Cambridge Assessment International Education

Teacher Guide

Incorporating language learning support

Cambridge IGCSE® / Cambridge IGCSE® (9–1) Mathematics 0580 / 0980

For examination from 2020

Version 1.0

Cambridge Pathway

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Contents

Introduction

The purpose of the teacher guide

This teacher guide is designed to help you to organise and plan your teaching for Cambridge IGCSE Mathematics. It includes advice and guidance on teaching strategies and how to prepare your learners for the final assessment.

As an international awarding body, many of our candidates are either multi-lingual or possess English as a second language, which presents them with great opportunities but also with potential barriers. Learners cannot develop academic knowledge and skills without access to the language in which they are discussed, constructed and evaluated. Therefore in this guide, we have included some prompts and tips on how to incorporate the development of language skills within the general teaching of this subject.

The information relating to language support is indicated using the icon shown here.

Where language levels are already highly developed amongst learners, this advice will not be applicable. However, it is often the case that those learners with lower ability skills in general and those with lower ability language skills tend to share similar misunderstandings.

Getting started

School Support Hub

You should make sure at an early stage that you have access to the School Support Hub, www.cambridgeinternational.org/support. You can obtain a login from your Examinations Officer.

The school support hub provides a wide range of resources to help you, including:

- syllabuses
- past examination papers and specimen papers
- mark schemes
- Principal Examiner Reports for Teachers (after the first sitting in 2020)
- example candidate response booklets (after the first sitting in 2020)
- schemes of work
- specimen paper answers
- frequently asked questions
- interactive learner guide
- community resources and discussion forum.

All of these forms of teacher support are invaluable in helping you and your learners understand exactly what Cambridge expects of candidates in examinations, and will help you to prepare your learners appropriately.

Syllabus

When planning your course, your starting point should be the syllabus. This contains information not only on the curriculum content but also the overall aims and assessment objectives. It gives details of the examination papers, the required equipment and additional information. It is important that you become thoroughly familiar with all parts of the syllabus document.

Scheme of work

You will then need to devise a scheme of work. You need to think about how you will organise the time that you have available to help learners to understand and learn all of the facts and concepts required by the syllabus, and to develop the necessary skills. Cambridge provides a scheme of work that you could use as a starting point but you will undoubtedly want to produce your own eventually. Your scheme of work will help you to determine what resources you will require to deliver the course and this will help you to build up teaching, learning and reference resources such as text books and worksheets.

1 Planning the course

This section looks at how you can plan your course to ensure that you can cover the whole syllabus within the time that you have available. The main types of planning are: long-term, medium-term (developing a scheme of work) and short-term (planning for individual lessons). This section also includes support for incorporating language into the lesson to help learners become more fluent and accurate users of English.

Language is an important part of communication and you should make sure that your learners complete given tasks in English. The language focus is not an additional element; it should be seen as the medium through which the topic content is taught. The promotion of critical thinking skills and collaborative work is considered to be very important in acquiring language and improving fluency. Personalisation of the topic is also known to increase motivation and self-confidence as well as interest in the topic. Section 3 provides some ideas and activities for incorporating language into the lesson without increasing your work load.

1.1 Key factors to consider when planning your course

These factors will need to be considered before starting the planning of your course:

- the amount of teaching time available each week for the duration of the course
- the availability of resources such as calculators, computers and software
- your learners' prior knowledge
- your learners' level of English
- whether your group is mono- or multi-lingual
- whether your teaching groups will be mixed ability or will be streamed by ability
- the number of lessons you will need to cover the syllabus (the recommended time for an IGCSE course is 130 hours of teaching time)
- the school calendar; holidays, examinations, etc.

1.2 Long-term planning

A long-term plan will provide the overall structure of your course. It will include the order in which topics will be taught, the approximate length of time to be spent on each and the factors listed in section 1.1 above. It will need to take into account the number and nature of the groups following the course and whether they should all follow the same path through the course.

Topics should also, ideally, be arranged so that they fit into the school's sessions, so that a topic is not split because of a school holiday or an examination session. In a two-year course, the second year will probably have fewer weeks because of the timing of the Cambridge examinations.

It is important to note that you do **not** need to teach the syllabus content in the order in which it is printed in the syllabus. It is likely that you will want to order your teaching to suit your learners' particular needs and preferences. This may be done in a number of ways, including:

- Start with a topic that learners will not have seen in the lower secondary course to generate interest and enthusiasm.
- Start with topics which are conceptually easier, saving the more difficult topics for the second year of the course.
- Use the suggested teaching order in the 'Scheme of Work' provided on the School Support Hub.
- Use prior assessment data from lower secondary to address any of your learners' weaker areas before you develop the new work.
- Use a structure that allows for short bite-size revisits to key prior learning as part of every lesson, e.g. in the lesson starter.

Long-term planning will also consider what you would like the learners to able to communicate either in spoken or written form at the end of the course. This will help with identifying what language could be included in medium- and short-term plans.

A long-term plan should consider the order and grouping of topics, the timing of assessment points and revision opportunities and also consider a balanced approach for different areas of the mathematics curriculum. There are certain topics that will have to be taught first to allow the development of knowledge and skills to access other topic areas on the course. Some of the topics on the syllabus will also have already been visited before as part of the lower secondary programme and might only need a short recap before linking to the next steps.

A long-term plan is not fixed; it is a working document. As the course progresses, you can adapt it as required. When you have worked through it once or twice you will have a much better idea of the best way for you to work through the syllabus.

1.3 Medium-term planning

Medium-term planning is the most important of the three types. It defines in moderate detail what will be taught and when. It also describes how language skills, practical work and other activities are to be incorporated into the course. Medium-term plans are often called 'Schemes of Work' and can be shared at the whole school level to inform other mathematics teachers of your plans.

Cambridge has produced one example of a scheme of work for this course, which is available from the School Support Hub (www.cambridgeinternational.org/support).

The Cambridge Scheme of Work is useful as:

- an example of **one way** of moving through the course
- a good source of possible activities mapped to each part of the syllabus
- a good source of exercises and resources.

Generally, we recommend that you only use this as a reference to help you create your *own* scheme of work because, the Cambridge Scheme of Work:

- represents only **one** possible approach and so isn't necessarily the best for your learners
- doesn't take into account the ethos, approach and/or facilities of your centre
- is arranged in a way that might not fit in with your long-term plan
- has no statement of the amount of time required for each element.

When adapting an existing scheme of work:

- add timings for each section
- you could include a note about the sort of output you would like your learners to produce in terms of language, e.g. oral, written, group/pair work, discussions, etc.
- always check the URLs before using them with your learners; web addresses can change, and you also need to know that what you're accessing is appropriate for your learners.

A medium-term plan is best developed with contributions from all of the teachers who will be using it. If they have had an input they will feel an 'ownership' of the plan and will be more likely to adhere to it.

