

# **PiXL Independence:**

## **GCSE Physics – Student Booklet**

### **KS4**

**Topic: Forces and Motion**

**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 – Forces and Motion**

**INSTRUCTIONS**

Score: /20

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

- 
1. The gradient of a line on a distance-time graph represents...
    - a. change in time.
    - b. speed.
    - c. acceleration.
    - d. distance travelled.
  
  2. Choose the correct equation for speed
    - a.  $v = \frac{s}{t}$
    - b.  $s = \frac{v}{t}$
    - c.  $v = s \cdot t$
    - d.  $t = v \cdot s$
  
  3. What speed would a car be travelling at if it covered 60 km in 80 minutes?
    - a. 0.75 m/s
    - b. 750 m/s
    - c. 12.5 m/s
    - d. 0.01 m/s
  
  4. Calculate the acceleration of a train travelling from rest to 24 m/s in 12 seconds.
    - a. 2 m/s<sup>2</sup>
    - b. 288 m/s<sup>2</sup>
    - c. 0.5 m/s<sup>2</sup>
    - d. 12 m/s<sup>2</sup>
  
  5. The area under the line of a velocity- time graph represents...
    - a. change in time.
    - b. acceleration.
    - c. change in velocity.
    - d. distance travelled in a given direction.
  
  6. When an object is decelerating (slowing down), the gradient of the line on a velocity – time graph will be...
    - a. positive.
    - b. negative.
    - c. zero.
    - d. proportional.

7. Which ONE of the following is the correct way to find the instantaneous speed of an object from a graph?
- Draw a tangent to the line on its distance – time graph.
  - Use the averages of the distance travelled and the time taken.
  - Use the speed equation instead.
  - Draw a tangent to the line on its velocity – time graph.
8. Newton's 2<sup>nd</sup> law of motion is represented by the equation...
- $F = a v$
  - $F = \frac{m}{a}$
  - $F = m v$
  - $F = m a$
9. The tendency of an object to stay at rest or moving at a constant speed is called...
- terminal velocity.
  - torque.
  - inertia.
  - resultant force.
10. A 20 kg sack of corn accelerates at  $0.80 \text{ m/s}^2$  into the back of a truck. What is its resultant force?
- 19.2 N
  - 16 N
  - 25 N
  - 0.04 N
11. The Earth's gravitational field strength at its surface is approximately...
- 10 N/kg
  - 11 N/kg
  - 1.6 N/kg
  - 8 N/kg
12. Select the correct statement to describe the resultant force and acceleration of an object travelling at terminal velocity.
- The resultant force is zero, acceleration is at its maximum value.
  - The resultant force is at its maximum value, acceleration is zero.
  - The resultant force is zero, acceleration is zero.
  - The resultant force is at its minimum value, acceleration is zero.
13. Which ONE of the following statements about stopping distances is incorrect?
- Stopping distance = thinking distance + braking distance.
  - Braking distance is the distance travelled by the vehicle whilst the braking force is acting.
  - Thinking distance is the time taken for the driver to react.
  - The greater the speed that the vehicle is travelling at, the longer the stopping distance will be.

