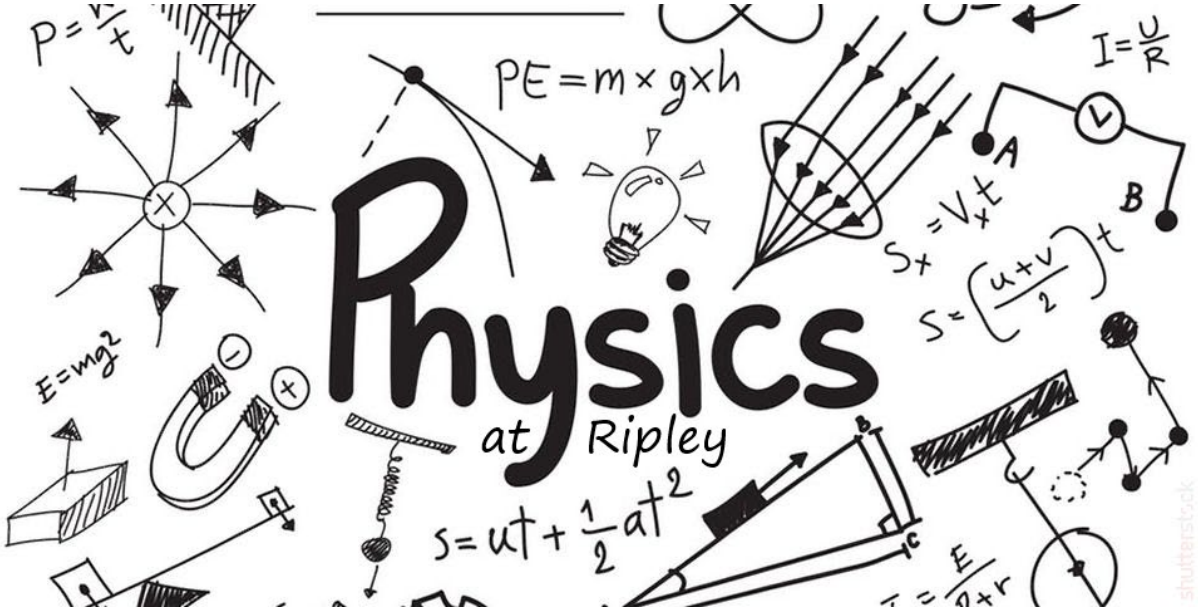
Summer task

A Level Physics Transition Booklet



Welcome

The purpose of this booklet is not to scare you or discourage you from studying what is undoubtable an extremely useful and rewarding course, it aims to support your transition from GCSE to A Level. The booklet contains a potential reading list to broaden your knowledge, links to Physics YouTubers and also provides you with a list of books that I would recommend purchasing to support your study.

Throughout your time studying A Level Physics, the staff at Ripley will support you every step of the way by answering all of your questions and sharing a love of the subject.

Welcome to A Level Physics.

Kind Regards

Mr Meeks

Course Outline

AS and A-level

1 Measurements and their errors

2 Particles and radiation

3 Waves

4 Mechanics and materials

5 Electricity

A-level only

6 Further mechanics and thermal physics

7 Fields and their consequences

8 Nuclear physics

9 Optional topics. You will study one of these: Astrophysics, Medical physics, Engineering physics, Turning points in physics or Electronics.

The assessment for the A-level consists of three exams

Paper 1	Paper 2	Paper 3
What's assessed Sections 1–5 and 6.1 (Periodic motion)	What's assessed Sections 6.2 (Thermal Physics), 7 and 8 Assumed knowledge from sections 1 to 6.1	What's assessed Section A: Compulsory section: Practical skills and data analysis Section B: Optional topic
Assessed • written exam: 2 hours • 85 marks • 34% of A-level	Assessed • written exam: 2 hours • 85 marks • 34% of A-level	Assessed • written exam: 2 hours • 80 marks • 32% of A-level
Questions 60 marks of short and long answer questions and 25 multiple choice questions on content.	Questions 60 marks of short and long answer questions and 25 multiple choice questions on content.	Questions 45 marks of short and long answer questions on practical experiments and data analysis. 35 marks of short and long answer questions on optional topic.

What we expect from you

To be adult learners. This means taking responsibility for your own learning. Monitor your progress, reflect upon any areas of difficulty and resolve these! Use your resources and ASK QUESTIONS! Our job is to support you in your learning- don't forget this!

To complete all homework to the best of your ability on time.

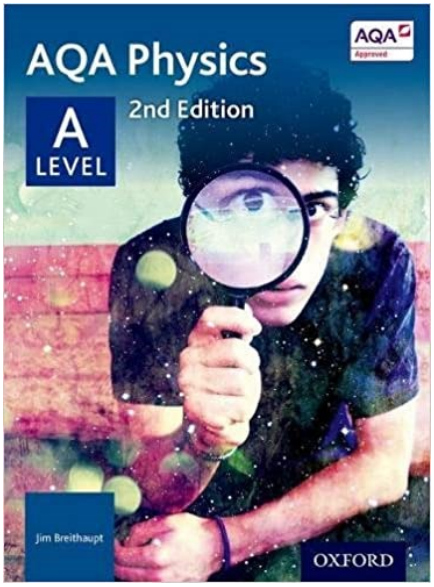
To read around the subject

A neat and organised folder with sections for class learning/ tests/ HW and revision notes (this shall be checked!)

To be prepared when you arrive in class to write/ calculate (i.e. have a full pencil case – and a calculator!)

To challenge yourself and to try your best.

Resources Provided



You will be provided with a course textbook to support your study.