A medium-term plan should not be fixed. It should be amended if it is found not to be working as planned and as new ideas and resources are developed. It should be reviewed at the end of each school year to assess how well it has worked and to decide if any improvements need be incorporated.

1.4 Short-term planning

Short-term planning involves planning for a single lesson or perhaps a small group of lessons.

It should include the:

- content and the language of the lesson
- activities that will take place
- progress that is expected of the learners during the lesson.

Short-term planning is something that is done by an individual teacher, taking into account their own strengths and the needs of the learners they will be teaching. Teachers new to the subject might need guidance but the plan should still be their own.

This process is covered in more detail in the next section, *2 Planning lessons*.

2 Planning lessons

2.1 Lesson plans and templates

A lesson plan is written by the teacher and should include details of how the lesson is intended to proceed. It should take account of:

- what is to be taught (learning objectives)
- what is to be achieved by the learners (lesson objectives, content and language)
- what the learners already know (previous learning and relevant knowledge)
- how learners understanding will be monitored (assessment of learning)
- how learners at different levels of ability are going to access the lesson (differentiation).

It should detail the learning activities that will take place and have approximate timings showing how long each part of the lesson will last. It should also briefly note the language focus for the lesson.

A lesson should ideally have three main parts:

beginning	this should be an activity/activities that engages and motivates the learners, as well as stimulating the background knowledge that the learners can bring to the topic
middle	this should include the main learning and language activities of the lesson
end	this should be an activity/activities in which learners can assess their understanding of what has gone before and feedback on it.

2.2 Constructing a lesson plan

It can be helpful to have a printed template to use in lesson planning. You can design your own, or there are many available on the internet or in books. On the following pages you will find an example of a completed lesson plan which includes helpful guidance.

A blank template of the example used here is available in the Appendix for you to copy.

Lesson:	**School:**	
Date:	**Teacher name:**	
Class:	**Number present:**	**Number absent:**
Learning objectives to which this lesson is contributing	*This will be based on something written in your medium-term plan. It will state which part of the syllabus the lesson is going to address.*	
Lesson objectives	*These objectives are what you intend the learners to fully understand and be able to do by the end of the lesson. It should be a list of outcomes that the lesson intends to target. Do not include too many outcomes – any target should be realistic and some learning objectives will take more than one lesson to be fully understood. You could include some indication of differentiation here by having some outcomes that are for 'all' learners, some that are for 'most' learners and some that are only for the best learners ('some').*	
Vocabulary, terminology and phrases	This will include key mathematical terminology that will be introduced in the lesson.	
Previous learning		

Plan

Planned timings	Planned activities	Resources
Beginning	*A starter activity should be a short introduction to the skills needed for the lesson. It should engage learners with mathematics. It can be a short question and answer session, a simple quiz to review prior learning, or a look at the common errors made in a topic. It could even be a rapid practical demonstration to introduce them to the topic to be covered in the lesson.* *A starter should also stimulate the interest of the learner by providing materials such as visuals for the particular vocabulary needed; or some activity that is personalised to encourage the learners to bring their own background knowledge and interest to the topic. It is vital that starter activities are not laborious; many good ideas and examples are available online. This should be learner focused with as little teacher talk time as possible.* *Give an estimated time, usually about five to ten minutes.* *Continues overleaf …*	*Your plan should also include a list of the resources that will be needed in each lesson. Examples include, course books, internet access, laptops, calculators, and graphing software.*

Plan		
Planned timings	**Planned activities**	**Resources**
Middle	*This is the main part of the lesson. This can build on and extend previous understanding, explore and solve practical problems, develop knowledge and skills, practise previously learned techniques or any of many other alternatives.* *It is important not to include too many activities, but equally important not to spend so much time on one activity that learners become de-motivated. There may be opportunities for investigation, explanation, practice and application of their newly acquired skills. Good lessons will involve the learners in the activities as much as possible.* *Activities should encourage the learners to have confidence in communication through speaking or writing and there should be some feedback from you regarding possible language and mathematical errors. Delayed feedback is recommended to avoid demotivating the learners and hindering communication; moreover, providing opportunities for learners to self and peer-assess will increase their independence.* *Activities should cater for the range of abilities in your classroom. They should include a variety of styles of questions and activities that will develop fluency with skills and knowledge, as well as opportunities to develop reasoning and problem-solving skills.* *Timings should be included for each separate activity but this is for guidance only and will need to be assessed as the lesson progresses. Your role during this part of the lesson is to support, challenge and assess.*	
End	*This is an important part of the lesson as brings it to an organised end. Learners (in groups or pairs) can assess how well they understand the material covered during the lesson. This may involve a short written exercise or a question and answer session. This may also include feedback from you on some mathematical errors noticed during the lesson, for example, the use of key mathematical terms.* *This is an excellent opportunity to re-examine key words and terms and possibly start to make a glossary of these to present on the wall.* *It may also be used to link to whatever is going to happen in the next session or for the homework.* *This part should take around five minutes.*	

Additional information		
Differentiation: How do you plan to give more support? How do you plan to challenge all learners including the more able learners?	**Assessment: How do you plan to check learning?**	**Health and safety check: ICT links**
Outline here, how will you try to ensure that the lesson is accessible to all of the learners so that all will benefit from the experience and be appropriately challenged. This is especially important with mixed ability groups. There is more on differentiation in section 3.	*Assessment for learning can take place all through the lesson. For example, by observation, short Q & A sessions, listening and asking directed or open questions, quizzes, homework, learners presenting the results of an investigation to the class, or by teacher-marking of classwork or homework. Do this to discover what your learners knew/understood before the lesson and how this has changed after the lesson.*	*If your lesson includes any practical activity, whether a demonstration or a class practical, an assessment of the risks involved should be included with the lesson plan. For example, if your lesson includes the use of technology such as laptops, or the use of external websites, the equipment should be safe and the external websites should be checked to make sure they are also safe.*

Reflection and evaluation	
Reflection *Were the lesson objectives realistic? What did the learners learn today? Were they any common misconceptions? What do I need to address next lesson? What was the learning atmosphere like? Did my planned differentiation work well? Did I stick to timings? What changes did I make from my plan and why?*	**Use the space below to reflect on your lesson. Answer the most relevant questions from the column on the left about your lesson.** *As soon as possible after the lesson you need to think about how well it went. This reflection will be helpful next time you teach the same topic. If the timing was wrong or the activities did not fully occupy the learners this time, you might want to change some parts of the lesson next time.* *It is a good idea to discuss with colleagues how your lesson went, good or bad. They might have valuable advice to offer you and such collaboration can help you to develop your own teaching skills. Sharing your lesson plan with other teachers in your centre will also enable them to learn from your experiences.* *There is no need to re-plan a successful lesson every year, but it is always good to learn from experience and to incorporate improvements next time.*

Summary evaluation

What two things went really well? (Consider both teaching and learning.)