14. The law of the conservation of momentum states that...
- in a closed system, the total momentum before a collision will equal the total momentum after a collision.
  - in an open system, the total momentum before a collision will equal the total momentum after a collision.
  - in an inelastic collision, the total momentum before a collision will equal the total momentum after a collision.
  - in any system, the total momentum before a collision will equal the total momentum after a collision.
15. Calculate the momentum of a 60 kg rugby player running at a velocity of 5 m/s.
- 3000 kg m/s
  - 300 kg m/s
  - 12 kg m/s
  - 120 kg m/s
16. A 10 kg trolley moving at a velocity of 2 m/s collides with a stationary 10 kg trolley. The trolleys move off together after the collision. Calculate the velocity of the trolleys after the collision.
- 40 m/s
  - 2 m/s
  - 20 m/s
  - 1 m/s
17. What effect does changing the impact time in a collision have on impact force?
- The longer the impact time, the less the impact force is reduced.
  - Changing the impact time will not have any effect on the impact force.
  - The longer the impact time, the more the impact force is reduced.
  - The shorter the impact time, the more the impact force is reduced.
18. Identify the correct equation for impact force.
- $F = \frac{m \Delta t}{\Delta v}$
  - $F = \frac{m \Delta v}{\Delta t}$
  - $F = m v t$
  - $F = \frac{m \Delta v}{a}$
19. Hooke's Law states that the extension of a steel spring is directly proportional to the force applied to it. If the spring stretches more than expected, the spring is said to have stretched beyond its...
- plastic limit.
  - yield strength.
  - spring constant.
  - limit of proportionality.
20. A spring is tested in a laboratory. When a force of 50 N is suspended from the spring, the extension of the spring is 0.04 m. Calculate the spring constant of the spring.
- 2 N/m
  - 125 N/m
  - 1250 N/m
  - $8 \times 10^{-4}$  N/m

## PiXL Independence – Level 2

### 5 questions, 5 sentences, 5 words

### GCSE Physics – Forces and Motion

#### 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:

|                                  |   |  |  |                                     |
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| <b>QUESTION:</b>                 | How does Newton's 2nd Law relate to forces and motion?  |  |  |                                     |
| <b>Sources:</b>                  | Website –<br>1. <a href="http://teachertech.rice.edu/Participants/louviere/Newton/law2.html">http://teachertech.rice.edu/Participants/louviere/Newton/law2.html</a><br>2. <a href="http://www.physicsclassroom.com/class/newtlaws/Lesson-3/Newton-s-Second-Law">http://www.physicsclassroom.com/class/newtlaws/Lesson-3/Newton-s-Second-Law</a>   |  |  |                                     |
|                                  | 3. Newton's 2 <sup>nd</sup> Law says that acceleration of an object is proportional to its resultant force.<br>4. Newton's 2 <sup>nd</sup> Law says that the acceleration of an object is inversely proportional to its mass.<br>5. The equation for Newton's 2 <sup>nd</sup> law is $F = ma$<br>6. The units for force are newtons, N. Mass is measured in kilograms, kg. Acceleration is measured using metres per second which has the unit $ms^{-1}$ .<br>7. A resultant force of 1 N will accelerate a mass of 1 kg by $1 ms^{-1}$ . |  |  |                                     |
| <b>Equation:</b><br><br>$F = ma$ | <b>Units:</b><br>F = Newtons, N<br>m = kilograms, kg<br>a = metres per sec, $ms^{-1}$   | <b>Acceleration – change of velocity per second.</b> | <b>Resultant force – single force that is the net of all the forces acting upon an object.</b> | <b>2 x force = 2 x acceleration</b> |

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| <b>QUESTION 1:</b> | <b>Describe the features of a distance-time graph and how it relates to the equation for speed.</b>  |
| <b>Sources:</b>    | <b>Website –</b><br>1. <a href="http://www.bbc.co.uk/education/guides/z3bqtfr/revision/1">http://www.bbc.co.uk/education/guides/z3bqtfr/revision/1</a><br>2. <a href="https://www.youtube.com/watch?v=I93-BkAJ3UY">https://www.youtube.com/watch?v=I93-BkAJ3UY</a> |

Blank area for student response.

