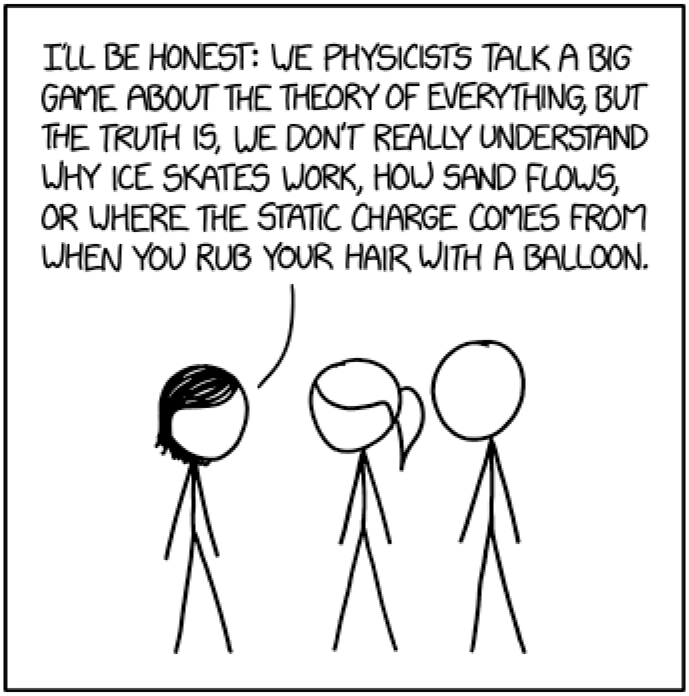


A LEVEL PHYSICS

BRIDGING TASK 1

2021-2022

Image Credit: xkcd.com/1867

Examination board: OCR Physics A (H556)

Exams

Paper 1: Modelling physics (01) assesses content from modules 1,2,3 and 5.

100 marks - 2 hour 15 minutes - 37% of total A level

Paper 2: Exploring physics (02) assesses content from modules 1,2,4 and 6.

100 marks - 2 hour 15 minutes - 37% of total A level

Paper 3: Unified physics (03) assesses content from all modules (1-6).

70 marks – 1 hour 30 minutes - 26% of total A level

Outline of Modules

- Module 1: Development of practical skills in physics (taught throughout the course
- Module 2: Foundations in physics (year 12)
- Module 3: Forces and motion (year 12)
- Module 4: Electrons, waves and photons (year 12)
- Module 5: Newtonian world and astrophysics (year 13)
- Module 6: Particles and medical physics (year 13)

Practical Endorsement

Practical endorsement in physics is achieved by successfully completing a series of practical activities over the two years of the course.

You will need to record all practical activity tasks completed and submit evidence. Your work will be marked and skills recorded by the teacher.

All written assessments are at the end of the two year course. Paper 3 will focus on practical skills you have learnt over the two years and the practical activities you carry out (though these may be in unfamiliar contexts or with unusual equipment).

The main differences between GCSE and A Level Physics

Although there is some overlap in topics, there is quite a lot of new material that you won't have met before. There is a greater level of mathematical detail required at A Level – you are expected to be able to manipulate and combine equations using algebra, use equations to determine important physical quantities from practical work and use mathematics to support an argument. Also, you need to go into more detail regarding the topics you are already familiar with and your level of thinking and explaining has to be deeper.

New material

There will be many more facts and unfamiliar terms to learn and recall in exams than there were at GCSE. Examples of new areas include the quantum physics, stationary waves, the properties of materials and the use of fields to describe electromagnetism and gravity. Don't be put off by all the complex terms you will start to come across, they are important for scientists to communicate precisely what they mean, and as you're A Level course progresses you will become more comfortable and confident with using them.

Detail

You must be prepared to go into a topic or subtopic in much more detail than at GCSE. This sometimes means using a wider array of mathematical techniques (e.g. the use of SUVAT equations for projectile motion). It might involve describing something in much more detail than before (e.g. the changing resistance of different components as a function of p.d.). You will also have to describe, in detail, how experiments are performed with a greater emphasis placed on using the results of an experiment to determine a value (e.g., acceleration due to gravity) and the uncertainty associated with it.

Thinking and explaining

As well as going into more detail and giving examples wherever you can, you need to justify your statements and apply your knowledge and skills to unfamiliar examples. Justifying what you are saying in A Level physics often involves applying a mathematical line of reasoning, i.e. explaining why something behaves the way it does, supported by a calculation. For example, knowing the equation that links current, p.d. and resistance allows you to calculate the resistance of a component. You can then apply this to calculate the resistance of an unknown component and describe how it changes in various situations.

