Monday, 26 June 2023

Dear prospective A Level Physicist,

If you are reading this it means you are a person of taste and distinction and are considering taking Physics at A Level. We need to prepare you as best we can for September.

- Primarily we need to do this so that you can get as good an experience as it is possible to get of what a Physics lesson will entail. A Level Physics is hard and requires consistent hard work for students to achieve their potential.
- Secondly we also need to give you're the opportunity to develop and build on the skills you gained at GCSE to give you a running start in September.
- Finally we also want to ensure that you have the summer homework that is handed out at taster lessons This booklet aims to achieve all three.

A Level Physics at Wallingford: An introduction

Specification:

We follow the OCR A specification, and place an emphasis on independent studying and this can come as a bit of a shock to many students who have become used to the level of provision at GCSE.

Flipped Classroom

We use a flipped class room approach whereby you learn the content at home and are assessed on it in lessons. This avoids a traditional scenario whereby a lesson is spent with the teacher telling you about the content and then sending you home with multiple questions to apply your understanding. The trouble with this can be that if you get stuck at home there is no one to help you.

So, before each lesson you are given “Flipped Notes” that gives you a series of small tasks to help you independently learn the content ready for the next lesson. You will generally find the resources you need to complete the tasks in you textbook but there is also often a QR code to take you to a website that will help. In the next lesson you are then given the questions that test your understanding and you progress with them until you get stuck, at which point the teacher or a peer is able to help you work through the difficulty. Many people struggle with this at first but then come to realize that the better they engage with independently learning at home the deeper and longer lasting their understanding becomes.

In each lesson you are then given Sorter Questions that start easy and get harder and harder. The aim of them is to sort pupils into those who have fully engaged with the flipped notes, can do the requested skills and are ready to go onto harder questions and those who need extra support before moving on.

Learning Agendas

At the start of all lessons you are given a Learning Agenda –as well as simply helping you organize your work lesson by lesson this is a bit like a menu for the lesson. At the top it outlines the spec points covered in each lesson. Then it gives you the SETTLER task that you are to get on with as soon as you arrive in the room. Then on the back are the Sorter questions and after that it lists the activities and worksheets used in the lesson and the homework that is expected for the next lesson.

In the event that you are absent you are able to get a copy of the LA from a colleague and so turn up to next lesson without your absence causing you to fall behind. Genius!

Textbooks

We issue each student with a copy of the relevant textbook and this can be your first port of call for helping complete the flipped notes. However, the very best learners also read around and beyond the textbook using online resources – some of which are linked to on the LA via a QR code.

We also work heavily with a book called Practice in Physics (3rd Edition) that you can source your own second hand copy from ebay for a few pounds.

Homework

Each week students get the same “standard homework” which include completing AND MARKING any remaining textbook, worksheet or PinP questions not completed in the lesson as well as completing the flipped notes for the next lesson.

Therefore this is what this summer work also contains.

It is expected that you submit photos of your workings to page 5 (rearranging equations), 7 (identifying significance of gradients), 10 (flipped notes) and 13 (summary questions) *before July 19th* and the remainder of your completed work (11, 12 and 13) on the first lesson in September in order to help us ascertain your suitability for the course and wether you are prepared to put the work in that you *will* need in order to achieve well at A Level. If you turn up in September without having completed the work you will be turned away and asked to return when the work is completed.

If you have any enquiries please email on paynet@wallingforschool.com

Many thanks for reading and Good Luck!!!

Part 1
Skills Practice

- This sections takes you through a couple of the more basic but essential skills, giving you worked examples and then some questions for you to apply your understanding.

Skill One : Rearranging Equations

Your ability to change the subject of a formula is essential for success in the Physics course.

The skill is continually assessed throughout each and every topic. A competent grasp of the skill will aid your speed and accuracy in answering questions.

The exam board require you to be able to change the subject of a formula to determine unknown quantities in the formula.

The Theory

To change the subject of the formula you will use inverse operations to manipulate the formula and make the quantity you are trying to find the subject.

