WAVES

QUANTITIES FOR THE WAVES UNIT

For this unit copy and complete the table.

Quantity	Symbol	Unit	Unit Symbol	Scalar / Vector
Time				
Period				
Frequency				
Wavelength				
Amplitude				
Distance				
Speed				
Velocity				

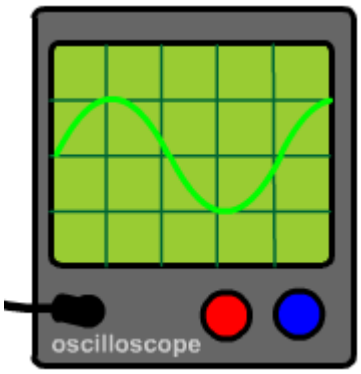
THE WAVES UNIT IN NUMBERS

Quantity	**Value**
What is the approximate speed of sound in air?	
What is the approximate speed of ultrasound in air?	
Does sound travel faster or slower in solids than in air?	
How many seconds in a minute?	
How many seconds in an hour?	
What is the speed of light in air?	
What is the speed of light in glass, eg in a fibre optic cable?	
What is the speed of microwaves in air?	
What is the speed of a television signal in air?	
What is the speed of a radio signals in air?	
At what speed do X-rays travel in air?	

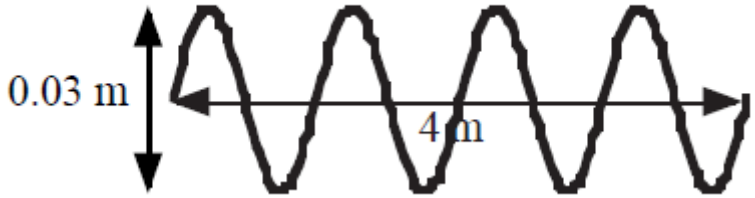
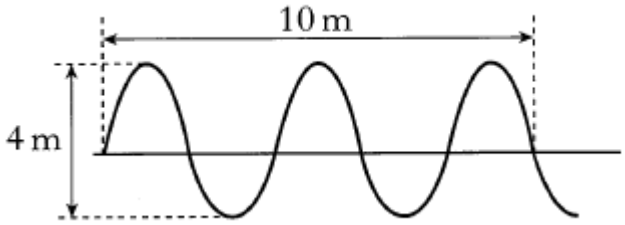
At what speed does gamma radiation travel in air?	
What is the approximate critical angle for light in glass?	
What is the smallest angle at which total internal reflection occurs in glass?	

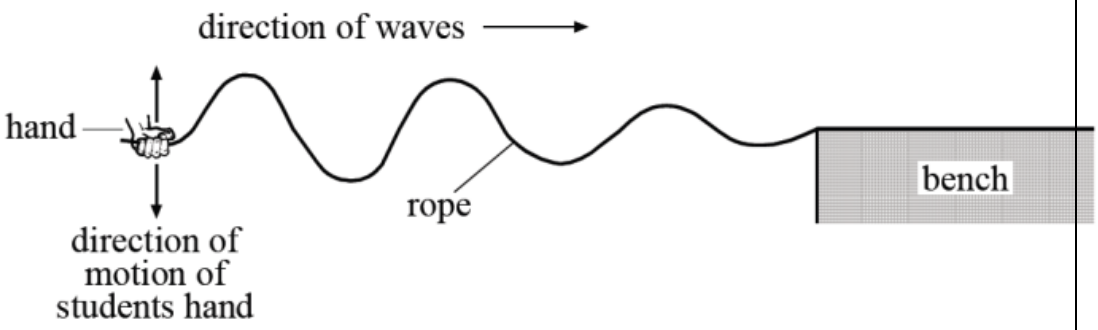
No.	CONTENT
Wave parameters and behaviours	
17.1	I can state what is transferred as waves.
17.1.1	State what is transferred when a wave travels from one place to another.
17.1.2	State the connection between waves and energy.
17.2	I can define transverse waves.
17.2.1	Draw and label a diagram showing a transverse wave.
17.2.2	Mark on your diagram the wavelength, amplitude, direction of energy transfer and direction of movement of particles.
17.3	I can define longitudinal waves.
17.3.1	Draw and label a diagram showing a longitudinal wave.
17.3.2	Mark on your diagram the wavelength, rarefaction, compression, amplitude, direction of energy transfer and direction of movement of particles.
17.3.3	What kinds of materials can sound travel through?
17.3.4	What can sound not travel through?
17.4	I can give examples of longitudinal and transverse waves.