How to achieve at A level

A different approach to your studies is needed at A Level compared to GCSE science. We've already explained that there is much more detail at A level so you will need to work hard in lessons and out of lessons in order to fully grasp the topics. You are expected to do an hour in private study for every hour you spend in the classroom. This is in addition to the time it takes to complete homework tasks.

At A Level you need to structure your own personal study. You need to organise yourself! Get yourself a diary, one with plenty of room for writing. Remember you will have 3 different subjects to stay on top of: reading, writing up notes, exam dates, practical dates, homework, revision and so on.

Time Management

Plan your time. Look carefully at when your physics classes are timetabled and plan appropriate times around these that you can write up your class notes and complete homework. Too often, students come to classes having not looked at a topic since the previous week. Try to plan a short session to look over work before the next lesson. If you develop this habit you will find the topic being discussed in the lesson makes much more sense.

Independent Study

- Re-reading your class notes or handouts as soon after the lesson as possible.
- Highlighting the key points and any areas you did not understand fully (and asking for help on these)
- Reading the relevant section in the textbook and other resources (see the Resources section of this guide)
- Re-writing your notes, include relevant diagrams, keywords and definitions and information that you have found in the other resources.
- Attempting some questions to see how much you really understand.

Remember, A levels in science are considerably harder than GCSE. We expect a much greater commitment from you in order to be successful. It should go without saying that independent-study is always completed, on time and to the best of your ability. If you don't understand something in your independent-study then you should look it up or ask your teacher for help. Your teacher will also ask to see your class notes on a regular basis. These should be presented in an organised folder.

Students who succeed in their A Level courses are those who developed a routine way of working in their own time so that they were able to add to and enhance their learning. This is independent learning and it makes a real difference.

What you need:

- Pen
- Pencil
- 30mm Ruler
- Rubber
- Sharpener
- Scientific Calculator
- Leaver Arch File for notes
- Dividers
- Flashcards

Bridging Projects

Please complete all questions on the bridging project.

You must bring your completed bridging project work along to your first physics lesson in September.

Incomplete or late bridging projects will receive a sanction.

We are looking forward to seeing you all in September.

Dr Morley (Coombeshead)

Mr Williamson (Teign)

The Sixth Form Teign School Coombeshead Academy

1. Making Measurements

Practical physics involves the correct treatment of measurements so that we can find out a relationship between variables or the value of some specific quantity. Once we have a method, it is important that we collect data and process it correctly. It is also necessary to comment on the data and be able to describe how close it comes to answering our original question and how sure we are about the outcome.

Ideally, we should design our method and carry it out so that the measurements we make are:

Reliable When repeating the method produces results that are consistently similar. There are always **random errors** present which stop us from making identical measurements of the same thing.

We improve reliability by carrying out repeat data and calculating a mean value – this helps cancel out the random errors and gets our measurement closer to the true value. The scatter of the points around a line of best fit on a graph will be reduced.

Valid If the measurements that have been acquired by a method can be used to give the required data or answer the original question, then the measurements are valid.

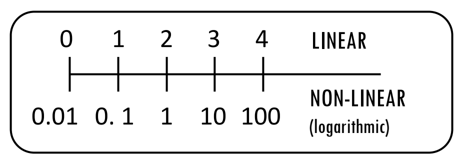
If you want to know a runner's speed, measuring the distance and time of the journey would be valid data. The lengths of her legs would be invalid data.

Using Measuring Instruments

How good our data is depends on the quality, build and use of our measuring apparatus. Consider these ideas:

Zero error If the measuring instrument isn't measuring anything, it should read 'zero'. If it doesn't, then you should note down the 'zero error' and account for it in your readings else all of your data will be out by the same amount every time. This is an example of a **systematic error**.

Linearity If the intervals on a scale are evenly spaced and the increase in intervals is equal as you move along the scale, then the scale is described as linear.



Range The lowest and highest values the device can measure.

Precision The precision of a device is the smallest non-zero value you can measure with it (or if the scale doesn't start at 0, the size of the intervals.).

There are two methods for finding precision of data:

- for one measurement or repeated identical values, write down the precision of the device.
- for several measurements, the precision of the mean is the same as the uncertainty.

Uncertainty A measure of how sure our result is close to the true value. Also called **probable error**. The uncertainty in a mean value is found by halving the range of the data. It should be quoted to the same number of decimal places as the mean value.

E.g. 3.4, 3.0, 3.5 cm Uncertainty = (3.5 - 3.0) / 2 = 0.25cm → Mean = 3.3 **± 0.3** cm

You should also be confident with standard HSW terms such as independent variable, control variable...; etc. Use the glossary in the course handbook to check you know them meanings of these terms.

Questions

A student is investigating how the length of a wire affects the size of the current through it.

1) What is her independent variable?

