Marshall Cavendish Education

Cambridge Assessment International Education
Endorsed for teacher support

Cambridge IGCSE™ Physics

Kaleem Akbar

TEACHER'S GUIDE

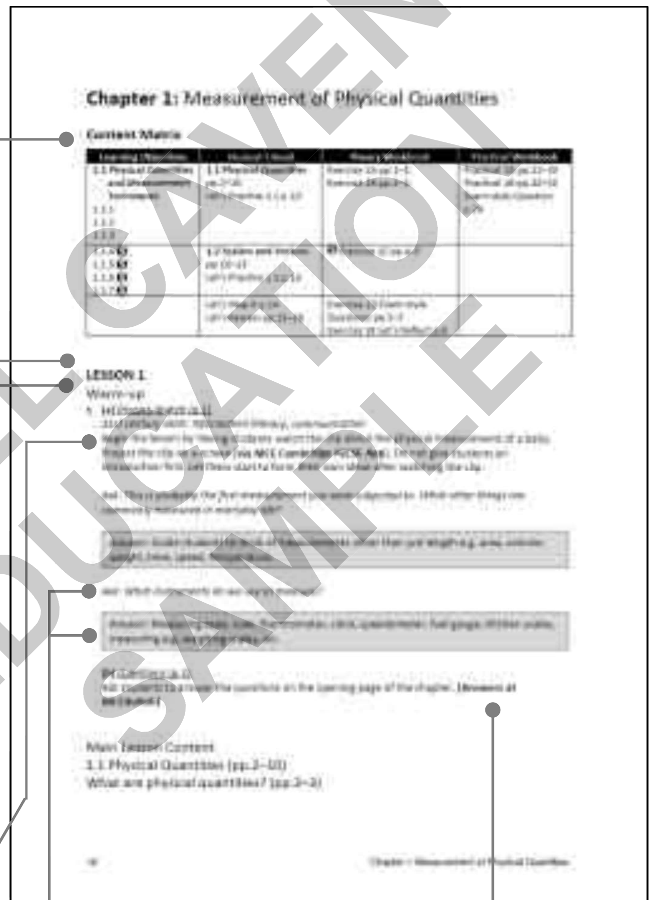
How to Use This Book

This **Teacher's Guide** is part of the Marshall Cavendish Education (MCE) suite of resources designed and created to support you as you teach the Cambridge IGCSE and IGCSE (9–1) Physics syllabuses (0625/0972).

The lesson plans in the Teacher's Guide are made available online in editable Word format for you to customise according to your classroom needs. The answer keys mentioned in the lesson plans are available online in MCEduHub (our online resource hub).

Content Matrix
The Content Matrix serves as a directory to help you locate easily the contents in the Student's Book, Theory Workbook and Practical Workbook that are relevant to each Learning Objective grouping.

Lesson Plan
Each chapter includes several Lesson Plans to help you conduct your lessons. If you are new to the syllabus, the Lesson Plan is written in such a way that gets you up and running quickly. If you are an experienced teacher, the editable Lesson Plans allow you to customise your lessons, making use of selected parts of the Teacher's Guide to support your teaching flow and including your own teaching ideas.


Chapter 1: Measurement of Physical Quantities

Content Matrix

LESSON 1

Warm-up

Main Lesson Content

1.1 Physical Quantities (pp.3–10)

What are physical quantities? (pp.3–4)

