Haywards Heath College

Welcome to A level Physics

In our opinion you have decided to study the most fascinating, challenging and inspiring subject in the world! You have decided to follow in the footsteps of Einstein, Newton, Curie, Planck, Faraday and many more. You have decided you want a challenge, but also to understand the world around you.

Throughout your time studying A Level Physics, we will support you every step of the way, answer your questions, but also share a love of the subject.

To help you bridge the gap between GCSE physics and A-level physics, this booklet contains a series of activities for you to complete over the next few weeks. Doing these will ensure that you are secure on some very necessary key skills, will help to keep your mind active, so that you will be ready to start the advanced topics next term. This should take you between 4-10 hours depending on how secure you are on your GCSE physics work.

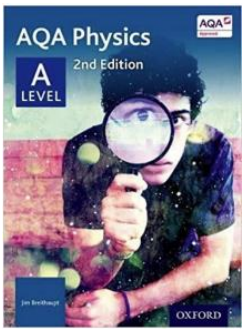
You will need to hand in this work at the beginning of September (Sep 11th). Welcome to A level Physics!

Contents:

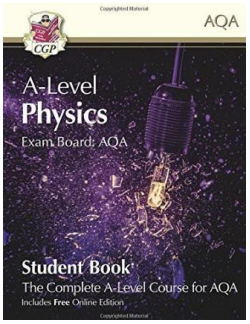
1. Course outline and Resources

The specification we follow is here: **AQA A level Physics specification and information**

The main textbook we use is AQA physics A level 2nd Edition. You will get an electronic copy of this through our Kerboodle subscription at college.
We do recommend that you also buy a hard copy (many 2nd hand options available online) so that you have it to hand and can annotate it freely.



As an optional additional textbook, the CGP A-level Physics book contains clearly structured explanations and questions which many students find extremely helpful.



Online resources: we will use these throughout the A level course. For now, just have a quick look so that you are familiar with them.

A level Physics online- a short video on every topic in AS physics. You will have free access to the A2 course videos through our college subscription from September. Also packed with example questions, tips and revision material.

Isaac Physics – a superb free resource for question practice, revision webinars and pre university stretch topics

Science Shorts AS physics – video tutorials on topics and with explanatory examples

Physics and Maths tutor – questions, flash cards, revision resources and past paper questions

Gorilla physics – a range of resources to help you tackle your physics studies

Malmesbury Science - sister channel to Science Shorts, with videos on the required practicals.

2. Activity: Exploring fun phenomena

Why does something happen? Can we explain it? And can we make prediction based on our understanding? Asking ourselves this question is at the heart of physics and the study of our universe.

Work through the links below to get you thinking.

1. The Institute of Physics (IOP) provides support to students and professionals internationally. Go to the IOP's 'big ideas in physics' page here and choose one of the 'big ideas' to read about.
   On a sheet of A4 paper, give a **short** (1/2 page) summary of what you have learnt.
2. Veritasium - fun phenomena questions. Watch the video. Do you have any ideas about the questions that are posed?
3. Now watch Veritasium - the answers.

3. Activity: Particles and radiation

You already know about the structure of the atom, alpha and beta decay. Now we will start to learn more about what holds the nucleus together, and the exciting world of particles, antiparticles, photons, annihilation and quarks.

1. You must be secure on GCSE atomic structure and radioactivity, so if you need to top up your understanding, watch GCSE atoms and radiation revision in 13 mins
2. Watch this video on The standard model to gain an overview of what we understand to be the building blocks of the universe in a subatomic realm.
3. On a sheet of A4 paper, write a summary/mind map/table of some of the subatomic particles and forces that the video mentions.
4. Go to Save my exams: Atoms and Isotopes Choose either the 'easy', 'medium' or 'hard' questions. On your sheet of paper, write down your answers to questions 1,2 and 3. Mark your questions afterwards. How did you do? Try and correct any misunderstandings.
5. *Optional Extension: watch these videos on the large hadron collider and visiting the large hadron collider. What did you learn?*

4. Activity: Forces

Mechanics helps us understand everything from our bodies' Achilles tendons and levers, to our motion around the sun and within the universe.