1.

2.

What two things would have improved the lesson? (Consider both teaching and learning.)

1.

2.

What have I learned from this lesson about the class or individuals that will inform my next lesson?

3 Classroom practice

The aim of any teacher is to get their learners to gain knowledge and understanding, to develop the skills to be able to apply this knowledge, and to learn to communicate what they know as effectively and accurately as possible in the time available to them on the course.

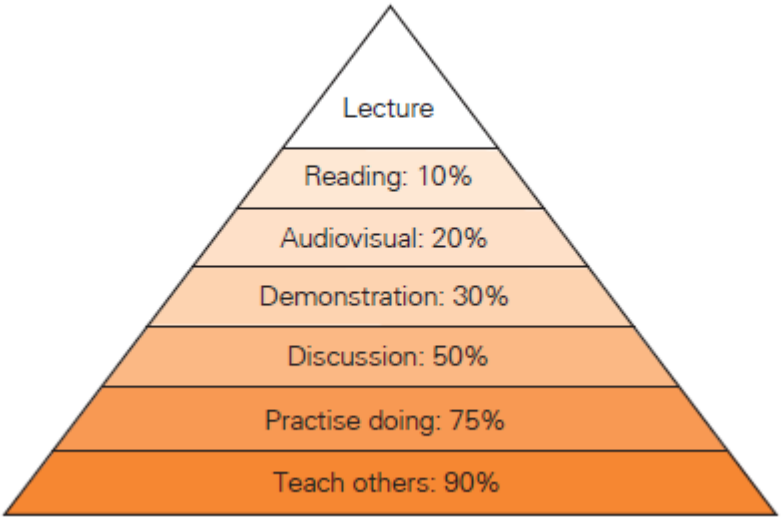
The teaching should take account of the different needs and abilities across the full range of learners represented in the group. Lessons should be interesting and involve the learners as much as possible.

3.1 Active learning

A description or explanation by the teacher is easily forgotten by the learner, even when it is understood. Videos and computer animations of some mathematical techniques can help, but they are still 'passive'. The learner is not involved in 'discovering' the information.

Research has shown that the more a learner is involved in the process of learning, the more they retain. This is also true of language acquisition.

The learning pyramid below shows the percentage of information retained as a result of different forms of delivery, stimulating different learning processes.



From this it can be seen that although audio-visual (videos and computer animations) may be better than a lecture (being told by a teacher) there are methods which are better still. Clearly not everything can be absorbed by discussion and practice, but activities where the learners actually participate work better.

At least some such activities (active learning) should be used alongside demonstration, modelling and problem solving/investigative work in order to maximise learning. There will not be time for everything to be covered in this way but some topics certainly should be. If you give learners guiding questions to answer while listening this will activate knowledge and language and will allow the learners to feedback the answers or contribute to the group discussion more effectively. This is an example of what is called 'scaffolding'.

There are, of course, many other methods of getting learners involved and plenty of ideas in books and on the internet.

3.2 Differentiation

Differentiation is a way of trying to ensure that members of your group with differing abilities can all access the material you are delivering. There are a number of ways of approaching this problem and, again, they can be found in books and on the internet. They fall into three main categories.

- **Differentiation by outcome** – In this method, an open-ended task is set that can be accessed by all, e.g. 'An investigation into sequences produced by patterns of tiles on a floor'.
  Learners will produce different results according to their ability, but all of their 'outputs' will be valid.
- **Differentiation by task** – Learners are set slightly different tasks based on the same objective. This could involve, for example, tasks that pose questions on the same topic but which require different amounts of understanding based of the difficulty and style of the questions being asked. An example of this might be a system of bronze, silver and gold activities and teachers then direct learners to the most appropriate starting point for them.
- **Differentiation by support** – All learners undertake the same task but less able learners are given additional support. Writing frames, where a template is provided for them to record their work, are one way of doing this. More able learners also have the role of 'teaching' other learners as part of their task.

3.3 Integrating content and language in the course

The objective of the language element of a lesson is to help the learners gain greater confidence in communicating their knowledge of the subject. Whether you are teaching a class including learners who have English as their second language, who are multi-lingual or who only speak English, the same difficulties of written expression occur within the subject to both lower level ability and second language learners.

Subject teachers are not expected to teach English, however, mathematical language and terminology should be learned at the same time as the subject content, as a fluent part of the content, so that it has greater meaning and offers contextual understanding; mathematical language should not be left to a specified language lesson. The confidence to communicate in accurate and precise language will also be of benefit to learners taking an external examination in English at the end of the course. A number of examination questions require explanations and reasoning and learners can gain marks for use of the correct mathematical language. For example, comments by some examiners on previous papers have noted the incorrect use of mathematical terminology, the lack of structure in writing a logical methodology and a lack of precision in answers. It will also benefit learners in the long term, should they continue their studies in the subject at a higher level with a view to their careers.

The teacher's role should therefore also be to support the language element of the lesson that underpins the mathematical content. This element should enhance learners' communicative skills and their accurate use of the correct terminology. A key part of this should be for teachers and learners to notice the language used in different stages of the lesson.

Here are some strategies that you can try in your next lesson:

- record language prompts on the whiteboard
- encourage learners to underline key terms
- use images
- provide writing frames
- enable learners to work collaboratively
- introduce learners to new language before setting a task
- model language in explanations and in interaction with learners
- activate prior knowledge of the subject
- create a bank of useful expressions

- repeat explanations and progressively increase the difficulty of explanations
- provide feedback on language and content
- highlight examples of good responses from learners.

To help learners with their use of language it may also be helpful to consider the following questions when writing a lesson plan for a subject area:

- What is the topic and what does it cover? (content)
- Is there something in the topic you can make personal to the learners? For example, is there something you can relate to their particular culture to stimulate interest and prior knowledge? (context, personalisation)
- What language will your learners need to produce during the lesson and later in the exam? (English)
- What is the language focused on? For example, it may be to use the correct terminology when giving reasons for angle calculations or for describing transformations, to explain a result, justify a decision, describe a result, or interpret given information. You can also think about the relevant vocabulary and terms they could practise to help with precision.

3.3.1 Some ways to integrate content and language

Language is the medium through which the content is delivered. However, your principle aim is not to teach the language but rather to provide language support, and use it in interesting ways. Mathematics has a symbolic language of its own, of course, and this should also be considered along with learners' understanding of written English. The following suggestions should help you think about what might support learners with the language during the lesson:

- Use of visuals and charts for building vocabulary and understanding meaning – this has been shown to stimulate interest and the learners' prior knowledge.
- Use gap fill and word definition to discover meaning – this helps with retaining the language to a greater extent than when learners are simply given the answers.
- Use checking questions to ensure understanding – asking learners if they could tell the group or their partner what they have to do is an important part of communication and retention.
- Pair and group work is important – learners learn from each other and it has been shown that teenagers prefer to work in groups rather than on their own. Learners need a safe place to practise the language before expressing it individually.
- Personalise the topic – this increases motivation and assimilation of the language.
- Oral interaction between learners in English about the content is beneficial as is cooperative work. The more the learners speak, the greater the development of accuracy and confidence in using the language.
- Repeat correct vocabulary commonly used in the topic.
- When learners are encouraged to notice the language, they are more likely to use it at a later date.
- The use of context, where appropriate, is important for learners to understand meaning.

