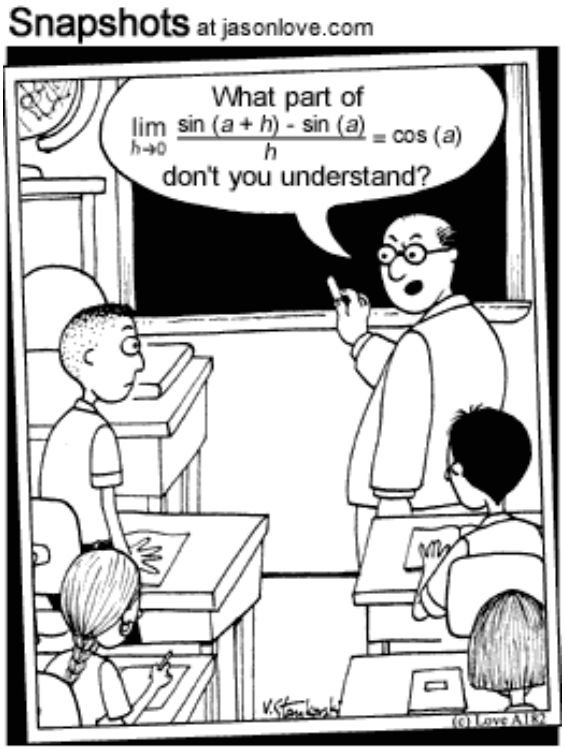
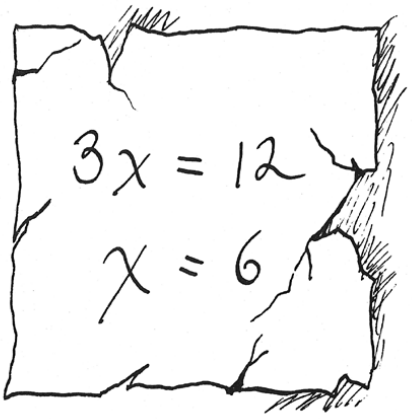
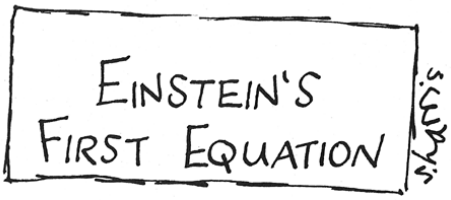
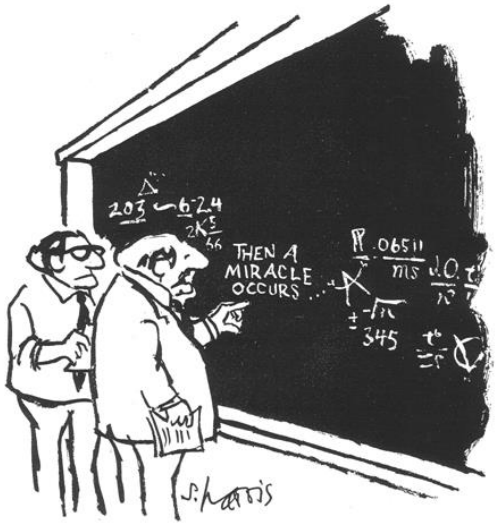
Physics @ RMGS – Introductory Work

