

# **PiXL Independence:**

## **Physics – Student Booklet**

### **KS5**

#### **Topic - Mechanics**

#### **Contents:**

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

# PiXL Independence – Level 1

## Multiple Choice Questions

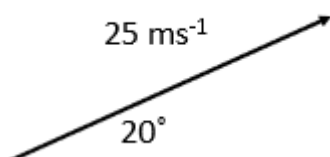
### A Level Physics – XXXX

#### INSTRUCTIONS

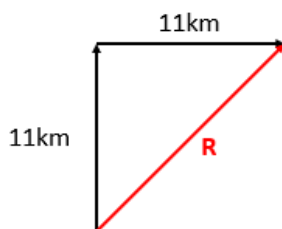
Score: /20

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

1. Which of the following lists of quantities contain only vectors?
  - a) Density, velocity, power, displacement
  - b) Force, velocity, momentum, time
  - c) Weight, velocity, displacement, acceleration
  - d) Energy, weight, acceleration, displacement
2. What is the horizontal component of the velocity vector?



- a)  $20 \cos 25^\circ$
  - b)  $25 \cos 20^\circ$
  - c)  $20 \sin 25^\circ$
  - d)  $25 \cos 20^\circ$
3. What is the magnitude of the resultant vector R?



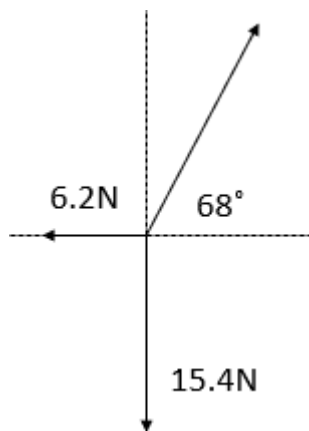
- a) 242 km
  - b) 15.6 km
  - c) 13.6 km
  - d) 11.0 km
4. The driver of a vehicle travelling at  $4 \text{ ms}^{-1}$  applies the brakes for 30s and slows down to  $2 \text{ ms}^{-1}$ . Which equation of motion should be used to calculate the deceleration during this time?
    - a)  $s = ut + \frac{1}{2}at^2$
    - b)  $v^2 = u^2 + 2as$

c)  $s = (u+v)/2 \times t$

d)  $v = u + at$

5. What is the gradient of a linear distance-time graph equal to?
- a) Velocity
  - b) Acceleration
  - c) Distance travelled
  - d) Time
6. In projectile motion, assuming air resistance is negligible, which quantity remains constant throughout the object's motion?
- a) Vertical velocity
  - b) Horizontal velocity
  - c) Height above the ground
  - d) Time

7. The forces below are in equilibrium. Find the magnitude of the force F.



- a) 38.1N
  - b) 16.6N
  - c) 14.8N
  - d) 2.0N
8. A cyclist turns a corner by applying equal but opposite forces of 20N to the ends of the handlebars. Calculate the moment applied to the handlebars if the distance from the centre to the end of the handlebars is 25cm.
- a) 10Nm
  - b) 5Nm
  - c) 20Nm
  - d) 500Nm
9. A sprinter runs with a uniform acceleration from rest to  $10.0\text{ms}^{-1}$  in 7.4s. What is their displacement in this time?
- a) 74m
  - b) 47m
  - c) 37m
  - d) 1.4m