3.3.2 Possible activities

(1) Activate prior knowledge by using simple visual clues to vocabulary, match pictures to words.
(2) Personalisation – start the lesson by making the topic relate to the learners' lives, e.g. favourite food eaten every day.
(3) Write key words in a larger font and use pictures or drawings to explain concepts. Underlining key words or phrases helps the learner to notice the language.
(4) Learners acquire and retain language through discovering the meaning themselves from within the text or through ordering a set of sentences to describe a process.
(5) Repeat the key language during the lesson in different exercises, e.g. use of key words, terms and phrases related to that topic (such as radius, diameter, circumference, tangent, etc. when working with circles), and the key words in assessment tasks.

(6) To help with developing thinking skills and using the language, start by asking simple questions using *what*, *when*, *where* and *which* followed by more challenging ones using *how* and *why*. This works well in group and pair work.
(7) Have a glossary and word bank available. Give the learners specific words and phrases to build the precise and more complex sentences they will need to be familiar with.
(8) Provide scaffolding – i.e. using activities where learners need to add correct answers from a choice to make the sentences correct. Follow this with practice of the same language used in sentences that have less scaffolding or have no scaffolding.
(9) Try and ensure pronunciation and word stress is correct. You can use delayed feedback. This means making notes during a group discussion time when the language may be difficult, and feeding this back to the whole group later in the lesson, just before the lesson review.

3.3.3 Some examples of exercises to integrate language learning within lessons

Exercise 1: The use of command words in mathematics

Command words provide the root of almost all questions in maths. It is learners' lack of understanding of the command words that often prevent them from accessing the question. The 2020 syllabus now includes a list of command words that learners should expect to see in the their examination questions. Some examples of how you could enhance leaners' understanding of command words, include:

- Always include 'understanding command words' in each lesson plan. Use the command words consistencly in oral and written questions to encourage familiarity and understanding.
- A matching card activity to match command words with their meaning. You can do something similar with other key words / terminology for a given topic. (See **Example 1** for an example of how this might look – note that not all command words have been included. See the syllabus for the full list of command words).
- A definitions list to refer to in learners' books and as a classroom display (see **Example 2**). This could be added to as the course develops. Make sure you use 'learner friendly' language and include examples.

Example 1

Draw a line from each **command word** to its definition. There will be some definitions that are not used.

Calculate	Work out approximately
Sketch	Provide structured evidence that leads to a given result
Show (that)	Make a simple freehand drawing showing the key features
Construct	Work out from given facts, figures or information, generally using a calculator
	Make an accurate drawing

Draw a line from each **key term** to its meaning. There will be some meanings that are not used.

Factorise	Put in order
Express (in terms of)	Work out from given facts, figures or information, generally using a calculator
Estimate	Work out approximately
Arrange	Write in a given form
	Use brackets to resolve into factors

Example 2

Command word	What it means	Example
Show (that)	You need to provide structured evidence that leads to a given result. You must show how to obtain the given answer by providing as many intermediate steps in your working as possible.	The speed of a car is x km/h. **Show that** the number of metres, a, travelled in 1 second is approximately $0.278x$. Distance in 1 hour = x km = 1000x metres Distance in 1 second (a) = $\frac{1000x \text{ metres}}{60 \times 60s}$ = 0.2777...x
Explain	You need to do one or more of the following: • set out purposes or reasons • make the relationships between things evident • provide why and / or how, and support with relevant evidence You can do this by setting out your working and statements clearly and in a logical order.	If n is odd, explain why the value of the expression $\frac{2k+n-1}{2}$ must be an integer. If n is odd then n – 1 is even. 2k is even So 2k + n – 1 is even + even = even $\frac{\text{even}}{2}$ is an integer

Exercise 2: Developing understanding and meaning of key terms

The following are some examples of activities that could be used to develop understanding and meaning of key mathematical terms.

Guess the quadrilateral

This shape has only one pair of parallel sides.

This shape has 4 equal sides and no right angles.

This shape has 2 pairs of adjacent sides equal.

This shape has 2 pairs of parallel sides and 2 pairs of equal sides.

This shape has no rotational symmetry and one line of symmetry.

This shape can be formed by reflecting an equilateral triangle along one of its edges.

True or false?

All rectangles are parallelograms	True ☐	False ☐
Prime numbers can only be divided by one and themselves	True ☐	False ☐
18 has 6 factors	True ☐	False ☐
There are 5 prime numbers between 40 and 60	True ☐	False ☐
An irrational number is a number with many decimal places	True ☐	False ☐
A cylinder is a prism	True ☐	False ☐
A cuboid has 12 edges	True ☐	False ☐
Enlargements make shapes bigger	True ☐	False ☐
The median is the middle number in a set of numbers	True ☐	False ☐

Taboo

This game helps learners to explore language by encouragning them to use a wide range of vocabulary.

Method:

- Divide learners into pairs.
- Give each pair a pile of taboo cards (see below), face down so that contents cannot be seen.
- One learner picks up a taboo card that they can look at but must not reveal to their partner.
- They must give clues so that their partner guesses the word at the top of the card.
- They **must** not use any of the taboo words, or parts of the words listed on the card.

Once a word is successfully guessed, the learners swap roles so that they each get a turn at giving the clues and guessing the word. The pair continues to take turns in this way until all the cards are used.

prime number	factor	gradient
Do **not** say: divide itself prime factor	Do **not** say: factorisation tree divide goes into	Do **not** say: rise steep line run

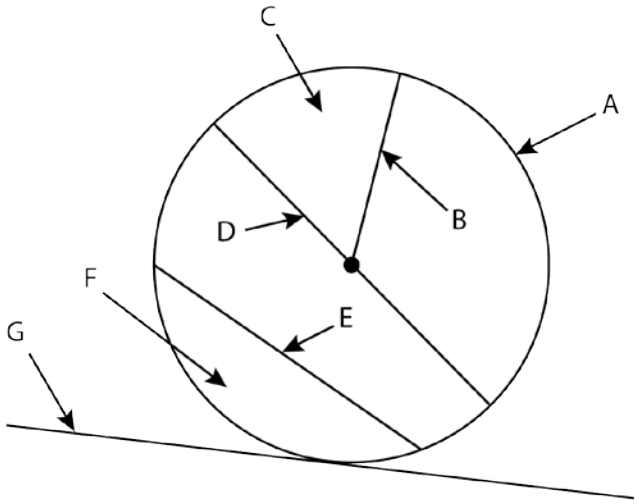
square root	cube number	equivalent
Do **not** say: divide square opposite two	Do **not** say: square power three multiples times	Do **not** say: equal ratio same fraction

You can adjust the level by changing what the learners are not allowed to say. For example, you could also include in ‘prime number’ that they’re not allowed to list example numbers. You can make your own or find ones made by other people online (be sure to check they’re appropriate).