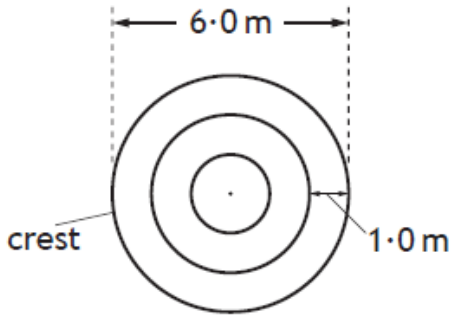
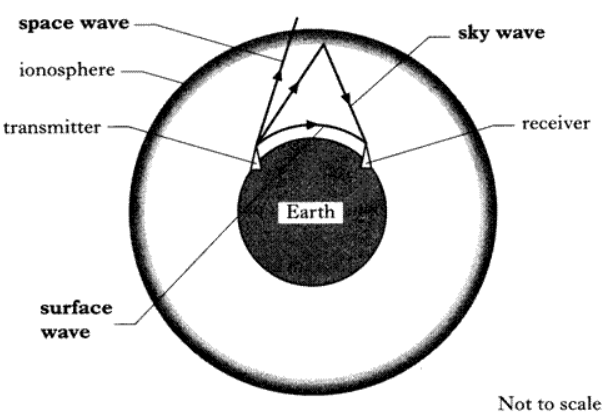
<table>
<tr><th>No.</th><th>CONTENT</th></tr>
<tr><td>17.4.1</td><td>Copy and complete the table below and place the following waves into the correct section of the table.
e-m waves (write each member of this group out separately), sound, seismic p-waves, seismic s-waves,

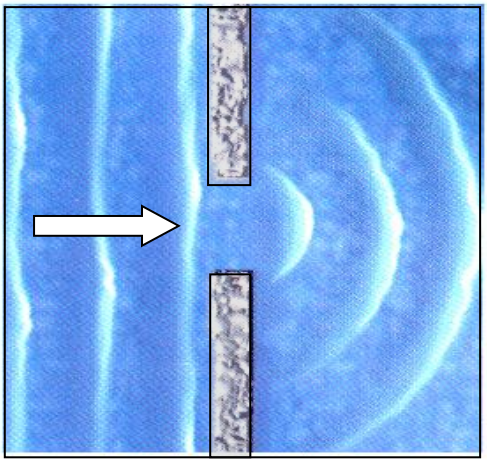
<table><tr><th>Transverse Waves</th><th>Longitudinal Waves</th></tr><tr><td></td><td></td></tr></table></td></tr>
<tr><td>17.4.2</td><td>Waves can be used to transmit signals. What type of waves would be used to
(a) tell competitors to start a race,
(b) broadcast TV signals,
(c) warn ships of shallow water,
(d) warn aircraft of high towers,
(e) pass down a fibre optic cable?</td></tr>
<tr><td>17.4.3</td><td> 