You will also be given past paper booklets for each section of the course which can be used to train yourself in exam technique. You must take these seriously and understand the answer to every question. Questions are repeated often (in one form or another) so practice is key.

Online Support

YouTube:

1. Physics Online – A video for every lesson in the AS year. For £19.99 you can gain access to the A2 materials.

   https://www.alevelphysicsonline.com/aqa

2. Science Shorts – Video tutorials going through topics and providing examples

   https://www.youtube.com/user/ScienceShorts

3. Gorilla Physics – A range of videos around Physics and how to increase your grades.

   https://www.youtube.com/channel/UCDWYbhR94ZYFUXd4NJvAHYQ

Practice Questions

1. Isaac Physics - https://isaacphysics.org/
2. Seneca learning https://www.senecalearning.com/
3. Cyber Physics https://www.cyberphysics.co.uk/

Further Reading

1. Moondust – In Search of the Men Who Fell to Earth
   This book uses the personal accounts of 9 astronauts and many others involved in the space program, looking at the whole space-race era.

2. Surely You're Joking Mr Feynman: Adventures of a Curious Character
   By reading this book you will get insight into his life's work including the creation of the first atomic bomb and his work in the field of particle physics.

3. Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe
   Any physics book by Marcus Chown is an excellent insight into some of the more exotic areas of physics that require no prior knowledge

4. A Short History of Nearly Everything
   A whistle-stop tour through many aspects of history from the Big Bang to now. This is a really accessible read that will refamiliarise you with common concepts and introduce you to some of the more colourful characters from the history of science.

5. Thing Explainer: Complicated Stuff in Simple Words
   Written by the creator of online comic XTCD (a great source of science humour) is a book of blueprints from everyday objects such as a biro to the Saturn V rocket and an atom bomb.

6. Why the Universe Exists: How particle physics unlocks the secrets of everything (New Scientist Instant Expert)

   If the recent discovery of the Higgs boson piqued your interest, then *Why The Universe Exists* will take you deeper into the world of particle physics, with leading physicists and *New Scientist* exploring how the universe functions at the smallest scales.

Movie Recommendations

1. Moon (2009) - With only three weeks left in his three year contract, Sam Bell is getting anxious to finally return to Earth. He is the only occupant of a Moon-based manufacturing facility along with his computer and assistant, GERTY. When he has an accident however, he wakens to find that he is not alone.

2. Gravity (2013) - Two astronauts work together to survive after an accident which leaves them stranded in space.

3. Interstellar (2014) - A team of explorers travel through a wormhole in space in an attempt to ensure humanity's survival.

4. The Imitation Game (2014) - Based on a true story. During World War II, the English mathematical genius Alan Turing tries to crack the German Enigma code with help from fellow mathematicians.

5. Apollo 13 (1995) - Based on a true story. NASA must devise a strategy to return Apollo 13 to Earth safely after the spacecraft undergoes massive internal damage putting the lives of the three astronauts on board in jeopardy.

6. From mach-20 glider to hummingbird drone - "What would you attempt to do if you knew you could not fail?" asks Regina Dugan, then director of DARPA, the Defense Advanced Research Projects Agency. In this talk, she describes some of the extraordinary projects that her agency has created.

https://www.ted.com/talks/regina_dugan_from_mach_20_glider_to_hummingbird_drone/up-next?language=en

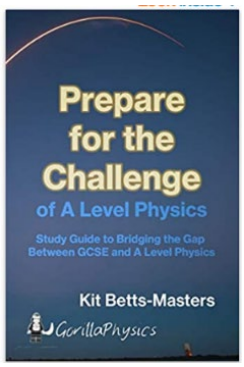
7. Is our universe the only universe? - Brian Greene shows how the unanswered questions of physics (starting with a big one: What caused the Big Bang?) have led to the theory that our own universe is just one of many in the "multiverse."

https://www.ted.com/talks/brian_greene_is_our_universe_the_only_universe?language=en

8. **The fascinating physics of everyday life -** Physicist Helen Czerski presents various concepts in physics you can become familiar with using everyday things found in your kitchen.https://www.ted.com/talks/helen_czerski_the_fascinating_physics_of_everyday_life/up-next?language=en
9. **We need nuclear power to solve climate change -** Joe Lassiter is focused on developing clean, secure and carbon-neutral supplies of reliable, low-cost energy. His analysis of the world's energy realities puts a powerful lens on the touchy issue of nuclear power.https://www.ted.com/talks/joe_lassiter_we_need_nuclear_power_to_solve_climate_change/up-next?language=en

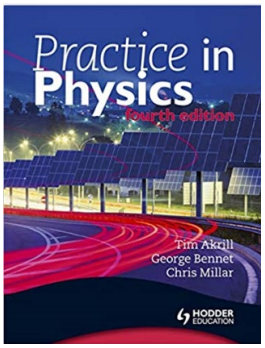
Other books

Prepare for the challenge of A Level Physics – Kit Betts-Masters



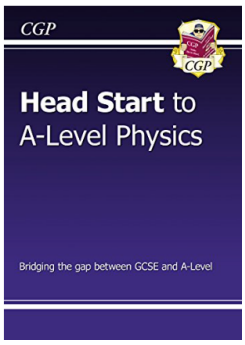
Practice in Physics (Akrill, Bennet and Millar)

Will support with practice calculations.