Exercise 3: Matching

In this example, using a diagram to match labels with visuals can help contextualise a word and help define it against associated terms.

The diagram shows parts of a circle.



Match the letters from the diagram to the correct **key term** below. Write each letter in the correct box.

Sector ☐ Diameter ☐ Chord ☐ Radius ☐ Segment ☐

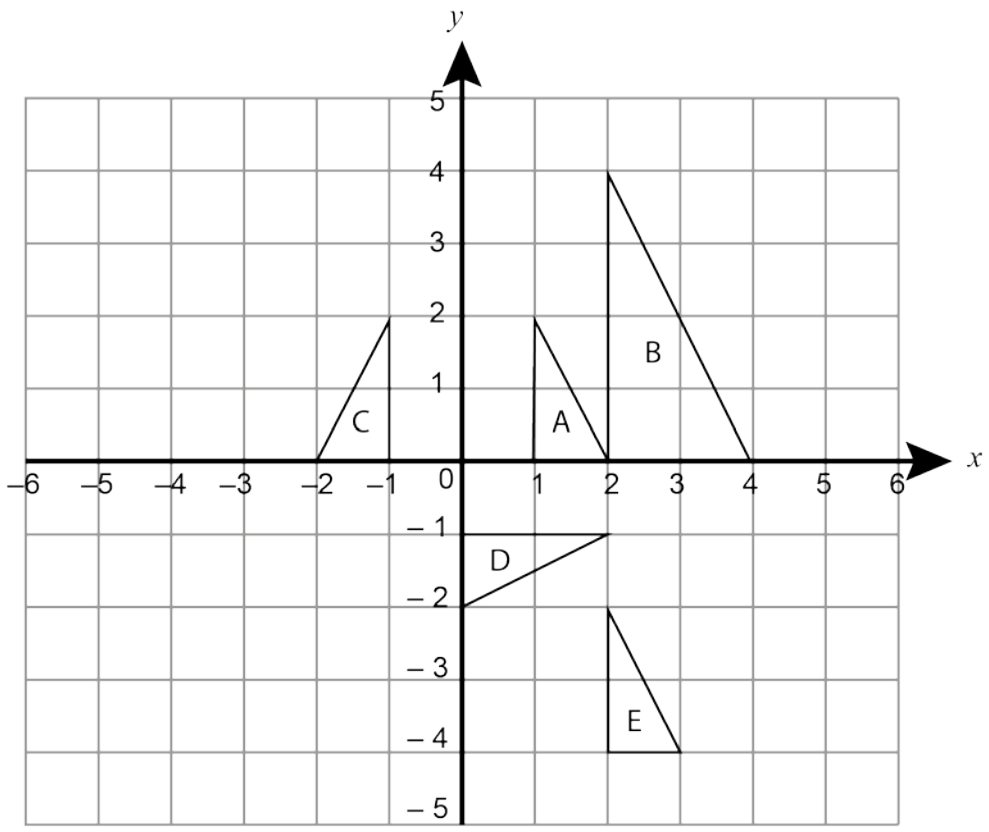
Which letters have not been matched with a key term? Write down the key term for each letter.

…… ☐ …… ☐

Exercise 4: Structured support through writing frames

Here's an example where learners have to think about the correct terms, the position they occupy in a process and the function they serve in that position all at the same time. The writing frame allows them to focus on the mathematics whilst also being familiar with how statements about transformation are usually structured.

The diagram below shows a series of transformations of the triangle A.



an enlargement **a translation** **90° anticlockwise** **a reflection** **the origin**

scale factor **centre** **vector** **a rotation** **90° clockwise** ***y* = 0** ***x* = 0**

Use the words above to complete each of the following sentences.

1. Triangle A is mapped onto triangle E by ……by …… $\begin{pmatrix} \ldots\ldots \\ \ldots\ldots \end{pmatrix}$.
2. Triangle A is mapped onto triangle B by ……, with …….. 2, and …….. (0, 0).
3. Triangle D is mapped onto triangle A by …… through ……., with centre ……
4. Triangle C is mapped onto triangle A by …… in ……

Exercise 5: Other useful activities

Below are a series of activities that can be used to encourage mathematical reasoning, problem solving and language interpretation.

- **Spot the error**

Provide some questions with solutions that contain an error. Learners have to identify the error and then correct the error.

- **Matching card activity**

This type of activity is best done in pairs. It reinforces and extends learners' reasoning skills.
A good example of this is the 'Lots of lines!' matching activity available at:
https://undergroundmathematics.org/geometry-of-equations/lots-of-lines

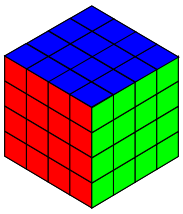
- **Group challenges**

Setting activities where learners work in larger group sizes creates a competitive element. Use activities that draw on skills from across the syllabus, whilst also involve language interpretation. A good example of this is the 'Wills Tower task': http://furthermaths.org.uk/docs/GCSE-Willis-Tower-Trig-Instructions.pdf ; http://furthermaths.org.uk/docs/GCSE-Willis-Tower-trig.pdf; http://furthermaths.org.uk/docs/GCSE-Willis-Tower-trig-Answer.pdf

- **Extended tasks/investigations**

These allow some exploration and let learners use and apply their mathematical skills in various contexts. Lots of examples like 'The pained cube' given below, can be found at https://nrich.maths.org/secondary.

The Painted Cube



Some white boxes are stacked to form a 4 × 4 × 4 cube. After stacking, each side of the 4 × 4 × 4 cube is dipped into coloured paint – you can see three sides of the cube in the diagram.

When the stack is taken apart, how many of the individual boxes will have:

- 1 painted face?
- 2 painted faces?
- 3 painted faces?
- no painted faces?

What happens if the boxes were stacked in a 3 × 3 × 3 cube instead?

What about other sizes of stacked cube?

Can you generalise for an $n \times n \times n$ cube?

- **Teach the team**
  In this type of activity, learners work in pairs; each pair has a different problem to solve. Give around 5 minutes for each pair to solve their problem. You then ask each pair to form a group of four by joining with another pair; in this group each pair has 5 minutes to teach the other pair what their problem is and how to solve it.

- **How many marks**
  Provide some model responses to an exam question, along with a mark scheme. Ask the learners to apply the mark scheme to the solutions and give an overall mark. This raises awareness of how marks are awarded in exams, common errors that can be made and model answers.