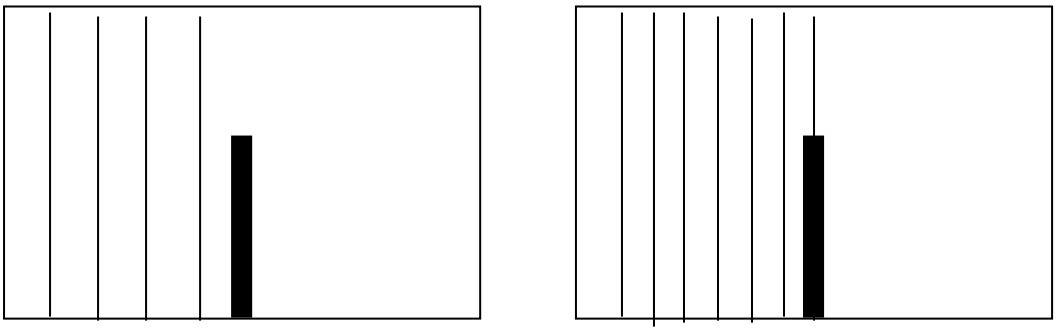
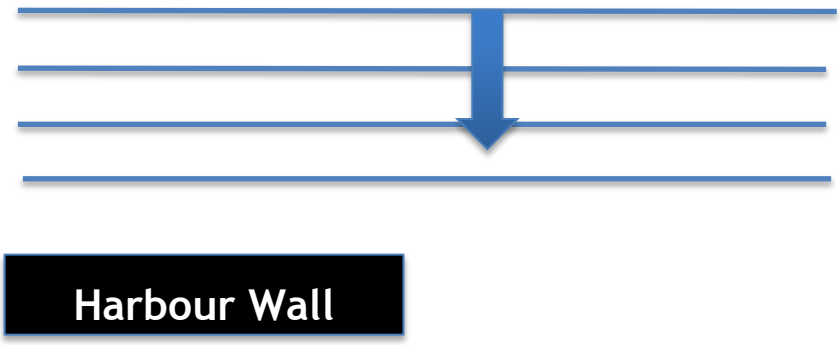
Explain how a sound wave be shown on an oscilloscope like in the diagram below although sound is a longitudinal wave..</td></tr>
<tr><td>17.5</td><td>I can determine the frequency, period, wavelength, amplitude and wave speed for longitudinal and transverse waves.</td></tr>
<tr><td>17.5.1</td><td>State what is meant by the frequency of a wave.</td></tr>
<tr><td>17.5.2</td><td>State the link between period and frequency.</td></tr>
<tr><td>17.5.3</td><td>If 20 crests pass a point in two seconds calculate the frequency of the wave.</td></tr>
</table>

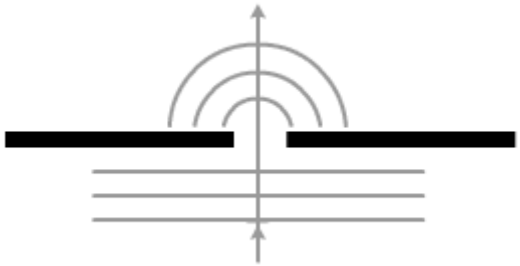
No.	CONTENT
17.5.3	The diagram below represents a wave 0.2 s after it has started.  Determine the a) wavelength b) amplitude c) frequency d) speed. for this wave:
17.5.4	The following diagram gives the information about a wave.  a. Determine the amplitude of the wave. b. Determine the wavelength of the wave.

No.	CONTENT
17.5.5	One end of a piece of rope is clamped to the end of a bench. A student produces transverse waves in the rope by moving the free end as shown in Figure 1.  ***Figure 1*** The student measures the frequency and wavelength of these waves. State the relationship she would use to calculate the speed of the waves from this information.
17.6	I can make use of the relationships between wave speed, frequency, wavelength, distance, number of waves and time ***(v = f λ) (d = vt)(f=1/T) (f=N/t) (λ=d/N.)***.
17.6.1	A water wave travels 200m in 15s. calculate the speed of the wave.
17.6.2	Calculate the time taken for the water wave given in 17.6.1 to travel a distance of 10 **km**?
17.6.3	State the formula linking speed, wavelength, and frequency, state the letter for each term and the unit each is measured in.
17.6.4	If the speed of sound is 340 ms^{-1}, what is the wavelength of a sound wave with a frequency of 2.0 kHz?
17.6.5	Twenty water waves pass a point in 30 seconds. Each wave has a wavelength of 1.2 m (A) Calculate the frequency of the waves. (B) Calculate the speed of the waves.
17.6.6	A sound wave has a frequency of 2.0 kHz, calculate the period of this wave.
17.6.7	A radio wave has a frequency of 97.7 MHz, state the number of waves generated per second.
17.6.8	State the time it would take one of the radio waves of frequency 97.7 MHz to pass a point