10. What does the rate of change of gradient on a displacement-time graph represent?
- a) Instantaneous velocity
  - b) Velocity
  - c) Displacement
  - d) Acceleration
11. A cannon is fired horizontally with a velocity of  $110 \text{ ms}^{-1}$  from a height of 1.2m above the ground level. What is the range of the ball when it lands?
- a) 132m
  - b) 91.7m
  - c) 54.4m
  - d) 26.9m
12. A golf ball is struck such that it has an initial velocity of  $42.0 \text{ ms}^{-1}$  at an angle of  $21^\circ$  to the horizontal. How long is it in flight for?
- a) 4.3s
  - b) 1.5s
  - c) 3.1s
  - d) 4.0s
13. A cricket ball of mass 163g, moving at  $6.0 \text{ ms}^{-1}$ , hits a cricket bat which provides an impulse of 1.4Ns in the opposite direction to the cricket ball's motion. What is the velocity of the cricket ball after it is struck?
- a)  $1.0 \text{ ms}^{-1}$
  - b)  $-2.5 \text{ ms}^{-1}$
  - c)  $1.4 \text{ ms}^{-1}$
  - d)  $-0.2 \text{ ms}^{-1}$
14. A sledge is pulled by a rope at an angle of  $25^\circ$  to the ground with a force of 61N for 50m. How much work is done in pulling the sledge?
- a) 2800J
  - b) 1300J
  - c) 55J
  - d) 26J
15. A cyclist travelling at  $4.2 \text{ ms}^{-1}$  maintains a constant velocity by applying a force of 80N against friction. What is the power supplied by the cyclist?
- a) 170W
  - b) 340W
  - c) 670W
  - d) 1400W
16. Which of the following statements about an object in equilibrium is correct?
- a) A body in equilibrium is always at rest

- b) A body in equilibrium has no net forces acting upon it
- c) A body travelling with constant acceleration is in equilibrium
- d) A body in freefall is in equilibrium

17. What is the area under a force-time graph not equal to?

- a) Impulse
- b) Change in momentum
- c) Rate of change in momentum
- d) Force x time

18. What is conserved in an elastic collision?

- a) Momentum and elastic potential energy
- b) Mass and velocity
- c) Momentum but not kinetic energy
- d) Momentum and kinetic energy

19. A gun of mass 1.8kg fires a bullet of mass 9.0g at a velocity of  $450\text{ms}^{-1}$ . What is the recoil velocity of the gun?

- a)  $0.4\text{ms}^{-1}$
- b)  $-2.25\text{ms}^{-1}$
- c)  $200\text{ms}^{-1}$
- d)  $-250\text{ms}^{-1}$

20. Whilst travelling along the motorway a driver notices that a fly has collided with the windscreen. What can be said of the size of the forces of the car and the fly?

- a) The size of the force of car on the fly is greater than the size of the force of the fly on the car
- b) The force of the car on the fly is approximately 100,000 times greater than the size of the force of the fly on the car
- c) The size of the force of the car on the fly is less than the size of the force of the fly on the car
- d) The size of the force of the car on the fly is equal to the size of the force of the fly on the car

# PiXL Independence – Level 2

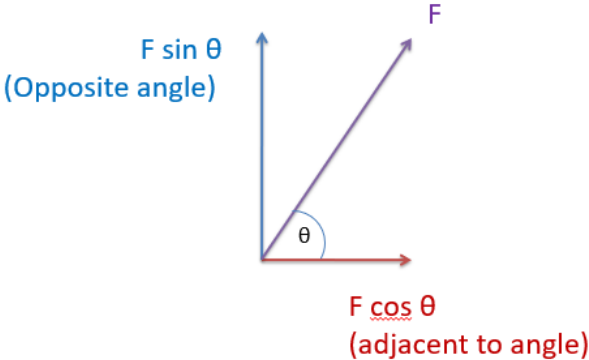
## 5 questions, 5 sentences, 5 words

### A Level Physics – Particle Physics

#### 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:** Base and derived units

QUESTION:	What is the difference between scalars and vector quantities and how can a vector quantity be resolved into horizontal and vertical components?			
Sources:	<p>Website</p> <p>1. <a href="http://www.cyberphysics.co.uk/topics/forces/vectors.htm">http://www.cyberphysics.co.uk/topics/forces/vectors.htm</a></p> <p>2. <a href="https://www.youtube.com/watch?v=2kHCvtTjOJs">https://www.youtube.com/watch?v=2kHCvtTjOJs</a></p>			
<p>1. Scalar quantities have only a magnitude (size), vector quantities have both magnitude and direction.</p> <p>2. Examples of scalar quantities include distance, speed, time and temperature.</p> <p>3. Examples of vector quantities include displacement, velocity, acceleration and force.</p> <p>4. To resolve a vector means to find the vector's horizontal and vertical components.</p> <p>5. For example,</p> <div></div>				
Vector – a quantity that has both size and direction	Scalar – a quantity that has a size but no direction	Displacement – how far an object has travelled from its start point to its end point in a given direction	Resultant vector – the net or overall effect of 2 or more vectors added together	Resolve – to generate two equivalent vectors from a single vector

