PiXL Independence:

Physics – Student Booklet

KS5

Topic - Electricity

Contents:

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PiXL Independence – Level 1
Multiple Choice Questions
A Level Physics – Electricity

INSTRUCTIONS **Score: /20**

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

1.
   a. Current, Q is measured in Coulombs
   b. Current, C is measured in Amps, A
   c. Current, C is measured in Coulombs, C
   d. Current, I is measured in Amps, A

2.
   a. Ammeters are and voltmeters must have a low resistance
   b. Ammeters must have a low resistance and voltmeters must have an infinite resistance
   c. Ammeters must have an infinite resistance and voltmeters must have a low resistance
   d. Ammeters and voltmeters must have an infinite resistance

3. What is the current in a circuit where 240 Coulombs of charge flow in 30 seconds?
   a. 1920 A
   b. 480A
   c. 120A
   d. 8A

4. How many electrons carry a total charge of 1 Coulomb?
   a. 1.60×10^{-19}
   b. 1.60×10^{19}
   c. 6.25×10^{18}
   d. 6.25×10^{-18}

5. What is 1 Volt not equivalent to?
   a. 1AC
   b. $1\ WA^{-1}$
   c. $1\ JC^{-1}$
   d. $1\ (WA)^{1/2}$

6. A solar cell delivers a constant current of 30mA for a period of 5.0 minutes. During this time the potential difference across the cell is 0.90V. Calculate the total energy transferred by the cell.
   a. 8100 J
   b. 140 J
   c. 8.1 J
   d. 10J

7. In a cathode ray tube 2.5×10^{15} electrons strike the surface in 10 seconds.
   What current does this represent?
   a. 2.5×10^{14}
   b. 4.0×10^{-5}
   c. 4.0×10^{-4}
   d. 1.6×10^{32}

8. What is Ohm's law?
   a. Current is inversely proportional to potential difference.
   b. Current is directly proportional to potential difference.
   c. Current is inversely proportional to potential difference at constant temperature.
   d. Current is directly proportional to potential difference at constant temperature.

9. A current of 8.0 mA flows through a fine piece of resistance wire when the potential difference across it is 8.0 V.
   What is the resistance of the wire?
   a. 10 Ω
   b. 100 Ω
   c. 1000 Ω
   d. 10 000 Ω

10. Which component can be described as being Ohmic?
   a. Semiconductor diode
   b. Filament lamp
   c. Fixed resistor
   d. Thermistor

11. What are the units for resistivity?
   a. Ωm^{-1}
   b. Ωm^{-2}
   c. Ωm
   d. Ωm^{2}

12. What is the cross-sectional area of a wire of diameter 0.32mm?
   a. $3.2 \times 10^{-7}\ m^2$
   b. $3.2 \times 10^{-1}\ m^2$
   c. $1.0 \times 10^{-7}\ m^2$
   d. $1.0 \times 10^{-1}\ m^2$

13. What is the resistance of a piece of conducting putty of length 0.1m and cross-sectional area $3.1 \times 10^{-4}\ m^2$? Resistivity of conducting putty = 4.0×10^{-3}.
   a. 1.29 Ω
   b. 12.4 Ω
   c. 7.75×10^{-3} Ω
   d. 80 700 Ω

14. How can the resistivity of a piece of wire be found from a graph of its resistance (y axis) versus length (x axis)?
    a. Gradient
    b. Gradient x cross sectional area
    c. 1/ gradient
    d. 1/ Y intercept

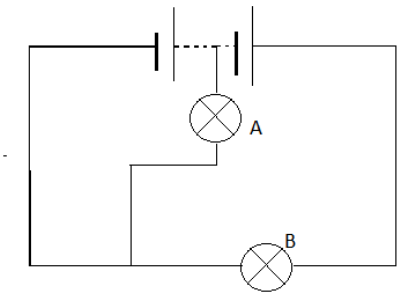
15. What is Kirchoff's 2nd law a consequence of?
    a. Conservation of mass
    b. Conservation of energy
    c. Conservation of charge
    d. Conservation of momentum

16. What is electromotive force?
    a. The amount of electrical energy per unit time transferred into an electrical circuit.
    b. The amount of electrical energy per unit charge transferred into an electrical circuit.
    c. The amount of electrical energy per unit time transferred out of an electrical circuit.
    d. The amount of electrical energy per unit charge transferred out of an electrical circuit.