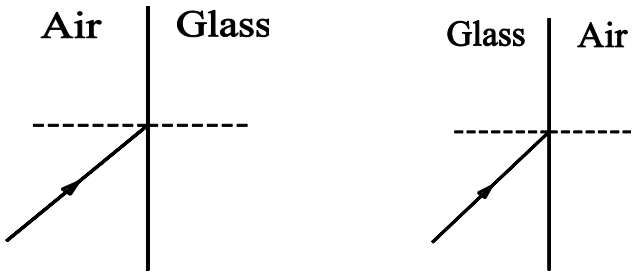
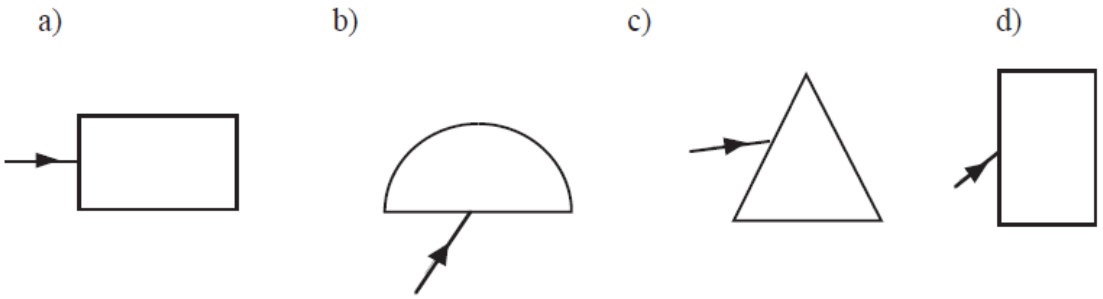
No.	CONTENT
17.6.9	The diagram represents the position of the crests of waves 3 seconds after a stone is thrown into a pool of still water.  Calculate the speed and the frequency of the waves.
17.6.10	The period of vibration of a guitar string is 8 ms. Calculate the frequency of the sound produced by the guitar string.
17.6.11	An oscilloscope can be used to display the signal in a telephone line. Draw diagrams showing what the pattern would be like for: (a) a loud, low pitched sound, (b) a loud, high pitched sound, (c) a quiet, high pitched sound, (d) a quiet, low pitched sound, (e) speech.
17.7	I can describe diffraction and associated practical limitations.
17.7.1	Explain what is meant by the term diffraction. *You may use diagrams to help you.*
17.7.2	 Not to scale This diagram shows three types of signal in which radio waves can be sent between a transmitter and receiver. State the signal with the longest wavelength. *You musy justify your answer.*
17.8	I can make comparisons of long wave and short-wave diffraction.