QUESTION 1:	How can a body in equilibrium be represented by drawing a force triangle?			
Sources:	<b>Website</b> 1. <a href="https://www.youtube.com/watch?v=2eNOIXC4UMs">https://www.youtube.com/watch?v=2eNOIXC4UMs</a> 2. <a href="https://www.youtube.com/watch?v=KzywuMU-8s4">https://www.youtube.com/watch?v=KzywuMU-8s4</a> (uses the cosine rule)			

QUESTION 2:	How can the principle of moments be used to find the magnitude of a force acting at a distance from the pivot?			
Sources:	<b>Website</b> 1. <a href="https://www.youtube.com/watch?v=bsb67yG6sBQ">https://www.youtube.com/watch?v=bsb67yG6sBQ</a> 2. <a href="https://www.youtube.com/watch?v=7x6SpYdkjC4&amp;t=1s">https://www.youtube.com/watch?v=7x6SpYdkjC4&amp;t=1s</a>			



QUESTION 3:	What are the equations of motion and how can problems involving uniform acceleration be solved using them?			
Sources:	<b>Website –</b> 1. <a href="https://www.youtube.com/watch?v=WJN_F3PYp58">https://www.youtube.com/watch?v=WJN_F3PYp58</a> 2. <a href="https://www.youtube.com/watch?v=O-PvBh15ILc">https://www.youtube.com/watch?v=O-PvBh15ILc</a>			

QUESTION 4:	What is projectile motion and how can the height reached by a projectile be found?			
Sources:	<p>Website –</p> <ol style="list-style-type: none"><li>1. <a href="https://www.youtube.com/watch?v=p30tWWEElxU">https://www.youtube.com/watch?v=p30tWWEElxU</a></li><li>2. <a href="https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html">https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html</a></li></ol>			

QUESTION 5:	What is Young's modulus and how can it be found from a force-extension graph?			
Sources:	<b>Website</b> 1. <a href="https://tinyurl.com/y9yppsvg">https://tinyurl.com/y9yppsvg</a> 2. <a href="http://www.cyberphysics.co.uk/topics/forces/young_modulus.htm">http://www.cyberphysics.co.uk/topics/forces/young_modulus.htm</a>			

# PiXL Independence – Level 3

## Physics in The News

### A Level Physics – Mechanics and Materials

#### Fake news

Sensationalized 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.

#### Release of Stephen Hawking's PhD thesis breaks the internet

News article: <https://tinyurl.com/yajaxouz>

Discussion article: <https://tinyurl.com/y9uzdsen>

Real article: <https://www.repository.cam.ac.uk/handle/1810/251038>

<https://tinyurl.com/ybdrbpvh>

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

<https://tinyurl.com/yawn7dgo>

#### Task 1:

You need to produce a 1 page essay on why the British physicist's 50 year old thesis was so popular when it was released to the public by Cambridge University last month and summarise some of its content by addressing the points below.

Essay section	Activity
<b>Introduction</b>	State how the Hubble constant, which is a measure of the age of the universe, is simply a derivation of the velocity = distance ÷ time equation.
<b>Describe</b>	Describe what is meant by Hawking radiation and how the effects of black holes, with their colossal gravitational attraction, can cause a heating effect when nearing the event horizon.
<b>Explore</b>	Describe how the Hubble telescope has been used to put Hawking's theories to the test.
<b>Evaluate</b>	Evaluate the likely consequences of a body approaching the event horizon and examine why this would lead to a body emitting radiation.