4 Preparing learners for final assessment

You will find past papers and marks schemes on the School Support Hub (www.cambridgeinternational.org/support). These can be used by learners for exam practise. You will also find Principal Examiner Reports for Teachers (PERTs), which are produced after each examination series. These reports indicate the strengths and weaknesses of candidate performance across the whole cohort and can be used to help you identify common areas of misconception, misunderstanding and weakness in order to improve your teaching.

4.1 Study habits

By the start of the IGCSE course, learners will probably have explored preferred methods for studying and revising. However, not all of these methods are necessarily effective.

Much research has been published on this subject, suggesting that some of the following methods are not effective (though of course it depends on the individual):

- generous use of highlighters
- reading and re-reading notes
- working exhaustively and alone
- re-writing existing notes to create a more attractive set of notes.

Dedicated learners will often revise intensely for long periods and convince themselves that they have prepared thoroughly. Sadly, they may well have been largely wasting their time, especially if they are aiming to develop a deep and lasting understanding of the topic, in addition to just passing the examination.

Here are some methods that are proven to work for **most** learners:

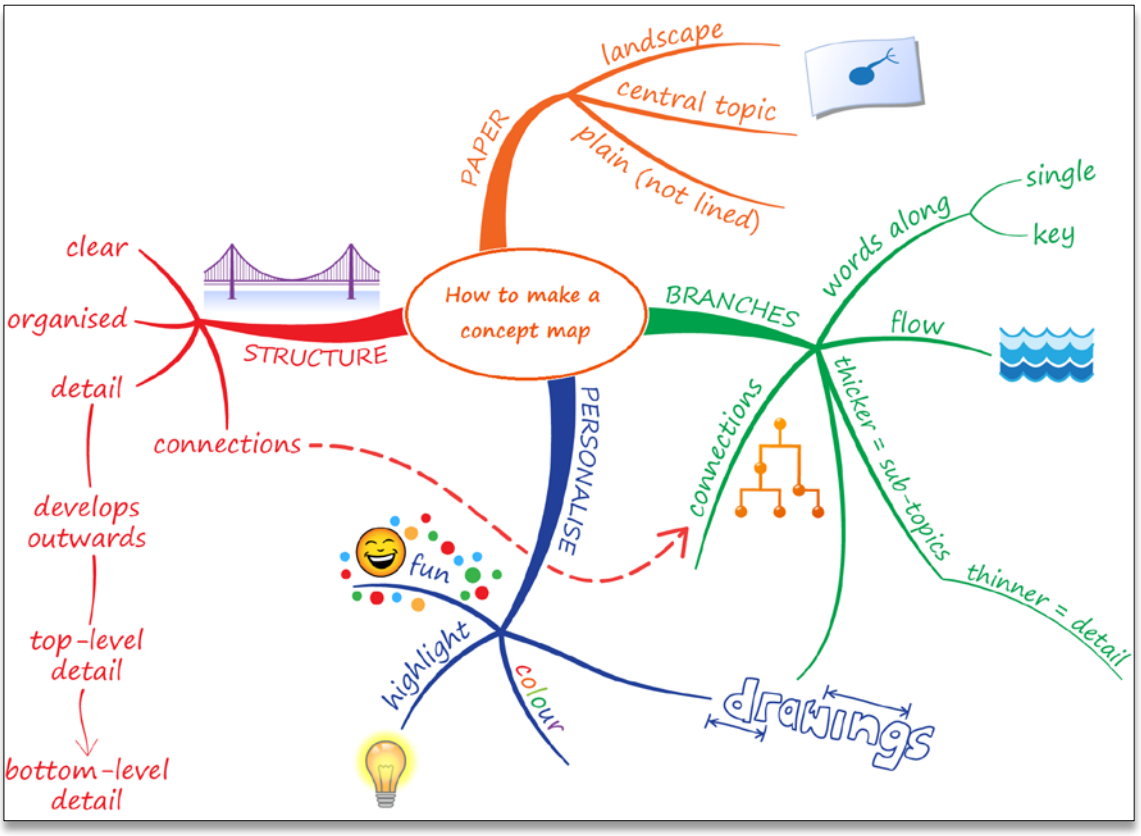
- Distributive practice: that is, spreading out study over time. This method is believed to aid true understanding of the topics.
- Studying in short bursts, followed by testing themselves regularly over several weeks.
- At the end of a revision session, writing down what they can remember.
- Creating a revision timetable for the mock and final exams. This will ensure that they study different subjects in small amounts but often.
- Answering lots of practice questions/past papers.
- Connecting ideas together by the use of concept maps.
- Using revision guides rather than the subject textbook.

Encourage your learners to consider and develop what works best for them. There is a Learner Revision Guide (www.cambridgeinternational.org/images/351658-learner-revision-guide-.pdf) available on our public website that provides some general guidance.

4.2 Deep subject understanding

When learners start to make connections between topics, the study of the subject becomes more enjoyable and they gain a deeper understanding of what they are doing.

Concept maps (see diagram below) can be drawn and connections made between sub-topics in a unit, between units in a syllabus, and indeed between related subjects.



4.3 Technology in and out of the classroom

There are a great range of technological tools that can be used in and out of the classroom. It is important for learners to experience their learning in a variety of different ways, not least to maintain interest and motivation. Below are just some of the possibilities.

4.3.1 Maths websites

These websites often combine tutorials with practice for learners and provide solutions to check answers. A number of sites offer interactive facilities where leaners can engage with materials and get instant feedback. The websites are especially useful for providing topic-based revision resources and solutions, and regular practice for daily skills. Some examples of good free to use maths revision sites include:

https://corbettmaths.com
www.mrbartonmaths.com
www.accessmaths.co.uk/revision-resources.html

Suggested websites for Cambridge IGCSE / IGCSE (9–1) Mathematics 0580 / 0980 can be found through the Resource centre on our public website: www.cambridgeinternational.org/i-want-to/resource-centre

There are many websites rich in resources and ideas to support the teaching of the syllabus (see also Section 5.1).

4.3.2 Mobile apps

Mobile apps for education have to be carefully selected to make sure they provide appropriate and meaningful learning outcomes. But if chosen well, they can provide another mode of learning or revision for the learner. There are numerous options, from games and quizzes to videos and animations.

'Socrative' is an excellent app for formative assessment and learners usually enjoy using it. You can create online multiple-choice style quizzes that give instant feedback to you, the teacher, so that you can quickly identify problem areas. Correction and explanation can then be dealt with immediately.

4.3.3 Podcasts

These audio teaching aids are a handy alternative tool and can be especially useful when learners are travelling to and from school or do not want to disturb others. Listening to the same podcasts over and over again can be especially useful for the second language learner; www.gcsepod.com has numerous podcasts for maths and other subjects.

