AQA Physics for A-level Year 1 and AS

Author: Dave Kelly

Your A-level students will need increased maths skills and stronger practical skills to successfully tackle the demands of AS and A-level Physics.

Our resources will help you deliver comprehensive support as students build the skills they need. Regular opportunities to consolidate and track progress will build towards confidence in the final examination.

- Supporting you through the changes the change in assessment structure will bring challenges – our coherent structure of Student Books, Teacher Guides and Skills and Practice resources will help you to understand, plan for and master these challenges
- Assess and progress from GCSE and across the linear course with varied skills practice integrated throughout the Student Books, Teacher Guides and Skills and Practice resources on Collins Connect
- **Prepare for practicals** develop your students' theoretical understanding with advice and explanations of best practice, plus carry out Required Practicals effectively with full teacher support
- Help prepare students for further study and scientific careers with plenty of stretch and challenge questions that develop higher-order thinking skills

The Student Books have entered the AQA approval process

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PHYSICS

AQA A-level

Collins

PHYSICS

Teaching A level Physics, how the resources support you:

Linear assessment

Terminal assessment in the form of three 2 hour papers at A-level and two 1.5 hour papers on the first four topics at AS Level

Practicals

Assessment of practical skills will be by written exam only. Practical-based questions will form 15% of the total assessment

Maths

40% of assessment marks require the use of Level 2 mathematical skills

Standalone AS qualification

The AS becomes a stand-alone qualification, which doesn't contribute to the A-level grade

- Extensive practice questions embedded throughout help build synoptic understanding
- Online resources including video worked examples and downloadable practice papers develop the skills and written techniques that students need for their final assessment
- Comprehensive Required Practical sections advise students on apparatus, techniques and how best to avoid common errors
- Detailed support for teachers and technicians in the Teacher Guides
- Practical based assignments and questions integrated throughout the Student Book and Teacher Guides
- Test and build mathematical skills with signposted Assignments throughout
- Video worked examples in the Skills and Practice resources model mathematical skills
- Planning tools in the Teacher Guide and Student Book content matched to the 2015 specification enable you to easily co-teach AS and year one of A-level

Comprehensive Student Support

The complete content coverage that your students will need. Help them build knowledge, application and evaluation skills through clear explanations set in real-life contexts, supported by maths and practical skills-focused assignments. Questions are integrated into every chapter to check knowledge, test skills and consolidate learning. Stretch and challenge questions extend students' understanding, and extensive practice questions help prepare for the final assessment.



Prior knowledge section at the start of each chapter consolidates knowledge from GCSE and gives students a route into the topic

5 WAVES

PRIOR KNOWLEDGE AND LEARNING

Visional remember some basic ideas about waves and, their likebastop, focus obsold recall that waves can be reflected and retriamat, and snow that sound, light, X-rays and their rest of the clientramagnetic spectrum are examples of enzyes.

in this chapter you will build on that base Anowhenge Nuovelle was readed as a solution of the Anowhenge Nuovelle and about the differences between progressive and stationary waves, about the autorposition of same and about polarination of transverse solutes. (Specificition 3.3.1.1.5.3.1.2.) \$31.15

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The tourumi was caused when the ourtho suddenly lifted a section of the seabed by several rectres, displacing amund 50 km⁺ of water.



rsuz sent a series of waves across th This debuttories sense a sense of eavies across the indian Oreau (Figure 2), Court in the deep ocean the waves were only 60 cen high, but they were traveling at the speed of a jet anrank. Entween 500 and 1000 km th⁻¹. As the traveurs reached the shallower reached to 20 km th⁻¹ and gree racketly to a twent of 20-50 m is some places.

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In text questions provide opportunities to check understanding and progress, whether learning a topic for the first time or revisiting it as part of revision

Boost understanding and mathematical skills with worked

maths examples

Stretch and challenge questions and activities encourage stronger students to move beyond the specification

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Figure 19

Worked Example

A wind driven ocean wave has a frequency of around 0.1 Hz and a wavelength of around 100 m. This gives a wave speed of

Compare this with the speed of a burnarii. which has a low the precision 2.7×10^{-5} Hz, but along wavelength of up to 500 km in the open sea. This gives a wave speed for the burnarii of