# PiXL Independence – Level 4

## Scientific Posters

### A Level Physics – Mechanics and materials

**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 practise all three of these skills.

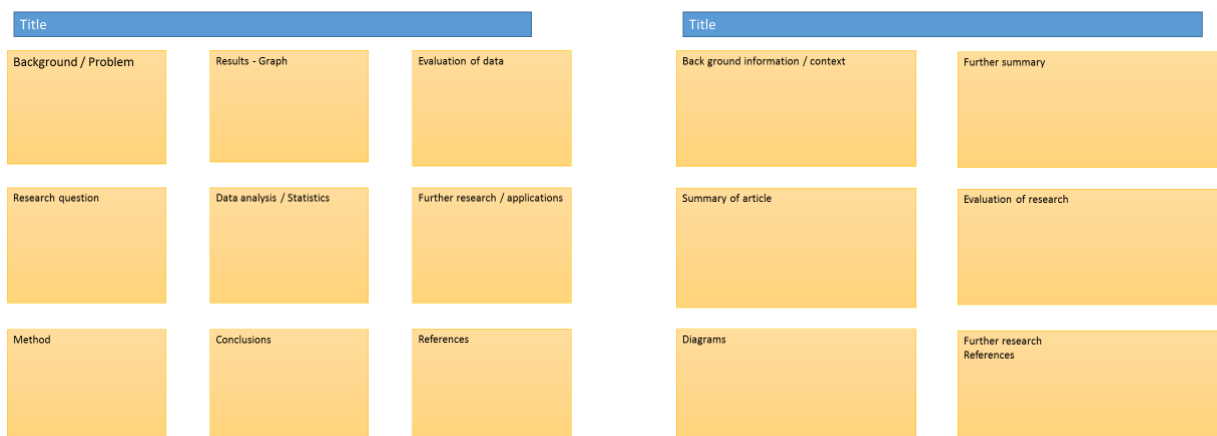
Scientific posters are a fine balance between being graphically interesting and attracting attention, as well as sharing just the right amount of text to convey a detailed scientific message. They are more detailed than a talk and less detailed than a paper.

Use this information to help structure your poster – [www.tiny.cc/posterskills](http://www.tiny.cc/posterskills)

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)

## Isaac Newton

### Background

Isaac Newton was a British physicist who devised the three laws of motion which relate the forces acting on an object to its motion. The importance of these laws was not recognised immediately. In addition to the laws of motion, Newton was also responsible for our current understanding of how objects exert a gravitational force of attraction on one another and the behavior of light as it passes through a medium.

### Sources:

<https://www.youtube.com/watch?v=kKKM8Y-u7ds>

<https://ed.ted.com/on/zCIJ4HAd>

<http://www.bbc.co.uk/timelines/zwwgcdm>

[https://www.youtube.com/watch?time\\_continue=21&v=E43-CfukEgs](https://www.youtube.com/watch?time_continue=21&v=E43-CfukEgs)

**Use other sources as necessary.**

### Task:

Produce a scientific poster about the work of Isaac Newton including the fundamental laws that he developed and in what ways Newton's developments are important to us today, over 300 years later.

<b>Recall</b>	Recall Newton's laws of motion.
<b>Describe</b>	Describe the scientific developments that Isaac Newton contributed to, outside of Forces and Motion.
<b>Compare</b>	Compare the properties of a refracting and reflecting telescopes such as the one the Newton was responsible for inventing.
<b>Evaluate</b>	Evaluate the differences between Newtonian and Einstein's perception of falling.

# PiXL Independence – Level 5

## Video summaries

### A-level Physics – Mechanics and materials

#### 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 to 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 video clips summarise the required practical for finding the Young's modulus of a wire. The first video outlines the procedure set up horizontally on a bench and uses copper. The second video considers suspending the wire in the vertical direction and goes on to define some other key vocabulary that you need to be familiar with.

**Source article:**

**Video 1** - <https://www.youtube.com/watch?v=VSLpfTTc0Sw>

**Video 2** - <https://www.youtube.com/watch?v=Lh7Em7lg5aM>

**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.**

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







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