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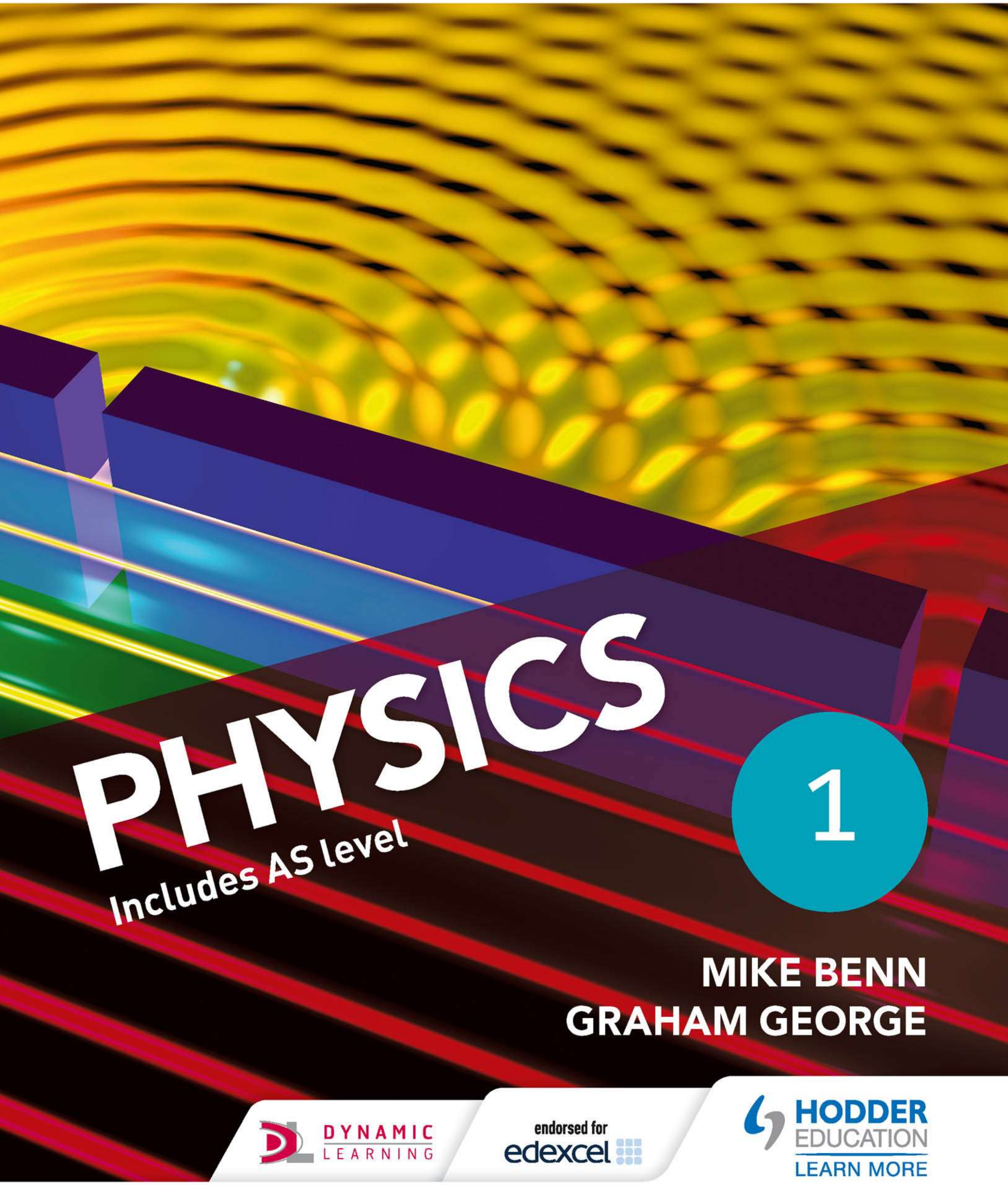

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Contents

Introduction

Welcome to *Edexcel A level Physics Year 1 Student's book*. The Edexcel specification has been developed from the best of the Edexcel concept-led and the Salters Horners context-led approaches. Although the book has been written specifically to cover the concept approach to the specification, it also makes a most valuable resource for the context approach as it is illustrated throughout by contextual examples and practice questions. The authors both have vast experience of teaching, examining and writing about physics. Both have examined for Edexcel at a senior level for over 30 years.