You can create your own podcasts online for free at 'Podbean', for example. Creating your own podcasts allows you to choose the emphasis you want and use the language you have been specifically using with your learners.

4.3.4 Video

Video is not just something that learners sit down and watch in order to add variation to a lesson. Videos can be stopped periodically and questions asked in the traditional way, or they can even be edited and you can inserted/embed questions within the video itself. This makes the process much more active, which increases learning potential. You could make your own or have a look at the many examples on YouTube and the Khan Academy, for example. https://corbettmaths.com has many examples of videos that are free to access.

4.3.5 Graphing Software

Learners often have better recall when they can visualise a solution. The appropriate use of graphing software to investigate, for example, transforming graphs, will make the topic much more meaningful and memorable than simply being given a list of rules to learn. Geogebra (www.geogebra.org) and Desmos (www.desmos.com) are two such software packages that could be used to do this. They can be used for solving equations, graphing functions, geometry applications and statistics.

4.3.6 Other software

There are some excellent free to use software for mathematics. Even a simple Excel spreadsheet can be used to help with algebra, graphing and statistics.

4.4 Providing feedback on learner work

It is necessary to provide meaningful feedback to your learners in order for them to improve the quality of their written answers and understanding of a subject. The learner may find the subject itself challenging and/or may not have the skills in English to deal fully with the question. Either way, meaningful feedback and reflection time are the answer. Providing feedback can be done in several ways, such as:

- Provide feedback orally in class so that learners write down the extra information they would need to get full marks.
- Allow learners individually to find the other pieces of information to get full marks.
- Provide a situation where the learners are actively engaged in reviewing the questions and in pairs or groups with teacher guidance. In this way they can collectively understand what solution and language use would have gained full marks. You can point out command words used in the question and encourage the learners to develop an understanding of what each word means.

The last suggestion however, takes time and it could be set as a group exercise to be started in learners own study time.

Technology is available to allow you to easily record units of your own teaching in short, manageable portions. These can be made available to learners who can watch them as a homework assignment. This saves time and allows you to concentrate on other aspects of learning and allows more time for formal assessment. The fact that these videos can be watched again and again is especially useful to the second language learner.

4.5 The mock examination

The mock examination is an important benchmark for teachers and learners, and it serves several purposes:

- It is an opportunity for the learner to be tested on the complete course material* under proper exam conditions.
- It encourages learners to start revising for the exams earlier (otherwise they might put off revision until only a month or less before for the real exam).
- It allows learners to become more familiar with the process of being examined, so that on the day of the actual examination they might feel less stressed and more confident – this is especially important for learners who are apprehensive or nervous about taking exams.
- It provides an opportunity to spread the revision load of the subject over several months.

** Even if learners have not completed the course by the time of the mock exams, an exam should be created that allows the learner to get the mock exam experience on the majority of the syllabus content.*

After reviewing the results of the mock exam, learners can gain an insight into the following:

- how successful their revision techniques had been
- which topics and sub-topics need more revision and practice
- if they had enough time to complete the exam and check through their answers
- if they were able to perform to their potential under pressure
- whether there are questions in which they would have gained the mark(s) had their English been clearer
- if they lost marks because of not being clear and/or using the correct terminology.

If learners treat the mock exams as if they were the finals, evidence indicates that they might perform even better in their real final assessment. Some learners might take considerable persuasion to take the mock exams seriously enough to revise properly. They need to be encouraged to appreciate that the process is a positive and supportive one, and one in which very useful feedback will be provided.

4.6 Use of past papers

Working through large quantities of past papers is a major factor in the success of a learner in the final assessment. Past papers allow learners to practise the type of questions that might come up in their final exams and can be used as unit tests or mock exams. However, it's important to keep in mind that mark schemes contain several alternative acceptable answers. This provides an opportunity for learners to suggest which is the best possible answer. Useful discussion might arise about the syllabus area on which the question is based.

Be aware of any data provided in the syllabus and, importantly, any changes to this data that might affect how learners understand any practice questions used from past papers.

The Principal Examiners Reports for Teachers (PERTs) are very helpful to use in conjunction with mark schemes. They indicate specific areas where learners performed well or need to improve. Some of these areas of weakness are mentioned year after year, which might help you decide on the length of time you should spend on certain areas or how you arrange the order of your teaching.

Learners need to be reminded that:

- In multiple-mark questions, they should:
  - underline key words and what exactly the question requires them to do
  - take note of the number of marks available as this will indicate the extent of the answer required; answers often appear as if the learner has not noticed that there are 5 marks available for example
  - show every step of a calculation (even if doing so appears unnecessary to able learners who arrive at the final answer easily); learners often don't realise that 'method marks' may be awarded even if though their final answer is incorrect, or method marks might be required in order for the final accuracy mark to be awarded
  - re-read the question after they think they have completed their solution as there is often more than one requirement in a question; learners sometimes omit parts of answers because they have simply forgotten what they initially read.

- The front page of the examination paper contains very important information about the use of calculators and the accuracy to which non-exact answers should be stated.
  - Non-exact answers are required to be given to 3 significant figures (unless the question states otherwise, and apart from angles given in degrees). Therefore, any working values used must be more accurate than 3 significant figures. When learners do not do this, they introduce a premature approximation error and their final answer becomes inaccurate.
  - Learners should ensure that calculators are used effectively and are set to the correct mode prior to starting the exam.

- When working with circles, learners should use the π button on calculators or 3.142. Candidates using 3.14 or $\frac{22}{7}$ might earn method marks but the answer range on mark schemes will exclude these values.

- When drawing graphs, points should be plotted with a sharp pencil and be accurate to within 1 mm.
  - If the points lie on a curve, the points should be joined with a smooth freehand curve.
  - If the points lie on a straight line (linear graphs) the line should be ruled.

- Correct mathematical terminology should be used when giving reasons in geometry, e.g. circle theorems, and when describing transformations.

- When learners have answered a question, they should read the final demand line before moving on to ensure that they have answered the question being asked.

- They should present their work in a clear, logical, step-by-step way. If a learner wants to re-answer a question or change a solution, it is better to use a fresh sheet of paper or blank page, rather than squashing solutions into any working space remaining. Poorly presented work can result in learners misreading their own writing and result in unnecessary errors occurring. In the examination, it is useful if learners indicate where they have continued their solution if this is the case.

- When a question indicates that a calculator must **not** be used, learners must ensure that they show **all** working steps and arithmetic, in order to provide sufficient evidence that they have followed this instruction; without the supporting working marks will not be awarded.

- When a question indicates that solutions by accurate drawing are **not** acceptable, learners should know that it is still fine for them to make sketches to help in their working. The instruction in this case is to avoid answers that have been found using scale or accurate drawings when a calculation is required. Sketches and diagrams are good ways to visualise the mathematics and should be encouraged.