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| <b>QUESTION 2:</b> | <b>Describe an experiment to investigate force and acceleration.</b> |
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| <b>Sources:</b> | <b>Website –</b><br>1. <a href="http://practicalphysics.org/investigating-newtons-second-law-motion.html">http://practicalphysics.org/investigating-newtons-second-law-motion.html</a><br>2. <a href="https://tap.iop.org/mechanics/newton/211/file_46371.doc">https://tap.iop.org/mechanics/newton/211/file_46371.doc</a> |
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| <b>QUESTION 3:</b> | <b>What is momentum and the conservation of momentum?</b> |
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| <b>Sources:</b> | <b>Website –</b><br>1. <a href="http://www.bbc.co.uk/education/guides/zv3j6sg/revision">http://www.bbc.co.uk/education/guides/zv3j6sg/revision</a><br>2. <a href="http://www.physicsclassroom.com/Class/momentum/u4l1a.cfm">http://www.physicsclassroom.com/Class/momentum/u4l1a.cfm</a> |
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| <b>QUESTION 4:</b> | <b>Describe a method to investigate Hooke's Law.</b>   |
| <b>Sources:</b>    | <b>Website –</b><br>1. <a href="http://www.gcscsciencemethods.co.uk/2012/05/hookes-law-1.html">http://www.gcscsciencemethods.co.uk/2012/05/hookes-law-1.html</a><br>2. <a href="http://www.batesville.k12.in.us/Physics/PhyNet/Mechanics/Newton3/Labs/SpringScale.html">http://www.batesville.k12.in.us/Physics/PhyNet/Mechanics/Newton3/Labs/SpringScale.html</a> |

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| <b>QUESTION 5:</b> | <b>Describe the factors that can affect the stopping distance of a vehicle.</b> |
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| <b>Sources:</b> | <b>Website –</b><br>1. <a href="https://www.kwik-fit.com/blog/10-things-that-can-affect-your-stopping-distance">https://www.kwik-fit.com/blog/10-things-that-can-affect-your-stopping-distance</a><br>2. <a href="http://www.gcse.com/fm/stopping_distances.htm">http://www.gcse.com/fm/stopping_distances.htm</a><br><b>(Continue to the following two pages also.)</b> |
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# PiXL Independence – Level 3

## Science in the News

### GCSE Physics – Forces and Motion

#### 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.

#### Is it safer to wear a cycling helmet or not?

News article: <http://www.telegraph.co.uk/men/active/recreational-cycling/11979540/Bike-helmet-laws-do-not-prevent-head-injuries.html>

NHS article: <https://www.nhs.uk/news/lifestyle-and-exercise/news-analysis-cycling-safety-special-report/>

Discussion article: <https://www.theguardian.com/science/2016/jan/24/bike-helmet-appetite-danger>

Real article: <http://www.cyclinguk.org/campaign/cycle-helmets-evidence>

#### Task 1:

You need to produce a 1 page essay on showing a balanced argument on the advantages and disadvantages of wearing a cycle helmet.

| Essay section       | Activity   |
|---------------------|--|
| <b>Introduction</b> | Write about how many people cycle each day and how many accidents there are as described in the articles.            |
| <b>Describe</b>     | Describe the effects of wearing and not wearing a cycling helmet on people who have been involved in an accident.    |
| <b>Explore</b>      | Why people choose to wear or not wear a cycle helmet?  |
| <b>Evaluate</b>     | What is the official message from the NHS/ government/ cycling associations on wearing a cycle helmet? Do you agree? |

## What is the physics behind fidget spinners?

News article: <http://www.mirror.co.uk/news/uk-news/fidget-spinners-what-you-need-10310296>

News article: <https://www.economist.com/news/business-and-finance/21728603-sales-might-have-peaked-they-have-changed-toys-lessons-fidget-spinners>

Discussion video: <https://www.youtube.com/watch?v=cVkU-owa3is>

Real article: <https://www.livescience.com/58963-how-fidget-spinners-work-physics.html>

### Task 2:

You need to produce a 1 page essay on the background to fidget spinners and the actual science behind the craze – how do they work? What are they made from? Are they adaptable in today's toy market?

| Essay section       | Activity   |
|---------------------|--|
| <b>Introduction</b> | Who invented the fidget spinner? What were they originally designed to do?   |
| <b>Describe</b>     | Using a diagram, describe all the component parts of a fidget spinner including materials and the reason behind that material choice.  |
| <b>Explore</b>      | Explore the physics concepts behind the fidget spinner – how does it move? Why does it keep moving for an extended period of time? If you come across any concepts you don't understand you must define their meaning (e.g. angular momentum). |
| <b>Evaluate</b>     | Evaluate whether the fidget spinner has the ability to adapt as a toy. Could the design be improved? How? Could the fidget spinner 'do' anything else?   |

