

# **PiXL Independence:**

## **GCSE Physics – Student Booklet**

### **KS4**

**Topic: Waves in matter**

**Contents:**

- I. Level 1 - Multiple Choice Quiz – 20 credits
- II. Level 2 - 5 questions, 5 sentences, 5 words – 10 credits each
- III. Level 3 - Science in The News – 100 credits
- IV. Level 4 - Scientific Poster – 100 credits
- V. Level 5 - Video summaries – 50 credits each

# PiXL Independence – Level 1

## Multiple Choice Questions

### GCSE Physics – Waves in matter

---

**INSTRUCTIONS****Score: /20**

---

- Read the question carefully.
  - Circle the correct letter.
  - Answer all questions.
- 

1. Which ONE of the following types of waves is NOT an example of a mechanical wave?
  - a. Sound waves
  - b. Light waves
  - c. Water waves
  - d. Seismic waves
  
2. Select the correct definition from the list below for a transverse wave.
  - a. The oscillations of a transverse wave are perpendicular to the direction in which the waves transfer energy.
  - b. The oscillations of a transverse wave are parallel to the direction in which the waves transfer energy.
  - c. The oscillations of a transverse wave are at  $45^\circ$  to the direction in which the waves transfer energy.
  - d. The oscillations of a transverse wave are in the same direction in which the waves transfer energy.
  
3. Which of the following statements about longitudinal waves is FALSE?
  - a. Sound waves are an example of a longitudinal wave.
  - b. A slinky spring can be used to demonstrate how longitudinal waves travel.
  - c. Longitudinal waves have areas of compression and rarefaction.
  - d. All electromagnetic waves are longitudinal waves.
  
4. What is the relationship between amplitude and energy?
  - a. The bigger the amplitude of the waves, the more energy the waves carry.
  - b. The smaller the amplitude of the waves, the more energy the waves carry.
  - c. Amplitude and energy are not related, they have no effect on each other.
  - d. Doubling the amplitude of the waves, reduces the amount of energy the wave carries by half.
  
5. If the time period of a wave is 4 secs, what is the frequency of the wave?
  - a. 4 Hz
  - b. 25 Hz
  - c. 0.25 Hz
  - d. 40 Hz

6. Identify the correct equation to calculate wave speed.
- $v = \frac{f}{\lambda}$
  - $v = F \cdot \lambda$
  - $v = \frac{\lambda}{F}$
  - $v = f \cdot \lambda$
7. Sound waves in air travel at an approximate speed of ...
- 34 m/s
  - 340 m/s
  - 3400 m/s
  - $3 \times 10^8$  m/s
8. Which piece of apparatus would be most suitable for investigating waves?
- A beaker of water.
  - A mirror.
  - A Ripple tank.
  - A flat piece of wood.
9. Refraction occurs at a boundary between two mediums because...
- the speed and wavelength of the waves change.
  - the speed of the waves change.
  - the speed and amplitude of the waves change.
  - the wavelength and the amplitude of the waves change.
10. Sound waves cannot travel through...
- matter.
  - solids.
  - a vacuum.
  - a gas.
11. A reflected sound wave is known as ...
- a repeat.
  - an echo.
  - a return.
  - a reverberation.
12. The frequency range of human hearing is...
- 200 – 20,000 Hz
  - 20 – 2,000,000 Hz
  - 200 – 200, 000 Hz
  - 20 – 20,000 Hz
13. Dolphins can use sonar to detect objects in the sea. How far away is the object from the dolphin if the sonar takes 1 sec to be returned? Sound travels at 1484 m/s in sea water.
- 742 m
  - 1484 m
  - 2968 m
  - 371 m