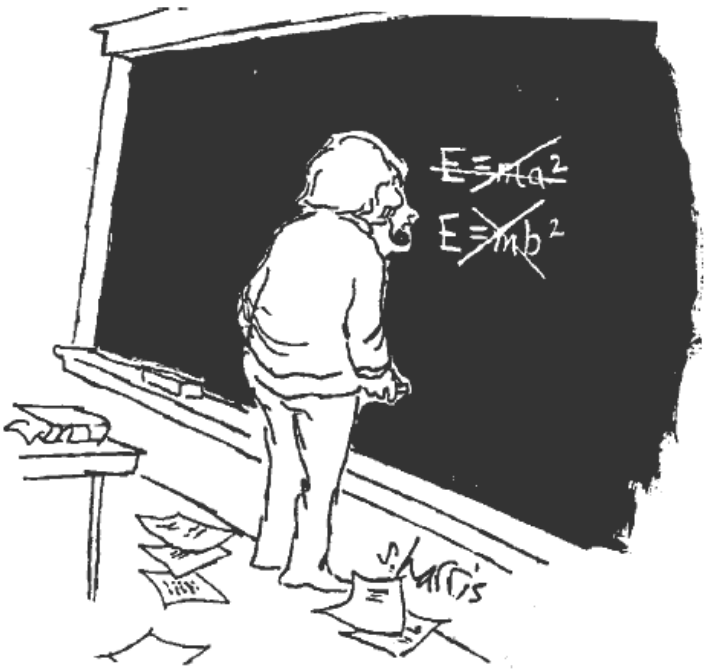








"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."



Introduction

Welcome to A-Level Physics. We are delighted you have chosen to study A level physics at RMGS. It is a challenging course that we hope you will benefit from and gain a greater understanding of why and how Physics is so important in the modern world.

What is Physics?

Physics is the science of matter and energy and how they interact with each other. The subject covers the physical properties and phenomena of heat, light, electricity and magnetism; it deals with the smallest building blocks that make up atoms to the entire structure of the universe.

Physics affects virtually every aspect of our lives. From the forces that govern our motion to the electrical devices you use every day, they all depend upon basic physical concepts and principles. Mechanical devices that allow us to interact with our environment and biological senses that adapt to the behaviour of sound, light, heat, electrical and mechanical systems.

Some things that you will learn might appear counterintuitive, or downright peculiar. Many of these ideas have been developed by some of the greatest thinkers and experimenters in our history. You will learn about particles that behave like waves, what our atoms are really made from, and the strange behaviour of light.

At the other extreme, you will look at the largest possible scale: the Universe, and the fastest possible speeds. By the end of the course you will find that there are some very strange behaviours indeed, which cannot be explained by classical laws that Isaac Newton discovered. Yet, these laws were good enough to be used to send the first men to the Moon.

Like any science, physics is constantly being updated, with theories being improved or even replaced as new discoveries build on previous knowledge and understanding. You could be the next generation of physicists that solve the questions of what dark matter is or what lies beyond our observable universe. You might be at the forefront of a new technology, or help develop the next generation of computers. Perhaps you will help to provide for humanity's need for more energy resources, or invent new ways of providing medical help to our society.

Science is often presented as one of two cultures: the other being the humanities[1]. It is possible through physics to see the beauty of the world and we hope you feel a similar wonder to physicist Richard Feynman at some of the things you discover as you continue to learn about the world:

...I stand at the seashore, alone, and start to think.

There are the rushing waves, mountains of molecules

Each stupidly minding its own business

Trillions apart, yet forming white surf in unison

[1] http://www.newstatesman.com/print/cultural-capital/2013/01/c-p-snow-two-cultures

Ages on ages, before any eyes could see

Year after year, thunderously pounding the shore as now

For whom, for what?