QUESTIONS

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- The speech of sound in air is about \$50 m s⁻¹. Calculate the wavelength of a sound wave that Tas a frequency of 256 Hz
- 17. The HISC transmits Radio 6 or Iong-wave band of a earwiningth of 1500 m. The spend of victor earwinin in an is approximately 5 × 10¹ m.6⁻¹. Calculate the frequency of these suitor earves.
- The graph in Figure 20 shows how the department of a molecule in the en walks with time as a loand walk power by a. Canadate the requirecy of the
 - noting wave
 - Use the graph to plot a velocity versus time graph for the silv motocuts

Jaure 20

REY IDEAS

- The sweetingth is of a progressive route is the distance between any like commutive points on a unity that have view to a discoverient and valoofly
- We points on a nume time any whole number of warmingers apart will have exactly the same displacement and velocity. These points are suid to be (highlare).
- The place difference between two values at any guest point, or between two points on a value can be expressed as a fraction of a cycle, or by an ingly in depression radians.
- The Biogency Followave sparse scale method of saves per second, researed in here (b);
- File brief barn for one complete wave to pink a point in the period 7 is secondly.
- The nume speed is in objact in the university multiplied by the forgeomy, if a 14.

Signposted assignments throughout build

confidence in Maths skills, practical skills, extended writing, AO2 and AO3

Now Task in to perspare a short, sin: 10-15 minute result for a small group of younger students atmat potentiation. Was should plan to winder at and control of the demonstrations table in Experiment. 1 or Experiment 2, to help you explain what MIGH IS

- At Breen to unite a plan for your lesson. Time about how you will Mart. For nonrope if will help if you can find out rubuli the databets arrwsty sectorstand databets marks. Venat guardisms could you tas ?
- A2 It would be conside to get an issued demonstration of the task of polarisation using a long spring or even a piece of thick rubber sating. How result you do this?
- Mang, Hom House you as HIVP AS Which esperiment (1 is 2) will you use? Road through the details given here and make your destant attack what to show. What superimous will you meet? Which down teles steps for example of the notice is writer you will do Usings so that your lessan gives smoothing. Include any ability preclambors gov will need to base. Your meed to the out the demonstrations first.
- A4 What will you wend to explain to the she Are lifete any diagrams that might be uneful to drive and show perfuge using presentations sufficient?
- AS If you get a there to give your lesson take incloses from your automoticand them write an evaluation of how you did with how your regist increase for this another take.

Experiment 1. Large polynomials. The experiment considered a service of demonstrations werning polynomial light. Much can be called used using over simple appendices for simpleases would only a project barrow a light mete-and a surry bay.

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RACTICAL SKILLS ASSIGNMENT 3- DEMONSTRATING POLARISATION A brain of powersed hard cart be produced by streng a function or a my Low Decoupt a obtained man.

- The internety of light can be massared using a light neter. It may be possible to find a setable app for a smartphere or tablet
- Approximation of service of service A lensing Powerson filter can be pained between multilector and the light source. The interview minimum of the can be related to the provide of the minimum of the service of the minimum of the minimum of the service of the amount of minimum of the amount of the amount of the minimum of the amount of the minimum of the amount of the amount of the amount of the minimum of the amount of the amount of the amount of the minimum of the amount of the amount of the amount of the amount of the minimum of the amount of the amou NT.CA THE PARAMETERS.
- Observing reflected agent inrough a Polaroid filter will reveal that the messive of light transmitted depends on the angle of the litter. This is because reflected light is partly polarised.
- I il a Perspec set aguare is placed between two polensing filters orientated in right angles, it should be possible to see stress patterns in the Perspec.

Esperiment 2. Microwave polar second A microwave receiver and transmitter ran be used to demonstrate polarisation of microwaves (Higher A1). The microwave formentities used in school transmit polarised serves, which can be detended by a receiver reserve in a particle. The application lagrant is used in provide provide a serves of during a school of solution that may be applied by the solution makes.



in power emilted by te The microsoft power encoded wheel approximate server low indipercents and darger. However, a is senable to warm shudleds that microsome energy can be dangerous and in it good practime to first them exposure, for example by turning the transmitter of mean text in usa.



5.1

5.1

'snapshot' shows how the displacement of the particles depends on their distance from the wave source, as a certain time.

