

PiXL Independence:

GCSE Physics – Student Booklet

KS4

Topic: Light and electromagnetic waves

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 – Light and electromagnetic waves

INSTRUCTIONS

Score: /20

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

-
1. Which order of the electromagnetic spectrum is correct?
 - a. Radio – microwave – ultraviolet – visible light – infrared – x ray – gamma ray.
 - b. Radio – microwave – infrared – visible light – ultraviolet – x ray – gamma ray.
 - c. Radio – microwave – infrared – ultraviolet – visible light – x ray – gamma ray.
 - d. Radio – microwave – infrared – visible light – ultraviolet – gamma ray – x ray.

 2. The wavelength of visible light ranges from...
 - a. 35 nm to 65 nm
 - b. 20 nm to 200 nm
 - c. 100 nm to 400 nm
 - d. 380 nm to 700 nm

 3. Electromagnetic waves all have the same wave speed in a vacuum. Select the correct wave speed from the list below.
 - a. 3×10^8 m/s
 - b. 3×10^6 m/s
 - c. 340 m/s
 - d. 3.4 m/s

 4. A mobile phone gives out electromagnetic waves of frequency 800 MHz Calculate the wavelength of these waves.
 - a. 4.25×10^{-7} m
 - b. 4.25×10^{-9} m
 - c. 0.38 m
 - d. 3.75×10^{-3} m

 5. Which ONE of the following statements about infrared radiation is FALSE?
 - a. Optical fibres in communication systems use infrared radiation instead of visible light.
 - b. The hotter an object is, the less infrared radiation it emits.
 - c. Infrared radiation is absorbed by your skin.
 - d. Infrared cameras can be used to see people and animals in the dark.

 6. Light from ordinary lamps and from the Sun is called 'white light'. This is because...
 - a. it does not contain black light from the visible spectrum.
 - b. it is made up of the primary colours from the visible spectrum.
 - c. it is made up of only white light from the visible range.
 - d. it has all the colours of the visible spectrum in it.

7. Microwaves and radio waves can be dangerous because...
 - a. they can penetrate and heat internal parts of people's bodies.
 - b. they can cause skin burns.
 - c. they can cause cancer.
 - d. they contribute to global warming.

8. Which ONE of these statements could NOT complete this sentence?
Radio waves of different frequencies are used for different applications because the wavelength affects how...
 - a. far they can travel.
 - b. they spread.
 - c. much information they can carry.
 - d. much energy in the wave is absorbed.

9. Carrier waves are...
 - a. waves that are used to carry information.
 - b. types of microwaves.
 - c. used for satellite tv signals.
 - d. able to carry more information than ordinary waves.

10. Compared with radio-wave and microwave signals, optical fibres are...
 - a. only able to carry one signal at a time.
 - b. able to carry less information.
 - c. more secure because the signal stays in the fibre.
 - d. regarded as being more dangerous to people.

11. Ionisation caused by high energy photons is...
 - a. where atoms become charged by gaining protons.
 - b. where atoms become charged by losing electrons.
 - c. where atoms become charged by protons turning into neutrons.
 - d. where atoms become charged by neutrons turning into protons.

12. The uses of gamma rays do NOT include...
 - a. Killing harmful bacteria in food.
 - b. Sterilising surgical equipment.
 - c. Killing cancer cells.
 - d. Creating images of broken bones.

13. The radiation dose received by a person is the measure of the damage done to their body by ionising radiation.
Which of the following does NOT affect the radiation dose.
 - a. The surface area exposed.
 - b. The type of radiation used.
 - c. Time period of exposure.
 - d. Energy per second absorbed by the body.

14. The law of reflection of light states that...
 - a. the angle of incidence < the angle of reflection.
 - b. the angle of incidence = the angle of reflection.
 - c. the angle of incidence = the angle of refraction.
 - d. the angle of incidence > the angle of reflection

15. An image that can be seen on a screen is called a...
- diffused image.
 - specular image.
 - virtual image.
 - real image.
16. A prism shows the dispersion of white light by...
- bending the white light as it exits the prism.
 - producing a spectrum of visible light.
 - speeding up the white light as it travels through the prism.
 - changing the direction of the white light by the same amount.
17. The primary colours of light are...
- red, yellow and green.
 - red, purple and green.
 - red, blue and yellow.
 - red, blue and green.
18. A book that appears red in white light will appear what colour under a blue light?
- white
 - red
 - black
 - purple
19. A convex lens...
- produces virtual images only.
 - is also known as a diverging lens.
 - can be used to correct short sightedness.
 - can be used as a magnifying glass.
20. Calculate the magnification of a lens that has an object height of 0.3mm and an image height of 30mm.
- x 100
 - x 9
 - x 0.01
 - x 10

