

# **PiXL Independence:**

## **GCSE Physics – Student Booklet**

### **KS4**

**Topic: Atomic structure**

**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 – Atomic structure

#### INSTRUCTIONS

Score: /20

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

1. A radioactive substance contains...
  - a. unstable electrons that become stable by emitting radiation.
  - b. unstable atoms that become stable by emitting radiation.
  - c. unstable protons that become stable by emitting radiation.
  - d. unstable nuclei that become stable by emitting radiation.
2. Rutherford used what kind of particles to conduct his particle scattering experiment?
  - a.  $\alpha$
  - b.  $\beta$
  - c.  $\gamma$
  - d.  $\lambda$
3. Which ONE of the following statements was NOT a result from Rutherford's experiment?
  - a. Most of the particles passed straight through the gold foil.
  - b. Most of the particles reduced speed significantly as they passed through the gold foil.
  - c. Some of the particles were deflected back through large angles.
  - d. A very small number of particles were deflected backwards.
4. Isotopes are atoms of the same element with...
  - a. the same number of protons, different numbers of neutrons.
  - b. different numbers of protons, the same number of neutrons.
  - c. different numbers of protons and neutrons.
  - d. the same number of protons, different numbers of electrons.
5. Which equation represents the decay of potassium to calcium by emitting a beta particle?
  - a.  ${}_{19}^{40}\text{K} \rightarrow {}_{19}^{41}\text{Ca} + {}_{0}^{-1}\beta$
  - b.  ${}_{19}^{40}\text{K} \rightarrow {}_{17}^{36}\text{Ca} + {}_{2}^{4}\beta$
  - c.  ${}_{19}^{40}\text{K} \rightarrow {}_{20}^{40}\text{Ca} + {}_{-1}^{0}\beta$
  - d.  ${}_{19}^{40}\text{K} \rightarrow {}_{16}^{38}\text{Ca} + {}_{4}^{2}\beta$
6. When using a Geiger counter to measure radiation, you must also consider what?
  - a. Contamination radiation
  - b. CMBR
  - c. Incidental radiation
  - d. Background radiation

7. The radiation from a radioactive substance can knock electrons out of an atom. This process is called...
  - a. extraction.
  - b. ionisation.
  - c. irradiation.
  - d. penetration.
  
8. Smoke alarms contain which radioactive source?
  - a. Alpha
  - b. Beta
  - c. Gamma
  - d. None of these
  
9. The half-life of a radioactive isotope is the average time it takes for the number of...
  - a. neutrons in the radioactive sample to halve.
  - b. atoms in the radioactive sample to halve.
  - c. radioactive nuclei in the sample to halve.
  - d. electrons in the radioactive sample to halve.
  
10. A sealed tube containing 8 mg of a radioactive isotope has a half-life of 10 hours. Calculate what mass of the isotope is in the tube after 30 hours.
  - a. 6 mg
  - b. 4 mg
  - c. 0.5 mg
  - d. 1 mg
  
11. Which ONE of these medical applications can radioactive isotopes NOT be used for?
  - a. The breakdown of kidney stones.
  - b. Medical imaging.
  - c. Treatment of cancer.
  - d. Tracers to monitor organs.
  
12. Nuclear fission is...
  - a. the joining of an atom's nucleus into two smaller nuclei, two or three neutrons and the release of energy.
  - b. the splitting of an atom's nucleus into two smaller nuclei, two or three neutrons and the release of energy.
  - c. the splitting of an atom into two smaller atoms, two or three neutrons and the release of energy.
  - d. the splitting of an atom's nucleus into two smaller nuclei, two or three protons and the release of energy.
  
13. The fuel in a nuclear reactor must contain isotopes capable of undergoing nuclear fission. The most common type of fuel used is...
  - a. Uranium-238.
  - b. Uranium-235.
  - c. Plutonium-239.
  - d. Thorium-232.