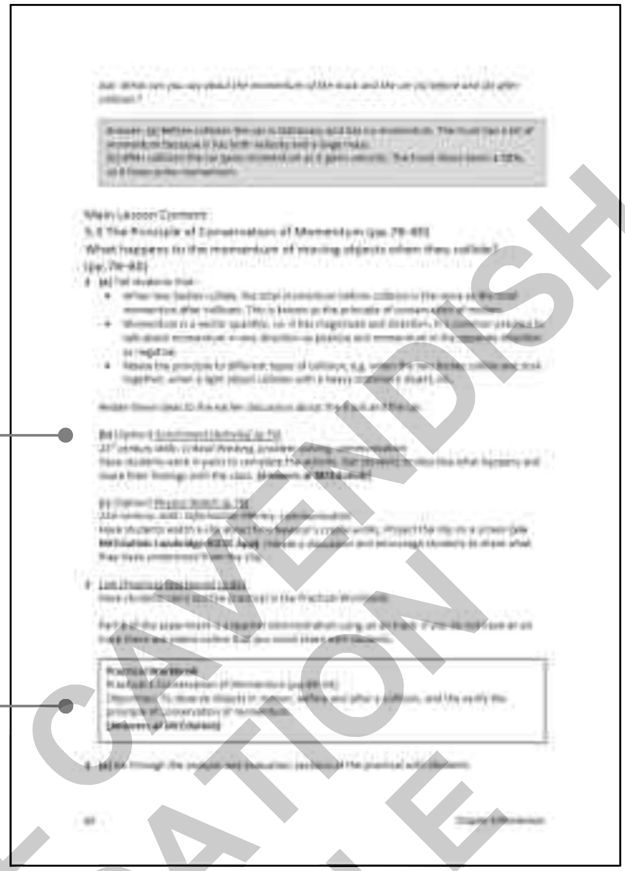
Warm-up
This section helps you begin your lesson with a variety of teaching ideas. For example, to start off a new chapter, you are provided with teaching ideas to engage your students using the Chapter Opener, which includes *Physics Watch* and *Questions*.

[MCE Cambridge IGCSE App]
You can download this App to your laptop or computer. Using this App, you can choose to project digital resources from *Physics Watch* on screen for the class.

Ask and **Answer**
You can use suggested questions provided to prompt students and draw out their ideas and understanding. Answers to these questions are provided immediately for your easy reference. They may include content beyond the syllabus for enrichment.

[Answers at MCEduHub]
You can access answers to questions in the Student's Book, Theory Workbook and Practical Workbook in My Resources at www.MCEduHub.com.

[Option]
This indicates additional content and context to help enhance and enrich learning, including some contexts that extend beyond the requirements of the syllabus. You can decide to skip 'Option' content and still fulfil the syllabus requirements. Features that include elements that are beyond the syllabus are indicated by an asterisk (*).

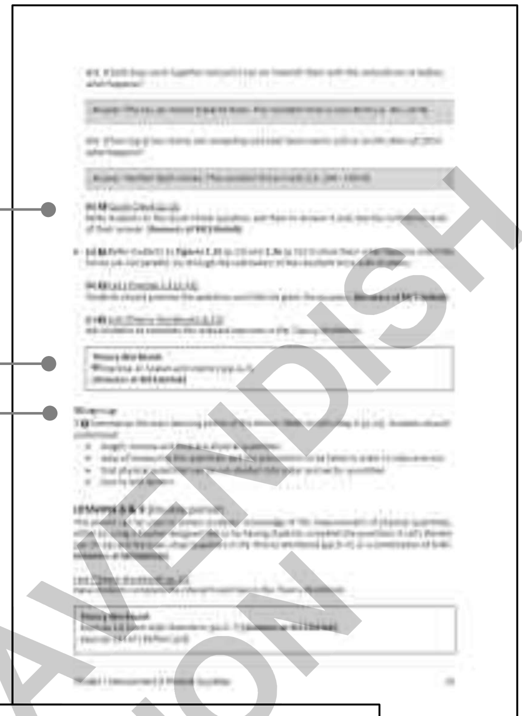


Practical Workbook
Practicals in the Practical Workbook are incorporated in the lesson plans where relevant. Each practical usually extends for a double period.

Support
This suggests ideas for you to facilitate your students in understanding the concepts to be learnt.

Challenge
This suggests ideas for you to challenge your students and foster a deeper understanding of the topic.