An example would be the equation for a straight line:

$$y = mx + c$$

You may already know a point (x, y) and the gradient m of the line, and would like to find the y-intercept c.

In its current form, the equation is not useful as a means to determine the value c. The equation needs to to be rearranged so c is the subject:

1. Initially you would want to bring all the variables that aren't c to one side of the equation using inverse operations.

   In this case it would mean taking away the term mx:

$$y - mx = c$$

2. If the unknown variable is still not the subject of the formula, further inverse operations would have to be carried out to remove it from the other variables.

   In our case, c is the subject of the formula and we have now done enough:

$$c = y - mx$$

Rearranging Equations : Worked Example

Particle accelerators are used by hospitals in radiotherapy treatment to cure cancer. Particles are accelerated between charged plates that control their direction.

The equation relating the work done on the particle and the kinetic energy of the particle is given below:

$$eV = \frac{1}{2}mv^2$$

where e is the charge of the particle, V is the potential of the charged plates, m is the mass of the particle and v is the velocity of the particle.

To ensure accelerators are operating correctly, a medical physicist wants to know the velocity v of the particles.

Rearrange the formula so that it is in a more appropriate form to determine the velocity of the particle.

Solution:
We would need to make v the subject of the formula:

1. To make v the subject, we need to move all other variables to one side of the equation:
   - v is initially divided by 2, and therefore to move 2 to the other side of the equation we use the inverse operation to multiply each side by 2

   $$2eV = mv^2$$

   - v is multiplied by m, and therefore to move m to the other side of the equation we use the inverse operation of dividing each side of the equation by m

   $$\frac{2eV}{m} = v^2$$

2. All the other variables are now on one side, but v is still not by itself; therefore, we must carry out a further inverse operation:
   - v is squared in its current form, and therefore to get v by itself we have to square root both sides

   $$v = \sqrt{\frac{2eV}{m}}$$

   Now v is the subject of the formula and the formula is now in a form that can be easily used to determine the velocity of the particles.

Your turn:-

A Clear photo of this sheet needs to be submitted **before July 19th.**

Equation	First Rearrangement		Second Rearrangement	
(Power of lens) $P = \frac{1}{f}$	$1 =$		$f =$	
(Magnification of lens) $m = \frac{v}{u}$	$v =$		$u =$	
(refractive index) $n = \frac{c}{v}$	$c =$		$v =$	
(current) $I = \frac{\Delta Q}{\Delta t}$	$Q =$		$t =$	
(electric potential) $V = \frac{\Delta E}{\Delta Q}$	$E=$		$Q =$	
(power) $P = \frac{\Delta E}{\Delta t}$	$E=$		$t=$	
(power) $P = VI$	$V=$		$I=$	
(conductance) $G = \frac{I}{V}$	$I=$		$V=$	
(resistance) $R = \frac{V}{I}$	$V=$		$I=$	
(resistance) $R = \frac{1}{G}$	$G=$			
(power) $P = I^2 R$	$I=$		$R=$	
(power) $P = \frac{V^2}{R}$	$V=$		$R=$	
(stress) $\sigma = \frac{F}{A}$	$F =$		$A =$	
(strain) $\varepsilon = \frac{x}{l}$	$x =$		$l =$	
(Young's modulus) $E = \frac{\sigma}{\varepsilon}$	$\sigma =$		$\varepsilon =$	
(conductance) $G = \frac{\sigma A}{L}$	$\sigma =$	$A=$		$L=$
(resistance) $R = \frac{\rho L}{A}$	$\rho =$	$L=$		$A=$
(resistivity) $\rho = \frac{1}{\sigma}$	$\sigma =$			
(phase angle) $\theta = 2\pi ft$	$f =$		$t =$	
	$a =$		$\sin\theta =$	

<u>Skill Two</u>: Calculations from graphs

During your coursework you will be asked to decide which graphs to plot in order to show a relationship or to calculate a physical constant.

It is important to aim at plotting a graph that will end up being a straight line.

This means arranging the equation so that the physical constant you want to discover *and any other constants* are on one side leaving your dependant and independent variables on the other.