As the title suggests, this book is designed primarily as a resource for the first year of the A-level course. It does, however, encompass all the material you need if you are only pursuing your studies of physics to AS level.

A key aspect of the text is the emphasis on practical work. Although you do not have a practical examination as such, questions on practical work pervade both AS papers. If you are doing A level, you will also have a third paper comprising practical-based and synoptic questions. There is also an internally assessed *Practical Endorsement* at A level, for which you need to start a portfolio of work in Year 1. All the *Core Practicals* in the specification are described here in detail and in such a way that students can carry out the experiments in a laboratory environment. Each experiment has a set of data for the reader to work through, followed by questions similar to those you will be asked in the examination. Questions within written examination papers will aim to assess the knowledge and understanding that students gain while carrying out practical activities, both within the context of the 16 core practical activities, as well as in novel practical scenarios. In addition, for A level, the completion of the 16 core practical activities can provide evidence of competence for the Science Practical Endorsement. The core practicals are also intended to provide students with opportunities to undertake investigative work, therefore the core practical experiments described in this book must be considered as examples of the sort of activity that could be undertaken.

Many other experiments – under the heading of *Activity* – are also described, together with data and questions. In addition, Chapter 2 is a guide to practical work which explains how you should approach practical work and contains some exercises for you to try. Before carrying out *any* practical activity, teachers *must* identify any hazards and assess any risks. This can be done by consulting a model (generic) risk assessment provided by CLEAPSS to subscribing authorities.

Emphasis is also placed on practice questions. The text is abundantly illustrated by *Examples* which are accompanied by answers to enable you to check your progress. There are then *Test Yourself questions* for you to try (answers for these can be accessed using the QR codes found in the *Free online resources* section at the end of this book) and at the end of each chapter there are *Exam Practice Questions*. These are graded in terms of difficulty (● = AS/A level grade E–C, ● = AS grade C–A/A level grade C and ● = AS grade A/A level grade C–A). In the *Exam Practice Questions* the mark allocation for each part is shown, as in the examination. The answers give an *indication* of how the marks might be awarded but not in the same detail that there would be in an actual mark scheme. Examples of mark schemes are given in Chapter 19.

Most students using this book will have completed a GCSE course in physics or combined science. The *Prior Knowledge* boxes at the start of each chapter list some of the material that you may have covered at GCSE .These boxes should serve as a useful reminder of your earlier work before you start each topic. It should be emphasised, however, that all of the basic concepts are explained fully in each chapter and that previous knowledge is not an essential pre-requisite.

Throughout the book there are *Key Terms* highlighted in the margin that you need to learn. There are also numerous *Tips*. These may be reminders, for example to use SI units, warnings to avoid common errors or hints about short cuts in performing calculations.

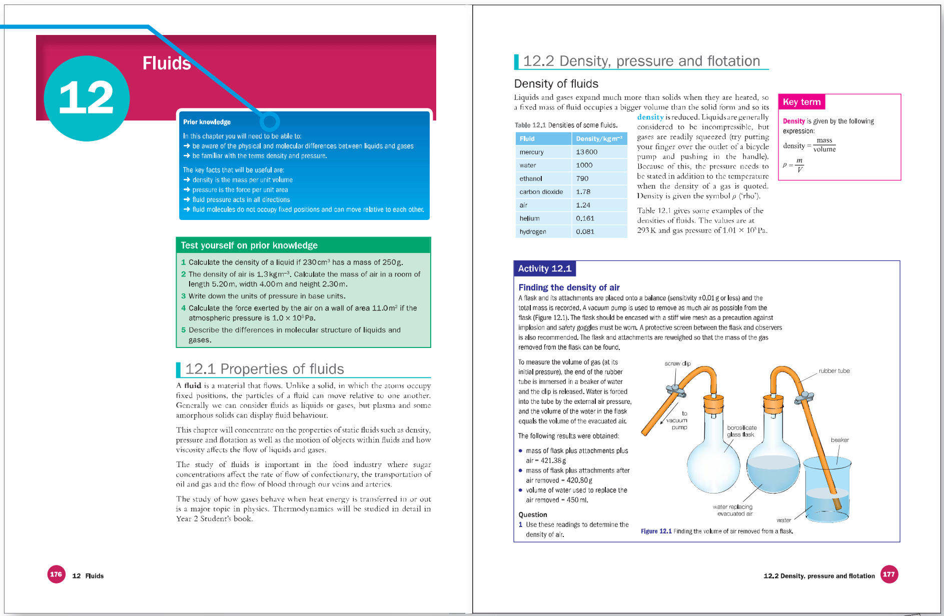
At the end of the book, Chapter 19 (*Preparing for the exams*) is a valuable guide on revision and exam technique. As you need to put these principles into practice from day one, you are strongly advised to read through this *before* you start your course (although you probably won't be able to attempt the questions). You should then re-visit Chapter 19 from time to time. The same goes for Chapter 18 (*Maths in physics*) where you will find an outline of the mathematical requirements for AS and A level physics, together with lots of simple (and not so simple!) examples for you to try.