Core/Supplement Differentiation
Supplement content is indicated using the icon S to differentiate it from Core content.



Theory Workbook
Exercises in the Theory Workbook are incorporated in the lesson plans as part of assessments.

Wrap-up
This section helps you to conclude your lesson. For example, you can consolidate what you have taught in the lesson by reviewing, summarising or having further discussions.

Some content within the lessons is not required in the syllabus but is very useful to enhance and provide complete understanding. This will be indicated using triangle symbols before (▶) and after (◀) the text.

Additional Teacher's Resources

In addition, MCEduHub contains further teacher's resources as listed below:

- **Scheme of Work (SOW)** – in editable Word format
- **PowerPoint Slides** – covering key concepts, to support frontal teaching in the classroom or for online lessons
- **Question Bank** – providing you with an online resource of questions from the Student's Book and Theory Workbook, as well as some additional questions. Questions are in Word format, for easy editing and customisation

These additional teacher's resources are not endorsed by Cambridge Assessment International Education.

Contents

Chapter 1: Measurement of Physical Quantities

Content Matrix

Learning Objectives	Student's Book	Theory Workbook	Practical Workbook
1.1 Physical Quantities and Measurement Techniques 1.1.1 1.1.2 1.1.3	**1.1 Physical Quantities** pp.2–10 Let's Practise 1.1 p.10	Exercise 1A pp.1–2 Exercise 1B pp.2–4	Practical 1A pp.11–19 Practical 1B pp.20–23 Exam-style Question p.24
1.1.4 Ⓢ 1.1.5 Ⓢ 1.1.6 Ⓢ 1.1.7 Ⓢ	**1.2 Scalars and Vectors** pp.10–13 Let's Practise 1.2 p.13	Ⓢ Exercise 1C pp.4–5	
	Let's Map It p.14 Let's Review pp.15–16	Exercise 1D Exam-style Questions pp.5–7 Exercise 1E Let's Reflect p.8	

LESSON 1

Warm-up

1 **(a)** Physics Watch (p.1)

21st century skills: Information literacy, communication

Begin the lesson by having students watch the clip about the physical measurement of a baby. Project the clip on a screen [**via MCE Cambridge IGCSE App**]. Do not give students an introduction first. Let them start to form their own ideas after watching the clip.

Ask: This is probably the first measurement you were subjected to. What other things are commonly measured in everyday life?

> Answer: Guide students to think of measurements other than just length e.g. area, volume, weight, time, speed, temperature.

Ask: What instruments do we use to measure?

> Answer: Measuring tape, ruler, thermometer, clock, speedometer, fuel gauge, kitchen scales, measuring jug, weighing scales, etc.

(b) Questions (p.1)

Ask students to answer the questions on the opening page of the chapter. **[Answers at MCEduHub]**

Main Lesson Content

1.1 Physical Quantities (pp.2–10)

What are physical quantities? (pp.2–3)

2 **(a)** Explain to students that:

- Physics is the study of the universe from the smallest sub-atomic particle to the largest galaxies.
- It is all about measurement and observing how bodies interact.
- It is important to measure as accurately as possible to get reliable results.

(b) Describe a physical quantity as a quantity that can be measured. It usually consists of a value, a numerical magnitude (size) and a unit. Start to develop ideas of units and their abbreviations. Give some everyday examples such as 25 kg, 4.5 km, 23.5 s, 37°C.

Support students to understand the word ***magnitude*** [Word Alert (p.2)].

(c) Introduce students to some physical quantities and their commonly used units (**Table 1.1** p.2) and some units that are derived from other physical units, e.g. those for area, volume and speed (**Table 1.2** p.3).

(d) [Option] Physics Watch (p.3)
21st century skill: Information literacy
Have students watch a clip about how unit errors can cause a disaster. Project the clip on a screen [**via MCEduHub**]. Initiate a discussion and encourage students to share what they have understood from the clip.