On a dead planet, with no life to entertain

Never at rest, tortured by energy

Wasted prodigiously by the sun, poured into space

A mite makes the sea roar

Deep in the sea, all molecules repeat the patterns

Of one another till complex new ones are formed

They make others like themselves

And a new dance starts

Growing in size and complexity

Living things, masses of atoms, DNA, protein

Dancing a pattern ever more intricate

Out of the cradle onto the dry land

Here it is standing

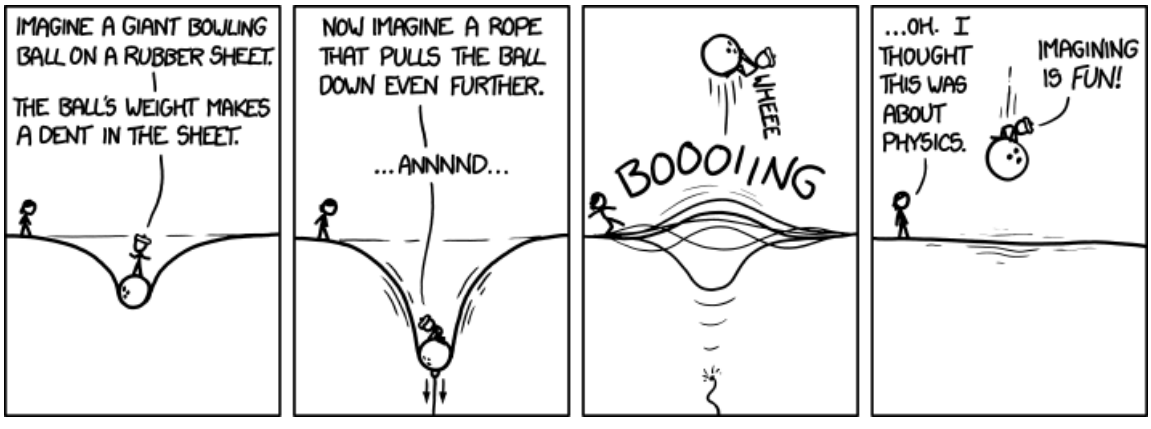
Atoms with consciousness, matter with curiosity

Stands at the sea, wonders at wondering

I, a universe of atoms

An atom in the universe

- Richard P. Feynman



Introductory Course

In physics there are certain tools that are required to help us investigate, model and understand the physical rules of our Universe.

We need Mathematical, experimental and processing skills as well as an understanding of the specialised language scientists use to make communication more succinct and universal.

There will be an introductory topic on this in the first couple of weeks in September, but if you want to get prepared and maybe even get a little head-start, then the exercises at the end of this booklet will help.

Use your GCSE knowledge and the information found elsewhereto help you answer them.

You can find the OCR mathematical skills and practical handbooks here:

http://www.ocr.org.uk/qualifications/as-a-level-gce-physics-a-h156-h556-from-2015/

Another way to keep your brain ticking over during the long summer break is to check out a book from our extensive reading list, many of which can be found in the school library.

The next page has some recommendations:

"It's called 'reading'. It's how people install new software into their brains"

"This book is defective. I tap the page and nothing happens!"

Year 12 Physics – summer reading list

Below is a list of books that we recommend for students studying A-Level Physics at RMGS.

▪ Surely You're Joking Mr Feynman	Richard Feynman
▪ Quantum – A Guide for the Perplexed	Jim Al-Khalili
▪ The Elegant Universe	Brian Greene
▪ Back of the Envelope Physics	Schwartz
▪ The New World of Mr Tompkins	Gamow and Stannard
▪ Einstein for Beginners	Schwartz and McGuinness
▪ Quantum for Beginners	McEvoy and Zarate
▪ Hawking for Beginners	McEvoy and Zarate
▪ Six Easy Pieces: Fundamentals of Physics Explained	Richard Feynman
▪ Physics of the Impossible: A Scientific Exploration of the World of Phasers, Force Fields, Teleportation and Time Travel	Michio Kaku
▪ We Need to Talk About Kelvin: What everyday things tell us about the universe	Marcus Chown
▪ Why Does $E=mc^2$?: (and Why Should We Care?)	Brian Cox and Jeff Forshaw
▪ The Quantum Universe: Everything that can happen does happen	Brian Cox and Jeff Forshaw
▪ How to Teach Quantum Physics to Your Dog	Chad Orzel
▪ The Pleasure of Finding Things Out	Richard Feynman
▪ In Search Of Schrodinger's Cat	John Gribbin
▪ A Short History of Nearly Everything	Bill Bryson
▪ Particle Physics: A Very Short Introduction	Frank Close
▪ Philosophy of Science: A Very Short Introduction	Samir Okasha
▪ Quantum Physics: A Beginner's Guide	Alastair I.M. Rae
▪ Chaos: making a new science	James Gleick
▪ Farewell to Reality: How Fairytale Physics Betrays the Search for Scientific Truth	Jim Baggott
▪ Paradox: The Nine Greatest Enigmas in Physics	Jim Al-Khalili
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▪ The Quantum Age: How the Physics of the Very Small has Transformed Our Lives	Brian Clegg
▪ Smashing Physics	Jon Butterworth

We **strongly** encourage you to read at least one of these books over the summer ready to discuss/review/feedback in lessons early next term.