17. Three identical resistors each of resistance 5Ω are connected at first in series and then in parallel.
    What is the ratio R_{Total} in series / R_{Total} in parallel?
    a. 1.7
    b. 9.0
    c. 0.1
    d. 15

18. A series circuit contains two resistors R_1 and R_2 connected to a battery of negligible internal resistance and emf of 12V. If R_1 has a resistance of 4Ω and receives 8V.
    What is the resistance of R_2?
    a. 2V
    b. 4V
    c. 6V
    d. 8V

19. In the following circuit, what would be the correct combination?



    a. Both lamps on
    b. Both lamps off
    c. Lamp A on, lamp B off
    d. Lamp A off, lamp B on

20. In a V-I graph with I on x axis and V on y axis how can the emf, ε and internal resistance, r be found?
    a. ε is equal to the gradient and r is equal to the y intercept
    b. ε is equal to the y intercept and r is equal to 1/gradient
    c. ε is equal to the gradient and r is equal to – y intercept
    d. ε is equal to the y intercept and r is equal to – gradient

PiXL Independence – Level 2
5 questions, 5 sentences, 5 words
A Level Physics – Electricity

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: Circuit rules

QUESTION:	**What are the circuit rules for series and parallel circuits?**
Sources:	**Website –** https://www.youtube.com/watch?v=x2EuYqj_0Uk **Interactive -** https://phet.colorado.edu/en/simulation/circuit-construction-kit-ac

1. **A series circuit contains a single loop and a parallel circuit contains more than one loop where the current splits.**
2. **In a series circuit the current is the same at all points and adding more bulbs increases the resistance and reduces the current.**
3. **In a series circuit the potential difference or voltage is shared between the components in the circuit.**
4. **In a parallel circuit the current received by each component is greater and the total current around the circuit is equal to the sum of the current through each branch.**
5. **Each component receives the same potential difference (voltage) as the supply.**

Potential difference is the energy per unit charge transferred from electrical into another form.	**Resistance is anything the resists the flow of charge in an electrical circuit and can be found using V/I.**	**Series circuit is a complete circuit with only one single branch and no junctions where current in the circuit splits.**	**Parallel circuit contains 2 or more branches with a junction where current splits.**	**Junction a point within a parallel circuit where current splits according to the resistance across each branch.**

QUESTION 1:	What is Ohm's law and how can resistance in series and parallel circuits be found?
Sources:	1. https://www.youtube.com/watch?v=-w-VTw0tQIE 2. http://www.s-cool.co.uk/a-level/physics/resistance/revise-it/resistance-ohms-law-and-conductance

QUESTION 2:	**What are I-V characteristics and how can they be obtained?**
Sources:	**Websites** 1. http://physicsnet.co.uk/a-level-physics-as-a2/current-electricity/current-voltage-characteristics/ 2. https://www.youtube.com/watch?v=hfPK6Lxdlfg

QUESTION 3:	**What is meant by resistivity and how can it be calculated?**
Sources:	**Website –** http://physicsnet.co.uk/a-level-physics-as-a2/current-electricity/resistivity/ **Interactive -** https://phet.colorado.edu/en/simulation/resistance-in-a-wire

QUESTION 4:	**What are the applications of a potential divider?**
Sources:	**Website** 1. https://www.youtube.com/watch?v=Zc8sUNMAVpU 2. http://www.s-cool.co.uk/a-level/physics/kirchoffs-laws-and-potential-dividers/revise-it/potential-dividers

QUESTION 5:	**How can the internal resistance of a battery be found?**
Sources:	**Website** **1.** https://www.youtube.com/watch?v=9r3Xgd79MFw **2.** https://www.youtube.com/watch?time_continue=9&v=SMmgtGIUQhk

PiXL Independence – Level 3
Physics in The News
A Level Physics – Electricity

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.

Children at risk of cancer from mobile phone use

News article http://www.dailymail.co.uk/health/article-486239/Using-mobile-phones-10-years-doubles-risk-brain-cancer.html

Discussion article https://www.nhs.uk/news/lifestyle-and-exercise/long-term-mobile-use-and-the-risk-of-brain-cancer/

Real article http://oem.bmj.com/content/64/9/626.full

Task 1:

You need to produce a 1-page essay on 'How mobile phone usage is linked to brain cancer'

Essay section	Activity
Introduction	What does the Daily mail article claim is the risk of mobile phone usage over a period of 10 years or more? Why does the article report that children are more susceptible to the risk from mobile phone use?
Describe	Describe the risks outlined on the NHS choices webpage and research study that are attributed to mobile phone use.
Explore	Give reasons why the validity of the research was questionable. What is meant by recall bias?
Evaluate	Evaluate the validity of the research. In particular describe the sample size used and its shortcomings.