2) What is her dependent variable?

3) Suggest one control variable.

She obtains the following results.

Length /cm	Current /A			
	1	**2**	**3**	**Mean**
0.10	0.19	0.24	0.21	0.21
0.20	0.51	0.49	0.52	0.51
0.30	0.81	0.81	0.80	0.81
0.40	1.12	1.11	1.14	1.12
0.50	1.39	1.42	1.43	1.41
0.60	2.03	1.75	1.72	1.74

4) What was the precision of her ammeter?

5) What was the precision of her ruler?

6) Circle the anomalous result in the table.

7) Ignoring the anomalous result, which value of length gives the largest range of readings for the current? State the value of this range.

8) Do you think the student's results are reliable? Explain your answer.

9) What is the uncertainty in the mean value of the current for the shortest and longest lengths of wire?

10) After she finishes the experiment, she realises that the needle on her analogue ammeter didn't return to zero but actually settled at -0.02 A. State what her measured values of the current for the longest length of wire should have been after correcting for this zero error.

Mark = /10

2. Tables and Graphs

An important part of any science discipline is communication of your findings. Certain standards are expected in terms of tables and graphs and you must get into the habit of meeting these standards every time you collect data.

Results tables

Independent variable, written as words or as a symbol, with units.

Dependent variable with units, clearly laid out with columns for repeated data and calculated mean.

Columns of processed data (calculated data from your measured values) with appropriate units.

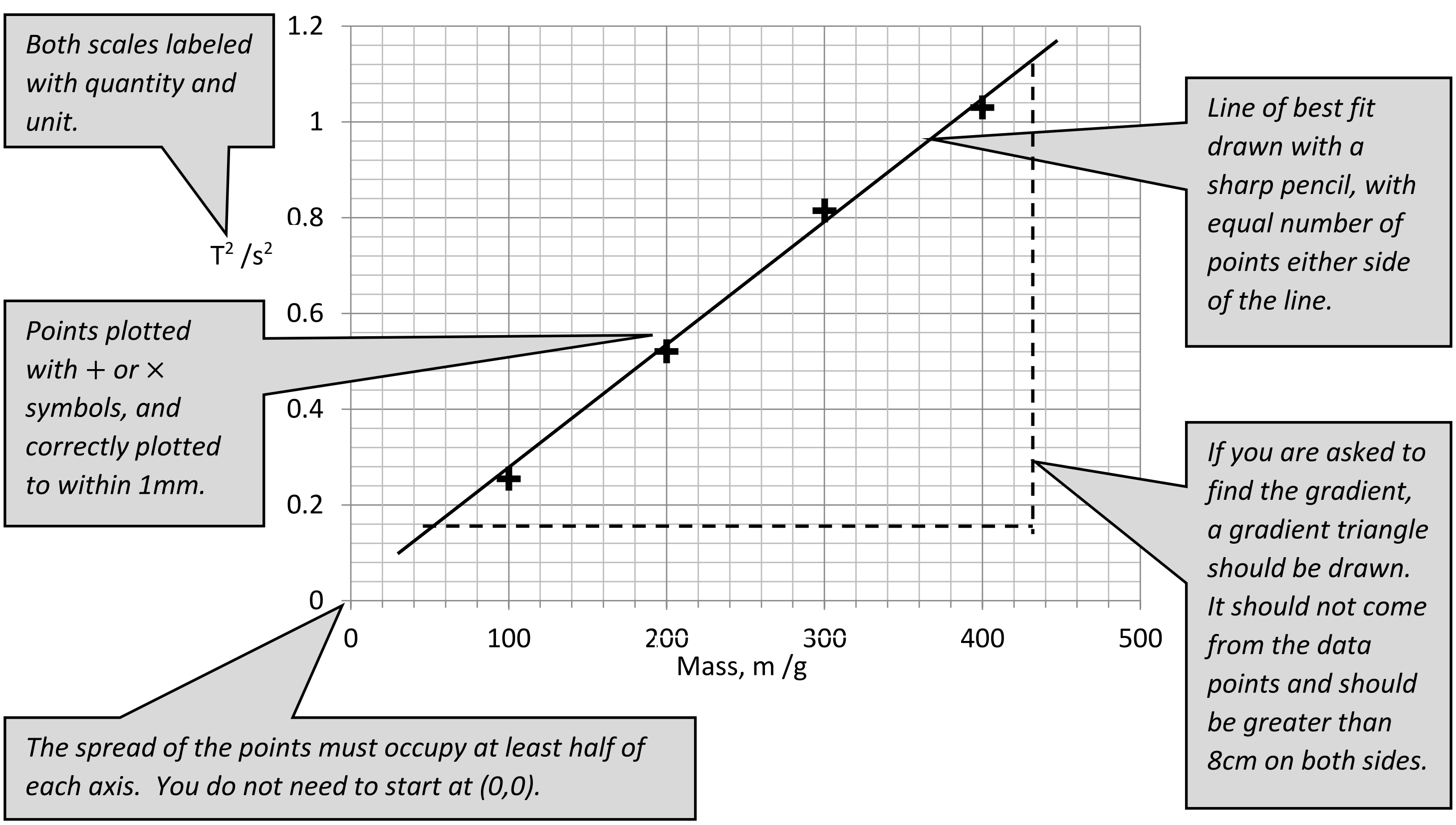
We write the unit after a slash, not in brackets.