1. You must be secure on GCSE forces, so if you need to top up your understanding, watch GCSE Forces revision in 25 mins
2. Watch this short video about a car (with passenger!) doing a 'bungee jump' Top Gear car bungee. On a sheet of A4 paper, write down/draw diagrams to describe the forces acting on the car as it moves off the support structure.
3. Now that you've had a think about forces, try this one: if a bullet is dropped vertically, and another bullet is fired horizontally from the same starting position, which bullet will hit the ground first? Write your prediction. Now watch this short video on Bullet fired vs bullet dropped. How did your prediction compare?
4. Go to Save my exams: Forces and their interactions Choose either the 'easy', 'medium' or 'hard' questions. On your sheet of paper, write down your answers to question 1 for all the sub topics 5.1 Forces and their interactions through to 5.9 Momentum. Mark your questions afterwards. How did you do? Try and correct any misunderstandings.
5. *Optional Extension: watch this awesome video on Physics Girl: ping pong balls, car crashes and space stations . What did you learn?*

5. Activity: Waves

From mobile phones to satellites, from x-rays to ultrasonic devices…it's hard to imagine our lives without energy being transferred from place to place. At A level we look again at how waves transfer energy, but then go on to explore some of the most exciting discoveries of the 20th century – and find that particles can behave like waves too.

1. You must be secure on GCSE waves, so if you need to top up your understanding, watch GCSE Waves revision in 18 mins.
2. How do noise cancelling headphones work? Research this. On a sheet of A4 paper, write a brief (1/2 page) summary, and include a labelled diagram.
3. Is light a wave or a particle? Newton said it was a stream of 'corpuscles', or particles. Not everyone agreed with him! Watch this short video and decide who you think is right. Young's double slit experiment
4. Go to Save my exams: waves in air, fluids and solids. Choose either the 'easy', 'medium' or 'hard' questions. On your sheet of paper, write down your answers to questions 1,2 and 3. Mark your questions afterwards. How did you do? Try and correct misunderstandings.
5. *Optional extension: watch this great short video on Physics Girl: resonance. Where else might you come across resonance and standing waves?*

6. Activity: Materials

What makes a material brittle or strong? What loads can a single glass thread support? Every substance on earth experiences forces, yet different materials behave in unique ways. From lycra and elastane, to ceramics and Kevlar, materials are a fascinating part of physics, chemistry and engineering.

1. What is fiberglass and what makes it useful? Read this article about a tiny fibreglass sailing boat.
2. Watch this video on Wonderful materials. New materials are constantly being developed!
3. You must be secure on GCSE Hooke's Law, so if you need to top up your understanding, watch GCSE Materials: Hooke's Law in 3 mins

7. Activity: Electricity

Ancient Egyptians experienced shocks from 'electric fish', and now, 4000 years later, it is hard to imagine a world without electricity. We will build on GCSE electricity to explore how the movement of charges can help us create the simplest circuits through to extraordinary superconductors.

1. You must be secure on GCSE Electricity, so if you need to top up your understanding, watch GCSE Electricity in 12 mins
2. Watch this video on making a powerful static electricity battery at home. What did you learn about a Leyden jar?
3. Go to Save my exams: Electricity. Choose either the 'easy', 'medium' or 'hard' questions. On your sheet of paper, write down your answers to questions 1,2 and 3. Do this for all sub topics from 2.1 Current, potential difference and resistance through to 2.4 Static Electricity. Mark your questions afterwards. How did you do? Try and correct any misunderstandings.
4. *Optional Extension: Electricity and magnetism are closely related. Watch this video on High temperature superconductors and a mobius strip What is a superconductor? What are their uses and what are their current limitations? If you have ever had an MRI scan you will have experienced a superconductor in use.*

8. Experimental physics and maths skills

A-level physics demands a lot of mathematical skill. We use standard form, prefixes, logarithms, algebra, equations, graph work, geometry and trigonometry, so you need to be secure on all this.