14. When nuclear fission occurs, several neutrons can be released which can cause other fissionable isotopes to split. This is called...
- a spontaneous reaction.
  - a fission reaction.
  - an uncontrollable reaction.
  - a chain reaction.
15. The reaction described in question 14 can be prevented in a nuclear reactor core by using...
- lead shielding.
  - control rods.
  - a moderator.
  - coolant.
16. Fusion reactions take place when...
- two small nuclei are fused together and release energy.
  - two small atoms are fused together and release energy.
  - two large nuclei are fused together and release energy.
  - two small nuclei are fused together and release neutrons.
17. Which ONE of the following would NOT be an advantage of a fusion reactor?
- Heavy hydrogen fuel is easily available in sea water.
  - The reaction product, helium, is a non-radioactive gas.
  - The energy released could be used to generate electricity.
  - Fusion reactors have a short start up time.
18. An alpha emitting isotope that seeps into houses through the ground in some areas is called...
- uranium gas.
  - radon gas.
  - thorium gas.
  - plutonium gas.
19. Nuclear waste must be stored securely for many years. The radiation it emits is dangerous because...
- it ionises the air we breathe.
  - it will irradiate the soil.
  - it can cause cancer.
  - it will start a chain reaction.
20. Radiation can be found naturally in the environment. The most common source of this radiation is from...
- radon gas.
  - rocks.
  - cosmic rays
  - plants.

## PiXL Independence – Level 2

### 5 questions, 5 sentences, 5 words

### GCSE Physics – Atomic structure

#### INSTRUCTIONS

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- 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 a radioactive substance?			
<b>Sources:</b>	Website – 1. <a href="https://www.youtube.com/watch?v=V-UtgheMNNU">https://www.youtube.com/watch?v=V-UtgheMNNU</a> 2. <a href="http://www.darvill.clara.net/nucrad/types.htm">http://www.darvill.clara.net/nucrad/types.htm</a>			
	1. A radioactive substance contains unstable nuclei that become stable by emitting radiation. 2. There are three main types of radiation – alpha, $\alpha$ , beta, $\beta$ and gamma, $\gamma$ . 3. Radioactive decay is random – it cannot be predicted. 4. All radioactive sources emit alpha, beta and gamma radiation. 5. A Geiger counter is used to measure the amount of radioactivity given off by a substance.			
Unstable nuclei	$\alpha$ , $\beta$ , $\gamma$	Random	All radioactive sources emit $\alpha$ , $\beta$ , $\gamma$ radiation.	Geiger counter

**QUESTION 1:**

Compare the plum pudding model and the nuclear model of the atom.

**Sources:**

**Website –**

1. <http://www.bbc.co.uk/education/guides/z44xsbk/revision>
2. <https://www.youtube.com/watch?v=4HOWi-vhy7Q>

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<b>QUESTION 2:</b>	<b>Define what is meant by alpha, beta and gamma radiation and how these can be shown in a decay equation for alpha and beta.</b>
<b>Sources:</b>	<b>Website –</b> <ol style="list-style-type: none"><li>1. <a href="http://www.darvill.clara.net/nucrad/types.htm">http://www.darvill.clara.net/nucrad/types.htm</a></li><li>2. <a href="http://www.passmyexams.co.uk/GCSE/physics/alpha-beta-gamma-rays.html">http://www.passmyexams.co.uk/GCSE/physics/alpha-beta-gamma-rays.html</a></li></ol>

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<b>QUESTION 3:</b>	<b>Compare the penetrating power of alpha, beta and gamma radiation – quantify your notes.</b>
<b>Sources:</b>	<b>Website –</b> <ol style="list-style-type: none"><li>1. <a href="http://www.passmyexams.co.uk/GCSE/physics/penetrating-properties-of-radiation.html">http://www.passmyexams.co.uk/GCSE/physics/penetrating-properties-of-radiation.html</a></li><li>2. <a href="http://www.gcsescience.com/prad11-physics-radioactivity-penetrating-ability.htm">http://www.gcsescience.com/prad11-physics-radioactivity-penetrating-ability.htm</a></li></ol>