Mass, m /g	Time for 10 oscillations, 10T /s			Time period T /s	T^2 / s^2
	1	2	Mean		
100.0	5.07	5.03	5.05	0.505	0.255
200.0	7.19	7.25	7.22	0.722	0.521
300.0	9.03	9.03	9.03	0.903	0.815
	10.01	10.20	10.15	1.015	.030

All values quoted to the correct precision

Processed data with correct number of significant figures compatible with the data from which it is derived.

Graphs



Questions

A student measured the current through a wire when she changed the potential difference across it. The ammeter was precise to the nearest 0.01A and the voltmeter to the nearest 0.01V

She obtained the following data:

Potential difference	current	
0.10	0.11	
0.20	0.22	
0.30	0.28	
0.40	0.43	
0.50	0.58	
0.60	0.61	
0.70	0.79	
0.80	0.9	
0.90	0.99	
1	1.1	

1. Correct all the mistakes you can find in the first two columns of her table.
   (*5 marks*)

2. Calculate the resistance for each pair of readings using the formula $\text{resistance} = \frac{\text{potential difference}}{\text{current}}$
   Fill in the third column in the table.

3. Plot a graph of potential difference against current (current on the x axis).
   (Attach it to the back of this skills booklet)
   (*5 marks*)

4. Calculate the gradient of your graph. Show your working!
   (*3 marks*)

5. What does the gradient represent?

6. Why do we bother drawing a graph and finding the gradient of the best fit line – why not take an average of the resistance values you calculated?

Mark = /16

3. Analysing Data

How certain are you that the data you have collected answers the original question? It is necessary for us to comment on the errors in our experiment and the effect this has on the outcome.

Error

Some factor that prevents you from measuring the true value.

- **Systematic error** — Non-random errors. For example, a zero error causes all values to be incorrect by the same amount. A parallax error where you always measure incorrectly at the wrong angle is also systematic.
- **Random error** — Errors with no pattern. By calculating a mean of many repeated measurements the effect of random errors is reduced and you get closer to the 'true' value.

To find out how much error is in our results, we need to find the uncertainty as a percentage of the measurement itself. Uncertainty is explained in chapter 1 of this skills booklet.

Percentage Uncertainty

$$= \frac{\text{uncertainty}}{\text{mean value}} \times 100$$

Length /cm	**Current /A**			
	1	**2**	**3**	**Mean**
0.10	0.19	0.24	0.21	0.21

For example, the uncertainty of the mean value of the current through a wire of length 0.10 cm is found by half of the spread of the data. Uncertainty = (0.24 – 0.19) / 2 = 0.025 cm → Mean = 0.21 ± **0.03** cm

$$\text{The percentage uncertainty} = \frac{\text{uncertainty}}{\text{mean value}} \times 100 = \frac{0.03}{0.21} \times 100 = \mathbf{14\%}$$

Errors always get bigger when you combine measurements together.

If you add or subtract quantities: Add together the uncertainties.
See the example at the bottom of page 223 in your AS Physics textbook.

If you multiply or divide quantities: Add together the percentage uncertainties.

Using the example above, assume we know the percentage uncertainty of the resistance of the wire is 2%. The resistance of the wire is 200 Ω. If we want to know the power of the wire we use the formula $P = I^2R$.

Percentage uncertainty in P = 14% + 14% + 2% = 30%

$P = I^2R$ = 0.21^2 x 200 = 8.82 W. 30% of this is 2.65 W

Therefore, **P = 8.82 ± 2.65 W (30%)**

$$\frac{\Delta P}{P} = \frac{\Delta I}{I} + \frac{\Delta I}{I} + \frac{\Delta R}{R}$$

You add the percentage error in I twice because it is I^2 or $I \times I$

Questions

1) Look at the following repeat readings for measurements of a potential difference: 0.05 V, 0.05 V, 0.05V

   a) What is the precision of the voltmeter?

   b) Is this reading necessarily accurate? Explain your answer.