You use the rearranged variables to determine which goes on which axis remembering that the gradient is calculated by dividing the change in the y by the change in the x.

Once you have determined what variable goes on what axis you should then get a straight line. But when you calculate the gradient of the line. In a simple three term equation the gradient is the unknown. But in more complex equations you need to remember that the gradient is the physics constant you are looking for *along with* the other constants in the equation. Therefore you need to manipulate the value for the gradient to calculate your desired physical constant.

EXAMPLE

Let's say that you want to measure the gravitational field strength of Earth with a pendulum. You vary the length and measure the period. You then decide to plot T^2 against l. The graph will be a straight line. What will its gradient be? To find this, compare the pendulum equation with the straight line equation as shown below:

$$T^2 = 4\pi^2 \frac{l}{g}$$

$$y = ax + b$$

I hope you can see that y corresponds to T^2, x corresponds to l, b corresponds to zero, and a corresponds to $\frac{4\pi^2}{g}$. This tells you that once you measure the gradient from your graph you will know the value of $\frac{4\pi^2}{g}$ and you will then be able to calculate g from this as:

$$gradient = \frac{4\pi^2}{g} \Rightarrow g = \frac{4\pi^2}{gradient}$$

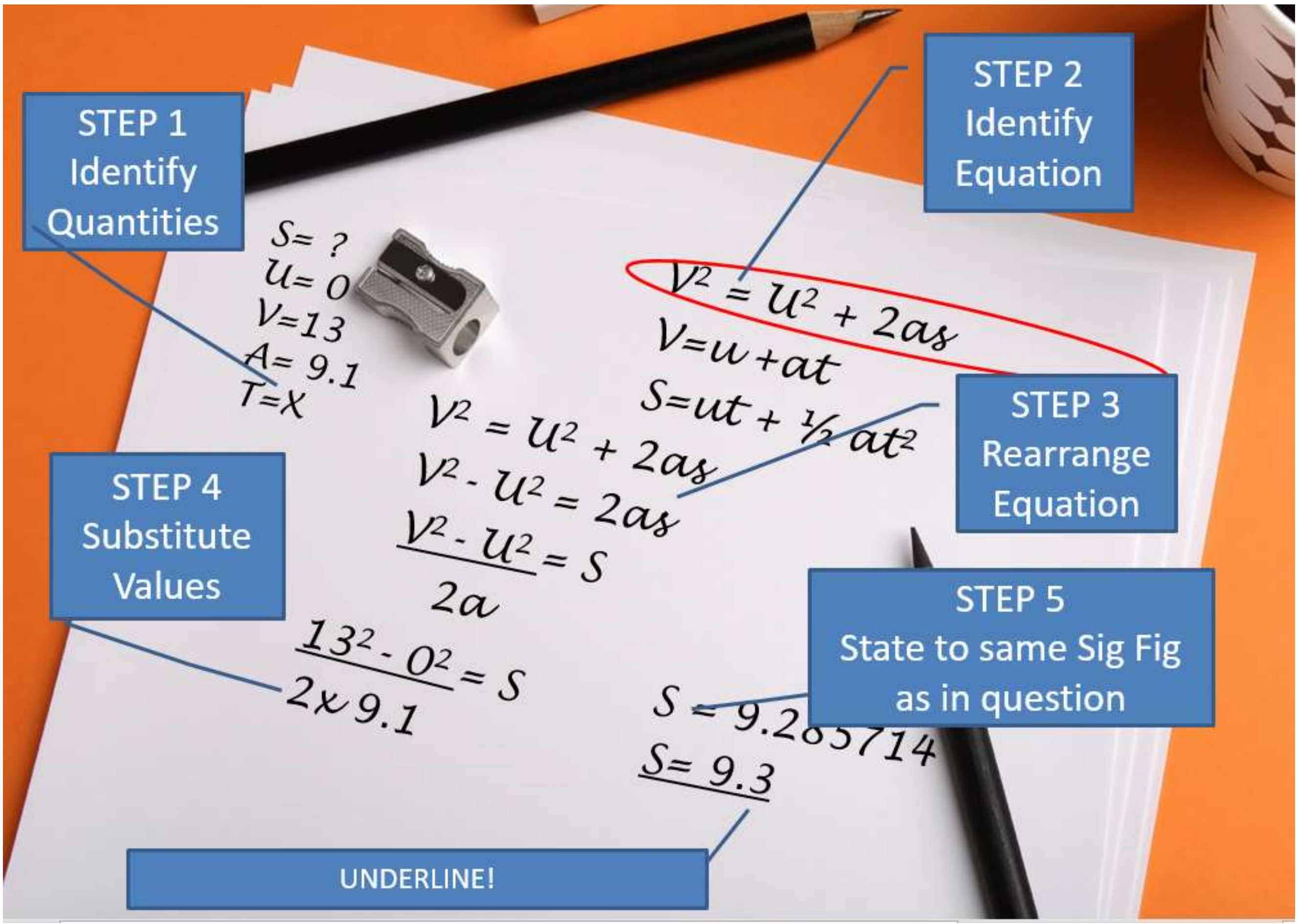
Your turn:-

Find the significance of the gradients in the scenarios below. The first few have been completed to help you see how it is done. A Clear photo of this sheet needs to be submitted **before July 19th.**

Equation	Plot y against x	gradient	Constant
$R = \frac{V}{I}$	$x-axis: current$ $y-axis: voltage$	$gradient = R$	R (for a fixed resistor)
$R = \frac{V}{I}$	$x-axis: voltage$ $y-axis: current$	$gradient = \frac{1}{R}$	R (for a fixed resistor)
$E = \frac{\frac{F}{A}}{\frac{x}{l}}$	$x-axis: force$ $y-axis: extension$	$gradient = \frac{l}{EA}$	$E = \frac{l}{A \times gradient}$ (Young's modulus)