The new age of super materials
News article http://news.bbc.co.uk/1/hi/technology/6412057.stm
Discussion article http://amlsuperconductivity.com/about-us/the-100-year-wait/
Real article http://www.rsc.org/images/Superconductors_tcm18-111849.pdf

Task 2:

You need to produce a 1-page essay on the properties of superconductors and why the development of superconductors is of such great importance.

Essay section	Activity
Introduction	Describe the properties of a superconductor, list examples of materials that exhibit superconducting properties and state what conditions are necessary for the material to exist in a superconducting state.
Describe	Describe the applications of superconductors and the new developments in technology they have been responsible for to date.
Explore	Explore the possibilities for superconductors in the future and list the factors that are responsible for preventing large-scale commercialization of the superconducting materials.
Evaluate	Evaluate the progress made in the development of superconducting materials to date and compare to what was hoped for when these super materials were first discovered 20 years earlier.

PiXL Independence – Level 4
Scientific Podcasts
A Level Physics – Electricity

INSTRUCTIONS

Scientific Podcasts
There are several types of evidence you will be asked to produce at university. In addition to the traditional essay and scientific poster, the use of Podcasts is becoming increasingly common. It is actually harder than you think to produce a short concise, detailed and accurate podcast, therefore this task will help you get ahead of the game when you get to university.

Creating your Podcast
There are lots of pieces of software to create podcasts and edit them, however, the easiest would be the voice recorder on your phone, just check that it runs for long enough and you can save it in a suitable format, e.g. MP3 before you complete your master piece and find you need to do it again! Alternatively, get set up with Audacity which is free and will help you familiarize yourself with it.

The University of Southampton has produced some excellent guidance on creating Podcasts, which you can access at www.tiny.cc/podcasts3 and select the producing academic podcasts link.
Here are three of the key tips:

1. Write out your objective and share it at the start of the podcast.
2. Give it structure like you would in an essay
3. Whilst it is important to plan a structure, sometimes it is harder to listen to someone who is reading than someone who is more naturally talking, therefore, try to have an outline and allow some natural speech.
4. Think about the recording, pick a quiet room and speak a bit louder than normal. Do a few trial runs and check the quality.

Examples
The naked scientists produce a series of podcasts (and is also a really useful website). Check out an example about a contagious cancer at www.tiny.cc/taz

What are the applications of thermistor and light dependent resistors in potential divider circuits

Background

Thermistors and light dependent resistors are two of the components whose properties you will need to be familiar with. In addition to this you should be able to describe their use in a potential divider circuit as a temperature or heat sensor and how the output across a fixed resistor in series with the component changes with an increase or decrease in light intensity or temperature.

Source articles:

http://www.cyberphysics.co.uk/topics/electronics/thermistor.html

http://www.a-levelphysicstutor.com/elect-simple-circuits.php#therm

http://www.doctronics.co.uk/voltage.htm

Task

At university interviews, you will often be asked to discuss applications of the theory you have studied in your Physics lessons. This is one example that you could discuss.
Read the articles on the uses of thermistors and light dependent resistors in sensing circuits then produce a podcast using the guidance below

Describe	Describe the properties of light dependent resistors and thermistors and how they change with temperature and light intensity.
Explain	Explain the uses of each of these components in a potential divider circuit and how the potential difference across each of the components in the circuit is affected by changing the light intensity or temperature.
Discuss	Discuss applications of each of these components.

PiXL Independence – Level 5
Video summaries
A-level Physics –Electricity

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 by TED and the RI present an introduction to superconductivity and electromagnetic levitation that link to the electricity topic. The first video focusses on the principle of quantum locking and ends be discussing some applications of this phenomena. The second video explains what is responsible for the levitation in simpler terms.

Source article:
Video 1 – Boaz Almog levitates a superconductor
Ted Ed talks: https://www.ted.com/talks/boaz_almog_levitates_a_superconductor

Video 2 – Levitating superconductor on a Möbius strip
Ted Ed talks: https://www.youtube.com/watch?v=zPqEEZa2Gis

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 Explain the properties of a superconductor.
2 Outline the principles of quantum locking or electromagnetic levitation.
3 Give examples of applications of a levitating superconductor.

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:	

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