The authors have enjoyed writing this book – we hope you enjoy reading it and find it, along with the supporting material, a valuable resource to help you with your studies. Good luck!

Get the most from this book

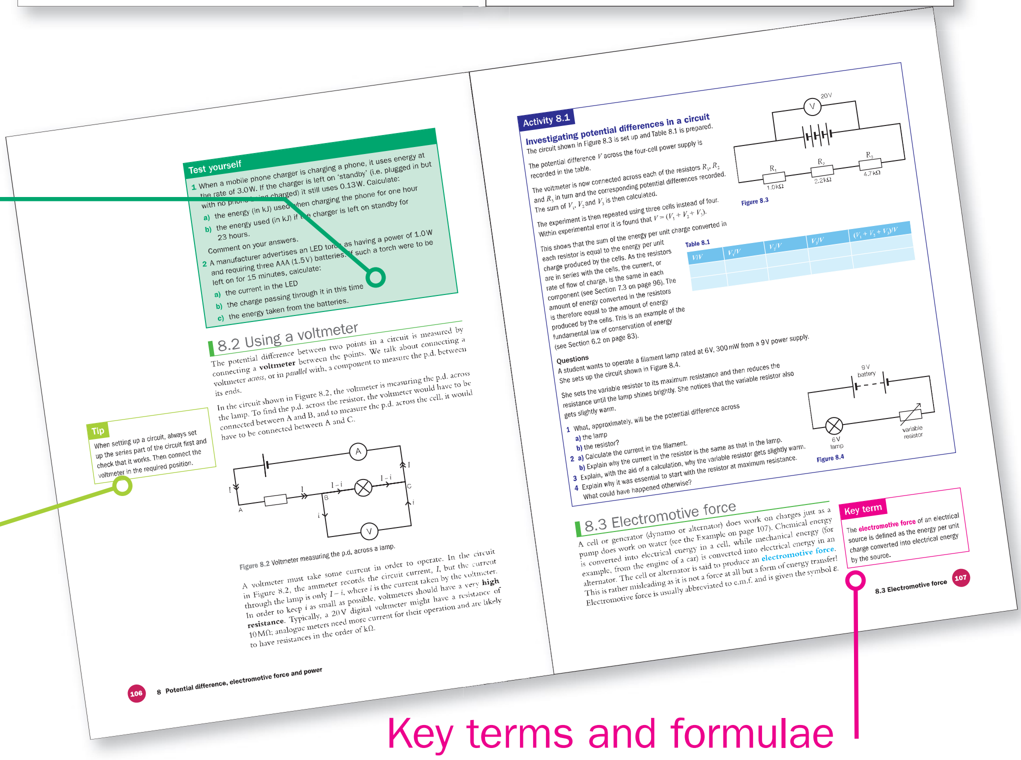
Welcome to the **Edexcel A level Physics Year 1 Student's Book**! This book covers Year 1 of the Edexcel A level Physics specification and all content for the Edexcel AS Physics specification.

The following features have been included to help you get the most from this book.



Prior knowledge

This is a short list of topics that you should be familiar with before starting a chapter. The questions will help to test your understanding.



Test yourself questions

These short questions, found throughout each chapter, are useful for checking your understanding as you progress through a topic.

