



NATIONAL 5 PHYSICS

INTRODUCTION

COURSE STRUCTURE

National 5 Physics is split into 7 topics

- Waves
- Electricity
- Mechanics
- Astrophysics
- Nuclear Radiation
- Thermodynamics
- Energy

For each topic you will receive a set of notes and a problem booklet.

Assessment

At the end of each topic you will be given an **A/B Test** which will give you practice of exam style questions. Once you have completed all seven units you will sit a **prelim** which will be very similar to the final exam. In addition you will also have to produce an **assignment** — this is where you do an experimental writeup under exam conditions. The marks from the exam and assignment are then combined to give you a final grade — A, B, C or D.

Online Resources

This booklet and all other materials for the National 5 course are available online at: www.tinyurl.com/n5physics

GREEK SYMBOLS

In Physics we often use greek letters as symbols for physical quantities (such as wavelength), units (such as Ohms) and prefixes (micro). Below is a handy guide to what these letters are:

GREEK ALPHABET

By Ben Crowder • bencrowder.net • Last modified 2 May 2012

Αα

ALPHA [a]
ἄλφα

Ββ

BETA [b]
βῆτα

Γγ

GAMMA [g]
γάμμα

Δδ

DELTA [d]
δέλτα

Εε

EPSILON [e]
ἕψιλόν

Ζζ

ZETA [dz]
ζῆτα

Ηη

ETA [eː]
ἦτα

Θθ

THETA [tʰ]
θῆτα

Ιι

IOTA [i]
ἰῶτα

Κκ

KAPPA [k]
κάππα

Λλ

LAMBDA [l]
λάμβδα

Μμ

MU [m]
μῦ

Νν

NU [n]
νῦ

Ξξ

XI [ks]
ξεῖ

Οο

OMICRON [o]
ὀ μικρόν

Ππ

PI [p]
πεῖ

Ρρ

RHO [r]
ῥῶ

Σσς

SIGMA [s]
σίγμα

Ττ

TAU [t]
ταῦ

Υυ

UPSILON [u]
ὑ ψιλόν

Φφ

PHI [pʰ]
φεῖ

Χχ

CHI [kʰ]
χεῖ

Ψψ

PSI [ps]
ψεῖ

Ωω

OMEGA [ɔː]
ὦ μέγα

UNITS

All quantities in physics **must** be accompanied by an appropriate **unit**. At National 5 you are severely penalised for omitting a unit — or using the wrong unit. For instance if you were measuring the length of an object you would say “The object is 5 metres long” **not** “The object has a length of 5.”

Prefixes

Sometimes in Physics we deal with quantities that are extremely large or very small. Rather than include a large number of zeros we use a **prefix**. Some prefixes you are probably familiar with, such as milli (m) or kilo (k). You will find a complete list of prefixes on page 5. However at National 5 you only need to remember six of them: nano (n), micro (μ), milli (m), kilo (k), mega (M) and giga (G).

Scientific Notation

Instead of using a prefix sometime it is easier to use **scientific notation**. In scientific notation numbers are written in the following form:

$$a \times 10^b$$

Where a is a decimal number and b is an integer (a whole number). For example:

- 200 can be written as 2×10^2
- 60,000,000 can be written as 6×10^7 or 60×10^6
- 0.0000562 can be written as 5.62×10^{-5} or 56.2×10^{-6}

Practice Questions

Write the following numbers in scientific notation:

1. 6,720,000,000,000
2. 0.00000000098
3. 0.6
4. 300,000,000
5. 0.000056
6. 90,000
7. 456
8. 23.1
9. 0.01
10. 725,000