The displacement is measured from the equilibrium position and may be either positive or negative. The maximum displacement caused by the wave is known as the **amplitude**. A lose figure 151. The amount of energy transferred by a wave depends on amount of energy transferred by a wave depends on the second secon

The distance between any two consesuitive points on a wave that have identical displacement and velocity is referred to as the **wavelength**, 3 (Figure 13). The sovelength is measured in metres.

Autompth a measured in metric. If we observed two points on the wave that are exactly one wavelength again (justic as 'a' and b' in Figure 1.5), we would see that tray-osoliate in step with each other. These points are said to be in phase. Points and the wave that are half a wavelength apait mean the opposite extreme of their osoliation at the same time, like points 'a' and 'i' in Figure 13. These points are in **antiphase**. It's, remarketly out of phase with each other Cher points not her wave like 'a' and'd', have a phase difference that depends on what fraction all avavelength lies between them.

Key ideas summary allows students to check progress easily and revise effectively for examinations

Required practicals pages provide

comprehensive guidance on apparatus, experimental techniques and how best to avoid common errors

The frequency of the signal generator is adjusted until the first harmonic is seen on the string. A graph of frequency by abili-against $\sqrt{2}$ is platted: a straight line verifies meanwhere verifies the relationship.

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- * The string thous be horizontal. A spirit level in a
- The independent variable in each case through be varied over as inde a range of values as is practicable.

. It can be difficult to find the exact frequenty at which the first harmonic occain. First adjustm of the signal generator are needed to get the maximum angehade on the Stationary wave

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5.2 LOOKING IN DETAIL AT WAVES

Displacement-distance graphs, wavelength and phase

ra praise ogressive valves can be drawn as they would ik as one instant in time (as in Figure 2). Such a

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2. To investigate the effect of varying the musi per

and angen, ju Mana per unit length Is more difficult to change Seemal different billings, such of different prokiness or denilis, goald be used. It is consider to braid-strings together to make strings of ju. Ja, Ja, 4a, 4b, Thelinggin, Lot the strings of su-famour. J. must be lengt constant.

The procedure is similar to that described existing 1. A graph of frequency (place) against JUL in

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- A graph of frequency (plants) against 10%
- a shaight low verifies the relationship.
- The following techniques are good practical
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REQUIRED PRACTICAL APPARATUS

Investigation one fue sanation of the frequency of dationary waters on a driving The am of the gradient is to verify the relationship

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The producal gives you the opportunity to show that

use appropriate analogue apparatus to record a range of measurements and to interpolate between scale markings

· une methods to increase accuracy of mean

use appropriate digital instru-tange of measurements

- The standard experiment for investigating stationary waves to a string uses a vibration transducer to vibrate the end of the stars, A ribration transducer is similar to a inudspeaker: it kan a vectal post in place of a paper some
- Now ended good in plant or a poper usite extraction transmission and the other read hum all hosp to that manufacter and the other read hum all hosp to that masses can not hung more it via a pulse pole Figure P1. The consider in the string can be varied by changing the mass. m.
- A signal generator is connected to the vibration transducer so that the impartury of oscillations can be connolled. The signal generator connectines has a distal reactout of frequency, attrough this can be



ments to impair a

une determines the Large of Nequencies and the other is a time control. The scale of the fine control is sometimes logarithms, rather than linear, so that a small movement of the control can make a large thange to the output frequency per Figure P21.

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- An alternative means of measuring the frequency is useful: the examples an excilencement with the minimum or a frequency part of adjust disputy. Unline a temposcope that the advantage that the survey are observed early, but man has to be taken as hashing laters i an cause proclams for some people.
- Techniques The frequency of the first hatmonic for a wave on a string
- (Figure P1) is given by $t = \frac{1}{2t} + \frac{1}{\sqrt{\pi}}$. Since only one

thousal by changed at a time, several legarate experiments are necessary Experit

- 1. To investigate the effect of benace, F
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QUESTIONS

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PHYSICS

Comprehensive Teacher Support

Teacher Guides help you deliver a linear course confidently with a clear sequence of learning mapped out in medium and long-term plans. The planning tools also enable you to co-teach AS and A-level. A wealth of differentiated activity sheets provide inspiration for fresh ways to develop students' skills in maths, practicals, analysis and evaluation. These extensive guides also provide support for hands-on practical work with activities, instruction guides and technician notes.