Tips

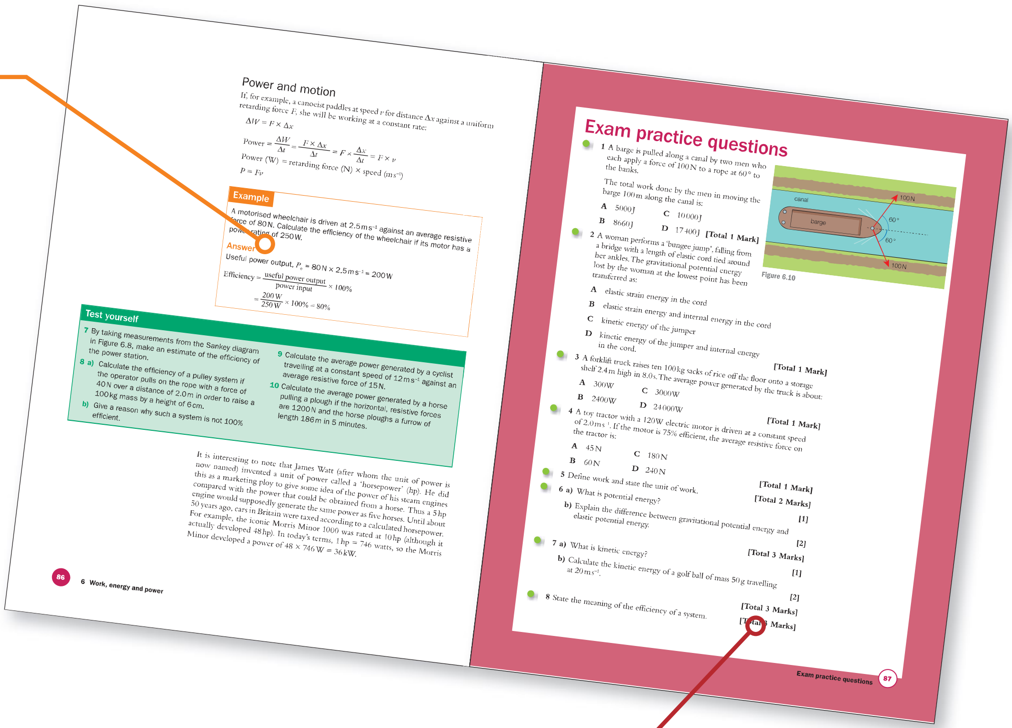
These highlight important facts, common misconceptions and signpost you towards other relevant topics.

Key terms and formulae

These are highlighted in the text and definitions are given in the margin to help you pick out and learn these important concepts.

Examples

Examples of questions and calculations feature full workings and sample answers.

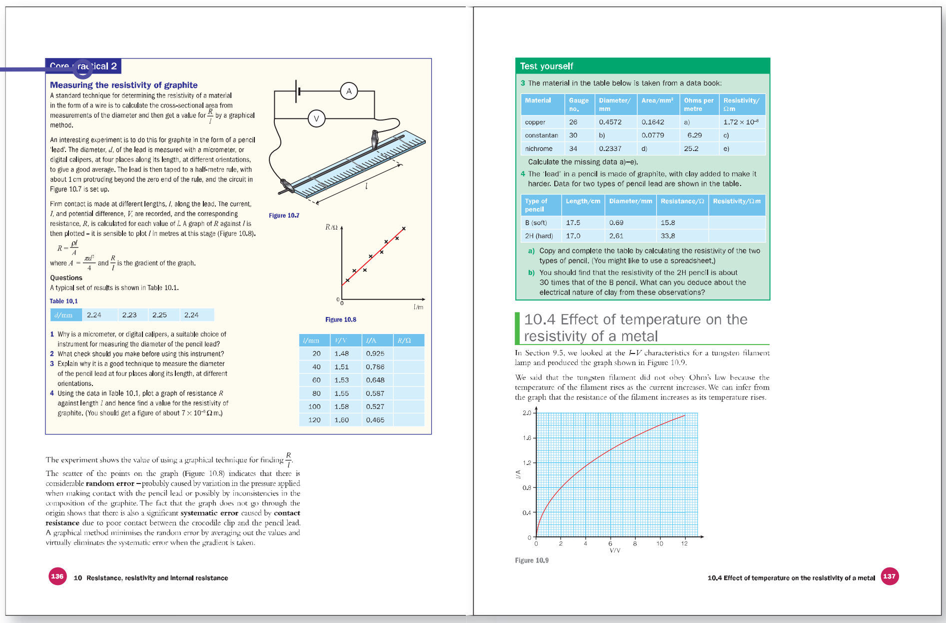


Exam practice questions

You will find Exam practice questions at the end of every chapter. These follow the style of the different types of questions you might see in your examination, including multiple-choice questions, and are colour coded to highlight the level of difficulty. Test your understanding even further, with Maths questions and Stretch and challenge questions.