$R = \frac{\rho L}{A}$	$x-axis: L$ $y-axis: R$	$gradient =$	$\rho =$ (resistivity)
$R = \frac{\rho L}{A}$	$x-axis: \frac{1}{A}$ $y-axis: R$	$gradient =$	$\rho =$ (resistivity)
$\frac{1}{2}mv^2 = Fs$ (stopping distance-velocity relationship)	$x-axis: v^2$ $y-axis: s$	$gradient =$	$F =$ (fricition)
$xd = \lambda L$ (double slit interference)	$x-axis: \frac{1}{d}$ $y-axis: x$	$gradient =$	$\lambda =$ (wavelength)
$xd = \lambda L$ (double slit interference)	$x-axis: L$ $y-axis: x$	$gradient =$	$\lambda =$ (wavelength)

Skill Three : Setting out work

Every year the report from the examiners state that too many people are unnecessarily loosing marks because their work is either poorly set out, set out incompletely or simply messy.
Similarly, in many questions the marks are awarded not for the final answer but for key stages in the workings so if you have not shown that step you will NOT get the mark. Therefore it is imperative that you set out your work in an ordered manner.



Furthermore, each step in this method has a reason behind it that makes sure you get the answer write by decreasing opportunities for mistakes.
Writing out the symbols in Step 1 means that not only do you only have to read the question once, but the symbols also help you more easily identify the correct equation as they are given in symbol form (not word form) in the equation booklet.
Rearranging the equation *before* you substitute (Steps 3 & 4) means you make fewer errors in arranging the question.
Writing out the substituted values in Step 4 means that you can visually check that your calculator entry looks the same as your handwritten equation – thus making it less likely that you make calculator errors.
Writing out an answer to multiple sig fid before finally stating it in the same sig fig as the question means you are going to avoid sig fig penalties but also shows that you have calculated the answer correctly.
Trust me – if you set out ALL your work like this from the very start it become second nature and you WILL become a Physics machine!!!!

Part 2:

Experiencing Flipped Learning and Learning Agendas.