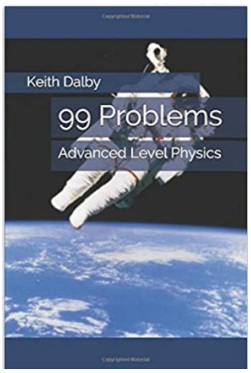
New Head Start to A-level Physics (CGP A-Level Physics)

Free on the Kindle App

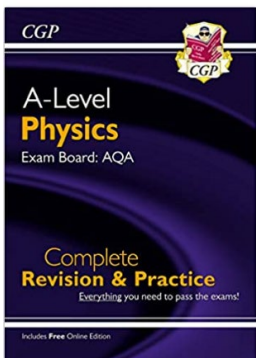


99 Problems: Advanced Level Physics (Dalby)

Will support with practice calculations.

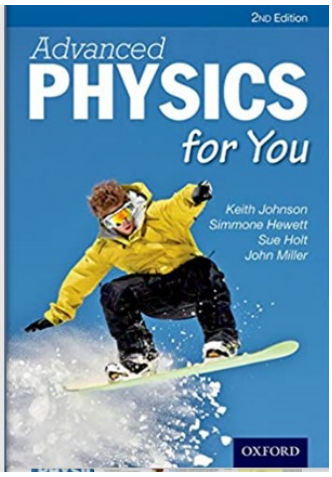


New A-Level Physics: AQA Year 1 & 2 Complete Revision & Practice with Online Edition (CGP)



Advanced Physics for you (Johnson, Hewett, Holt and Miller)

This book is not related to any exam board and offers alternative explanations and practice questions.



Activities

The next part of this workbook has a range of activities for you to have a go at. This work is designed to help prepare you for A-level physics. It covers some of the basic skills that will be used throughout the course. Many of these extend and develop ideas you will have come across at GCSE in science and maths. You will need to use a combination of careful reading, research, logic and persistence. You should expect to find some parts difficult, but if you persevere you will often find you can do them!

YOU MAY USE A CALCULATOR THROUGHOUT

Please complete as much of this booklet as possible, including the self-assessment below, then hand in during the first week of teaching in September.

Confidence: ***A = all parts correct and understood*** ***C = some parts correct and mostly understood*** ***E = few parts correct or poorly understood***	**Self Assessment**		
	Mark	**Confidence (A-E)**	**ISSUES / COMMENTS**
1. Unit Prefixes – complete table + questions	……/25		
2. (a) SI system of units – complete table (b) Derived units – complete table	……/11		
3. Maths-powers of ten and standard form – complete calculations	……/18		
4. Significant figures – read + complete calculations			

5. Rearranging equations	……/10		
6. Showing your working – read			
7. Bringing it all together – How many of these challenging questions did you crack?	……/10		
8. Revise and Extend: Energy and Power	……/30		
9. Revise and Extend: Speed and Acceleration	……/26		
10. Trigonometry	……/15		
11. Past Paper Questions	……/11		

1. Unit Prefixes

Prefixes are written in front of units to indicate multiplication or division by multiples factors of 1000. So mega means x1,000,000. (One exception is 'centi', as in cm, which means divide by 100)

YOU MUST LEARN THE PREFIXES BY HEART AND BECOME ADEPT AT WORKING WITH THEM.

1. Complete the following table. (You will need to research some of the missing units).

Symbol		Multiplier	Which means…
	terra		
		$\times 10^9$	
M			× 1,000,000
k			× 1000
(None)	- - -	- - -	× 1
m			
	micro		/ 1,000,000

n			
		$\times 10^{-12}$	
f			

2. Expand each of these quantities to write out the answer in full (i.e. without the prefixes)

   a) 900mV =
   b) 12MJ =
   c) 1.67mm =
   d) 3.456kg =
   e) 700nm =
   f) 0.72pA =

3. Write each of the following using an appropriate prefix:

   g) 0.005A =
   h) 30000s =
   i) 5 x 10^5m =
   j) 1001m =
   k) 0.006V =
   l) 2,100,000N =

4. Convert each of the following to the indicated units:

   a) 34nm = …….mm

   b) 0.012s = …….μs

   c) 4.5MJ = …….kJ

2. Units (a) The SI system of units

Look up the following terms and write a few sentences about each:

Physical Quantities	
SI Units	
Base Units	
Derived Units	

In physics all units can be derived from six base units. Research how the base units are defined.

Base Quantity	Base Unit	Definition (Note: you do not need to learn these definitions)
Length	metre (m)	
Mass	kilogram (kg)	
Time	second (s)	
Temperature	kelvin (K)	
Current	ampere (A)	

4. Units (b) Derived units

In physics all non-base quantities are called **derived quantities** and are defined by equations.
E.g. (a) Define speed. (b) Define charge.

(a) speed = distance / time **(b) charge = current × time.**

The units of these new quantities are **derived units** and are established from these same equations. So,

(b) The unit of speed = unit of distance / unit of time = m / s = $\underline{\mathbf{m{\cdot}s^{-1}}}$ (‘metres per second’)*

(c) The unit of charge = the unit of current × the unit of time = $\underline{\mathbf{A{\cdot}s}}$ (‘amp second’)

*NOTE: At A level we write divided units, such as ‘metres per second’ as ms^{-1} **not** m/s.

In the SI system, many of these derived units get their own name. For example, the SI unit of charge is the coulomb (C). So we can say that one coulomb is equal to one amp second.

or **C = A s**

Any SI unit can be expressed in terms of base units. To find the base units work though the defining equations one by one, unit you end up with the base units. For example, what are the base units of a Joule? This requires two steps:

- Energy (Work) = Force × distance moved, So one joule = one newton metre (**J = N·m**)
- Force is defined from F = m a, so one newton = one kilogram metre per second squared (or **$N = kg{\cdot}m{\cdot}s^{-2}$**)
- Therefore, a joule = **N m** = **$(kg{\cdot}m{\cdot}s^{-2})$ m = $\underline{kg{\cdot}m^2{\cdot}s^{-2}}$**

1. Complete the table below.
Try working these out rather than looking them up. You can use the earlier answers to help with the harder ones.