(e) [Option] Enrichment [Info] (p.2)
21st century skill: Information literacy
Share the interesting facts about measurement. Encourage students to come up with others.

3 **(a)** Develop the idea of the range of measurements that can be made. Length is a good one to start with.

Ask: Can you think of some very long distances that can be measured?

> Answer: e.g. Length of a football pitch, height of a very tall building e.g. Burj Khalifa in Dubai, the Shanghai Tower, distance from Earth to the Moon, distance from Earth to the Sun, distance to the nearest star, etc.

Ask: Can you think of some very short distances that can be measured?

> Answer: e.g. thickness of a human hair, thickness of a piece of paper, distance between molecules etc.

(b) Develop the idea of prefixes for standard units (see **Table 1.3** p.3). Students will have come across the kilometre, the centimetre, the millimetre. Discuss what the prefixes mean.

(c) Develop the use of standard form for expressing large and small physical quantities. Students may have come across standard form in mathematics, but guide them to relate the ideas to actual physical quantities they will have met before, e.g. 1 kilometre (km) = 1×10^{3} m and 1 millimetre (mm) = 1×10^{-3} m.

How do we measure length? (pp.4–5)

4 **(a)** Remind students that we need to measure a range of lengths or distances, and so we need a variety of instruments. Discuss what a metre rule can be used to measure.

Ask: What is a sensible distance to measure with a metre rule?
What is the smallest unit on a metre rule?
Can you use a metre rule to measure the thickness of a human hair?
Can you use a metre rule to measure the circumference of a cricket ball?

> Answers:
> - Anything from a few mm to a metre.
> - 1 mm
> - No, it is too small.
> - No, the rule is not flexible enough.

(b) [Option] Enrichment [Think] (p.4)
Refer the students to **Figure 1.5** (p.4) and ask students to work in pairs to answer the question, and then share their answers with the class. **[Answers at MCEduHub]**

(c) Explain to students that the thickness of a sheet of paper can be measured by taking the average value of a sheet of paper in a stack.

(d) Discuss with students other small distances that can be measured in a similar way, e.g. thickness of a coin (using a stack of coins), diameter of a wire (by winding it round something and measuring several diameters) etc.

(e) Remind students of the need to choose the right instrument when measuring a length. The smallest division on a metre rule is 1 mm. Tell them that is the ***precision*** of the metre rule.

5 **(a)** Remind students that it is important to measure as accurately as possible to get valid results. Some errors can be avoided, and some can be reduced.
- One error that can be avoided is parallax error. Show students **Figures 1.6 a** and **b** (p.4) and discuss parallax error and how to avoid it.
- Check that the instrument being used does not have a zero error. For a metre rule this would occur if the end of the rule is damaged and the zero is not actually at the end of the rule. **Figures 1.6 a** and **b** show the measurement of the length of an object with a metre rule. Discuss with students how the length of the object is actually found in this case.
- Taking several readings and finding the average can minimise the effect of random errors and uncertainties.

(b) [Option] Quick Check (p.4)
Refer students to the Quick Check question, ask them to answer it and rate the confidence level of their answer. **[Answers at MCEduHub]**

How do we measure volume? (p.5)

6 **(a)** Remind students that they can find the volume of a regularly shaped object by measuring its dimensions with an appropriate instrument, and then using an equation to calculate the volume. Ask them for some examples of equations that they have come across, e.g. the volume of a cube, the volume of a cylinder, the volume of a sphere.

(b) Show students a measuring cylinder and describe how it can be used to measure the volume of a liquid. Stress the precautions that should be taken (i.e. the measuring cylinder should be placed on a level surface, there should be no bubbles in the liquid, and the reading must be taken with the eye at the same level as the bottom of the meniscus to avoid parallax error).