1. Watch the following GCSE revision video sessions:
   Standard form revision
   Vectors revision
   Trigonometry revision
   Displacement revision

2. On a sheet of A4 paper, SHOWING ALL WORKING, complete the following activities (A through to E).

A. Greek letters

Greek letters are used often in science. They can be used as symbols for numbers (such as π = 3.14...), as prefixes for units to make them smaller (eg μm = 0.000 000 001 m) or as symbols for particular quantities (such as λ which is used for wavelength).

The Greek alphabet is shown below.

A	α	alpha	N	ν	nu
B	β	beta	Ξ	ξ	ksi
Γ	γ	gamma	O	ο	omicron
Δ	δ	delta	Π	π	pi
E	ε	epsilon	P	ρ	rho
Z	ζ	zeta	Σ	ς or σ	sigma
H	η	eta	T	τ	tau
Θ	θ	theta	Y	υ	upsilon
I	ι	iota	Φ	φ	phi
K	κ	kappa	X	χ	chi
Λ	λ	lambda	Ψ	ψ	psi
M	μ	mu	Ω	ω	omega

Q1. List all of the uses of Greek letters that you have encountered in your GCSE Science and Maths studies so far.

B. SI Units

SI units

Every measurement must have a size (eg 2.7) and a unit (eg metres or °C). Sometimes, there are different units available for the same type of measurement. For example ounces, pounds, kilograms and tonnes are all used as units for mass.

To reduce confusion, and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

The seven SI base units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	m	kilogram	kg
length	l or x	metre	m
time	t	second	s
electric current	I	ampere	A
temperature	T	kelvin	K
amount of substance	N	mole	mol
luminous intensity	(not used at A-level)	candela	cd

All other units can be derived from the SI base units. For example, area is measured in square metres (written as m^2) and speed is measured in metres per second (written as ms^{-1}).

Q1. Learn the SI base units above.
Q2. From Newton's second law, we know that **resultant force = mass x acceleration**. Write down the derived unit for force using this relationship.
Q3. What is the derived unit for energy? (hint, think about energy as work done, and the physics relationship you already know).

C. Prefixes

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

There is a wide range of prefixes. The majority of quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, a distance of 33 000 m would be quoted as 33 km. The most common prefixes you will encounter are:

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Q1.

Which SI unit and prefix would you use for the following quantities?

1. The length of a finger
2. The temperature of boiling water
3. The time between two heart beats
4. The width of an atom
5. The mass of iron in a bowl of cereal
6. The current in a simple circuit using a 1.5 V battery and bulb

Sometimes, there are units that are used that are not combinations of SI units and prefixes. These are often multiples of units that are helpful to use. For example, a light year is a distance of 9.46 × 1012 km

Q2.

Re-write the following in SI units: 1 minute , 1 hour , 1 tonne

Q3. Rewrite the following quantities:

1502 metres in kilometres

0.000 45 grams in micrograms

0.000 45 metres in millimetres

1055 kilometres in metres

180 megaseconds in seconds

2500 centimetres in millimetres

Q4. The table below summarizes how to convert between prefixes:

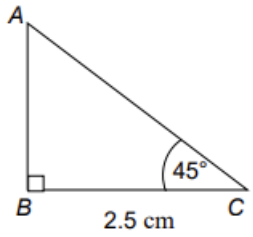
Symbol	Name	What it means		How to convert	
P	peta	10^{15}	1000000000000000		↓ x1000
T	tera	10^{12}	1000000000000	↑ ÷ 1000	↓ x1000
G	giga	10^{9}	1000000000	↑ ÷ 1000	↓ x1000
M	mega	10^{6}	1000000	↑ ÷ 1000	↓ x1000
k	kilo	10^{3}	1000	↑ ÷ 1000	↓ x1000
			1	↑ ÷ 1000	↓ x1000
m	milli	10^{-3}	0.001	↑ ÷ 1000	↓ 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				

D. Using sine, cosine and tangent:

(a) Work out the length of *AB*.