Derived quantity	**Defining equation**	**Standard SI unit (if applicable)**	**Equivalent base units**
speed	S = d / t	n/a	$m{\cdot}s^{-1}$
momentum	p = m v	n/a	$kg{\cdot}m{\cdot}s^{-1}$
acceleration	a = (v - u) / t	n/a	
Force	F = m a	newton (N)	
Power	power = work/time P = W/t		
frequency	frequency = 1/time period f = 1 / T		s^{-1}
Charge	charge = current × time Q = I t	coulomb (C)	A·s
potential difference	voltage = work/charge V = W/Q		

resistance	R = V / I		
specific heat capacity	SHC = Energy / (mass × temperature change) c = Q / (m × θ)		

5. Maths – Powers of 10 and standard form (aka scientific notation)

You need to be able to use your calculator to work in standard form or use power of ten notation to replace unit suffixes.

[Tip: you should use the [x10^x] button on your calculator for entering powers of ten.]

1. Rewrite these numbers in standard form, removing any unit prefixes:

a) 3141 …….

b) .00055 …….

c) 2.0002 …….

d) 120000 *(2sf)* …….

e) 120000 *(6sf)* …….

f) 843×10^4 …….

g) 1.5 µm …….

h) 12.0×10^{-2} nm …….

i) 999 MJ …….

j) 245 mg …….

k) 16 pF …….

l) 97.237 GN …….

All of the equations we use in Physics require variables to be converted to standard SI units. This means any prefixes must first be removed. For example to calculate resistance in ohms (Ω) you divide the p.d. in volts (V) by the current in amps (A), If current = 8.0 mA (milliamps) and the voltage was 12 kV (kilovolts) the correct calculation would be:

$R = V/I = 12 \times 10^3 / 8.0 \times 10^{-3} = 1.5 \times 10^6\ \Omega$

Try the above on your calculator before you continue.

2. Calculate the following showing your working, giving the answers in appropriate units. (This means removing suffixes, except for grams which need to be converted to kg)

a) Area (m^2) = 120 mm × 250 mm

b) Area (m^2) = 2.4 m × 60 cm

c) Density ($kg \cdot m^{-3}$) = 48 g ⁄ 12 cm^3

d) Charge in coulombs, Q=I t
= 3.0 × kA × 20 μs

e) Speed squared, $v^2 = (16\ m \cdot s^{-1})^2$

f) Force, F = m a = 923000g × 9.8 $m \cdot s^{-2}$

6. Rules for significant figures (sig fig or sf)

Read from the left and start counting sig figs when you encounter the first non-zero digit

1. All non zero numbers are *significant* (meaning they count as sig figs)

- 613 has three sig figs
- 123456 has six sig figs

2. Zeros located between non-zero digits are *significant* (they count)

- 5004 has four sig figs
- 602 has three sig figs
- 6000000000000002 has 16 sig figs!

3. Trailing zeros (those at the end) are *significant* only if the number contains a decimal point; otherwise they are insignificant (they **don't** count)

- 5.640 has four sig figs
- 120000. has six sig figs
- 120000 has two sig figs – unless you're given additional information in the problem

4. Zeros to left of the first nonzero digit are *insignificant* (they **don't** count); they are only placeholders!

- 0.000456 has three sig figs
- 0.052 has two sig figs
- 0.00000000000000000000000000000000052 also has two sig figs!

Rules for calculations

When you perform a calculation the answer should be given to the same number of significant figures as the weakest piece of data that was used in the calculation. For example if a piece of card is 11.3 cm long and 2.4 cm wide then the area = 27.12 cm^2 (on the calculator), but should be written as **<u>27 cm^2</u>** (i.e. 2 sig fig) because the width (2.4) was only given to 2 sig fig.

C. Practice Questions

1. State the number of sig figs in each of the following numbers:

(a) 0.0000055 g ……. (c) 1.6402 g ……. (b) 3.40×10^3 mL …….

2. Compare the following numbers:

370 000 v 3.70×10^6 (standard form)

Explain the advantage of giving an answer in standard form

……

……

4. Complete each of the following calculations using your calculator, giving your answer in standard form with the correct number of significant figures, with your answer in the units indicated.

(a) $\rho = m / V = 0.542\ g / 0.027\ cm^3 =$ ……$g \cdot cm^{-3}$

(b) $E = m\ c^2 = 231.5 \times 10^{-3} \times (3.00 \times 10^8)^2 =$ ……J

(c) Mean time = (23 + 20 + 21 + 22 + 25) / 5 = ……s

(d) Height difference = 2.32m – 2.07m = ……m

5. Complete the following calculations using a calculator, showing your working and giving an answer in standard form to the correct number of significant figures, in appropriate units:

a) $\dfrac{2.3 \times 6.5}{3.7 \times (9.1)^2}$

b) $(314)^3 / (9.9^2)$

c) $(12 \times 45g) / 12\ cm^3$

d) $1.2 \times 10^{-6} \times 1.5 \times 10^{-4}$

e) $(16\ m \cdot s^{-1})^2$

f) $923Kg \times 9.8\ m \cdot s^{-2}$

7. Rearranging Equations

Rearrange these equations to express them in the terms that follow:

1. $v = x / t$ a. $x = ?$ b. $t = ?$

2. $F = m\,a$ a. $m = ?$ b. $a = ?$

3. $a = (v - u) / t$ a. $t = ?$ b. $v = ?$ c. $u = ?$

4. $v^2 = u^2 + 2as$ a. $v = ?$ b. $a = ?$ c. $u = ?$

5. $s = ut + \frac{1}{2} a t^2$ a. $u = ?$ b. $a = ?$ c. $t = ?$

6. $\frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2}$ a. $R_{tot} = ?$ a. $R_1 = ?$

8. Show your working clearly

When answering physics questions you need to lay out your working clearly showing all the steps, working left to right and top to bottom. Your final answer should be found to the bottom right of your working and should be underlined. Below is an example for you to base your own answer style on.