(c) Show them how the displacement of water can be used to measure the volume of an irregularly shaped object. Discuss the various arrangements for objects that sink, objects that float, and large objects that sink and refer students to **Figures 1.7–1.10** (pp.5–6).

Wrap-up

7 Review the lesson by summarising the key points. By the end of the lesson, students should understand:

- that physical quantities are quantities that can be measured, and have magnitude and a unit
- the use of prefixes and/or standard form for expressing large and small units
- the need for accurate measurement
- the use of an appropriate instrument for the quantity being measured.

LESSONS 2 & 3 (Double period)

Warm-up

1 Remind students of the previous lesson in which they learnt about measurement of length and volume, and the need to reduce errors and to measure as accurately as possible.

This period will be a practical lesson in which they will put what they learnt into practice. The experiments are arranged as a circus and there are 7 experiments which should be arranged prior to the start of the practical lesson at various points around the laboratory. Split the class into 7 working groups and organise where each group will start.

All the groups should move to the next experiment at the same time, and when instructed by the teacher. All 7 experiments should be completed within the double period.

Information and notes for teachers and technicians are found at the back of this book.

Main Lesson Content

2 Link [Practical Workbook] (p.6)

> **Practical Workbook**
> Practical 1A Measurement of Length and Volume (pp.11–19)
> Objectives: To become familiar with simple laboratory equipment and to take a variety of measurements as accurately as possible.
> **[Answers at MCEduHub]**

Wrap-up

3 If time permits, discuss the results students obtained and confirm the values they should have recorded for each experiment. If there is no time left, follow up at the beginning of the next lesson.

The following points should be emphasised:

- The need to use the most appropriate instrument e.g. metre rule or measuring tape.
- The need to avoid errors where possible, e.g. parallax error (measuring cylinder and metre rule) zero error (metre rule).
- Calculation of a small distance by measuring multiples and then dividing by the number of objects, e.g. thickness of a coin, diameter of a wire.
- Take several measurements and average, e.g. finding the diameter of a marble.
- How many significant figures in which it is appropriate to express the answer.

LESSON 4

Warm-up

1 Discuss with students how we tell the time. Obvious suggestions will be by using a watch, clock or mobile (cell) phone.
Ask: How did people tell the time before clocks were invented?

> Answers:
> By timing different events, e.g.
> - the length of the day was determined by the rising and the setting of the sun,
> - the phases of the moon repeat in a regular pattern and so the time from one new moon to the next is fairly regular,
> - the seasons of the year repeat in a regular pattern,
> - a sundial casts a shadow that moves as the sun moves across the sky,
> - the length of time a candle takes to burn down was used to measure time,
> - an hourglass measured the time taken for sand to trickle through a narrow gap
> - a water clock uses the flow of water to measure time.

(b) Discuss the possible difficulties we would have if we used such measuring instruments today in the laboratory. The most obvious is the fact that these events are not fixed. The length of the day is shorter in the winter than in the summer, the candle clock would burn down faster if there was a breeze, a sundial is not useful if there is no sun, and they don't measure very small intervals of time etc.

Main Lesson Content

How do we measure time? (pp.7–10)

2 Explain that in order to measure time we need an event that repeats at regular intervals.

Ask: Can you think of repeating events that can be used to measure time accurately?

> Answer:
> Students might need some help with this question. Examples are:
> - a mechanical clock uses a mainspring that is wound up; as it unwinds it operates a series of its parts and gears which turn the hands over a dial.
> - a pendulum clock uses a swinging weight as its timekeeping mechanism to operate the parts and gears.

▶ Modern examples include:

- a quartz clock/watch uses a tiny quartz crystal as its timekeeping mechanism. When electric current passes through a quartz crystal it vibrates at a very precise frequency.
- an atomic clock uses the oscillation of an atom as its timekeeping mechanism. The International System of Units (SI) defines the second as the time it takes a caesium-133 atom to oscillate exactly 9,192,631,770 times.
- a radio-controlled clock is a clock that is controlled by a radio signal received from a place where an atomic clock is located, e.g. the National Metrology Centre, Singapore. ◀

3 **(a)** Show students a simple pendulum, consisting of a weight attached to a string. Show them that when the weight is pulled to one side and released it swings back and forth.