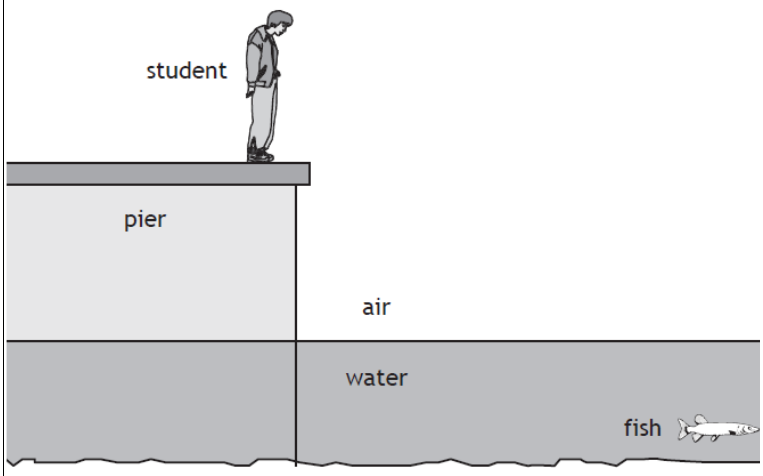
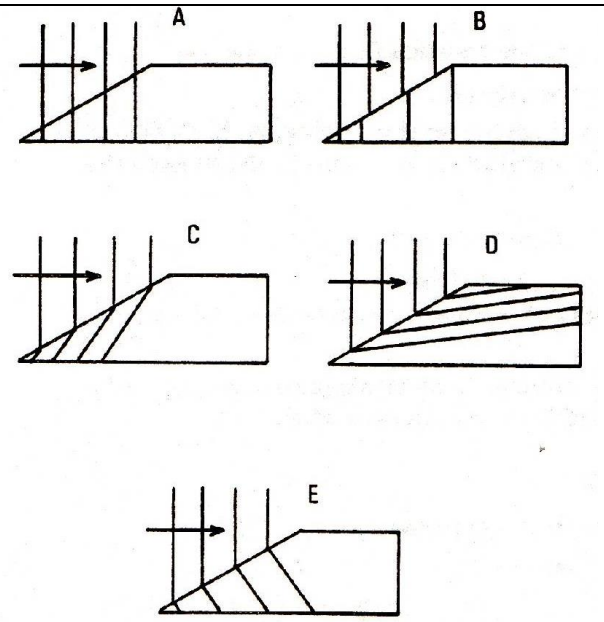
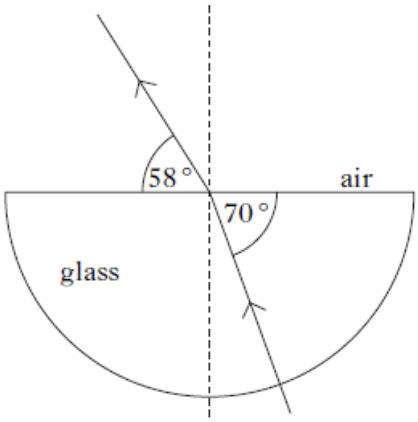
No.	CONTENT
17.8.1	State which waves have the longer wavelength - those used for radio or TV.
17.8.2	Explain in terms of diffraction, why radio reception in an area can be good, but TV reception poor.
17.9	I know when diffraction of waves occurs.
17.9.1	State examples when diffraction occurs.
17.9.2	When waves diffract through a gaps state what happens to the a) wave speed b) frequency c) wavelength
17.10	I can compare how long waves and short waves diffract.
17.10.1	The diagram below shows water waves passing through a gap in a harbour wall. The arrow shows the direction the wave is travelling.  Water waves with a shorter wavelength are now passed through the same gap. What difference, if any, will this have after they have passed through? A ship breaks into the harbour wall and breaks a piece off making the gap larger. What difference, if any, will this have after waves pass through the harbour?

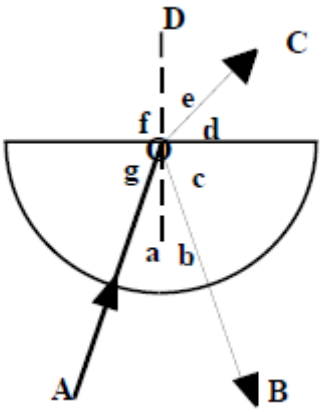
No.	CONTENT
17.10.2	Copy and complete the diagram to show the difference between long waves and short waves as they diffract around a barrier. 
17.10.3	When waves pass through a gap, the width of the gap changes the way the waves emerge from the gap. Draw a diagram (a) to show how waves diffract when the gap is greater than one wavelength. (b) to show how waves diffract when the gap is greater than one wavelength.
17.11	I can draw diagrams using wavefronts to show diffraction when waves pass through a gap or around an object.
17.11.1	The diagram shows wavefronts arriving at a harbour wall. Copy and complete the diagram to show the wavefronts passing the harbour wall. 
17.11.2	Repeat the question above showing the same habour wall when waves of a longer wavelength arrive at it.

