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# INTERNATIONAL ADVANCED LEVEL MATHEMATICS/ FURTHER MATHEMATICS/ PURE MATHEMATICS GETTING STARTED GUIDE

Pearson Edexcel International Advanced Subsidiary in Mathematics (XMA01) Pearson Edexcel International Advanced Subsidiary in Further Mathematics (XFM01) Pearson Edexcel International Advanced Level in Mathematics (YMA01) Pearson Edexcel International Advanced Level in Further Mathematics (YFM01) Pearson Edexcel International Advanced Level in Further Mathematics (YFM01) Pearson Edexcel International Advanced Level in Pure Mathematics (YFM01) Pearson Edexcel International Advanced Level in Pure Mathematics (YPM01) First teaching September 2018 First examination from January 2019 First certification from August 2019 (International Advanced Subsidiary) and August 2020 (International Advanced Level



# Getting Started Guide: IAL Mathematics 2018

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## Getting started for teachers

## 1. Introduction

## **Research and key principles**

This Getting Started guide will give you an overview of the International Advanced Level (IAL) in Mathematics qualification and what it means for you and your students. This guidance is intended to help you plan the course in outline and give you further insight into the principles behind the content to help you and your students succeed.

## **Key principles**

The specification has been developed with the following key principles:

#### **Clear specification**

Clear guidance on what students need to learn, providing clarity for planning, teaching and assessment. A review of other curricula and qualifications was undertaken to ensure that it is comparable with those taken in high-performing jurisdictions internationally. Key stakeholders were consulted on content and assessment, including higher education academics, teachers and employers to ensure this qualification is suitable for an international context

#### Progression, not repetition

The specification allows the development of understanding while at the same time avoiding repetition, ensuring students are engaged and thereby inspired to develop their knowledge.

#### Reflect today's global world

The International Advanced Level in Mathematics specification develops an understanding of current developments in mathematics.

#### **Clear assessments**

Clear and consistent use of command words across assessments and between series. Our approach to assessments, definitions for the command words and details of how the command words are explained can be found in the glossary.

#### **Clear mark schemes**

The new mark schemes provide a consistent understanding of the skills, and connections between these skills, required for each question type. Clear wording reflects how teachers and examiners describe the qualities of student work, so the expectations are clear for teachers and markers.

#### **Skills for progression**

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The variety of content that will be found in the examination allows the student to demonstrate knowledge as well as its application, which are required elements for further study or progression into employment.

#### 1.2 Support for the new specification

Our package of support to help you plan and implement the new specification includes:

**Getting Ready to Teach events** – We will provide Getting Ready to Teach events, delivered by subject specialists, ahead of the first teaching in September 2018. This training event will outline all the requirements for teaching and learning in the new specification to support teachers to deliver their teaching with confidence.

**Planning** – In this guide, we have provided a course planner that you can adapt to suit your department.

**Teaching and learning** – To support you in delivering the new specification, we will be providing suggested resource lists and suggested activities.

**Understanding the standard** –Sample Assessment Materials will be provided.

**Tracking learner progress** – Results Plus provides the most detailed analysis available of your students' exam performance. It can help you identify topics and skills where students could benefit from further learning.

**Subject Adviser service/(Maths Emporium)** – Our Maths Emporium service, contains over 15,000 files to do with Edexcel Mathematics and all the qualifications that we offer, including past papers, mark schemes, examiner reports and grade boundaries. You can sign up <u>here</u> for an account.

Our subject advisor team, can be contacted with any questions in the following ways:

- E-mail: mathsemporium@pearson.com
- Phone
  - Intl: + 44 (0)20 7010 2174

Centres may find it beneficial to review this document in conjunction with:

- International Advanced Level Mathematics Sample Assessment Material
- <u>Assessment Objective descriptors in International Advanced Level Mathematics</u>
   <u>specification</u>

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## 2. Qualification overview

## What has changed?

This section provides an overview of the course to help you see what you will need to teach. The overview gives a general summary of each of the examined papers.

## 2.1 Changes to specification

| Content area            | What has changed?   | What is added?   |
|-------------------------|---|--|
| Pure mathematics C12    | Content is now separated<br>into P1 and P2                          | <ul> <li>P1</li> <li>1.7 Interpret linear and quadratic inequalities graphically</li> <li>1.8 Represent linear and quadratic inequalities graphically</li> <li>P2</li> <li>Section 1 Proof</li> <li>4.3 Increasing sequences, decreasing sequences and periodic sequences</li> </ul> |
| Pure mathematics C34    | Content is now separated into P3 and P4                             | <b>P4</b><br>1.1 Proof by contradiction  |
| Decision mathematics D1 | Algorithms on graph is<br>extended<br>Matchings has been<br>removed | <ul><li>3.2 Travelling Salesman</li><li>3.3</li><li>3.4</li></ul>  |

The applied mathematics and further pure mathematics units are unchanged.