- The following section has example materials that you would be given. Firstly the Flipped notes that are given *before the lesson* and then the Learning agenda.
- You really should engage with the flipped learning. If you simply see it as homework to keep your teacher quiet you will not get the same deeper understanding that those who truly engage with the independent learning opportunity that they offer.
- Then once you have done this, apply your understanding to the lesson, starting with the SETTLER and then moving onto the SORTER QUESTIONS.
- Remember, in a class room scenario you would NOT have your flipped notes out. The sorters are not an exercise in copying out flipped notes, they are to see if you have truly understood the content and can independently apply the skills within them. So cover up your flipped notes before tackling them
- After this there is a screenshot from a PinP book so that you can get on with the questions listed on the LA.
- Following this are the numerical answers to the PinP questions. This is because we place a large emphasis on students marking their own work so that they can get immediate feedback as to how they are doing.
- In fact we expect all textbook and PinP questions to be self marked, and that is a student gets a question incorrect they reattempt now they know the answers. If a student still cannot get a correct answer, that is the point at which they seek help from a teacher.
- Then there are the summary questions from the textbook.
- Finally there are the flipped notes for the next lesson.
- As you will *actually be doing one of these methods in your one of you first Physics lesson in September you really need to engage with the flipped notes.*

There we are! A virtual Physics Lesson.
Let’s hope it doesn’t put you off!!!

Module 1 – Forces and Motion DUE 19th July

3.1.2 Kinematics

Specification points to Pre Learn

1. State the 5 equations for motion under constant acceleration

1. Clearly show and describe the stages of the derivation of $S=ut+1/2at^2$ on a velocity time graph

2. Using the same graph describe how to derive s=vt-1/2 at 2

3. Clearly show and describe the derivation of $V=u+at$ from a velocity time graph.

4. Clearly show and describe the derivation of the equation for average speed.

5. Clearly show and describe the derivation of an equation without t

SORTER QUESTIONS

1. Clearly show and describe the stages of the derivation of S=ut+1/2 at 2 on a velocity time graph.

2. A ball is dropped from a window 5m above the ground. Calculate the time it takes to reach the floor.

3. Another ball is dropped from a window twice the height. Calculate and compare the final velocities of the two balls. Why is difference in velocities not the same as the difference in heights?

4. A train accelerates from rest along a track for 3 minutes and reaches a final speed of 22 mls. What distance does it cover during this acceleration?

5. Show how to derive the SUVAT equation with no t.

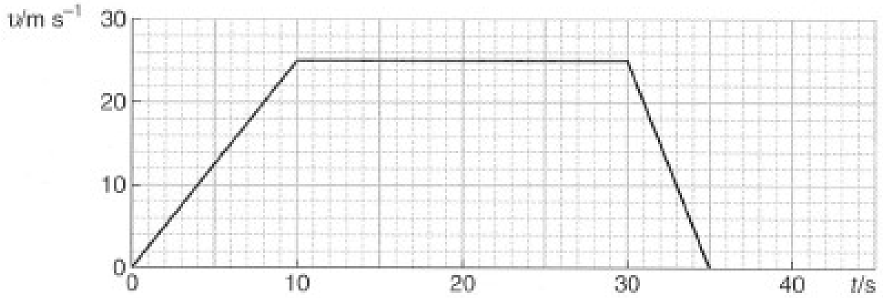
Screen Shots of Practice in Physics

Practice in Physics is our "go to" bank of questions. You are expected to mark the calculations yourself using the answers in the back (PTO)

DON'T FORGET TO SET OUT ALL CALCUALTIONS AS SHOWN IN SKILL THREE

1.17 A man, John L. Stapp, travelling in a rocket-powered sledge, accelerated from 0 to 284 m s^{-1} (about 630 m.p.h.) in 5.0 s and then came to a stop in only 1.5 s. Calculate his acceleration
(a) while he is speeding up **(b)** while he is slowing down.

1.18 The graph shows, in idealised form, a velocity–time graph for a typical short journey.
(a) Calculate the acceleration at each stage of the journey and display your answers on an acceleration–time graph.
(b) Sketch a displacement–time graph for this journey.