- Take care to be clear when answering questions involving comparing two or more pieces of data: it is often unclear which piece of data the learner is discussing and the comparative language is not used properly.

4.6 Diagnostic question grids

A useful tool to analyse weaker areas for learners would be to construct a diagnostic question grid using an Excel spreadsheet (or equivalent). This can be used with any examination or assessment and will provide useful formative information on the class and individuals for you to use in planning next steps.

An example is shown below with green, amber and red codes used to highlight different levels of achievement on each question.

These are the subject content references from the syllabus

These are the high level topic areas of the course. Each mark within a question is mapped to a broad topic area. The numbers in the column (see circle below) indicate how many marks can be mapped to a given topic area for each question. For example, Q5 has a maximum of 2 marks available, and 2 of these marks are from the topic area 'probability and statistics'.

Question Number	Content Reference	Number	Algebra	Geometry	Prob and stats	Max Mark	Class Mean Mark	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7	Student 8	Student 9
1	2.2		1			1	0.55	0	1	1	1	1	1	1	1	1
2	1.11	1				1	0.58	0	1	0	0	0	0	0	0	0
3	2.5		1			1	0.34	0	1	0						
4	2.7		1			1	0.60	0	0	0						
5	8.2				2	2	1.44	0	0	2	2	2	2	0	0	0
6	4.7			4		4	0.80	0	1	0	1	1	1	2	0	0
7	5.3			3		3	2.24	3	3	3	3	3	1	2	0	0
8	3.2		3			3	1.54	3	2	0	2	0	0	2	1	1
9	9.7				1	1	0.62	1	1	0	1	0	1	1	0	1
10	2.3		4			4	2.28	0	0	0	4	4	0	4	1	4
11	6.1			1		1	0.51	0	0	1	1	0	0	0	1	1

The mark a student was awarded for a question.

Maximum mark available for the question.

The mean mark that your class scored on a question.

The colour-coding is set up as follows:

- Green = full marks were awarded
- Amber = part marks were awarded
- Red = no marks were awarded

This kind of diagnostic data can help you to see if there are any areas of content that your learners are weaker at than others.

You can use a mail merge to produce individual reports/targets for each learner. You might need support from your IT administrator to set up the automatic colour-coding and mail merge for reports. Once the spreadsheet is set up, you can adapt it for different tests.

4.7 Command words

It is important that learners understand the vocabulary of the assessment objectives and the ‘command words’ of exam questions that indicate the approach they should take to an answer. For example, ‘compare’, ‘calculate’ or ‘describe’.

The ‘command words’ are listed in the syllabus. Think about the skills level required to carry out each of the commands listed. For example, ‘write down’ indicates a less complex task than ‘show that’ or ‘explain’ since the latter cases require full and structured evidence to be presented. Ensure learners are familiar with the command words and key terms used in mathematics.

You can use the Example Candidate Response (ECR) booklet to help explain the meaning of the command words to learners. The ECR booklet contains candidate responses that have been marked as ‘high’, ‘middle’ and ‘low’ grades and is produced after the first examination has been sat. Showing learners good sample responses to questions using different command words can help them see how increasing levels of skill relate to the marks available. Asking questions in ascending order of skill whilst teaching a topic will encourage learners to ask themselves similar questions when they are learning alone. When they become practiced at this, they will begin to see patterns emerging where the same processes and logic can be applied to similar scenarios even if they have not been covered in class.

5 Resources and support

5.1 Finding and evaluating resources

There is no shortage of resources to aid the teaching of mathematics. They can be found in text books and on the internet. The problem is not so much finding resources, but evaluating whether they will suit your situation and are effective. The quality of resources varies widely from 'homemade' ones that are uploaded to the internet, to professionally produced ones.

When possible, the easiest way to find reliable resources is to get them from a colleague who has already used them and can tell you how good they are.

You can also find resources on the Cambridge Support Hub (see section 5.2 below). There is also a list of endorses text books to support the course at www.cambridgeinternational.org/i-want-to/resource-centre

Resources from the internet and from books need to be scrutinised to see if they are of use.

Some websites that may be useful are:
www.mrbartonmaths.com
https://nrich.maths.org
https://corbettmaths.com
www.tes.com/teaching-resources/hub/secondary (sharing resources site)
www.cimt.org.uk/projects/mep/index.htm
www.resourceaholic.com
http://furthermaths.org.uk (good for stretch and challenge for the most able).

5.2 School Support Hub

On the School Support Hub (www.cambridgeinternational.org/support), you will be able to access the syllabus and copies of past papers together with their mark schemes, Principal Examiner Reports for Teachers and grade thresholds. You will also be able to download a scheme of work – this is just one example of a possible route through the syllabus with some suggested teaching activities. There is also a list of resources and a link to the 'Discussion Forum' where teachers can post comments and questions. It is worth looking at this from time to time and following interesting threads even if you do not post any comments of your own.

5.3 Training

The School Support Hub and Cambridge Events calendar (www.cambridgeinternational.org/events) on our public website has a list of upcoming training events. These include:

- online courses, self-study and tutor-led courses; the tutor-led courses are highly recommended to help you improve your teaching skills – these are available at Introductory level for new teachers and Extension level for those who have already been teaching IGCSE / IGCSE (9–1) Mathematics for one year
- face-to-face courses, held at venues all over the world at different times throughout the year; these enable you to meet up with other teachers, and also to interact directly with a trainer from Cambridge.

In addition, Cambridge runs professional development courses for teachers who want to develop their thinking and practice. These include a range of Cambridge International Certificate and Diploma level programmes in:

- Teaching and Learning
- Educational Leadership
- Teaching Bilingual Learners
- Teaching with Digital Technologies

You can find information about these at www.cambridgeinternational.org/qualifications/teacher.

Appendix: Sample lesson plan template

Lesson:	**School:**	
Date:	**Teacher name:**	
Class:	**Number present:**	**Number absent:**
Learning objectives to which this lesson is contributing		
Lesson objectives		
Vocabulary, terminology and phrases		
Previous learning		
Plan		
Planned timings	**Planned activities**	**Resources**
Beginning		
Middle		
End		
Additional information		
Differentiation: How do you plan to give more support? How do you plan to challenge all learners including the more able learners?	**Assessment: How do you plan to check learning?**	**Health and safety check; ICT links**

Reflection and evaluation	
Reflection Were the lesson objectives realistic? What did the learners learn today? What was the learning atmosphere like? Did my planned differentiation work well? Did I stick to timings? What changes did I make from my plan and why?	**Use the space below to reflect on your lesson. Answer the most relevant questions from the box on the left about your lesson.**

Summary evaluation

What two things went really well? (Consider both teaching and learning.)

1.

2.

What two things would have improved the lesson? (Consider both teaching and learning.)

1.

2.

What have I learned from this lesson about the class or individuals that will inform my next lesson?

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