized in the vertical plane. This can then pass through the second vertical Polaroid.
- In the middle diagram the light becomes polarized in the horizontal plane.
- In the bottom diagram the light becomes vertically polarized but this cannot pass through a horizontal plane Polaroid.

This is proof that the waves of the EM spectrum are transverse waves. If they were longitudinal waves the forwards and backwards motion would not be stopped by crossed pieces of Polaroid; the bottom set up would emit light.

Applications

TV aerials get the best reception when they point to the transmission source so they absorb the maximum amount of the radio waves.

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My notes on Longitudinal and Transverse Waves	
Questions (2. After writing your notes, what questions could you be asked?)	My notes (1. write your notes here)
Summary (definitions I must learn, key ideas I must remember).	

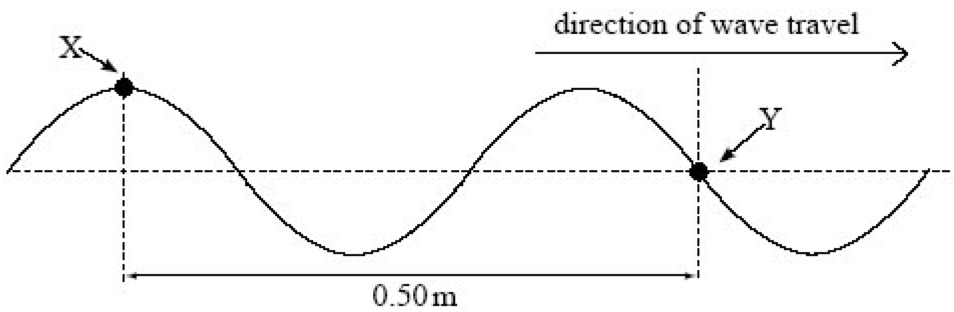
TASK 7: A Level Waves Exam Questions

Q1. Complete the first column in the table to show which of the waves listed are transverse and which are longitudinal.
Complete the second column to show which waves can be polarised.

type of wave	transverse or longitudinal	can be polarised (answer yes or no)
light		
microwaves		
ultrasound		

(Total 3 marks)

Q2. (a) The diagram below represents a progressive wave travelling from left to right on a stretched string.



(i) Calculate the wavelength of the wave.

answer .... m
(1)

(ii) The frequency of the wave is 22 Hz. Calculate the speed of the wave.

answer............................m s^{-1}
(2)

(iii) State the phase difference between points X and Y on the string, giving an appropriate unit.

answer ....

(2)

(b) Describe how the displacement of point Y on the string varies in the next half-period.

....

....

....

....

....

....

(2)

(Total 7 marks)

Q3.(a) State the difference between *transverse* and *longitudinal* waves.

....

....

....

....

(2)

(b) State what is meant by *polarisation*.

....

....

....

....

(2)

(c) Explain why polarisation can be used to distinguish between transverse and longitudinal waves.

....

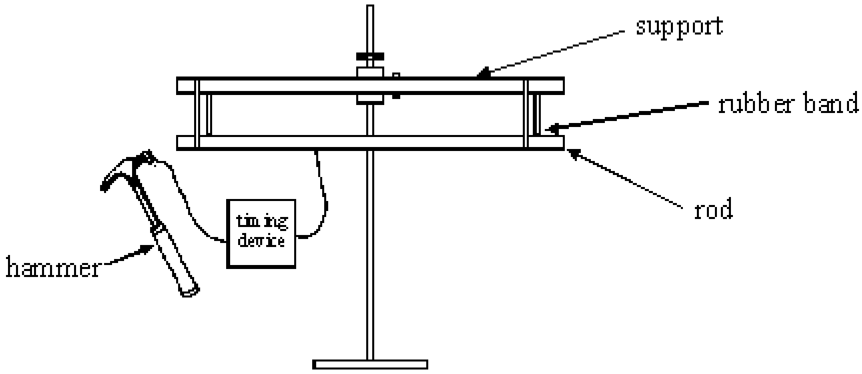
....

....

....

(2)
(Total 6 marks)

Q4. The diagram below shows a hammer being struck against the end of a horizontal metal rod. A pulse of sound travels along the rod from where the hammer strikes it to the far end and back again. The sound pulse throws the hammer and rod apart when it returns. An electrical timing circuit measures the time for which the hammer and the rod are in contact.



(a) Circle the word below that describes the type of wave that travels along the rod.

transverse **longitudinal**

(1)

(b) State the name of the effect that causes the sound pulse to return to the hammer.

....

(1)

(c) The rod is 0.45 m long and the time for which the hammer is in contact with the rod is 1.6×10^{-4} s. Calculate the speed of sound in the rod.

Speed of sound ....

(3)
(Total 5 marks)

Q5. The least distance between two points of a progressive transverse wave which have a phase difference of 60° (or $\frac{\pi}{3}$ rad) is 0.050 m. If the frequency of the wave is 500 Hz, what is the speed of the wave?

A 25 m s^{-1}

B 75 m s^{-1}

C 150 m s^{-1}

D 1666 m s^{-1}

(Total 1 mark)

Q6. By approximately how many times is the wavelength of audible sound waves greater than the wavelength of light waves?

A 10^2

B 10^6

C 10^{10}

D 10^{14}

(Total 1 mark)

Q7. The speed of sound in water is 1500 m s^{-1}. For a sound wave in water having frequency 2500 Hz, what is the minimum distance between two points at which the vibrations are 60° out of phase?

A 0.05 m

B 0.10 m

C 0.15 m

D 0.20 m

(Total 1 mark)

Q8. Which one of the following types of wave **cannot** be polarised?

A radio

B ultraviolet

C microwave

D ultrasonic

(Total 1 mark)

Q9. A wave of frequency 5 Hz travels at 8 km s^{-1} through a medium.

What is the phase difference, in radians, between two points 2 km apart?

A 0^o

B $\frac{\pi}{2}$ or 90^o

C π or 180^o

D $\frac{3\pi}{2}$ or 270^o

(Total 1 mark)