Ch6, Q4

A white snooker ball with a kinetic energy of 15J collides with a red ball. On impact the white ball stops, transferring all of its KE to the red ball. The mass of the red ball is 120 g. What would be the velocity of the red ball immediately following the collision?

STEPS: Equation being used → rearrange → values inserted → calculated answer → units → sig fig

$$KE = \frac{1}{2}mv^2 \quad \therefore \quad \frac{2KE}{m} = v^2 \quad \therefore \quad v = \sqrt{\frac{2\times 15J}{0.12\text{kg}}}$$

$$= 15.8\ \text{ms}^{-1} \ \underline{= 16\ \text{ms}^{-1}\ (2sf)}$$

EIGHT STEPS TO IMPROVE THE QUALITY OF YOUR WORKING

- Show all steps
- Work left to right and top to bottom
- Rearrange equations before substituting values
- If a calculation is two step, underline the answer to the first step before proceeding as this may get marks
- Your writing should be small and neat. Don't scrawl.
- You should be able to easily check over your working to find mistakes
- Plan to use the available answer space wisely
- Try to leave space for correcting mistakes if you go wrong

9. Bringing it all together

Brain-gym for the physics-muscle in your head (It hurts to start with, but gets easier with practise)

These problems will challenge you to work with powers and units, rearrange equations and use your calculator carefully. Helpful formulae for volume and surface area are given on the last page, as are the answers.

Lay out your working clearly, work step by step, and check your answers. If you get one wrong, go back and try again. Do not be disheartened if they seem difficult to start with, persevere and seek help – you will improve. Importantly, have fun!

Questions:

1. How many mm^2 are there in

(a) 1cm^2 ? ……

(b) 1 m^2 ? ……..

(c) 1 km^2 ? ……

2. How many cm^3 are there in

(a) 1mm^3 ? ……

(b) 1 m^3? ……

3. A piece of A4 paper is 210 × 297 mm. All measurements are to the nearest mm. Calculate its area in (a) mm^2, (b) cm^2, (c) m^2. Give answers to the correct number of significant figures.

……

……

……

a) Area = ... mm^2

b) Area = ... cm^2

c) Area = ... m^2

4. A plastic toy is supplied in a cubic box, 4.0 cm each side. How many of them pack into a carton 80 × 52 × 70 cm? (Students often get the wrong answer and can't see why. Visualise the actual problem don't just rely on maths!)

5. A copper atom has a diameter of 217 pm (pico-meters). How many of them would fit inside 1mm3 of copper to 3 sig. fig? (Tip: for simplicity, treat them as cubes of side 217 pm)

6. Water has a density of 1.0 g cm^{-3}. Express this in (a) kg cm^{-3}, (b) kg m^{-3}, (c) kg mm^{-3}

……

……

……

a) Density = ... kg cm^{-3}

b) Density = ... kg m^{-3}

c) Density = ... kg mm^{-3}

7. A regular block of metal has sides 12.2 × 3.7 × 0.95 cm, and a mass of 107g. Find its density in Kg m^{-3} to a suitable number of significant figures.

8. A measuring cylinder is filled with 1.00 litres of water. The column of water inside forms a regular cylinder 32.0 cm high. What is (a) the area of the surface of the water (in mm2)? (b) the internal diameter of the cylinder (in mm)? TIP: Visualise the problem clearly. Draw a diagram if it helps. Use the equation of the volume of a cylinder)

9. The diameter of the sun is 1.4×10^6 km. Its average density is 1.4 g $cm^{-3.}$ What is its mass in kg? (TIP: The trick here is to convert the units carefully before you start)

10. The total energy arriving in the Earth's upper atmosphere from the sun is 174×10^{15} Watts. Given that the Earth's diameter is 12.8×10^3 km, what is the average intensity of this radiation in W m^{-2}?
(TIP: Think about the units carefully. What does W m^{-2} mean?)

GEOMETRICAL EQUATIONS

arc length	$= r\theta$
circumference of circle	$= 2\pi r$
area of circle	$= \pi r^2$
surface area of cylinder	$= 2\pi rh$
volume of cylinder	$= \pi r^2 h$
area of sphere	$= 4\pi r^2$
volume of sphere	$= \frac{4}{3}\pi r^3$

Answers:

1. a) 10^2 (100)
   b) 10^6 (1,000,000)
   c) 10^{12}
2. a) 10^{-3} (1/1000)
   b) 10^6 (1,000,000)
3. a) 6.237×10^4 mm^2 (62,370 mm^2)
   b) 6.237×10^2 cm^2 (623.7 cm^2)
   c) 6.237×10^{-2} m^2 (0.06237 m^2)
4. 4420
5. 9.79×10^{19}
6. a) 1×10^{-3} kg cm^{-3}
   b) 1×10^6 kg m^{-3}
   c) 1×10^{-6} kg mm^{-3}
7. 2.50×10^3 kg m^{-3}
8. a) 3125 mm^2
   b) 63.1 mm
9. 2.0×10^{30} kg
10. 338 W m^{-3}

10. KS4 Revision & Extension

Energy and Power

Look up definitions for each of the following quantities and write down the equations and any notes you think are helpful