2) A student measured the length of her nose to be 5.2cm

   a) What is the precision of her ruler?

   b) What is the uncertainty in her measurement?

   c) What is the percentage uncertainty in her reading?

3) Look at the following repeat readings for measurements of a current: 1.20 A, 1.21 A, 1.26 A

   a) What is the mean value?

   b) What is the range of the readings?

   c) What is the uncertainty in the readings?

   d) What is the percentage uncertainty in the mean value?

4) Look at the following repeat readings for the measurement of the mass of a ferret:

   650g, 645g, 652g, 690g, 654g

   a) What is the mean value?

   b) What is the range of the readings?

   c) What is the uncertainty in the readings?

   d) What is the percentage uncertainty in the **smallest** value?

Mark = /13

4. Physical Quantities

Maths and Physics have an important but overlooked distinction by students. Numbers in Physics have meaning – they are the size of physical quantities which exist. To give numbers meaning we suffix them with units. There are two types of units:

Base units These are the seven fundamental quantities defined by the Système international d'Unités (SI units). Once defined, we can make measurements using the correct unit and make comparisons between values.

Basic quantity	Unit	
	Name	Symbol
Mass	kilogram	kg
Length	metre	m
Time	second	s
Current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Derived units These are obtained by multiplying or dividing base units. Some derived units are complicated and are given simpler names, such as the unit of power Watt (W) which in SI units would be m^2kgs^{-3}.

Derived quantity	Unit	
	Name	Symbols
Volume	cubic metre	m^3
Velocity	metre per second	ms^{-1}
Density	kilogram per cubic metre	kgm^{-3}

Notice that at A-Level we use the equivalent notation ms^{-1} rather than m/s.

Do not become confused between the symbol we give to the quantity itself, and the symbol we give to the unit. For some examples, see the table on the right.

Quantity	Quantity symbol	Unit name	Unit symbols
Length	L or l or h or d or s	metre	m
Wavelength	λ	metre	m
Mass	m or M	kilogram	kg
Time	t	second	s
Temperature	T	kelvin	K
Charge	Q	coulomb	C
Momentum	p	kilogram metres per second	$kg\ ms^{-1}$

Prefix	Symbol	Name	Multiplier
femto	f	quadrillionth	10^{-15}
pico	p	trillionth	10^{-12}
nano	n	billionth	10^{-9}
micro	μ	millionth	10^{-6}
milli	m	thousandth	10^{-3}
centi	c	hundredth	10^{-2}
kilo	k	thousand	10^{3}
mega	M	million	10^{6}
giga	G	billion	10^{9}
tera	T	trillion	10^{12}
peta	P	quadrillion	10^{15}

Often the value of the quantity we are interested in is very big or small. To save space and simplify these numbers, we prefix the units with a set of symbols.

Knowledge of standard form and how to input it into your calculator is essential.

For example: 245×10^{-12} m = 245 pm
2.45×10^{3} m = 2.45 km

We may need to convert units to make comparisons.

For example: Which is bigger, 0.167 GW or 1500 MW?

$$0.167\text{ GW} = 0.167 \times 10^{9}\text{ W} = 167 \times 10^{6}\text{ W} = 167\text{ MW} < 1500\text{ MW}$$

Physical Quantities - Questions

11) The unit of energy is the joule. Find out what this unit is expressed in terms of the base SI units.

12) Convert these numbers into normal form:

a. 5.239×10^3
b. 4.543×10^4
c. 9.382×10^2
d. 6.665×10^{-6}
e. 1.951×10^{-2}
f. 1.905×10^5
g. 6.005×10^3

13) Convert these quantities into standard form:

a) 65345 N
b) 765 s
c) 486856 W
d) 0.987 cm^2
e) 0.000567 F
f) 0.0000605 C
g) 0.03000045 J

14) Write down the solutions to these problems, giving your answer in standard form:

a. $(3.45 \times 10^{-5} + 9.5 \times 10^{-6}) \div 0.0024$
b. $2.31 \times 10^5 \times 3.98 \times 10^{-3} + 0.0013$

15) Calculate the following:

a. 20mm in metres
b. 3.5kg in grams
c. 589000 µm in metres
d. 1m^2 in cm^2 (careful)
e. 38 cm^2 in m^2

16) Find the following:

a. 365 days in seconds, written in standard form
b. 3.0×10^4 g written in kg
c. 2.1×10^6 Ω written in MΩ
d. 5.9×10^{-7} m written in µm
e. Which is bigger? 1452 pF or 0.234 nF

Mark = /27

5. Significant Figures

Number in Physics also show us how certain we are of a value. How sure are you that the width of this page is 210.30145 mm across? Using a ruler you could not be this precise. You would be more correct to state it as being 210 mm across, since a ruler can measure to the nearest millimetre.