Definitions

Define the following words:

Independent variable
Dependent variable
Control variable
Continuous variable
Discrete variable
Ordered variable
Categoric variable
Accuracy
Precision
Reliability
Calibration
Random error
Systematic error
Zero error
Mean value
Anomalous results
Line of best fit
Gradient
Y-Intercept

How do you improve the precision of a reading?

How do could you improve the reliability of your results?

If a weighing scale read 20g when nothing was placed on it, how would you describe it?

If you used this to find the masses of different samples of metal what type of error would it produce?

How could you calculate the true value for each of the masses?

How do you calculate a mean value of 4 readings?

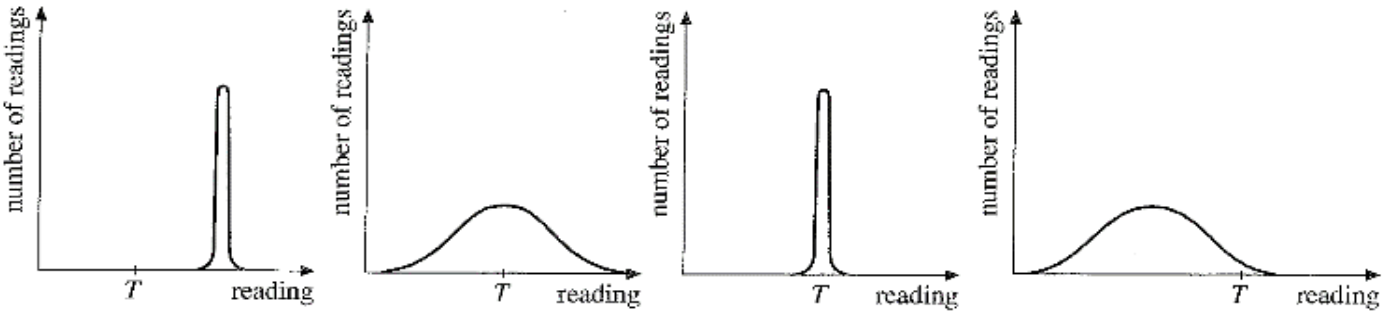
If all your readings are to 2 significant figures how many sig fig can your mean value be? Why?

Which type of variable would the following be classed as:

Height in cm?
Gender?
Dress size?
Attractiveness?
Distance in m?
Brightness?
Volume of CO_2 produced in m^3?
Temperature in Fahrenheit?
Favourite chocolate bar?
Current in Amps?
Smelliness?
Age in days?
pH?
Pressure in Pa?
Loudness?
T-Shirt size?

If *T* represents the true value which of the graphs below represents:

A. Precise and accurate?
B. Precise but not accurate?
C. Accurate but not precise?
D. Neither accurate nor precise?



Prefixes and S.I. Units

In Physics we have to deal with quantities from the very large to the very small. A prefix is something that goes in front of a unit and acts as a multiplier. This sheet will give you practice at converting figures between prefixes.

Symbol	Name	What it means		How to convert	
P	peta	10^{15}	1000000000000000		↓ x1000
T	tera	10^{12}	1000000000000	↑ ÷ 1000	↓ x1000
G	giga	10^{9}	1000000000	↑ ÷ 1000	↓ x1000
M	mega	10^{6}	1000000	↑ ÷ 1000	↓ x1000
k	kilo	10^{3}	1000	↑ ÷ 1000	↓ x1000
			1	↑ ÷ 1000	↓ x1000
m	milli	10^{-3}	0.001	↑ ÷ 1000	↓ x1000
µ	micro	10^{-6}	0.000001	↑ ÷ 1000	↓ x1000
n	nano	10^{-9}	0.000000001	↑ ÷ 1000	↓ x1000
p	pico	10^{-12}	0.000000000001	↑ ÷ 1000	↓ x1000
f	femto	10^{-15}	0.000000000000001	↑ ÷ 1000	