Work

Kinetic Energy

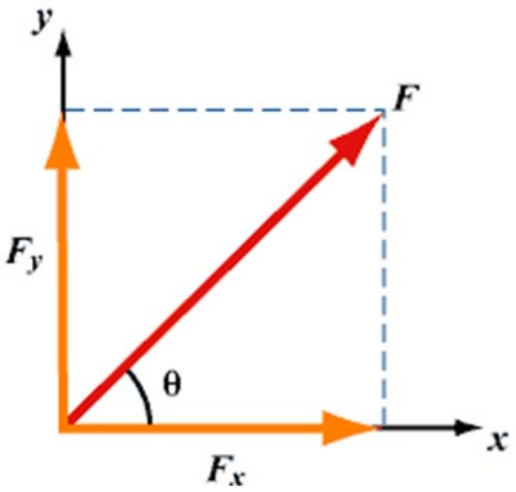
Gravitational Energy

Elastic Potential Energy

Efficiency

Power (including electrical power)

Resolving Vectors



In A level Physics you will need to work with vectors that act at odd angles. Often the easiest way to deal with this is to convert the diagonal vector into horizontal and vertical components.

For example, in the case of a force F acting at an angle **ϴ**, can be treated as two forces acting horizontally (F_x) and vertically (F_y). These can be calculated with trigonometry:

$$F_y = F \text{ Sin } (\theta) \quad \textit{and} \quad F_x = F \text{ Cos } (\theta)$$

You may need to use this in the following questions

Watch the following video from Physics Online:

https://www.youtube.com/watch?v=tr2wxyJhBv0

Work Questions:

What is the definition of work?

……

……(2)

In the following calculations take g = 9.8 N kg-1

1i) A box is pushed 3m along the floor by a horizontal force of 500N

……

……

Work = …… J

Energy is transferred into……(2)

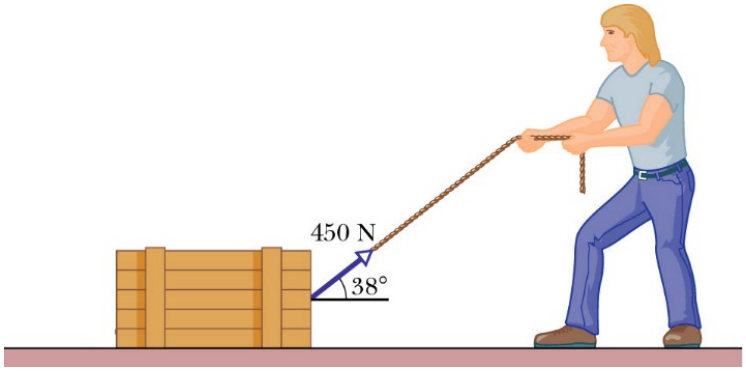
ii) An electric lift raises 540 kg load through a height of 18.3 metres

……

……

Work = …… J

Energy is transferred into……(3)



iii) A man uses a rope to pull a box along a floor, as shown above. He drags the box 3.0 km. (Think back to the video – This is moving you on from GCSE)

……

……

……

Work done = …… J

Energy is transferred into…… (4)

iv) A student adds three 100g slotted masses to a spring of spring constant, k = 6.0 Nm^{-1}. It extends by 14.0 cm.

……

……

……

Work done = …… J

Energy is transferred into…… (4)

Power Questions

1) What is the defintion of power?

……

……..(2)

2) Which of the following are units of power? (circle all of the correct units)

joule second watt joule second -1 newton metre second-1 amp volt (2)

Explain why power is equal to force × velocity

……

……

……(2)

Explain why power is equal to current × potential difference

……

……

…… (2)

3i) In two minutes a rocket gained 370 MJ of kinetic energy and 1300 MJ of gravitational potential energy.

……

……Power = W (2)

3ii) In the following 30 seconds the rocket travels at a steady speed of 320 ms^{-1}. Assuming the power of the engines to be constant, calculate the thrust force produced by the engines. (Use P = F x v)

……

……Force N (2)

4) A 12V electric motor is used to lift a 50g mass through 1.0m. The overall efficiency of this system is 10%. Whilst in operation it draws a current of 0.25A.

i) Find the useful power output of the electric motor

……

……Power W (2)

ii) How long does it take the motor to raise the mass 1.0m? (You will need to use multiple equations. Start with E = QV, what could E be changed to? What about Q?) DO NOT PANIC, YOU WILL LEARN THE SKILLS FOR THIS.

……

……..Time s (2)

11. Speed and Acceleration

Speed Questions

1. A bullet travels 300m in 2.60 seconds what is its velocity in (a) m s^{-1} (b) km h^{-1} ?

……

……

……

2. An alpha particle covers 2.0 cm travelling at 5% the speed of light (speed of light=3.0 x10^8 m s^{-1}). How long does it take to cover this distance?

……

……

……

3. A cyclist is racing on a circular track at an average speed of 8.35 m s^{-1}. She completes three laps in 2 minutes 24.36 seconds. What is the radius of the track?

……

……

……

4. A light-year is the distance light travels in one year. Calculate this distance in metres to 3 significant figures, given that the speed of light is 3.00 × 10^8 m s^{-1}.

……

……

……

Acceleration Questions

5. A horse is cantering at 3.1 m s^{-1} and breaks into a gallop reaching a speed of 5.6 m s-1 in 3.5 seconds. Calculate its acceleration.

……

……

……

6. A car travelling at 16.0 m s-1, brakes for 3.20 s, decelerating at a rate of 3.125 m s-2. What is its final speed?

……

……

……

7. An Olympic diver strikes the water at a speed of 7.2 m s^{-1}, and comes to rest in 1.2 seconds. What is his acceleration?