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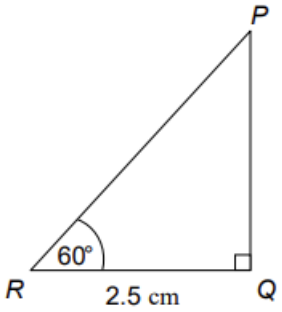
(b) Work out the length of *PR*.



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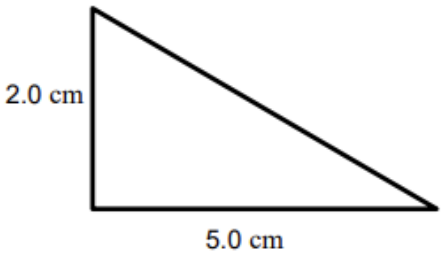
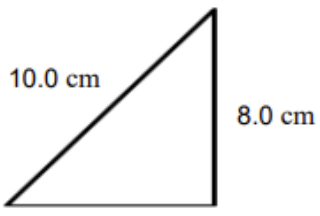
E. Using Pythagoras' theorem





F. Rearranging formulae

Rearrange $y = 2x + 3$ to make x the subject.

Rearrange $C = 2\pi r$ to make r the subject.

Rearrange $E = \frac{1}{2}mv^2$ to make v the subject.

Rearrange $s = ut + \frac{1}{2}at^2$ to make u the subject.

Rearrange $s = ut + \frac{1}{2}at^2$ to make a the subject.

Rearrange $\omega = \frac{v}{r}$ to make r the subject.

Rearrange $T = 2\pi\sqrt{\frac{v}{r}}$ to make r the subject.

Rearrange $v = \omega\sqrt{A^2 - x^2}$ to make x the subject.

Note: in science, subscripts are often used to label quantities. So in the following two examples, there are two masses, m_1 and m_2. The 1 and 2 are part of the quantity and should be kept with the m.

Rearrange $F = \frac{Gm_1m_2}{r^2}$ to make m_2 the subject.

Rearrange $F = \frac{Gm_1m_2}{r^2}$ to make r the subject.

G. Vocabulary for practical investigations:

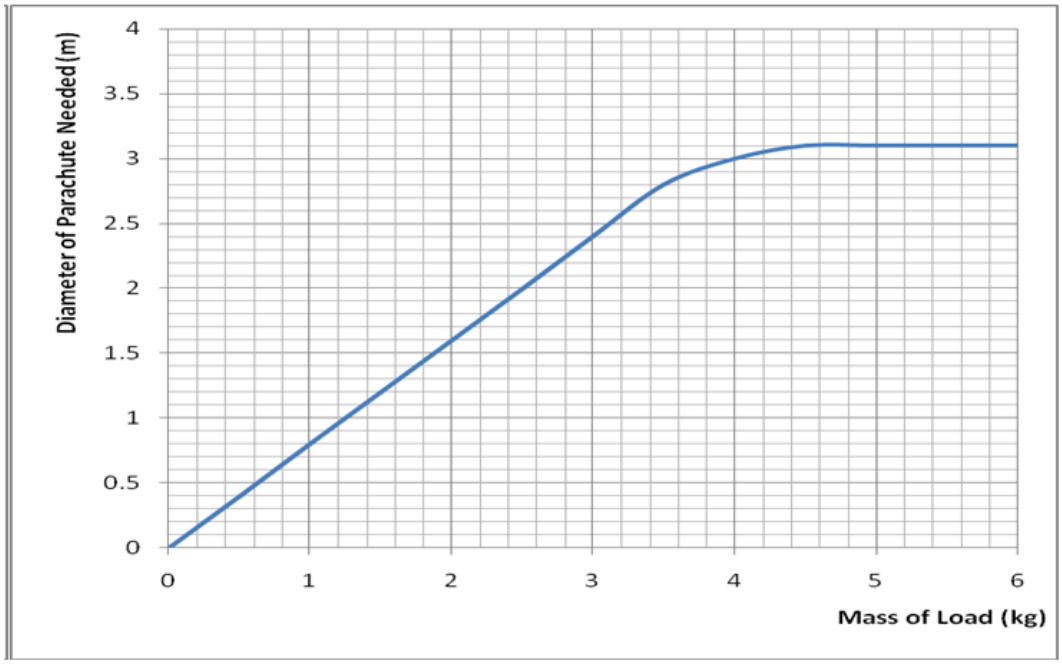
Join the boxes to link the word to its definition.