Convert the figures into the prefixes required.

s	ms	µs	ns	ps
134.6				
96.21				
0.773				

m	km	mm	Mm	Gm
12873				
0.295				
57.23				

kg	Mg	mg	g	Gg
94.76				
0.000765				
823.46				

A	mA	µA	nA	kA
0.000000678				
3.56				
0.00092				

Significant figures

For each value state how many significant figures it is stated to.

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2		1066		1800.45		0.07	
2.0		82.42		2.483×10^4		69324.8	
2.00		750000		2.483		0.0063	
0.136		310		5906.4291		9.81×10^4	
0.34		3.10×10^2		200000		6717	
54.1		3.1×10^2		12.711		0.91	

Add the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Value 3	Total Value	Total to correct sig figs
51.4	1.67	3.23		
7146	–32.54	12.8		
20.8	18.72	0.851		
1.4693	10.18	–1.062		
9.07	0.56	3.14		
739762	26017	2.058		
8.15	0.002	106		
132.303	4.123	53800		
152	0.8	0.55		
0.1142	4922388	132000		

Multiply the values below then write the answer to the appropriate number of significant figures

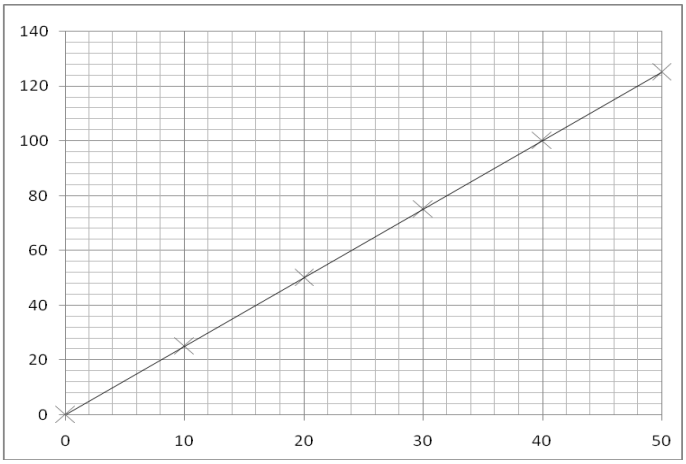
Value 1	Value 2	Total Value	Total to correct sig figs
0.91	1.23		
8.764	7.63		
2.6	31.7		
937	40.01		
0.722	634.23		

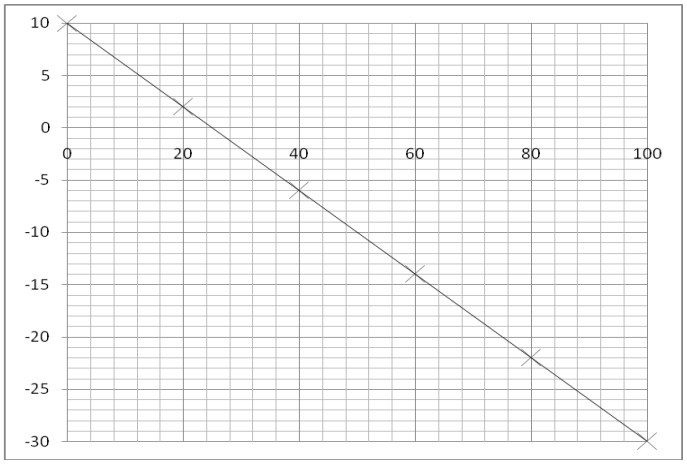
Divide value1 by value 2 then write the answer to the appropriate number of significant figures