To show the precision of a value we will quote it to the correct number of significant figures. But how can you tell which figures are significant?

The Rules

1. All non-zero digits are significant.
2. In a number with a decimal point, all zeros to the right of the right-most non-zero digit are significant.
3. In a number without a decimal point, trailing zeros may or may not be significant, you can only tell from the context.

Examples

Value	# of S.F.	Hints
23	2	There are two digits and both are non-zero, so are both significant
123.654	6	All digits are significant – this number has high precision
123.000	6	Trailing zeros after decimal are significant and claim the same high precision
0.000654	3	Leading zeros are only placeholders
100.32	5	Middle zeros are always significant
5400	2, 3 or 4	Are the zeros placeholders? You would have to check how the number was obtained

When taking many measurements with the same piece of measuring apparatus, all your data should have the same number of significant figures.

For example, measuring the width of my thumb in three different places with a micrometer:

20.91×10^{-3} m 21.22×10^{-3} m 21.00×10^{-3}m   **all to 4 s.f**

Significant Figures in Calculations

We must also show that calculated values recognise the precision of the values we put into a formula. We do this by giving our answer to the same number of significant figures as the least precise piece of data we use.

There is no way we can state the runners speed this precisely.

For example: A man runs 110 m in 13 s. Calculate his average speed.

Speed = Distance / Time = 110 m / 13 s = 8.461538461538461538461538461538 m/s

= 8.5 m/s to 2 s.f.

This is the same number of sig figs as the time, which is less precise than the distance.

Significant Figures - Questions

1) Write the following lengths to the stated number of significant figures:
    a) 5.0319 m to 3 s.f.
    b) 500.00 m to 2 s.f.
    c) 0.9567892159 m to 2 s.f.
    d) 0.000568 m to 1 s.f.

2) How many significant figures are the following numbers quoted to?
    a) 224.4343
    b) 0.000000000003244654
    c) 344012.34
    d) 456
    e) 4315.0002
    f) 200000 stars in a small galaxy
    g) 4.0

3) For the numbers above that are quoted to more than 3 s.f, convert the number to standard form and quote to 3 s.f. ↑

4) Calculate the following and write your answer to the correct number of significant figures:
    a) 2.65 m x 3.015 m
    b) 22.37 cm x 3.10 cm
    c) 0.16 m x 0.02 m
    d) $\frac{54.401 \text{ m}^3}{4 \text{ m}}$

Mark = /19

6. Using Equations

You are expected to be able to manipulate formulae correctly and confidently. You must practise rearranging and substituting equations until it becomes second nature. We shall be using quantity symbols, and not words, to make the process easier.

Key points

- Whatever mathematical operation you apply to one side of an equation must be applied to the other.
- Don't try and tackle too many steps at once.

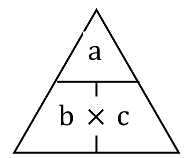
Simple formulae

The most straightforward formulae are of the form $a = b \times c$ (or more correctly $= bc$).

Rearrange to set b as the subject: Divide both sides through by c $\frac{a}{c} = \frac{b \times c}{c}$ therefore $\frac{a}{c} = b$

Rearrange to set c as the subject: Divide both sides through by b $\frac{a}{b} = \frac{b \times c}{b}$ therefore $\frac{a}{b} = a$

Alternatively you can use the formula triangle method. From the formula you know put the quantities into the triangle and then cover up the quantity you need to reveal the relationship between the other two quantities. This method only works for simple formulae, it doesn't work for some of the more complex relationships, so you must learn to rearrange.



More complex formulae

Formulae with more than 3 terms		Formulae with additions or subtractions		Formulae with squares or square roots	
Find ρ	$R = \frac{\rho l}{A}$	**Find h**	$Ek = hf - \Phi$	**Find *g***	$T = 2\pi\sqrt{\frac{l}{g}}$
Divide by l	$\frac{R}{l} = \frac{\rho l}{Al}$	Add Φ	$Ek + \Phi = hf - \Phi + \Phi$	Square	$T^2 = 4\pi^2\frac{l}{g}$
Cancel l	$\frac{R}{l} = \frac{\rho l}{Al}$	Cancel Φ	$Ek + \Phi = hf$	Multiply by *g*	$gT^2 = 4\pi^2 l$
Multiply by A	$\frac{R}{l} = \frac{\rho l}{Al}$	Divide by *f*	$\frac{Ek+\Phi}{f} = \frac{hf}{f}$	Divide by T^2	$g = \frac{4\pi^2 l}{T^2}$
Cancel A	$\frac{R}{l} = \frac{\rho l}{Al}$	Cancel *f*	$\frac{Ek+\Phi}{f} = h$		

Symbols on quantities

Sometimes the symbol for a quantity may be combined with some other identifying symbol to give more detail about that quantity. Here are some examples.