(b) Explain the meaning of one complete oscillation by referring to **Figure 1.11** (p.7).

(c) Explain that the time taken for one complete oscillation is called the ***period*** of the pendulum. One complete oscillation can be measured from any point in its swing as long as the time is measured from that point and back to its original starting position and travelling in the same direction, i.e. it could be from the mid-point to one side, through the mid-point to the other side, and back to the mid-point.

(d) Change the length of the pendulum, pull it to one side and release. Show the effect of using different lengths.

Ask: What happens to the period of the pendulum when its length is changed?

Answer: When the length changes, the period changes. The period of a short pendulum is less than the period of a long pendulum.

Ask: Does the speed of the pendulum bob change during one oscillation?

Answer: Yes.

Ask: When is it fastest?

Answer: In the middle of the swing, at its lowest point.

Support students to understand that ***motion*** means movement, and ***calibrated*** means that the length of the pendulum can be adjusted so that its period matches scale divisions of the clock marked in units of time [Word Alert (p.7)].

(e) Explain to students how a short time interval of time can be determined by measuring multiple oscillations and then dividing by the number of oscillations.

(f) Link [Backward] (p.2)
Remind students that the SI unit of time is the second.

4 **(a)** Discuss various instruments currently used to measure time, e.g. a mechanical clock, a mechanical wristwatch, a quartz watch, a mechanical (analogue) stopwatch, a digital stopwatch, a mobile (cell) phone etc.

Ask: Which instruments are the most accurate, and why?

Answer: A quartz wristwatch or a digital stopwatch because they rely on the vibrations of a quartz crystal. And a mobile (cell) phone because it is controlled by a radio signal received from a place where an atomic clock is located e.g. the National Metrology Centre, Singapore.

Ask: Which would you use to measure an event at a sporting event, e.g. an athlete running a 100 m race?

Answer: A digital stopwatch.

(b) Show students a digital stopwatch, and demonstrate that it can measure time intervals of 0.01 of a second.

Ask: Could I use this to measure an athlete running the 100m race to an accuracy of 0.01 s?

Answer: Theoretically, yes. But human reaction time, i.e. the time it takes for the human brain to tell the hand to stop and start the watch, will affect the reading.

[Option]***Challenge** students to find out what is the smallest interval of time that can be measured.

Answer: The smallest theoretical unit of time is called Planck time and it is 10–43 s. The smallest unit of time ever measured is called the zeptosecond (10–21 s, a sextillionth of a second) In 2020 scientists in Germany measured how long it takes a photon to cross a hydrogen molecule as 247 zeptoseconds.

(c) [Option] <u>Enrichment [Activity] (p.8)</u>
21st century skill: ICT literacy
Ask students to complete this activity about online reaction tests.

5 Explain to students that, in situations where human reaction time can affect the results, electronic sensors can be used to switch the timer on and off. For example, a timer can be switched on when a beam of light is interrupted and switched off when a second beam of light is interrupted, thus the time for an object to travel between the two light beams can be measured. In many events involving large numbers of athletes, e.g. a marathon, the participants can wear a transponder that marks their time, location and speed at every point. (A transponder is a device that transmits and responds, i.e. it receives a signal and transmits another signal.)

6 **(a)** Go through Worked Example 1A (p.9) with students.

(b) <u>Quick Check (p.9)</u>
Refer students to the Quick Check question, ask them to answer it and rate the confidence level of their answer. **[Answers at MCEduHub]**

Wrap-up

7 Review the lesson by summarising the main points. By the end of the lesson students should understand that:

- Time is measured using an event that repeats in a regular manner.
- Time can be measured using a pendulum, and the length of the pendulum affects the time period of the oscillation.
- When we measure time using a stopwatch, we must remember the impact of human reaction time.