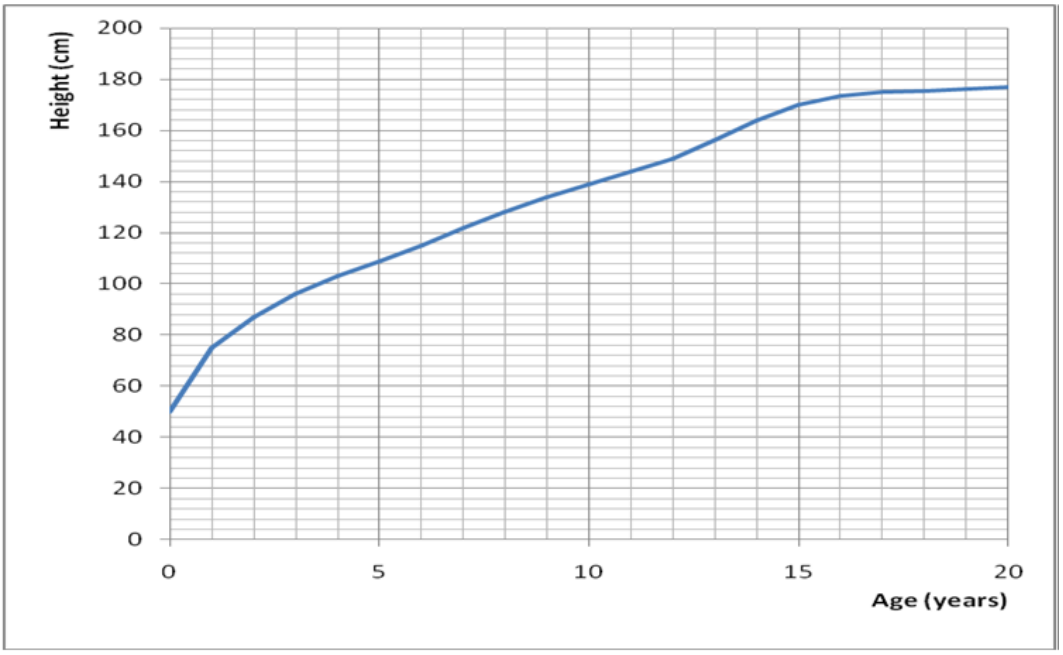
Accurate	A statement suggesting what may happen in the future.
Data	An experiment that gives the same results when a different person carries it out, or a different set of equipment or technique is used.
Precise	A measurement that is close to the true value.
Prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment.
Range	Physical, chemical or biological quantities or characteristics.
Repeatable	A variable that is kept constant during an experiment.
Reproducible	A variable that is measured as the outcome of an experiment.
Resolution	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.
Uncertainty	The interval within the true value can be expected to lie.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Measurements where repeated measurements show very little spread.
Dependent variable	Information, in any form, that has been collected.