PiXL Independence – Level 2

5 questions, 5 sentences, 5 words

GCSE Physics – Light and electromagnetic waves

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, 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:

| | | | | |
|--|--|--|---|--------------------------------|
| QUESTION: | How are optical fibres used in communication? | | | |
| Sources: | Website – 1. http://www.bbc.co.uk/education/guides/zjqfr82/revision/1 2. http://www.passmyexams.co.uk/GCSE/physics/optical-fibres.html | | | |
| <ol style="list-style-type: none"> 1. Optical fibres are very thin glass fibres. 2. Used to transmit information using light or infrared radiation (IR). 3. When the light rays/ IR radiation reaches the surface of the fibre it is reflected back into the fibre. This is how the signal is carried. This is called total internal reflection (TIR) 4. Optical fibres can carry more information than radio waves. 5. Optical fibres are more secure because the signal stays inside the fibre. | | | | |
| Glass Fibres | Light or IR radiation | Reflected at the surfaces – TIR angle greater than critical angle | Critical angle – angle of incidence beyond which TIR takes place. | Secure More information |

| | |
|--------------------|---|
| QUESTION 1: | What are the uses of radio waves and microwaves? |
|--------------------|---|

| | |
|-----------------|--|
| Sources: | Website – 1. https://revisionworld.com/gcse-revision/physics/electromagnetic-radiation/radio-waves-microwaves 2. http://www.bbc.co.uk/schools/gcsebitesize/science/triple_ocr_gateway/space_for_reflection/satellite_communication/revision/1/ |
|-----------------|--|

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | |
|--------------------|--|
| QUESTION 2: | What is the difference between a real and virtual image. Give examples of each. |
| Sources: | Website – 1. http://hyperphysics.phy-astr.gsu.edu/hbase/geoopt/image.html 2. http://www.src.gov.jm/wp-content/uploads/2013/01/LensesFAQ.pdf |

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | |
|--------------------|--|
| QUESTION 3: | Describe how x rays and gamma rays are used in medicine. Comment on the safety aspects of using these rays. |
| Sources: | Website – 1. http://www.bbc.co.uk/schools/gcsebitesize/science/add_gateway_pre_2011/radiation/treatmentrev1.shtml 2. http://agni.phys.iit.edu/~vpa/medical%20applications.htm |

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | |
|--------------------|--|
| QUESTION 4: | What is black body radiation? |
| Sources: | Website – http://www.bbc.co.uk/programmes/p04yj8l3 Interactive - https://phet.colorado.edu/en/simulation/blackbody-spectrum |

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | |
|--------------------|--|
| QUESTION 5: | What is the order of the electromagnetic (EM) spectrum and what are the range of frequencies and wavelengths for each part of the spectrum? What do all parts of the EM spectrum have in common? |
| Sources: | Website – 1. http://www.s-cool.co.uk/gcse/physics/uses-of-waves/revise-it/electromagnetic-spectrum 2. http://www.gcse.com/waves/emspectrum.htm |

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

PiXL Independence – Level 3

Science in the News

GCSE Physics – Light and electromagnetic waves

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. www.tiny.cc/fakenews2

At home, the Brexit vote also suffered from the circulation of misleading news stories www.tiny.cc/fakenews3

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.

Mobile phones can fry your brain!

News article: <http://www.smh.com.au/comment/health-risks-mobile-phones-20170113-gtqsnu.html>

NHS article: <http://www.nhs.uk/Conditions/Mobile-phone-safety/Pages/Risks.aspx>

Discussion article: <http://www.cancerresearchuk.org/about-cancer/causes-of-cancer/cancer-controversies/mobile-phones-wifi-and-power-lines>

Real article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4350886/>

Task 1:

You need to produce a 1 page essay on the health effects of mobile phones.

| Essay section | Activity |
|---------------------|--|
| Introduction | What are mobile phones? Who could be at risk? What are the claimed health risks of using mobile phones? |
| Describe | Describe how a mobile device sends and receives information and define all scientific terminology used e.g. ionising. |
| Explore | Explore how mobile phone usage could damage cell structure and the possible health risks of this. What could people do to minimise the risk from mobile phones? |
| Evaluate | Evaluate the claims that have been made. What is the evidence to suggest that mobile phones are responsible for causing health issues? What do you think would be a sensible action to take in the future? |

Does laser eye surgery work to correct eye sight issues?