Symbol	Meaning
Δx	A change in x (difference between two values of x)
$\Delta x/\Delta t$	A rate of change of x
<x> or $\bar{x}$	Mean value of x
$\vec{x}$	Quantity x is a vector
x_1 x_2	Subscripts distinguish between same types of quantity

Using Equations - Questions

1) Make t the subject of each of the following equations:

   a) $V = u + at$

   b) $S = \frac{1}{2} at^2$

   c) $Y = k(t - t_0)$

   d) $F = \frac{mv}{t}$

   e) $Y = \frac{k}{t^2}$

   f) $Y = 2t^{1/2}$

   g) $v = \frac{\Delta s}{\Delta t}$

2) Solve each of the following equations to find the value of *t*:

   a) $30 = 3t - 3$

   b) $4(t + 5) = 28$

   c) $\frac{5}{t^2} = 10$

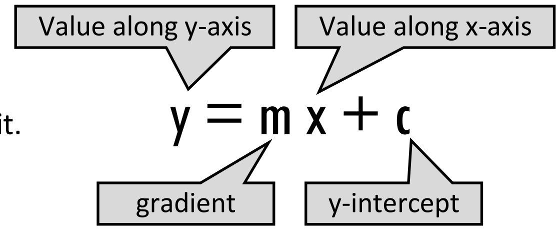
   d) $3t^2 = 36$

   e) $t^{-1/2} = 6$

   f) $t^{1/3} = 3$

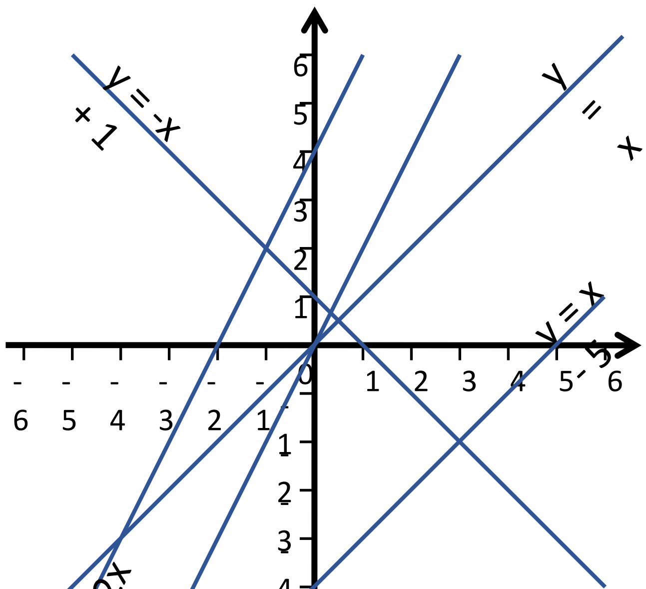
Mark = /13

7. Straight Line Graphs



If a graph is a straight line, then there is a formula that will describe it.

Here are some examples:



y = x	A positive line through the origin Gradient, m = 1	y-intercept, c = 0
y = x – 5	Parallel to y = x but transposed by -5. Gradient, m = 1	y-intercept, c = -5
y = 2x	A positive line through the origin Gradient, m = 2	y-intercept, c = 0
y = 2x + 4	Parallel to y = 2x ,transposed by 4. Gradient, m = 2	y-intercept, c = 4
y = -x + 1	A negative line, parallel to y = -x Gradient, m = -1	y-intercept, c = 1

DIRECTLY PROPORTIONAL describes any straight line **through the origin**. Both y α x and Δy α Δx

LINEAR describes any other straight line. Only Δy α Δx.

U

If asked to plot a graph of experimental data at GCSE, you would plot the *independent variable* along the x-axis and the *dependent variable* up the y-axis. Then you might be able to say something about how the two variables are related.

At A-Level, we need to be cleverer about our choice of axes. Often we will need to find a value which is not easy to measure. We take a relationship and manipulate it into the form y = mx + c to make this possible.

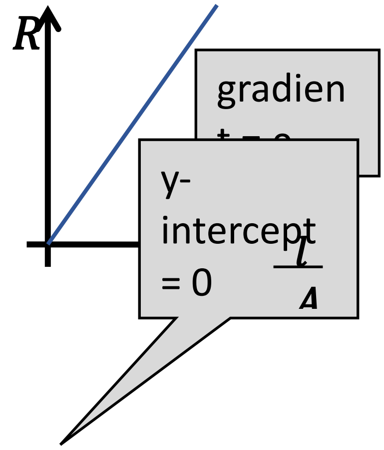
Example: $R = \frac{\rho l}{A}$ is the relationship between the resistance R of a conductor, the resistivity ρ of the material which it is made of, its length l, and its area A.