Prefixes and their Values

Prefix	Symbol	Value	Value in Scientific Notation
yotta	Y	1,000,000,000,000,000,000,000,000	1×10^{24}
zetta	Z	1,000,000,000,000,000,000,000,000	1×10^{21}
exa	E	1,000,000,000,000,000,000,000	1×10^{18}
peta	P	1,000,000,000,000,000,000	1×10^{15}
tera	T	1,000,000,000,000	1×10^{12}
giga	G	1,000,000,000	1×10^9
mega	M	1,000,000	1×10^6
kilo	k	1,000	1×10^3
centi	c	0.01	1×10^{-2}
milli	m	0.001	1×10^{-3}
micro	μ	0.000001	1×10^{-6}
nano	n	0.000000001	1×10^{-9}
pico	p	0.0000000000001	1×10^{-12}
femto	f	0.00000000000000001	1×10^{-15}
atto	a	0.0000000000000000001	1×10^{-18}
zepto	z	0.00000000000000000000001	1×10^{-21}
yocto	y	0.0000000000000000000000001	1×10^{-24}

Practice Questions

Re-write the following quantities with the correct prefixes:

1. 4,000,000 Ω
2. 0.000001 m
3. 687,000,000 Hz
4. 0.0000000000052 s
5. 3,784 J
6. 200,000 W
7. 0.023 Sv

ACCURACY

In Physics you will often calculate an answer to a question that has a large number of significant figures or decimal places. Because it is highly unlikely that we know the answer that precisely it is important to round off any answers that you find.

How many Significant Figures?

The simple rule is this: Your answer should have **no more than** the number of significant figures given in the question. If different numbers in the question are given to a different number of significant figure you should use the number of significant figures in the value given to the **smallest** number of significant figures.

Example

Question: A rocket motor produces 4,570 N of thrust to a rocket with a mass of 7.0 kg. What is the acceleration of the rocket?

The calculated answer to this question would be $652.8571429 \text{ m s}^{-2}$. However the least accurate value we are given in the question is the value of the mass. This is only given to two significant figures. Therefore our answer should also be to two significant figures: 650 m s^{-2} .

THE STANDARD “THREE MARKER”

One of the most common types of questions in the exam is the three mark calculation question. They are similar to the Processing problem solving questions in the portfolio. Whilst there are many ways to solve this type of problem the following steps will always work, even on more complex formulas.

1. Write down the **relevant** information from the question.
2. Write down the **correct** formula from the formula sheet.
3. Substitute the values from step 1 into the equation from step 2.
4. Solve for the unknown variable using **algebra**.
5. Add the correct **unit**.

Example

This example question is a type you will be very familiar with from Maths!

Question: A maglev train, of mass 300,000 kg, on a test run completes a 134 km loop of the test rack in 30 minutes. What was the average speed of the train in km/h on the test run?

Answer:

Step 1:

$$d = 134$$

$$v = ?$$

$$t = 30 \text{ minutes} = 0.5 \text{ hours}$$

Step 2:

$$d = vt$$

Step 3:

$$134 = 0.5v$$

Step 4:

$$v = 134 \div 0.5$$

$$v = 268$$

Step 5:

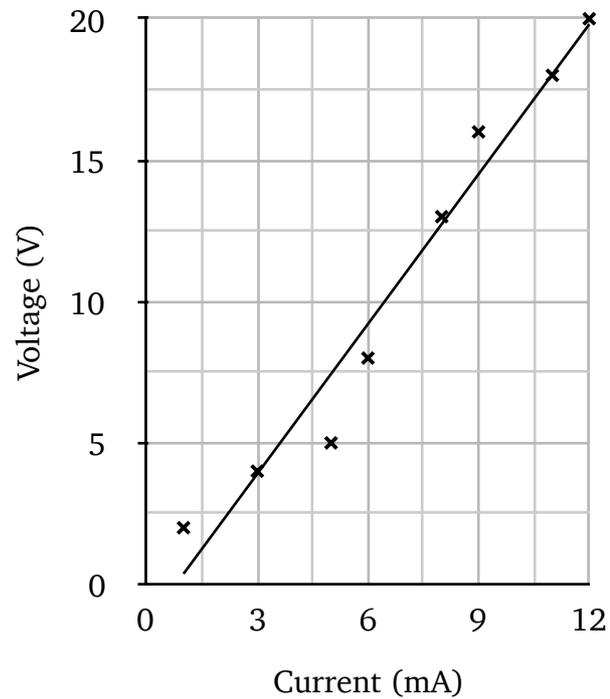
$$v = 270 \text{ kph}$$

GRAPHS

In Physics it is often useful to use a graph to interpret and understand experimental data or a relationship between two variables. There are several types of graph we can use and they are listed below:

- Bar graphs and charts — these are (almost) **never** used in Physics. You can assume that if a question asks you to draw a graph the examiner is not looking for a bar graph (and you will get no marks).
- Pie charts — these are used on occasion, typically when it is needed to represent percentages, such as showing the different energy sources used across the country.
- Line graphs — these are used sometimes in Physics, most notably in velocity/time graphs. The **independent** variable or **time** is always plotted on the **x-axis**. The **dependant** variable is always plotted on the **y-axis**. The points should always be plotted with an \times or a $+$, never dots or circles. The points should be joined with **straight lines**. Line graphs should usually **not** be used for experimental data.
- Scatter graphs — the most used type of graph used in Physics. The **independent** variable or **time** is always plotted on the **x-axis**. The **dependant** variable is always plotted on the **y-axis**. The points should always be plotted with an \times or a $+$, never dots or circles. If the points look like they are almost on a straight line then a **line of best fit** should be added. If the points do not look straight then a **free hand curve** or **curve of best fit** should be added.

An Example of a Good Graph



Gradients

The gradient of a line is a measure of how steep the slope is. The larger the gradient the steeper the slope. For a straight line you can work out the gradient by taking any two points on the line and finding the difference in the y values and dividing by the difference in the x values. There are several ways of writing the formula for this (gradient is represented by the letter **m**):

$$m = \frac{\Delta y}{\Delta x} = \frac{(y_1 - y_2)}{(x_1 - x_2)} = \text{change in } y \div \text{change in } x$$

EXPERIMENT REPORTS

When you do an experiment in any science it is important that you make a note of what you did and what you found out. So that other scientists can understand and repeat your experiment if they want to it is important that your experimental report follows the standard format.

Aim

What were you trying to find out?

Hypothesis

What did you think would happen? What was your prediction?

Method

How did you carry out your experiment? Your instructions need to be detailed and clear, and ideally include a labelled diagram of the equipment you used.

Results

What were your results? This is normally a table of data, this should be your **raw** data, don't miss anything out!

Analysis

How can you process your results to make them easier to understand? This might mean drawing a graph or doing some statistics.

Conclusion

What do your results tell you? Was your prediction correct? Have you fulfilled your aim?

Evaluation

How could you improve the accuracy or precision of your experiment? Are there any further experiments you could do to investigate your aim further? Can you think of a new aim for a new experiment?

RESEARCH

Finding out about science doesn't have to be always done through an experiment yourself. Sometimes you can find out what you want to know by doing research. This means looking at books, the internet, TV, radio and other media to discover what scientists around the world think about a particular issue or idea. But beware! You must make sure that your source is **reliable**, **relevant** and **retrievable**.

Relevance

Is this information useful? You must make sure that the information you are looking up is useful to you. For instance if you have been asked to find out if mobile phones cause cancer, a website talking about drivers crashing their cars because they are distracted by their phone is not a relevant source.

Reliability

Who are you getting your information from? Do you trust the information to be accurate and true? Why do you trust the information? These are all vital questions that you must be able to answer in order to use a source of information.

Retrievability

It is important that any information that you use as a source is retrievable so that someone else can look at your source and decide if they agree with you about the source's reliability and relevance. This means that you need to provide a **reference** that includes sufficient detail so that another person can find your information. What a reference needs to include depends on what type of source you are using:

- For websites you need to provide: The name of the website, the full URL and the date when you last checked the website. An example is shown below:
BBC News, <http://www.bbc.co.uk/news/science-environment-39797373>, last accessed 4/5/17
- For books you need to provide the title of the book, the name of the author, the page number(s) you used and the book's ISBN number. An example is shown below:
Fundamentals of Physics; Halliday, Resnick and Walker, pages 920 – 928, ISBN 0-471-39222-7