14. Ultrasound waves are used for medical scans because they are partly reflected at a boundary between...
- air and body tissue.
  - body tissue and bone only.
  - body tissues of the same type.
  - two different types of body tissue.
15. Which ONE of the following is NOT an advantage of using ultrasound?
- Ultrasound is non-ionising.
  - Ultrasound can be used to scan organs.
  - Ultrasound can be used to scan soft tissues.
  - Ultrasound can detect chemical changes within the body's tissues.
16. Ultrasound waves are sound waves of a frequency...
- above 2 kHz.
  - above 20 kHz.
  - above 20 MHz.
  - above 200 kHz.
17. Which ONE of the following statements about seismic waves is correct?
- Primary seismic waves and secondary seismic waves are longitudinal waves.
  - Primary seismic waves and secondary seismic waves are transverse waves.
  - Primary seismic waves are longitudinal waves and secondary seismic waves are transverse waves.
  - Primary seismic waves are transverse waves and secondary seismic waves are longitudinal waves.
18. Earthquakes are recorded by detectors on the surface of the Earth called...
- accelerometers.
  - seismometers.
  - Quake-alarms.
  - motion detector.
19. Seismic P waves are useful for investigating the inner structure of the Earth because they...
- travel slower than S waves.
  - are reflected by solid rock.
  - are refracted by different densities of rock.
  - cannot travel through liquids.
20. The frequency of a sound wave is 440 oscillations every second. Calculate the time period of the tuning fork.
- $2.5 \times 10^{-3}$  s
  - 440 s
  - $4.4 \times 10^{-3}$  s
  - 2.5 s

## PiXL Independence – Level 2

### 5 questions, 5 sentences, 5 words

### GCSE Physics – Waves in matter

#### INSTRUCTIONS

---

- For each statement, use either the suggested website or your own text book to write a 5-point summary. In examinations, answers frequently require more than 1 key word for the mark, so aim to include a few key words.
- It is important to stick to 5 sentences. It is the process of selecting the most relevant information and summarizing it, that will help you remember it.
- Write concisely and do not elaborate unnecessarily, as it is harder to remember and revise facts from a big long paragraph.
- Finally, identify 5 key words that you may have difficulty remembering and include a brief definition. You might like to include a clip art style picture to help you remember it.

#### Example:

<b>QUESTION:</b>	What is the difference between a longitudinal and a transverse wave?			
<b>Sources:</b>	<b>Website –</b> 1. <a href="https://www.mytutor.co.uk/answers/4229/GCSE/Physics/What+is+the+difference+between+Transverse+and+Longitudinal+waves%253F">https://www.mytutor.co.uk/answers/4229/GCSE/Physics/What+is+the+difference+between+Transverse+and+Longitudinal+waves%253F</a> 2. <a href="http://www.acs.psu.edu/drussell/Demos/waves/wavemotion.html">http://www.acs.psu.edu/drussell/Demos/waves/wavemotion.html</a>			
	1. Oscillations of a transverse wave are perpendicular to the direction in which the waves transfer energy. 2. All electromagnetic waves are transverse. 3. Oscillations of longitudinal waves are parallel to the direction in which the waves transfer energy. 4. Sound waves are longitudinal. 5. Mechanical waves can be transverse or longitudinal.			
<b>Transverse wave</b>	<b>Perpendicular – at 90°</b>	<b>Oscillations - vibrations</b>	<b>Parallel – in the same plane as.</b>	<b>Mechanical waves</b>

<b>QUESTION 1:</b>	<b>Describe how to use a slinky spring to demonstrate the difference between a longitudinal and a transverse wave.</b>
<b>Sources:</b>	<b>Website –</b> 1. <a href="https://www.youtube.com/watch?v=iT4KAc0Ag1E">https://www.youtube.com/watch?v=iT4KAc0Ag1E</a> 2. <a href="#">Variety of waves   IOPSpark</a>