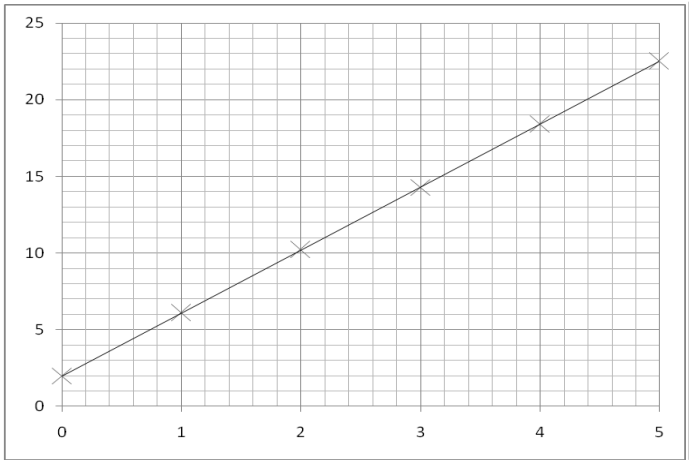
Value 1	Value 2	Total Value	Total to correct sig figs
5.3	748		
3781	6.434		
91×10^2	180		
5.56	22×10^{-3}		
3.142	8.314		

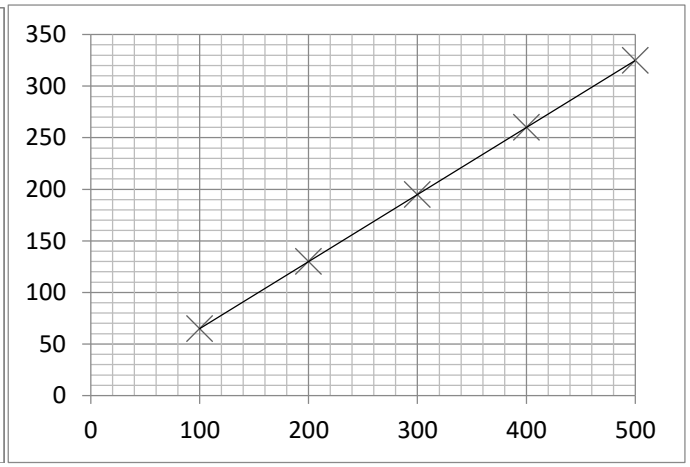
Gradient of a line

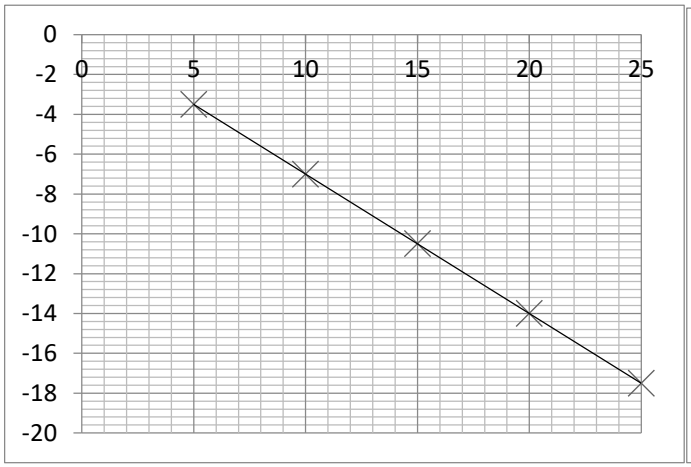
Calculate the gradients of the graphs below. Work out the equation for the line.