# PiXL Independence – Level 4

## Scientific Posters

### GCSE Physics – Forces and Motion

#### INSTRUCTIONS

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#### Scientific Posters

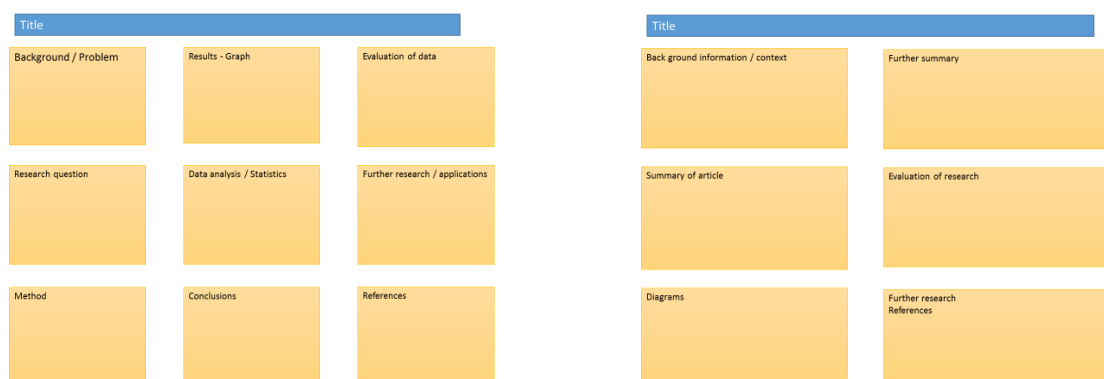
Scientists communicate research findings in three main ways. Primarily, they write journal articles much like an experiment write up. These are very concise, appraise the current literature on the problem and present findings. Scientists then share findings at conferences through talks and scientific 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/postereq](http://www.tinyurl.com/postereq)

## Safety and Transport

### Background

When choosing a car for yourself or your family, safety is at the forefront of your mind. There are safety features in cars we now take for granted, from seat belts to crumple zones and airbags, but how do they prevent us from getting injured?

### Source articles

<http://www.gcsescience.com/pfm46.htm>

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

<http://www.bbc.co.uk/education/guides/zv3j6sg/revision/5>

**Use other sources as necessary.**

### Task:

Produce a scientific poster on how seat belts, crumple zones and air bags in vehicles work to keep us safe. You must include the forces that the body experiences and how this impact force is reduced.

|                 |  |
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| <b>Recall</b>   | Write a list of the different safety measures that a car has.  |
| <b>Describe</b> | Describe how each of the different safety measures works to keep the occupants of the vehicle safe. Write your answer in terms of forces and momentum.                         |
| <b>Compare</b>  | Compare each of the safety measures – which do you think are the most effective and important to have in a vehicle?  |
| <b>Evaluate</b> | Can any of these safety features be further improved? Can you think of any addition safety features that a vehicle could have in order to keep the driver and passengers safe? |

# PiXL Independence – Level 5

## Video summaries

### GCSE Physics – Forces and Motion

#### 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 an in depth look at the way that animals move and what engineers can take from nature when designing new innovations. The second video discusses how nature is influencing the products and systems that technology and design are using.

#### Source articles:

##### Video 1 – The sticky wonder of gecko feet

Ted Talk: [https://www.ted.com/talks/robert\\_full\\_on\\_animal\\_movement](https://www.ted.com/talks/robert_full_on_animal_movement)

##### Video 2 – Biomimicry's surprising lessons from nature's engineers

Ted Talk: [https://www.ted.com/talks/janine\\_benyus\\_shares\\_nature\\_s\\_designs](https://www.ted.com/talks/janine_benyus_shares_nature_s_designs)

**Task:**

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

1. Discuss how engineers can use ideas from nature.
2. Discuss how nature is influencing the products and technology in design.

**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

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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).

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**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



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



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