Activities and Core practicals

These practical-based activities will help consolidate your learning and test your practical skills. Edexcel's Core practicals are clearly highlighted.



Dedicated chapters for developing your **Maths** and **Practical skills** and **Preparing for your exam** are also included in this book.

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1 Quantities and units

Prior knowledge

In this chapter you will need to:

➜ use common measures and simple compound measures such as speed

➜ substitute values into formulae and equations using appropriate units and rearrange equations in order to change the subject.

The key facts that will be useful are:

➜ mass, length and time are examples of measurable physical quantities

➜ kilogram (kg), metre (m) and second (s) are units of mass, length and time

➜ speed is the distance covered per unit time and is measured in metres per second ($m\,s^{-1}$)

➜ vector quantities have both size and direction.

Test yourself on prior knowledge

1 A man walks 1.6 km in 20 minutes. Calculate his average speed.

2 A sprinter runs 200 m at an average speed of $8.0\,m\,s^{-1}$. Calculate the time taken for her to complete the distance.

3 Acceleration can be calculated by dividing a change in speed by the time taken. State the unit of acceleration.

4 Speed is a scalar quantity and velocity is a vector. Explain the difference between the two.

1.1 Physical quantities, base and derived units

An elderly physicist was asked how much he had in the bank.

'How much of what?' he responded.

'Money, of course!'

'Fifteen million, three hundred thousand, one hundred and four,' he replied.

The physicist was not a rich man. He had quoted his balance in Turkish Lira which, at that time, had an exchange rate of 2.6 million to the pound (1.4 million to the American dollar).

The story has relevance to measurements in physics. It is meaningless to state that the size of a wire is 10; we must state the quantity that is measured (in this case, the length of the wire) and the unit (such as cm). In this chapter, and throughout this book, you will identify and use a number of **base quantities** (and their units) that are fundamental to all physical measurements. You will develop and use derived units for quantities for a wide range of physical properties.

Tip

Many students lose marks in examinations by failing to include the unit of a derived quantity! Always show the unit for all calculated quantities.

All measurements taken in physics are described as physical quantities. There are seven quantities fundamental to physics. These are mass, length, time, temperature, current, amount of substance and luminous intensity. All other quantities are derived from these base quantities – for example, speed is distance (length) divided by time.

SI units

A system of measurement is needed so that a comparison of the sizes can be made with the values of other people. Over the years, many different systems of units have been used. In the UK and US, pounds and ounces, degrees Fahrenheit and miles are still common measurements of mass, temperature and length, respectively. Scientists have devised an international system that uses agreed **base units** for the seven base quantities. These are termed **SI units** (abbreviated from the French Système International d'Unités).

The base units needed for AS (and A level) examinations are defined in Table 1.1.

Tip

Remember the convention that for quantities the symbols are *italicised*, and those for units are written in plain font. This convention is used throughout this book and the AS and A level examinations

Table 1.1 Base quantities and units.

Base quantity	Base unit	Symbol	Definition
length	metre	m	the distance travelled by electromagnetic radiation through a vacuum in a time of $\frac{1}{299\,792\,458}$ second
mass	kilogram	kg	the mass of a standard platinum–iridium cylinder held in Sèvres, France
time	second	s	9 192 631 770 periods of the radiation emitted from an excited caesium-133 atom
current	ampere	A	the current that, when flowing in two infinitely long parallel wires placed one metre apart in a vacuum, produces a force per unit length of $2 \times 10^{-7}\,\mathrm{N\,m^{-1}}$
temperature interval	kelvin	K	$\frac{1}{273.16}$ of the thermodynamic temperature difference between absolute zero and the triple point of water
amount of substance	mole	mol	the amount of substance that contains the same number of elementary particles as there are atoms in 12 grams of carbon-12

Derived units

Many physical quantities are defined in terms of two or more base quantities. Some examples you may be familiar with are area, which is the product of two lengths, speed, which is the distance (length) divided by time, and density, which equals mass divided by volume (length cubed).

Table 1.2 includes some of the derived quantities and units that will be used in this book. Expanded definitions will be given in later chapters.