--	--	--	--	--

--	--	--	--	--

<b>QUESTION 2:</b>	<b>Describe an experiment to investigate waves using a ripple tank.</b>
<b>Sources:</b>	<b>Website –</b> <b>1.</b> <a href="https://www.youtube.com/watch?v=55z1xL_CBb8">https://www.youtube.com/watch?v=55z1xL_CBb8</a> <b>2.</b> <a href="http://crodriguez.s3-website-us-east-1.amazonaws.com/Handouts/Physics/Ripple%20Tank%20Lab.pdf">http://crodriguez.s3-website-us-east-1.amazonaws.com/Handouts/Physics/Ripple%20Tank%20Lab.pdf</a>

--	--	--	--	--

--	--	--	--	--

<b>QUESTION 3:</b>	<b>Describe an experiment investigating waves on a string.</b>
<b>Sources:</b>	<b>Website –</b> 1. <a href="https://phet.colorado.edu/en/simulation/wave-on-a-string">https://phet.colorado.edu/en/simulation/wave-on-a-string</a> 2. <a href="#">Waves On A String   Pearson+ Channels</a>

--	--	--	--	--

--	--	--	--	--



<b>QUESTION 4:</b>	<b>How does the ear work and what frequency range can the ear detect?</b>
<b>Sources:</b>	<b>Website –</b> 1. <a href="http://kidshealth.org/en/kids/ears.html">http://kidshealth.org/en/kids/ears.html</a> 2. <a href="https://www.youtube.com/watch?v=EEvwwGui2Ac">https://www.youtube.com/watch?v=EEvwwGui2Ac</a>

--	--	--	--	--

--	--	--	--	--

<b>QUESTION 5:</b>	<b>Draw and label a wave. Write definitions for each label you add.</b>
--------------------	---

<b>Sources:</b>	<b>Website –</b> 1. <a href="http://www.physicsclassroom.com/class/waves/Lesson-2/The-Anatomy-of-a-Wave">http://www.physicsclassroom.com/class/waves/Lesson-2/The-Anatomy-of-a-Wave</a> 2. <a href="https://scienceaid.net/physics/waves/properties.html">https://scienceaid.net/physics/waves/properties.html</a>
-----------------	--

--	--	--	--	--

--	--	--	--	--

# PiXL Independence – Level 3

## Science in the News

### GCSE Physics – Waves in matter

#### INSTRUCTIONS

---

#### Fake news

Sensationalised news stories have been around for some time, but with the mass growth of social media, the problem seems to have grown in recent years. At the very least, the US Presidential election has certainly highlighted the impact that misleading information can have.

At home, the Brexit vote also suffered from the circulation of misleading news stories. Therefore, the ability to identify real information, track it back to the source article and make your own judgement is a very important skill. This activity will help you develop that skill.

#### Are ultrasound scans safe for unborn babies?

News article: <http://news.bbc.co.uk/1/hi/health/8493796.stm>

NHS article: <http://www.nhs.uk/conditions/ultrasound-scan/pages/introduction.aspx>

Discussion article: <http://www.two-views.com/ultrasounds/risks.html#sthash.Uhbksmp4.dpbs>

Real article: [Warning over 'souvenir' baby scans | Nursing Times](#)

#### Task 1:

You need to produce a 1 page essay on the findings from the articles on the safety of ultrasound on unborn babies.

Essay section	Activity
Introduction	What is ultrasound and why it is used to create images of unborn babies?
Describe	Describe how ultrasound works to create images of the inside of the body. Define all scientific terms used.
Explore	Explore the context of the news article and outline the advantages and disadvantages of using ultrasound to scan unborn babies.
Evaluate	Evaluate, with reference to risks vs benefits, the use of ultrasounds. Do you think there should be any restrictions?

## Can animals predict natural disasters like earthquakes?

News article: [Can animals predict natural disasters? \(tuscaloosnews.com\)](http://tuscoosnews.com)

News article: [The animals that detect disasters - BBC Future](http://bbc.com/future)

Discussion article: [Animals & Earthquake Prediction | U.S. Geological Survey \(usgs.gov\)](http://usgs.gov)

Real article:

[http://news.nationalgeographic.com/news/2003/11/1111\\_031111\\_earthquakeanimals.html](http://news.nationalgeographic.com/news/2003/11/1111_031111_earthquakeanimals.html)

### Task 2:

You need to produce a 1 page essay on whether there is evidence to suggest that animals can predict natural disasters like earthquakes.