Lesson plan 5.7

Lesson 5.7 Stationary waves on a string

LEARNING OUTCOMES

In this lesson students carry out Required practical 1: Investigation into the variation of the frequency of stationary waves on a string with length, tension and mass per unit length of the string. This is compulsory for A-Level students and provides them with opportunities to develop and demonstrate (and for you to assess) their mastery of the following practical competencies: • follows written procedures and mathematic when using instruments of the string.

Chapter 5: Wayes

- applies investigative approaches and methods when using instruments and equipment safely uses a range of practical equipment and materials makes and records observations
- and their skills in using apparatus and techniques in the following areas: use appropriate analogue apparatus to record a range of measurements and to interpolate between scale markings use appropriate digital instruments to obtain a range of measurements use methods to increase accuracy of measurements

- use a signal generator (and oscilloscope) generate and measure waves using a vibration transduce

It is strongly advised that AS students also complete this required practical, as they can expect questions based on it in their examination Paper 2. As with all practical work, it will help to develop their hands-on skills and their understanding of the scientific process through investigation.

THE JOURNEY SO FAR

Students have learned that two waves of the same frequency with a fixed phase difference, travelling in opposite directions, superpose to create a stationary wave, and that such a situation is set up when a wave is reflected.

Students will need to be familiar with the apparatus, techniques and mathematics required before they embark on their assessed practical work. Student Book 1, Chapter 5, Required practical 1 introduces students to all of these aspects. Working through these in an earlier lesson, together with a teacher demonstration of the apparatus, is essential.

LESSON OUTLINE Engage and remind

Remind students what they are going to do in this lesson. Show them the apparatus and ensure that they all have a copy of Activity sheet 5.7.1 Investigating the variation of frequency of stationary waves on a string. This will guide them through their practical work and how to record and analyse their results. Although students will do the practical work in groups, those who are A-Level candidates must independently record their results and analysis. Core activities

Ensure that students know what is meant by 'the first harmonic' and refer them to *Student Book 1, Chapter 5*. Refer to *Technician otes for Activity 52.7* to set up the practical. Give students a rough value for setting up the first harmonic for the lightest string. The aim is to verify that if < (12/t)/(T/L), so dudents need to carry out three separate experiments, varying in turn T (tension), µ (mass per unit length) and I (length). You may need to allow two lessons to complete the work. You could reduce the scope for AS-only students.

The signal generator may not give an accurate value of the frequency. A-Level students should, if possible, be given enough time to increase the accuracy of *by* taking measurements for the second and possibly third harmonics as well as the first. Ensure that students understand the simple relationship between the frequencie for the different harmonics on a string, and they understand that the averaging reduces the overall uncertainty.

Some A-Level students could construct a calibration curve for the signal generator frequency, using an oscilloscope. See the Stretch and challenge section at the end of Activity sheet 5.7.7. Alternatively, a stroboscr could be used to construct a calibration curve, but this device is just as likely to be as bady calibrated as the signal generator, and care should be taken with its use as the flashing light can induce epileptic episodes. It is also likely to be very distracting for other students in the room.

Consolidate and look ahead

Ensure that all students have their results and their estimated uncertainties recorded by the end of the lesson. They can draw their graphs in the next lesson or for homework.

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Support progress signposted sequence of learning

Chapter 2: Inside the aton

Activity sheet 2.1.1

Understanding the Maltese cross tube

TASK 1 Observe the demonstration of a Maltese cross tube

TASK 2

The diagram shows the circuit for a Maltese cross tube



01. Identify the cathode (negative terminal) on the diagram.

02. Draw an arrow on the diagram to show the direction of the current in the tube.

03. Imagine a magnetic field is directed through the apparatus from North, on this side, to South on the opposite side. Determine which way the electron beam will move and mark it with an arrow on the diagram.

04. How could the apparatus be used to show that cathode rays are negatively charged particles?

05. The shadow cast by the negatively charged particles (electrons) remains sharp when the bean is deflected by the magnetic field. What does this tell you about the individual electrons? 06. Many electrons strike the Maltese cross and are absorbed. Where do they go?

07. If the cross is disconnected from the anode (positive terminal), the image looks more like a clover I Explain why this clover leaf shape appears.

Stretch and challenge

08. The anode is earthed. If the potential difference between the anode and cathode is 2000 V, what is the potential of the anode and the potential of the cathode? 09. How would the potentials change if the cathode was earthed instead of the anode?

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