……

……

……

8. A falling ball strikes a floor with a velocity of 4.2 m s^{-1} and rebounds with a velocity of -3.8 m s^{-1}. It is in contact with the floor for 0.12 seconds. What was its acceleration?

……

……

……

9. A Porsche is quoted as having a *"0-60 time of 4.2 seconds"*. This means it accelerates from zero to 60 miles per hour in 4.2 seconds. Given that 1 mile = 1.55 km, calculate its acceleration in ms^{-2}

……

……

……

10. At the University of Errors Science Tower, a brick is observed falling past the window of the physics laboratory. A quick thinking physics student records its speed as 4.59 m s^{-1}. A moment later it passes the ground floor windows of the engineering faculty and an alert engineer records its speed as 12.91 m s^{-1}.

(a) Assuming acceleration due to gravity to be 9.81 m s^{-1} and assuming air resistance to be negligible, how long was the 'moment' between these observations?

……

……

……

(b) By considering its average speed calculate the height between the Physics and the Engineering labs.

……

……

……

12. Trigonemetry

Trigonemtry is a huge part of A Level Physics, but its becomes easy after plenty of practice. Lets practice so that we have the basics.

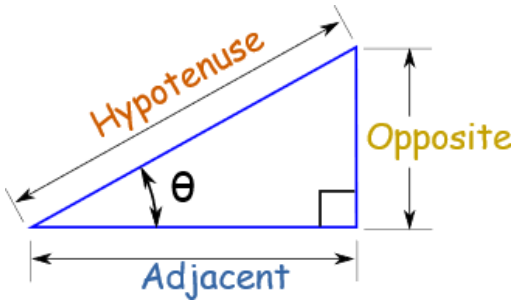
Watch the videos below:

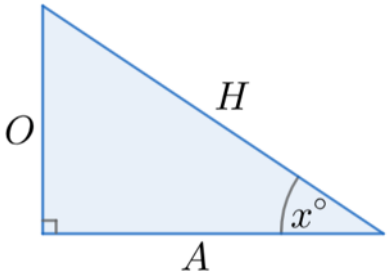
https://www.youtube.com/watch?v=q9lLOlyPmC8
https://www.youtube.com/watch?v=z925v3v9Va4
https://www.youtube.com/watch?v=fMkctlXg8P0

Finding angle using arc sin and arc cosine

https://www.youtube.com/watch?v=RWyY3n9nTf8

It may be useful to think of trigonometry triable until you get used to using trig (I hate triangles but it seems to work).

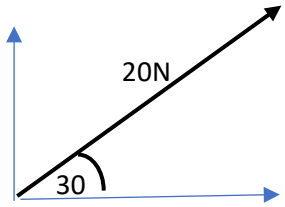
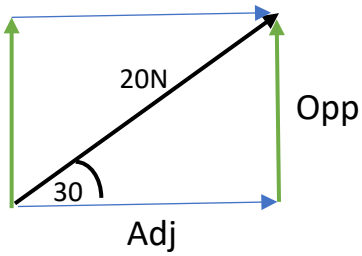




Using trigomentry, resolve these forces into horizontal and vertical components.

Worked example

A force of 20N at 30° to the horizontal

<table>
<tr><td> 
</td><td>Draw it out</td></tr>
<tr><td rowspan="3"> 
</td><td>Label your opposiste and adjacent (The green and blue arrow on the same length)</td></tr>
<tr><td>To calculate the opposite you will use sine

Sin(30) x 20 = 10N</td></tr>
<tr><td>To calculate the adjacent you will use cosine

Cos(30) x 20 = 17.3N</td></tr>
</table>

Have a go at these:

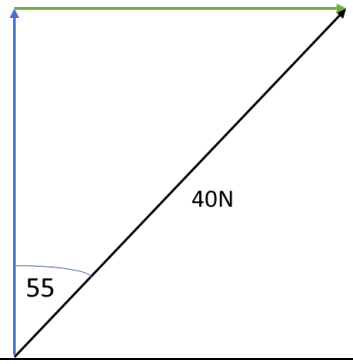
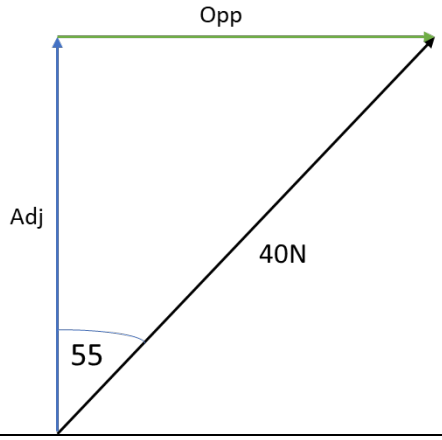
1. A force of 40N at 35° to the horizontal
2. A force of 600N at 40° to the horizontal
3. A velocity of 30ms^{-1} at 25° to the horizontal
4. A velocity of 2000ms^{-1} at 60° to the horizontal
5. A force of 80N at 75° to the horizontal

Drawing	Calculations

Using trigomentry, resolve these forces into horizontal and vertical components.

Worked example

A force of 40N at 55° from the vertical.