News article: <http://www.dailymail.co.uk/health/article-1334246/Tempted-laser-eye-surgery-Its-risks.html>

NHS article: <http://www.nhs.uk/Livewell/Eyehealth/Pages/Lasers.aspx>

Discussion article: <http://www.lasereyesurgeryhub.co.uk/how-does-laser-eye-surgery-work/>

Real article: <http://www.telegraph.co.uk/sponsored/health/optical-express-opticians/11646191/laser-eye-surgery-myths.html>

Task 2:

You need to produce a 1 page essay on whether laser eye surgery works to correct common sight issues.

| Essay section | Activity |
|----------------------|---|
| Introduction | What is laser eye surgery? How long has it been an option for patients? How many people each year opt for laser eye surgery? |
| Describe | Describe how the eye sees an image and how the lens and cornea work to create the image on the retina. Describe what laser surgery involves in order to correct the patient's sight issues. |
| Explore | Explore the suitability of laser eye surgery for all patients. Is it more suitable for some eye conditions than others? |
| Evaluate | Evaluate the risks and benefits to laser eye surgery. |

PiXL Independence – Level 4

Scientific Posters

GCSE Physics – Light and electromagnetic waves

INSTRUCTIONS

Scientific Posters

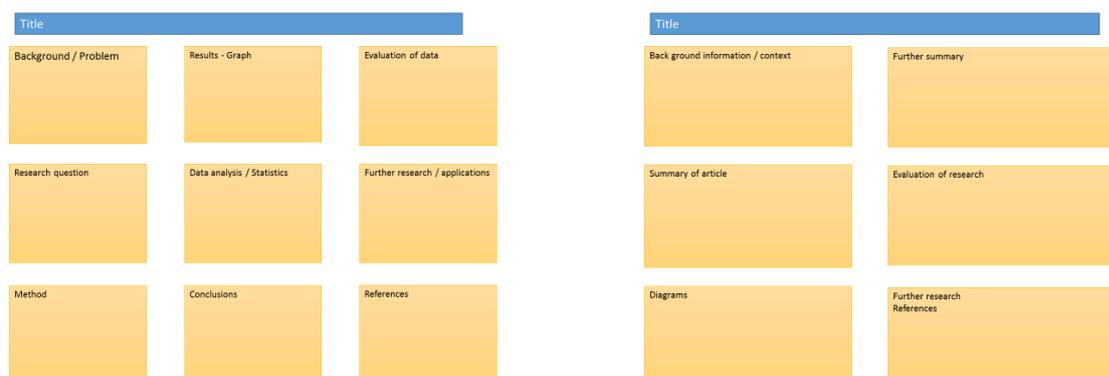
Scientists communicate research findings in three main ways. Primarily, they write journal articles much like an experiment write up. These are very concise, appraise the current literature on the problem and present findings. Scientists then share findings at conferences through talks and scientific 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 – www.tiny.cc/posterskills (that's Poster Skills not Posters Kill!) More detailed guidance is available at: www.tiny.cc/posterskills2

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 www.tinyurl.com/postereg

Formation of REAL and VIRTUAL images using convex and concave lens.

Background

Convex and concave lens are used many times every day to enable us to see the world around us. They form images which are real, virtual, magnified, diminished, inverted and upright. You must be able to draw ray diagrams to show how each lens forms an image and the properties that the image will have.

Source articles

<http://www.physicsclassroom.com/class/refrn/Lesson-5/Converging-Lenses-Ray-Diagrams>

<http://hyperphysics.phy-astr.gsu.edu/hbase/geoopt/raydiag.html>

<https://www.youtube.com/watch?v=ZZ1Gs-aV4Ek>

<https://www.youtube.com/watch?v=-zE7iPv7rDA>

<http://www.gcscience.com/pwav27.htm>

Use other sources as necessary.

Task:

Produce a scientific poster on...

| | |
|-----------------|--|
| Recall | Recall all the scientific terminology associated with drawing a ray diagram and the definitions of those words e.g. principle axis, focus, focal length, concave, convex. |
| Describe | Describe, using step by step instructions, how to draw a ray diagram of a REAL image by a convex lens, a VIRTUAL image by a convex lens and a VIRTUAL image by a concave lens. |
| Compare | Compare the differences between a REAL and VIRTUAL ray diagram. |
| Evaluate | Evaluate the different properties (nature) of REAL and VIRTUAL images. |

PiXL Independence – Level 5

Video summaries

GCSE Physics – Light and electromagnetic waves

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 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 remember - **The NEW knowledge**.
- 3 **Summary** – The most important step that is carried out after the lecture or video. This helps to reinforce learning.

Background

The following short videos present two topics that link to your learning. The first is on what ultraviolet waves are. The second video discusses why people should wear sunscreen and health benefits linked to its use.

Source article:

Video 1 – What are ultraviolet waves?

Website: <https://www.youtube.com/watch?v=QW5zeVy8aE0>

Video 2 – Why do we have to wear sunscreen?

Ted Ed talks : <https://ed.ted.com/lessons/why-do-we-have-to-wear-sunscreen-kevin-p-boyd>

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 the main features of ultraviolet waves.
2. Discuss why people should wear sunscreen, with its related health benefits.

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

| | |
|--------------------|---------------|
| Objectives: | Title: |
| | Date: |
| Summary: | |



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.