<table>
<tr><th>No.</th><th>CONTENT</th></tr>
<tr><td>17.11.3</td><td>Waves exit a gap as shown in the diagram below. For the waves to exit as semi-circular waves what can you state about the width of the gap compared to the wavelength of the waves.
  </td></tr>
<tr><td colspan="2">Electromagnetic Spectrum</td></tr>
<tr><td>18.1</td><td>I can state the relative frequency and wavelength bands of the electromagnetic spectrum.</td></tr>
<tr><td>18.1.1</td><td>List the members of the electromagnetic spectrum in order of increasing wavelength.</td></tr>
<tr><td>18.1.2</td><td>As the wavelength of the radiation increases, state what happens to its frequency.</td></tr>
<tr><td>18.1.3</td><td>Radio waves have a wide range of frequencies.
The table gives information about different wavebands.
<table>
<tr><th>Waveband</th><th>Frequency Range</th><th>Example</th></tr>
<tr><td>Low frequency, (LF)</td><td>30 kHz- 300 kHz</td><td>Radio 4</td></tr>
<tr><td>Medium frequency, (MF)</td><td>300 kHz – 3 MHz</td><td>Radio Scotland</td></tr>
<tr><td>High frequency, (HF)</td><td>3 MHz- 30 MHz</td><td>Amateur Radio</td></tr>
<tr><td>Very High frequency, (VHF)</td><td>30 MHz – 300 MHz</td><td>Radio 1 FM</td></tr>
<tr><td>Ultra High frequency, (UHF)</td><td>300 MHz – 3 GHz</td><td>BBC1 and ITV</td></tr>
<tr><td>Very High frequency, (SHF)</td><td>3 GHz – 30 GHz</td><td>Satellite TV</td></tr>
</table>
Coastguards use signals of frequency 500 kHz. State the waveband these signals belong to.</td></tr>
</table>

No.	CONTENT
18.1.4	A student makes the following statements about different types of electromagnetic waves. I Light waves are transverse waves. II Radio waves travel at 340 m s−1 through air. III Ultraviolet waves have a longer wavelength than infrared waves. Copy each statement and mark a tick or a cross to indicate if each of the student's statements are correct.
18.2	I can make reference to typical sources, detectors and applications, of the electromagnetic spectrum.
18.2.1	Draw a table listing a detector for each member of the electromagnetic spectrum. For each type of wave in the e-m spectrum give an example of the following (a) typical source producing this type of waves (b) detector (c) A practical use for the radiation
18.3	I can state whether radiations in the electromagnetic spectrum are transverse or longitudinal waves.
18.3.1	Copy the sentence below inserting the correct type of wave. Radiations in the electromagnetic spectrum are $\frac{\text{transverse}}{\text{longitudinal}}$ waves.
18.4	I can state what all radiations in the electromagnetic spectrum have in common.
18.4.1	State what all waves in the electromagnetic spectrum have in common.
18.4.2	State the speed of light in air.
18.4.3	State how the speed of light in air compares to the speed of light in glass.
18.4.4	List the waves that travel at the same speed as light in air.
Refraction	
19.1	I know when refraction occurs.
19.1.1	State what causes the refraction of light.

No.	CONTENT
19.1.2	State a cause of refraction in water waves at the beach.
19.2	I can give a description of refraction.
19.2.1	State what is meant by the term refraction.
19.2.2	Copy and complete these diagrams showing how light passes from air to glass, and glass to air. 
19.2.3	On each of your completed diagrams above mark the following (a) the angle of incidence, (b) the angle of refraction, (c) the normal line.
19.2.4	Copy and complete the diagrams below to show the path of the rays. 

No.	CONTENT
19.2.5	 A student looking from a pier into some calm water sees a fish. Copy and complete the diagram to show the path of a ray of light from the fish to the student. (diagrams available on the website and from your teacher) You should include the normal in your diagram
19.2.6	Copy out the correct diagram which represents the refraction of light waves after meeting a glass block as shown? 
19.2.7	Copy the diagram below and state  a) the angle of incidence b) the angle of refraction.

No.	CONTENT
19.3	I can describe the qualitative (info) relationship between the frequency and the energy associated with a form of radiation.
19.3.1	State the relationship between the frequency and the energy of waves.
19.3.2	For electromagnetic waves, E=hf or Energy = Planck's Constant x frequency. a) Find out the value of Planck's constant, and b) Calculate the energy associated with a wave of frequency 6×10^{14} Hz
19.3.3	State whether radio waves or infrared radiation have greater energies associated with them. *You must justify your answer*.
19.4	I can identify the normal, angle of incidence and angle of refraction in ray diagrams showing refraction.
19.4.1	Identify the following from the diagram shown below. i) the incident ray ii) the reflected ray iii) the refracted ray iv) the normal v) the angle of incidence vi) the angle of refraction vii) the angle of reflection. 
19.4.2	Explain why a ruler, placed in a beaker of water, appears to change as it enters the water.
19.4.3	Draw a diagram to show this, by trying it for yourself

Now complete the following questions from past exam papers

Paper	Year	Question No