LESSONS 5 & 6 (Double period)

Warm-up

1 Remind students that in the previous lesson they saw that the length of a pendulum was related to the period of an oscillation. Introduce the practical very briefly, telling students to follow the instructions in the Practical Workbook to find the relationship between the length of a pendulum and its period. Remind students of the definition of one oscillation.

Main Lesson Content

2 **(a)** Let's Investigate 1A and Link [Practical Workbook] (pp.8–9)

> **Practical Workbook**
> Practical 1B Pendulum (pp.20–23)
> Objectives: To vary the length l of the pendulum, measure the time period T for various lengths, and find the relationship between T and l.
> **[Answers at MCEduHub]**

(b) Ask students to answer the Exam-style question in the Practical Workbook (p.24) either as classwork or as a homework exercise.

Wrap-up

3 **(a)** Discuss with students the main conclusions of the experiment.

- The graph of T vs l shows that as l increases so does T, but it is not a linear relationship (i.e. it is not a straight line graph).
- To find the length of the pendulum with a time period of 1.0 s, students should have drawn a line from the T-axis to the curve, and then from the curve to the l-axis. The value should be about 0.25 m.
- The graph of T^2 vs l should give a straight line through the origin. Discuss with students what this means mathematically, i.e. T^2 is proportional to l.
- Discuss the reason for measuring 20 oscillations of each length of the pendulum (to minimise the error as the time period of one oscillation is too small to measure).
- Discuss the reason for repeating the measurement of time for each length of pendulum (to reduce error).

Support students to understand that ***linearly*** means ***in a straight line*** [Word Alert (p.9)].

(b) Suggest students read the notes on Practical Skills Build-up at the front of the Practical Workbook for more information on the above points.

LESSON 7

For students studying the core content only, this lesson can be spent consolidating the main learning points of Measurement of Physical Quantities by completing the following exercises. For students studying the supplement content these exercises could be completed as a homework exercise.

Warm-up

1 **(a)** Discuss with the students what they have learnt. Write a list on the board, or draw a concept map to show students how to link the ideas. Refer students to Let's Map It in the Student's Book (p.14) to compare with the concept map they have helped to design. Let's Map It includes both core and supplementary topics. It would be useful to point this out to students.

(b) Let's Practise 1.1 (p.10)
Students should practise the questions and then be given the answers. **[Answers at MCEduHub]**

(c) Link [Theory Workbook] (p.10)
Ask students to complete the relevant exercises in the Theory Workbook.

Theory Workbook Exercise 1A Physical Quantities (pp.1–2) Exercise 1B Measuring Quantities (pp.2–4) **[Answers at MCEduHub]**

Main Lesson Content

Ⓢ 1.2 Scalars and Vectors (pp.10–13)

Ⓢ What are scalars and vectors? (pp.10–11)

2 **(a)** Ⓢ Remind students that they have learnt a physical quantity consists of magnitude (size) and a unit. Such physical quantities are called ***scalar*** quantities.
Give an example of a scalar quantity, e.g. speed. Speed tells us how fast or slow an object is moving (i.e. it has magnitude).

(b) Ⓢ Explain that some physical quantities also have direction, and they are called ***vector*** quantities. If we want to describe how fast a body is moving in a particular direction we use the term velocity, instead of speed. Force is a vector quantity because we need to know the direction of the force as well as its magnitude, e.g. is it pushing or pulling?

3 Ⓢ Refer students to **Table 1.5** (p.11) for a list of scalar and vector quantities.

4 Ⓢ Refer students to **Figure 1.21** (p.11) and show them how to draw the vector diagram of a force of 20 N in the direction 45° north of east.

Ⓢ Vector diagrams (pp.11–13)

5 **(a)** Ⓢ Ask students to think of two boys pulling each other in opposite directions, Boy A exerting a force of 20 N and Boy B a force of 40 N.