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<b>QUESTION 4:</b>	<b>What is 'half-life' and how can it be calculated from a graph? Include worked examples in your notes.</b>
<b>Sources:</b>	<b>Website –</b> <b>1.</b> <a href="https://www.youtube.com/watch?v=0vFHPfnWORc">https://www.youtube.com/watch?v=0vFHPfnWORc</a> <b>2.</b> <a href="http://www.gcsescience.com/prad16-half-life.htm">http://www.gcsescience.com/prad16-half-life.htm</a>

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<b>QUESTION 5:</b>	<b>What are the uses of radioactive substances? Include an example for each type of radiation.</b>
<b>Sources:</b>	<b>Website –</b> <b>1.</b> <a href="http://www.darvill.clara.net/nucrad/uses.htm">http://www.darvill.clara.net/nucrad/uses.htm</a> <b>2.</b> <a href="http://www.bbc.co.uk/education/guides/zkktyrd/revision/1">http://www.bbc.co.uk/education/guides/zkktyrd/revision/1</a>

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# PiXL Independence – Level 3

## Science in the News

### GCSE Physics – Atomic structure

#### INSTRUCTIONS

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#### 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](http://www.tiny.cc/fakenews2)

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

#### The Risks of Radiation Therapy

News article: <https://www.cheatsheet.com/health-fitness/these-popular-cancer-treatments-have-the-most-dangerous-side-effects.html/?a=viewall>

NHS article: <http://www.nhs.uk/Conditions/Radiotherapy/Pages/Introduction.aspx>

Discussion article: <https://health.usnews.com/health-news/patient-advice/articles/2015/05/22/radiation-evolving-choices-in-cancer-treatment>

Real article: <http://www.cancerresearchuk.org/about-cancer/cancer-in-general/treatment/radiotherapy/follow-up/long-term-side-effects>

#### Task 1:

You need to produce a 1 page essay on the risks surrounding radiation therapy.

Essay section	Activity
<b>Introduction</b>	What is radiation therapy? What is radiation therapy used to treat?
<b>Describe</b>	Describe how radiation therapy would be conducted using a specific type of tumor, e.g. brain, breast, liver.
<b>Explore</b>	Explore the risk associated with having radiation therapy.
<b>Evaluate</b>	Evaluate whether the benefit outweighs the risk for the patient.

## What would be the environmental impact of a nuclear attack?

News article: <http://www.mirror.co.uk/news/world-news/north-korean-nuclear-attack-hawaii-11240408>

News article: <http://www.nucleardarkness.org/warconsequences/>

NHS article: <http://www.nhs.uk/conditions/Radiation/Pages/Introduction.aspx>

Discussion article: <http://www.bmartin.cc/pubs/82cab/>

Real article <http://www.who.int/mediacentre/factsheets/fs371/en/>

Video: [https://www.ted.com/talks/irwin\\_redlener\\_warns\\_of\\_nuclear\\_terrorism](https://www.ted.com/talks/irwin_redlener_warns_of_nuclear_terrorism)

### Task 2:

You need to produce a 1 page essay on the environmental impact of a nuclear attack.

<b>Essay section</b>	<b>Activity</b>
<b>Introduction</b>	What are nuclear weapons and how powerful are they?
<b>Describe</b>	Describe the ways nuclear attack and radiation fallout would impact the Earth.
<b>Explore</b>	Explore what precautions could be taken to minimise these impacts.
<b>Evaluate</b>	Evaluate the role of individuals and government in providing protection against nuclear fallout and how effective these might be.

# PiXL Independence – Level 4

## Scientific Posters

### GCSE Physics – Atomic structure

#### INSTRUCTIONS

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#### 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](http://www.tiny.cc/posterskills) (that's Poster Skills not Posters Kill!) More detailed guidance is available at: [www.tiny.cc/posterskills2](http://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](http://www.tinyurl.com/postereg)

## Compare nuclear fission and nuclear fusion, their role in generating energy and their long-term futures.

### Background

Both fission and fusion are nuclear reactions that produce energy, but that is where their similarities end. Fission is the splitting of a heavy, unstable nucleus into two lighter nuclei, and fusion is the process where two light nuclei combine together releasing vast amounts of energy. Both have a place in the energy generation industry but, where is it?