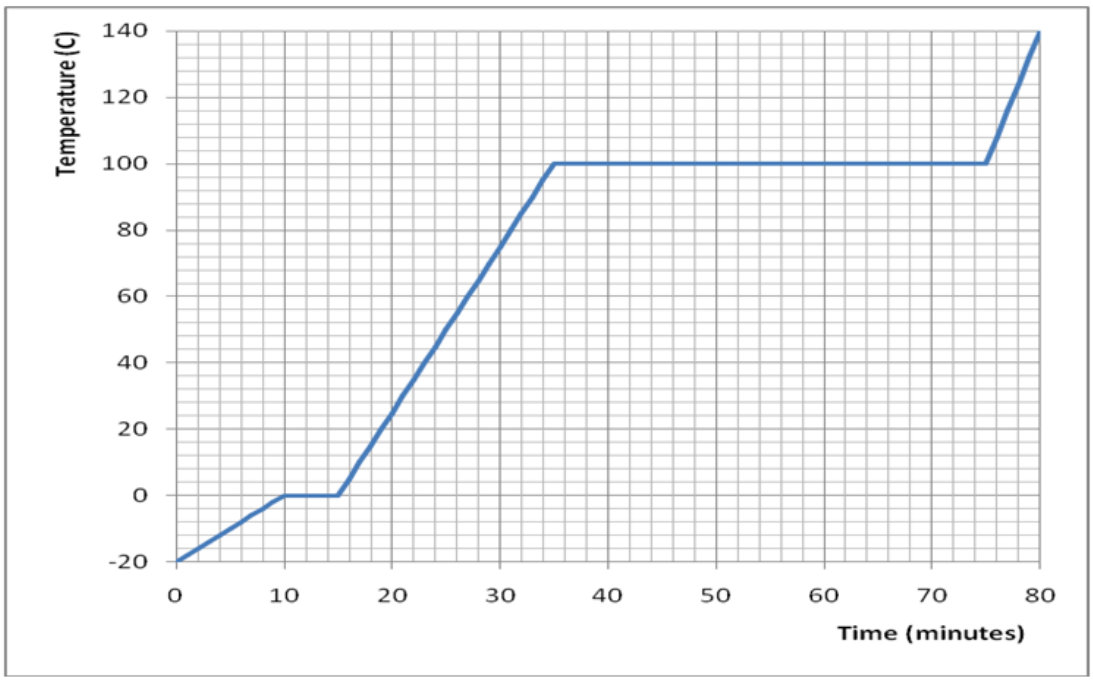
H. Graphs

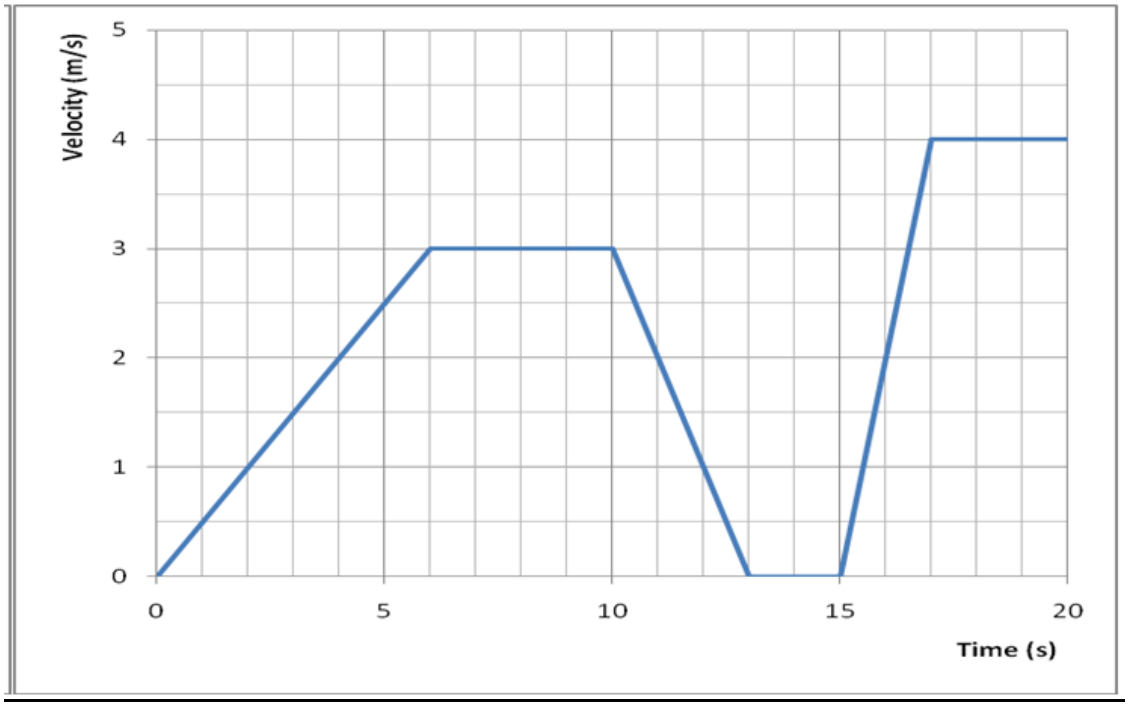
Explain the relationship between the two variables shown in the graphs below.