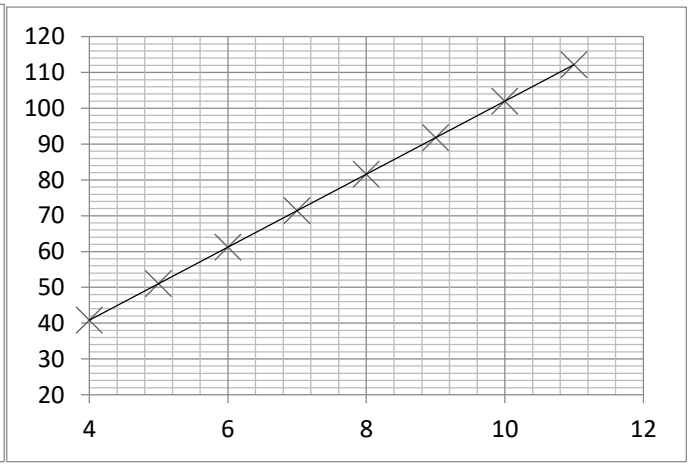


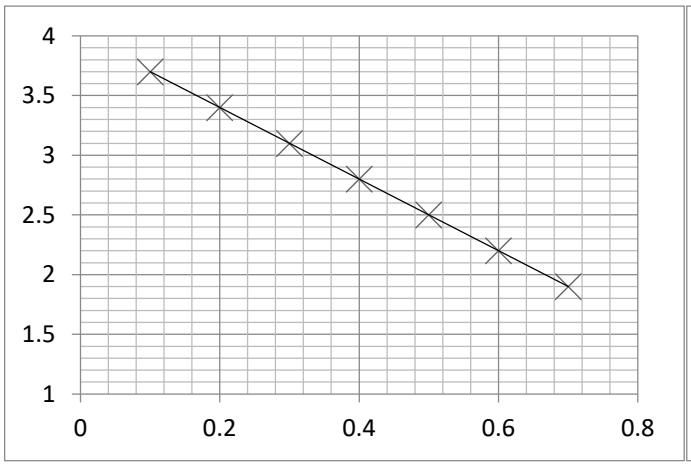


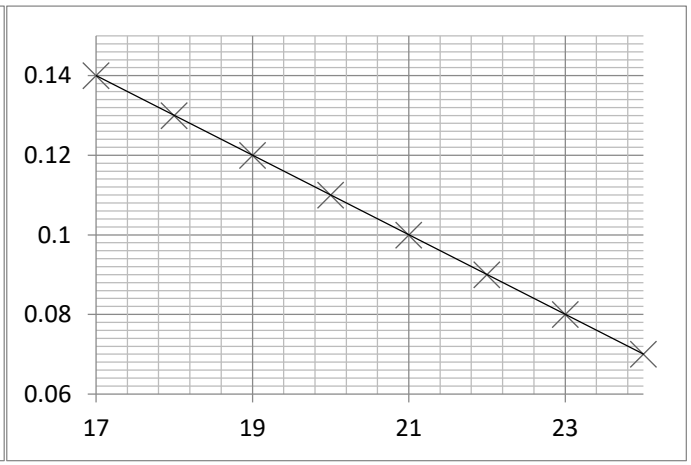












Finally, a little self-reflection……..What kind of student are you?



Do you prepare for lessons by reading and reviewing the notes from the last one?	☐
Do you use the above review exercise to prepare any questions you have for the teacher and bring them up at the next lesson?	☐
Do you engage actively in class, for example by asking for clarity, stopping the teacher to initiate a discussion about the things you need additional help with, tell the teacher you don't understand, discuss your work as you go along with fellow students, take the initiative at the end of the lesson and fix a time to see them for extra help?	☐
Have you got good independent study habits? Do you do over and above what the teachers ask of you? e.g. checking your progress against the exam board syllabus, reading text books (maybe even other than the ones provided to accompany your course), reading magazines and periodicals (such as New Scientist, Physics Review, Scientific American), make an effort to go to shows, plays and galleries featuring your subject, use the VLE or other web-based resources? Do you ever get together with friends on the course for a work-in or self-led tutorial? *A level and University study require of the best students that they secure the highest grades by working beyond the strictly limited time available for lessons.*	☐
Do you routinely redraft your lesson notes into a neat version, maybe even referencing relevant pages in the text book or web site link, at the end of each day?	☐
Do you use in school study periods for any of the above? (or do those periods get frittered away in coffee / visits to picnic basket and chats?)	☐

Students who are successful **in any course, especially A 'levels,** will tick **most** of these boxes. Better to arrive in September with this kind of approach, than realising half way into the course, when it is too late.