1.19 A baby buggy rolls down a ramp which is 15 m long. It starts from rest, accelerates uniformly, and takes 5.0 s to reach the bottom.
(a) Calculate its average velocity as it moves down the ramp.
(b) What is its velocity at the bottom of the ramp?
(c) What is its acceleration down the ramp?

1.20 One type of aeroplane has a maximum acceleration on the ground of 3.5 m s^{-2}.
(a) For how many seconds must it accelerate along a runway in order to reach its take-off speed of 115 m s^{-1}?
(b) What is the minimum length of runway needed to reach this speed?

1.21 A particle moves in a straight line. Its motion can be described as follows:
at $t = 0$, $v = 0$
$0 < t < 10$ s, $a = 4.0$ m s^{-2}
10 s $< t < 20$ s, $a = -4.0$ m s^{-2}.
Sketch the velocity–time graph and use it to find the change of displacement of the particle between $t = 0$ and $t = 20$ s.

1.22 Draw displacement–time, velocity–time and acceleration–time graphs for the following situations. Use the same time axes for all three graphs in each situation. [Hint: you will probably find it easiest to begin with the velocity–time graph.]
(a) An electrically-powered milk float moving from one house to another on a straight road.
(b) A ball, attached by an elastic cord to a fixed point on the ground, and hit horizontally away from that point.

1.23 The graph shows the horizontal speed of a long jumper from the start of his run-up to the moment when he takes off.
(a) What is his maximum acceleration?
(b) Estimate the distance he runs before he takes off.
(c) Sketch the general shape of his acceleration against time.

Summary Questions

- Summary Questions are from the textbook and it is *normally* expected that students complete AND mark the summary questions for each lesson's content.

However, this year a clear photo of your workings *set out as shown* needs to be submitted **before July 21st**.

Summary questions

1 A vehicle accelerated from $13.4\ m\ s^{-1}$ to $22.3\ m\ s^{-1}$ in 8.70 s. Calculate the distance travelled. *(3 marks)*

2 A runner changes her velocity from $3.2\ m\ s^{-1}$ to $4.2\ m\ s^{-1}$. In this time she travels 200 m. Calculate her acceleration. *(3 marks)*

3 In 2009 Usain Bolt sprinted 100 m in 9.58 s, setting a record. Assuming that he travelled at a constant acceleration from start to the finish, calculate his acceleration. *(3 marks)*

4 A dragster travels 0.25 miles in a time of 4.6 s along a straight track from a standing start. 1 mile ≈ 1600 m. Calculate:

a its acceleration; *(3 marks)*

b its final velocity. *(3 marks)*

5 An apple is dropped from a tall building. Calculate the distance it travels between time $t = 3.0$ s and $t = 5.0$ s. Assume the acceleration of the falling apple is $9.81\ m\ s^{-2}$. *(4 marks)*

6 A car is travelling at $28\ m\ s^{-1}$. The driver applies the brakes. The car skids for a distance of 30 m before stopping. Calculate the magnitude of the deceleration of the car. *(3 marks)*

There is not enough room here to set out your workings properly.
Use a separate sheet.

1.17 **(a)** $57\ m\ s^{-2}$; **(b)** $-190\ m\ s^{-2}$
1.18 **(a)** $+2.5\ m\ s^{-2}$, zero, $-5.0\ m\ s^{-2}$
1.19 **(a)** $3.0\ m\ s^{-1}$ **(b)** $6.0\ m\ s^{-1}$ **(c)** $1.2\ m\ s^{-2}$
1.20 **(a)** 33 s **(b)** 1.9 km
1.21 400 m
1.23 **(a)** $4.1\ m\ s^{-2}$ **(b)** just > 30 m

REMINDERS

- It is expected that you submit photos of the completed work on page 5 (rearranging equations), 7 (identifying significance of gradients), 10 (flipped notes) and also show complete workings (as outlined on page 8) for the questions on p13 (summary questions) *before July 19th.*
- The remainder of your completed work, including showing full workings for the questions on pages 11, 12 and 13 (both these two also need to be marked) is to be handed in on the first lesson in September
- <u>Please also bring a ring binder or level arch file to the first lesson in September.</u>