Describe the general trend/relationship
Identify sections of highest/lowest gradient
Quote any significant numerical values
Calculate any gradients you can





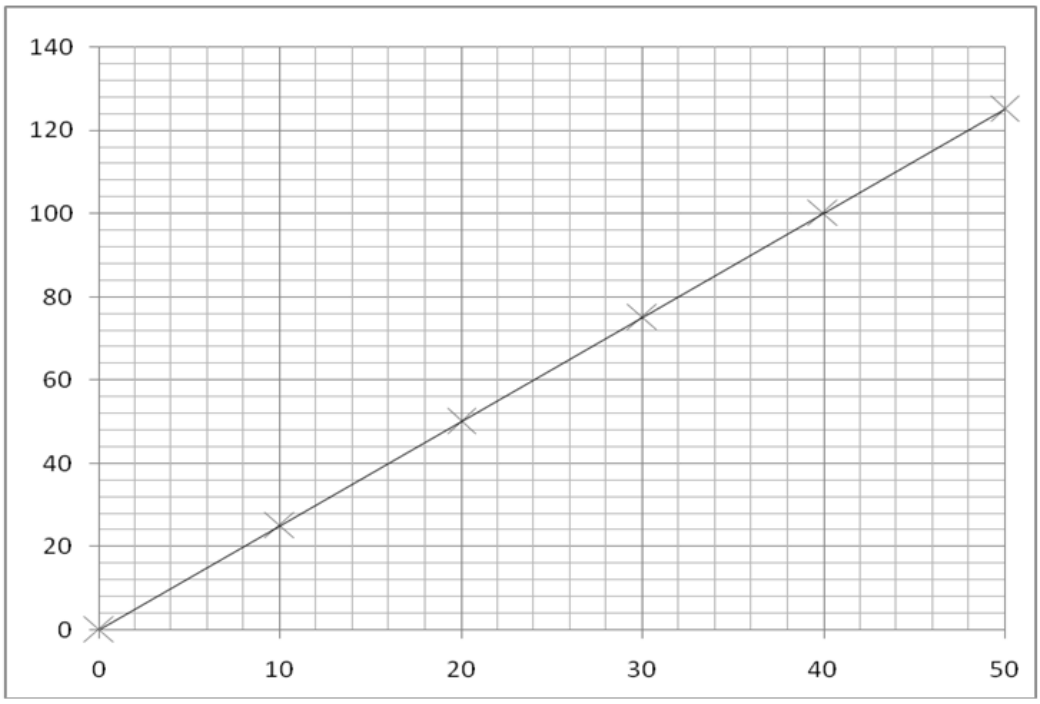

Temperature (C)
140
120
100
80
60
40
20
0
-20
0
10
20
30
40
50
60
70
80
Time (minutes)