Essay section	Activity
<b>Introduction</b>	Introduce how an earthquake is caused and how the tremors reach the surface of the Earth.
<b>Describe</b>	Describe how earthquakes are detected using instruments and how animals detect earthquakes.
<b>Explore</b>	Explore the evidence that suggests that animals are able to predict earthquakes. What are the timescales for their predictions?
<b>Evaluate</b>	Evaluate which method would be the most reliable and give the longest timescale needed for governments to react to a prediction of an earthquake.

# PiXL Independence – Level 4

## Scientific Posters

### GCSE Physics – Waves in matter

#### INSTRUCTIONS

---

#### Scientific Posters

Scientists communicate research findings in three main ways. Primarily, they write journal articles much like an experiment write up. These are very concise, appraise the current literature on the problem and present findings. Scientists then share findings at conferences through talks and scientific posters. During a science degree, you would practice all three of these skills.

Scientific posters are a fine balance between being graphically interesting and attracting attention and sharing just the right amount of text to convey a detailed scientific message. They are more detailed than a talk and less detailed than a paper.

Use this information to help structure your poster – <https://www.wikihow.com/Make-a-Scientific-Poster>

More detailed guidance is available at: <https://guides.nyu.edu/posters>

#### Creating your poster

It is easiest to create a poster in PowerPoint; however, you need to add custom text boxes rather than using the standard templates.



Posters need to be eye catching, but readable from a distance. If you use PowerPoint, start with a 4:3 slide (for easier printing, it can then be printed on A3) and use a 14-16 pt font. The first box could be larger to draw people in. You can use a background image, but pick a simple one that is of high quality. Select 'text box fill' and select 'change the transparency' to maintain the contrast and partially show the picture.

You can experiment with different layouts and you should include images. Avoid a chaotic layout, posters are read from top left column downwards.

Remember to include the authors and references.

Finally, look at the examples given on the University of Texas website which also offers an evaluation of each <https://ugs.utexas.edu/our/poster/samples>

## How does a loudspeaker transmit sound waves?

### Background

Loudspeakers are used in many everyday modern devices from televisions to mobile phones to headphones. Loudspeakers convert electrical signals into audio sound, to provide a quality version of the original sound recorded. The quality of the sound produced depends on the quality of the products used to make the loudspeaker.

### Source articles

<http://www.gcscience.com/pme14.htm>

<http://www.howmusicworks.org/103/Sound-and-Music/Amplitude-and-Frequency>

<http://www.huffingtonpost.co.uk/2014/11/21/expensive-speakers-value-for-money-why n 6088948.html>

Use other sources as necessary.

### Task:

Produce a scientific poster on how a loudspeaker transmits electrical signals into sound waves.

<b>Recall</b>	Draw and label diagram of a sound wave (longitudinal).
<b>Describe</b>	Describe how pitch, amplitude and frequency are all related in order to produce a desirable sound that we interpret as music. Describe how a loudspeaker works to transmit sound.
<b>Compare</b>	Compare the difference between musical notes and general noise. What is 'noise' in terms of a loudspeaker? How does a loudspeaker try to eliminate 'noise'?
<b>Evaluate</b>	How do cheaper loudspeakers compare to more expensive loudspeakers? Are more expensive loudspeakers worth the extra money you would pay for them?

# PiXL Independence – Level 5

## Video summaries

### GCSE Physics – Waves in matter

#### Cornell Notes

At A level and University, you will make large amounts of notes, but those notes are only of use if you record them in a sensible way. One system for recording notes is known as the Cornell notes system. This method encourages you to select relevant information, rather than trying to write a transcript of everything said. More importantly, it forces you to spend a few minutes reviewing what you have written, which has been scientifically proven to aid learning and memory retention.