We do an experiment to find R, l and A, which are all easy to measure.
We want to find the resistivity ρ, which is harder.

This example doesn't need rearranging,
just rewriting $R = \frac{\rho l}{A}$ into the shape y = mx + c:

R	=	ρ	$\frac{l}{A}$	
y		**m**	**x**	**+ c**

So it is found that by plotting R on the y-axis and l/A on the x-axis, the resitivity ρ will be the gradient of the graph.



Straight Line Graphs - Questions

1) For each of the following equations that represent straight line graphs, write down the gradient and the y intercept:

   a) $y = 5x + 6$

   b) $y = -8x + 2$

   c) $y = 7 - x$

   d) $2y = 8x - 3$

   e) $y + 4x = 10$

   f) $3x = 5(1-y)$

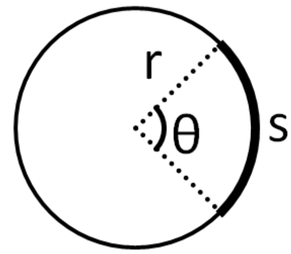
   g) $5x - 3 = 8y$

Mark = /14

8. Trigonometry

When dealing with vector quantities or systems involving circles, it will be necessary to use simple trigonometric relationships.

Angles and Arcs



There are two measurements of angles used in Physics.

- **Degrees** There are 360° in a circle
- **Radians** There are 2π radians in a circle

Whichever you use, make sure your calculator is in the correct mode!

To swap from one to the other you need to find what fraction of a circle you are interested in, and then multiply it by the number of degrees or radians in a circle.

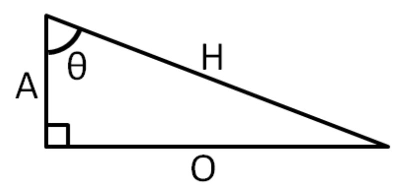
$$\theta_{\text{radians}} = \frac{\theta_{\text{degrees}}}{360} \times 2\pi \qquad \text{or} \qquad \theta_{\text{degrees}} = \frac{\theta_{\text{radians}}}{2\pi} \times 360$$

For example: To convert 90° into radians: $\theta_{\text{radians}} = \frac{\theta_{\text{degrees}}}{360} \times 2\pi = \frac{90}{360} \times 2\pi = \frac{1}{4} \times 2\pi = \frac{\pi}{2}$ radians
(We tend to leave answers in radians as fractions of π)

To find the length of an arc, use $s = \theta r$. The angle must be in radians. What would the relationship be if you wanted the entire circumference? Compare to this formula.

Sine, Cosine, Tangent

Recall from your GCSE studies the relationships between the lengths of the sides and the angles of right-angled triangles.



Using SOHCHATOA:

$$\sin\theta = \frac{\text{O}}{\text{H}} \qquad \cos\theta = \frac{\text{A}}{\text{H}} \qquad \tan\theta = \frac{\text{O}}{\text{A}}$$

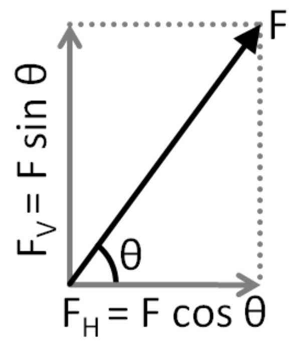
Vector Rules

A **vector** is a quantity which has two parts: SIZE and DIRECTION
(e.g. force, velocity, acceleration)

A **scalar** is a quantity which just has SIZE
(e.g. temperature, length, time, speed)

We represent vectors on diagrams with arrows.

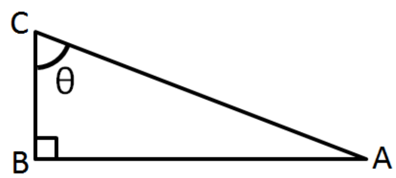
To simplify problems in mechanics we will separate a vector into horizontal and vertical components. This is done using the trigonometry rules.



Trigonometry - Questions

1) Calculate:
   a) The circumference of a circle of radius 0.450 m

   b) the length of the arc of a circle of radius 0.450m for the following angles between the arc and the centre of the circle:
      i. 340°
      ii. 170°
      iii. 30°



2) For the triangle ABC shown, calculate:
   a) Angle θ if AB = 30cm and BC = 40cm

   b) Angle θ if AC = 80cm and AB = 35cm

   c) AB if θ = 36° and BC = 50 mm

   d) BC if θ = 65° and AC = 15 km

3) Calculate the horizontal component X and the vertical component Y of a 65 N force at 40° above the horizontal.

Mark = /10