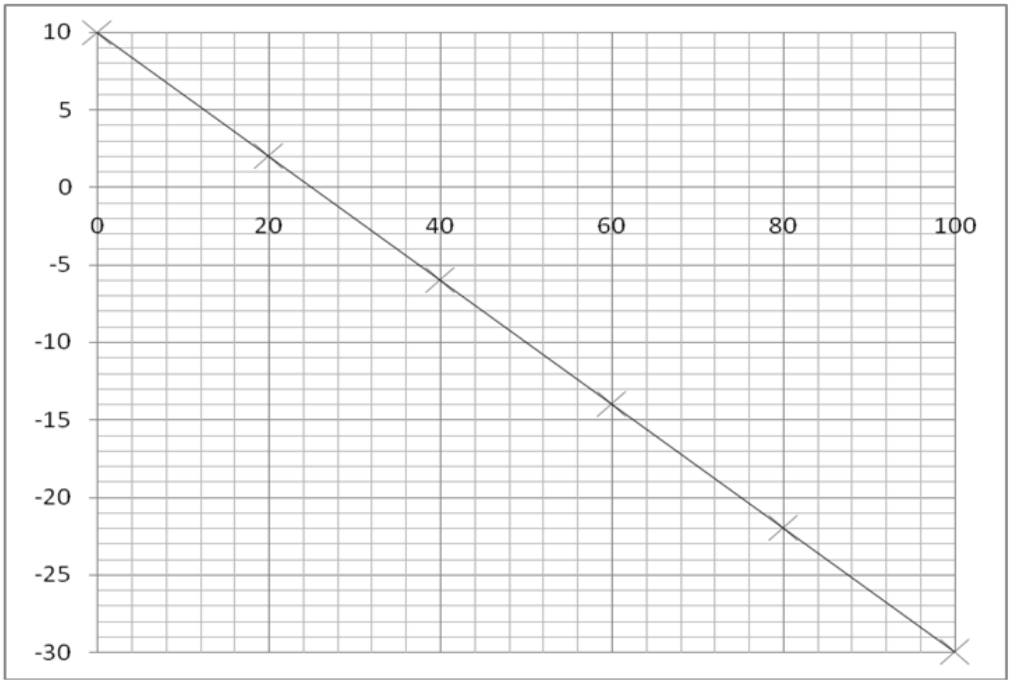

Velocity (m/s)
5
4
3
2
1
0
0
5
10
15
20
Time (s)

I. Gradients

Calculate the gradients of the graphs below.

Use the gradient to work out the equation of each line.





J. Rearranging and deriving equations

Q1

Rearrange $v^2 = u^2 + 2as$ to make a the subject	
Substitute this into $F = ma$	
Substitute this into the equation $P = Fv$	
Substitute this into the equation $E = Pt$	
Use $v = \frac{s}{t}$ to simplify the equation	

Q2

Substitute $v = u + at$ into the equation $\lambda = \frac{h}{mv}$	
Multiply out the brackets	
Substitute this into the equation $d \sin \theta = n\lambda$	

Q3

Substitute $R = \frac{V}{I}$ into the equation $\rho = \frac{RA}{l}$	
Substitute $V = \frac{E}{Q}$ into the equation	
Substitute $E = Pt$ into the equation	
Use $I = \frac{Q}{t}$ to remove t from the equation	
Simplify this	

9. Further resources and recommendations

You can sign up FREE to Isaac Physics. Now go to GCSE to A level transition. You will find lots of gameboards, quizzes and explanations of key maths and physics preparation here.
Scroll down to **Gameboards: GCSE to A level transition - skills (full)** or click **here** **to get started**.
This will take you to interactive question and answers with hints and corrections given along the way.

Well done! You have now completed your pre-A level physics preparation.
Don't forget to keep your work safely as you will need to hand it in during your first week at college.

We look forward very much to meeting you in September!