The ideal is to write everything on one page, but some students may prefer to type and others will to handwrite their notes. Whichever option you use, remember the aim is to summarise and condense the content with a focus on the objectives that you are trying to learn and understand.

#### There are three main sections to the Cornell notes:

- 1 **Cue/ Objectives** – This can be done before or after the lecture. You may have been provided with the objectives or you may need to decide what they were (in a less well-structured lecture) or you may want to make the link to your learning if this is an additional task or lecture you are viewing, such as this video.
- 2 **Notes** – In this space you record concisely, simply the things you are less likely to remember. **The NEW knowledge.**
- 3 **Summary** – The most important step that is carried out after the lecture. This helps to reinforce learning.

#### Background

The following short videos present two topics that link to your learning. The videos discuss how engineers try to earthquake proof buildings to save lives and how buildings are tested from the Bristol Science Centre. The second video discusses why buildings are prone to collapse during an earthquake.

#### Source article:

**Video 1 – Why it's impossible to engineer earthquake-proof buildings**

**YouTube:** <https://www.youtube.com/watch?v=cVk5i62hJjQ>

**Video 2 – Why do buildings fall in earthquakes?**

**Ted Ed talks:** <https://ed.ted.com/lessons/why-do-buildings-fall-in-earthquakes-vicki-v-may>

**Task:**

**You need to produce a set of Cornell notes for the videos given above.  
Use the following objective to guide your note taking, this links to your learning.**

- 1 Discuss how engineers' earthquake proof buildings.
- 2 Discuss why buildings are prone to collapse.

**Objectives**  
What are the main learning outcomes that have been shared with you?  
This will help guide you to taking the RIGHT notes during the video.

Title  
Date

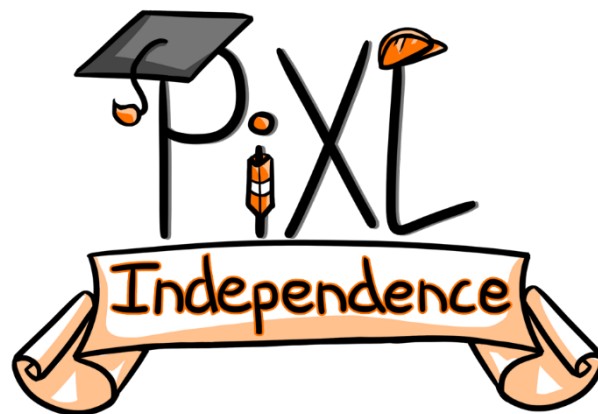
Sketch down note and key words  
Do not write in full sentences whilst you listen, put quick sketches, single words, mind maps, short hand etc.  
To help train you for university, try not to pause the video because you could not pause a live lecture (However, a lecture may give more natural pauses for you to catch up).

**Summary (after the video)**  
What are your main points of learning from this video.  
This is your chance to make sense of your notes.  
Make clear connections to the things you need to know



<b>Objectives:</b>	<b>Title:</b>
	<b>Date:</b>
<b>Summary:</b>	

<b>Objectives:</b>	<b>Title:</b>
	<b>Date:</b>
<b>Summary:</b>	



**Commissioned by The PiXL Club Ltd.**

This resource is strictly for the use of member schools for as long as they remain members of The PiXL Club. It may not be copied, sold, or transferred to a third party or used by the school after membership ceases. Until such time it may be freely used within the member school.

All opinions and contributions are those of the authors. The contents of this resource are not connected with, or endorsed by, any other company, organisation or institution.

PiXL Club Ltd endeavour to trace and contact copyright owners. If there are any inadvertent omissions or errors in the acknowledgements or usage, this is unintended and PiXL will remedy these on written notification.