### Source articles

<http://www.passmyexams.co.uk/GCSE/physics/nuclear-fusion.html>

<http://www.passmyexams.co.uk/GCSE/physics/nuclear-fission.html>

<http://www.gcsescience.com/prad37-nuclear-power-moderator-control-rod.htm>

<http://www.passmyexams.co.uk/GCSE/physics/nuclear-reactor.html>

<https://www.youtube.com/watch?v=LekacMuM12Y>

<https://www.youtube.com/watch?v=mZsaaturR6E>

[http://www.bbc.co.uk/schools/gcsebitesize/science/ocr\\_gateway\\_pre\\_2011/living\\_future/3\\_fuels\\_for\\_power3.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/ocr_gateway_pre_2011/living_future/3_fuels_for_power3.shtml)

<http://www.bbc.co.uk/education/clips/zvmcd2p>

<http://www.world-nuclear.org/information-library/current-and-future-generation/outline-history-of-nuclear-energy.aspx>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4678124/>

Use other sources as necessary.

### Task:

Produce a scientific poster on the role of nuclear fission and nuclear fusion in the generation of energy.

<b>Recall</b>	Define the processes of fusion, fission and chain reaction.
<b>Describe</b>	Describe what conditions are needed for fission and fusion to take place. What does a fusion reactor look like? What does a fission reactor do?
<b>Compare</b>	Compare the two ways of generating energy – discuss environmental, social, economic and general safety and waste management impacts.
<b>Evaluate</b>	Evaluate the futures of both fission and fusion.

# PiXL Independence – Level 5

## Video summaries

### GCSE Physics – Atomic structure

#### 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 TED talks present two topics that link to your learning. The first is on the people who have remained in a radioactive disaster area and their reasons for doing so. The second video discusses how people's perceptions of nuclear power might actually be preventing us from conserving the environment.

#### Source article:

**Video 1 – Why stay in Chernobyl? Because it's home.**

**Ted Ed talks :**

[https://www.ted.com/talks/holly\\_morris\\_why\\_stay\\_in\\_chernobyl\\_because\\_it\\_s\\_home](https://www.ted.com/talks/holly_morris_why_stay_in_chernobyl_because_it_s_home)

**Video 2 – How fear of nuclear power is hurting the environment.**

**Ted Ed talks:**

[https://www.ted.com/talks/michael\\_shellenberger\\_how\\_fear\\_of\\_nuclear\\_power\\_is\\_hurtin\\_g\\_the\\_environment](https://www.ted.com/talks/michael_shellenberger_how_fear_of_nuclear_power_is_hurtin_g_the_environment)

**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 reasons people stay in radioactive areas despite the dangers.
2. Discuss how people's perceptions of nuclear power may actually be harming the environment.

**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

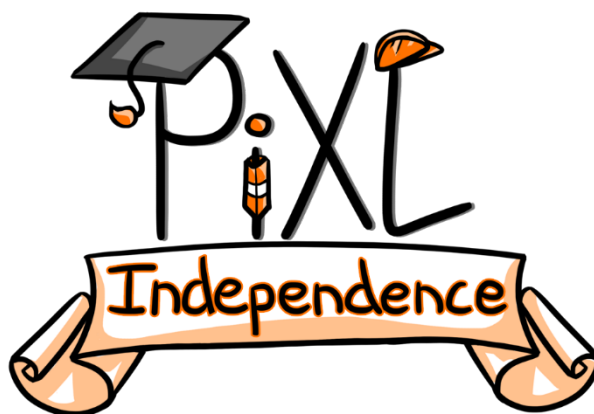
Sketch down note and key words  
Do not write in full sentences whilst you listen, put quick sketches, single words, mind maps, short hand etc.  
To help train you for university, try not to pause the video because you could not pause a live lecture (However, a lecture may give more natural pauses for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



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