<table>
<tr><td> 
</td><td>Draw it out</td></tr>
<tr><td rowspan="3"> 
</td><td>Label your opposiste and adjacent</td></tr>
<tr><td>To calculate the opposite you will use sine

Sin(55) x 40 = 32.8N</td></tr>
<tr><td>To calculate the adjacent you will use cosine

Cos(55) x 40 = 22.9N</td></tr>
</table>

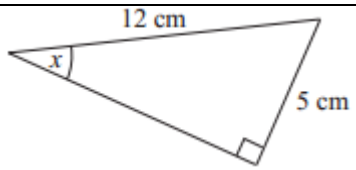
Have a go at these:

1. A velocity of 55ms^{-1} at 25° to the vertical
2. A velocity of 2000ms^{-1} at 40° to the vertical
3. A force of 80N at 35° to the vertical
4. A force of 38N at 15° to the vertical
5. A force of 2.5kN at 50° to the vertical

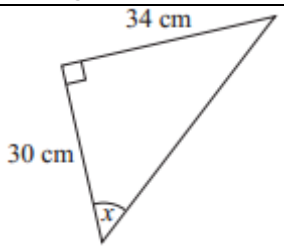
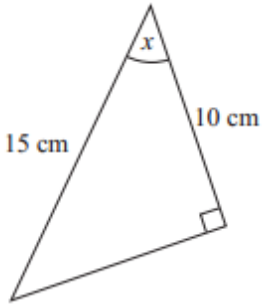
Drawing	Calculations

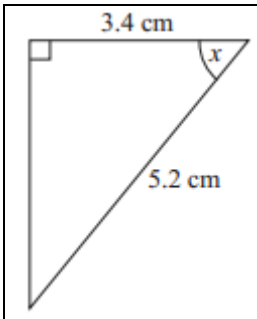
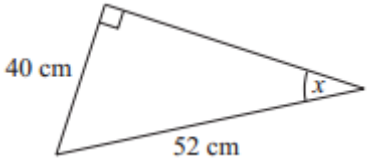
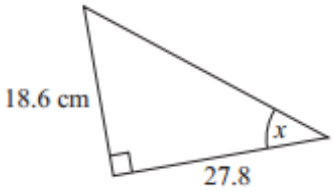
Calculating angles:

Example:

	1) Identify the sides you have – Opposite and Hypothenuse 2) Select the funtion that has both of these – Sine 3) Sin(θ) = Opp / Hyp 4) However you're looking for the angle so it becomes: $Sin^{-1}(opp/hyp)$ Sin^{-1} (5 / 12) = 24.6°

Your go:

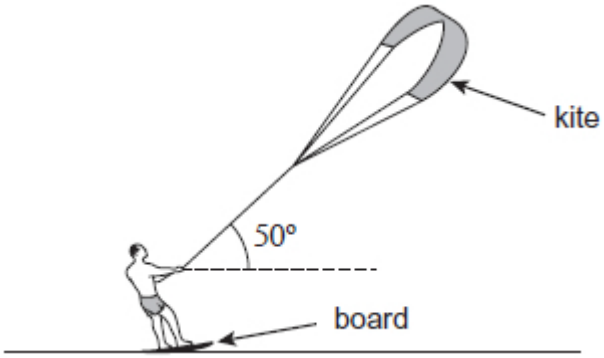
 3.4 cm x 5.2 cm	
 40 cm x 52 cm	
 18.6 cm x 27.8	

11. Previous A Level Questions

Q1.

Figure 1 shows a kite boarder holding a line that is attached to a kite.

Figure 1



The wind blows the kite and the kite boarder moves at a constant speed across a level water surface. The tension in the line is 720 N and the line makes an angle of 50° to the horizontal.

(a) (i) Calculate the vertical component of the tension in the line.

vertical component of tension _____ N

(2)

Q2.

(a) (i) State the difference between a scalar quantity and a vector quantity.

_____

_____

(1)

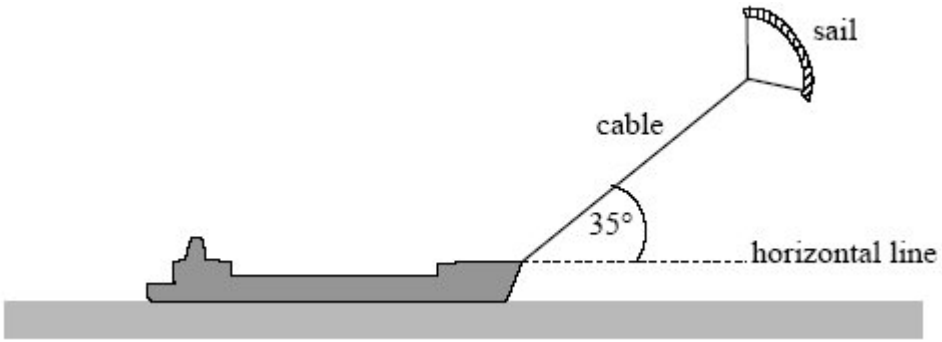
(ii) State **two** examples of a scalar quantity and **two** examples of a vector quantity.

scalar quantities _____

vector quantities _____

(3)

(b) The diagram below shows a ship fitted with a sail attached to a cable. The force of the wind on the sail assists the driving force of the ship's propellors.



The cable exerts a steady force of 2.8 kN on the ship at an angle of 35° above a horizontal line.

(i) Calculate the horizontal and vertical components of this force.

horizontal component of force _____ kN

vertical component of force _____ kN

(2)

(ii) The ship is moving at a constant velocity of 8.3 m s^{-1} and the horizontal component of the force of the cable on the ship acts in the direction in which the ship is moving.
Calculate the power provided by the wind to this ship, stating an appropriate unit.

Think back to an equation you were given earlier that links power, force and velocity.

Answer _____

(3)

Further Activities

It is important to ensure you have secure GCSE knowledge. Ensure you have looked at areas of strength and weakness and have the skills ready to progress.

You may want to use the following to review knowledge:

1. Seneca Learning

2. Isaac Physics

Thank you for completing this booklet. If you have any further questions, please feel free to contact me. See you in September.

Mr Meeks