Ask: What will happen?

> Answer: Boy A will be pulled towards Boy B, because Boy B is exerting a greater force. The resultant (net) force is 20 N (i.e. 40 - 20 N) in the direction towards B.

Ask: If both boys work together and pull a toy car towards them with the same forces as before, what happens?

Answer: The toy car moves towards them. The resultant force is now 60 N (i.e. 40 + 20 N).

Ask: If two tug of war teams are competing and each team exerts a force on the other of 150 N what happens?

Answer: Neither team moves. The resultant force is zero (i.e. 150 - 150 N).

(b) Ⓢ Quick Check (p.12)
Refer students to the Quick Check question, ask them to answer it and rate the confidence level of their answer. **[Answers at MCEduHub]**

6 **(a)** Ⓢ Refer students to **Figures 1.25** (p.12) and **1.26** (p.13) to show them what happens when the forces are not parallel. Go through the calculation of the resultant force with students.

(b) Ⓢ Let's Practise 1.2 (p.13).
Students should practise the questions and then be given the answers. **[Answers at MCEduHub]**

(c) Ⓢ Link [Theory Workbook] (p.13)
Ask students to complete the relevant exercises in the Theory Workbook.

Theory Workbook
Ⓢ Exercise 1C Scalars and Vectors (pp.4–5)
[Answers at MCEduHub]

Wrap-up

7 Ⓢ Summarise the main learning points of this lesson. Refer to Let's Map It (p.14). Students should understand:

- length, volume and time are physical quantities
- ways of measuring the quantities and the precautions to be taken in order to reduce errors
- that physical quantities can be sub-divided into scalar and vector quantities
- how to add vectors.

LESSONS 8 & 9 (Double period)

This period can be used to review students' knowledge of the measurement of physical quantities, either by using a teacher designed test or by having students complete the questions in Let's Review (pp.15–16) and the Exam-style Questions in the Theory Workbook (pp.5–7), or a combination of both. **[Answers at MCEduHub]**

Link [Theory Workbook] (p.13)
Have students complete the relevant exercises in the Theory Workbook.

Theory Workbook
Exercise 1D Exam-style Questions (pp.5–7) **[Answers at MCEduHub]**
Exercise 1E Let's Reflect (p.8)

For over 60 years Marshall Cavendish Education has been empowering educators and students in over 80 countries with high-quality, research-based, Pre-K-12 educational solutions. We nurture world-ready global citizens by equipping students with crucial 21st century skills through our resources for schools and education centres worldwide, including Cambridge schools, catering to national and international curricula.

The *Marshall Cavendish Education Cambridge IGCSE™ Physics* series is designed for students preparing for the Cambridge IGCSE and IGCSE (9–1) Physics syllabuses (0625/0972). The series translates insights from educational psychology classic "How People Learn" into highly effective learner-centred classroom practices.

TG The **Teacher's Guide** contains step-by-step lesson plans to support teachers. The lesson plans include suggestions for classroom activities and discussions. Warm-up and wrap-up activities are provided to stimulate discussion and check understanding, while the challenge and support features provide for differentiated instruction.

Answer keys to questions in the Student's Book, Theory Workbook and Practical Workbook are available in My Resources at www.mceduhub.com.

This resource is endorsed by Cambridge Assessment International Education

- ✓ Provides teacher support for the Cambridge IGCSE and IGCSE (9–1) Physics syllabuses (0625/0972) for examination from 2023
- ✓ Has passed Cambridge International's rigorous quality-assurance process
- ✓ Developed by subject experts
- ✓ For Cambridge schools worldwide

Series architecture

- Student's Book
- Theory Workbook
- Practical Workbook
- Teacher's Guide
- e-book

ISBN 978-981-4927-99-4
9 789814 927994

Marshall Cavendish Education