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## **Changes to Assessment objectives**

The Assessment Objectives and weightings are as follows:

| Assessmen | it objective  | Minimum<br>weighting |
|-----------|---|----------------------|
| A01       | Recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of contexts.   | 30%                  |
| AO2       | Construct rigorous mathematical arguments and proofs through use<br>of precise statements, logical deduction and inference and by the<br>manipulation of mathematical expressions, including the<br>construction of extended arguments for handling substantial<br>problems presented in unstructured form.   | 30%                  |
| A03       | Recall, select and use their knowledge of standard mathematical<br>models to represent situations in the real world; recognise and<br>understand given representations involving standard models;<br>present and interpret results from such models in terms of the<br>original situation, including discussion of the assumptions made and<br>refinement of such models. | 10%                  |
| A04       | Comprehend translations of common realistic contexts into<br>mathematics; use the results of calculations to make predictions, or<br>comment on the context; and, where appropriate, read critically<br>and comprehend longer mathematical arguments or examples of<br>applications.  | 5%                   |
| A05       | Use contemporary calculator technology and other permitted<br>resources (such as formulae booklets or statistical tables) accurately<br>and efficiently; understand when not to use such technology, and<br>its limitations. Give answers to appropriate accuracy.  | 5%                   |

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## 3. Planning

#### 3.1 Planning and delivering the course

The IAL in Mathematics qualification can be taught and assessed as either:

- distinct modules of teaching and learning with related units of assessment taken at appropriate stages during the course; or
- a linear course, that is assessed in its entirety at the end

One of the first decisions that centres will have to make is whether they intend to offer a sequential or thematic approach. A modular A Level will offer a more flexible approach as topics can be selected in an order that meets the needs of the students.

With examinations available in January, June and October there is flexibility for unit delivery and teaching.

We have provided an editable scheme of work including a suggested teaching plan to support you in planning your teaching of the new qualifications.

#### 3.2 Suggested resources

To support the teaching and learning of the new specification, we have provided a comprehensive list of suggested resources throughout the scheme of work.

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## 4. Content guidance

#### Introduction

This section provides an overview of the content of each of the units. The specification contains more detail on what each of the content headings include.

#### Pure Mathematics 1:

#### Topics

Algebra and functions; coordinate geometry in the (x,y) plane; trigonometry; differentiation; integration

#### Pure Mathematics 2:

#### Topics

Proof; algebra and functions; coordinate geometry in the (x, y) plane; sequences and series; exponentials and logarithms; trigonometry; differentiation; integration

#### Pure Mathematics 3:

**Topics** Algebra and functions; trigonometry; exponentials and logarithms; differentiation; integration; numerical methods

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#### Pure Mathematics 4:

#### Topics

Proof; algebra and functions; coordinate geometry in the (x, y) plane; binomial expansion; differentiation; integration; vectors

## Further Mathematics 1:

#### Topics

Complex numbers; roots of quadratic equations; numerical solution of equations; coordinate systems; matrix algebra; transformations using matrices; series; proof

#### **Further Mathematics 2:**

#### Topics

Inequalities; series; further complex numbers; first order differential equations; second order differential equations; Maclaurin and Taylor series; Polar coordinates

#### Further Mathematics 3:

#### Topics

Hyperbolic functions; further coordinate systems; differentiation; integration; vectors; further matrix algebra

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#### Mechanics 1:

#### Topics

Mathematical models in mechanics;

vectors in mechanics;

kinematics of a particle moving in a straight line;

dynamics of a particle moving in a straight line or plane;

statics of a particle;

moments

#### Mechanics 2:

#### Topics

Kinematics of a particle moving in a straight line or plane; centres of mass; work and energy; collisions; statics of rigid bodies

#### Mechanics 3:

#### Topics

Further kinematics; elastic strings and springs; further dynamics; motion in a circle; statics of rigid bodies

#### Statistics 1:

#### Topics

Mathematical models in probability and statistics; representation and summary of data; probability; correlation and regression; discrete random variables; discrete distributions; the Normal distribution

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#### Statistics 2:

#### Topics

The Binomial and Poisson distributions; continuous random variables; continuous distributions; samples; hypothesis tests

#### Statistics 3:

#### Topics

Combinations of random variables; sampling; estimation, confidence intervals and tests; goodness of fit and contingency tables; regression and correlation

#### **Decision Mathematics 1:**

#### Topics

Algorithms; algorithms on graphs; algorithms on graphs II; critical path analysis; linear programming

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## 5. Assessment guidance

Each of the above units:

- is externally assessed
- has a written examination of 1 hour and 30 minutes
- has 75 marks

When students have taken an eligible combination of units for a qualification, they are entitled to claim that qualification. The process of claiming a qualification is often referred to as *cashing in*. This can only take place in an exam series and is done by entering the qualification code for the qualification along with the entry codes for any units being taken in the same exam series.

The allowable unit combinations for each of the qualifications in the specification are given below.

#### Pearson Edexcel International Advanced Subsidiary

The International Advanced Subsidiary in Mathematics, Further Mathematics and Pure Mathematics qualifications each consist of three externally-examined units:

| Qualification  | Compulsory units | Optional units                          |
|--|------------------|---|
| International Advanced Subsidiary in Mathematics         | P1, P2           | M1, S1, D1                              |
| International Advanced Subsidiary in Further Mathematics | FP1              | FP2, FP3, M1, M2,<br>M3, S1, S2, S3, D1 |
| International Advanced Subsidiary in Pure<br>Mathematics | P1, P2, FP1      |   |

#### Pearson Edexcel International Advanced Level

The International Advanced Level in Mathematics, Further Mathematics and Pure Mathematics qualifications each consist of six externally-examined units:

| Qualification                           | Compulsory units          | Optional units     |
|---|---------------------------|--------------------|
| International Advanced Level in         | P1, P2, P3, P4            | M1 and S1 or       |
| Mathematics                             |                           | M1 and D1 or       |
|   |                           | M1 and M2 or       |
|   |                           | S1 and D1 or       |
|   |                           | S1 and S2          |
| International Advanced Level in Further | FP1 and either FP2 or FP3 | FP2, FP3, M1, M2,  |
| Mathematics                             |                           | M3, S1, S2, S3, D1 |
| International Advanced Level in Pure    | P1, P2, P3, P4, FP1       | FP2 or FP3         |
| Mathematics                             |                           |                    |

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The certification of each qualification requires different contributing units. For example, students who are awarded certificates in both International Advanced Level Mathematics and International Advanced Level Further Mathematics must use unit results from 12 different units, i.e. once a unit result has been used to cash in for a qualification, it cannot be re-used to cash in for another qualification.

#### Results

Scores in unit tests are converted to a uniform mark scale in order to generate qualification results. Students will receive a uniform mark between 0 and 100 for each unit.

| Maximum<br>uniform mark | А  | В  | С  | D  | E  |
|-------------------------|----|----|----|----|----|
| 100                     | 80 | 70 | 60 | 50 | 40 |

The uniform marks at each grade threshold for each unit are:

The minimum uniform marks required for each qualification grade:

#### International Advanced Subsidiary (cash-in code: XMA01, XFM01, XPM01)

| Maximum<br>uniform mark | А   | В   | С   | D   | E   |
|-------------------------|-----|-----|-----|-----|-----|
| 300                     | 240 | 210 | 180 | 150 | 120 |

Students with a uniform mark in the range 0–119 will be Unclassified (U).

#### International Advanced Level (cash-in code: YMA01, YFM01, YPM01)

| Maximum<br>uniform mark | А   | В   | С   | D   | E   |
|-------------------------|-----|-----|-----|-----|-----|
| 600                     | 480 | 420 | 360 | 300 | 240 |

Students with a uniform mark in the range 0–239 will be Unclassified (U).

For International Advanced Level in Mathematics, A\* will be awarded to students who have achieved grade A overall (at least 480 of the 600 maximum uniform mark) and at least 180 of the 200 combined maximum uniform mark for the P3 and P4 units.

For International Advanced Level in Further Mathematics, A\* will be awarded to students who have achieved a grade A overall (at least 480 of the 600 maximum uniform mark) and at least 270 of the

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300 combined maximum uniform mark for their best three IA2 units (whether pure or application units).

For International Advanced Level in Pure Mathematics, A\* will be awarded to students who have achieved a grade A overall (at least 480 of the 600 maximum uniform mark) and at least 270 of the 300 combined maximum uniform mark for their IA2 units.

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## 6. Examination entry codes

| Unit name            | Legacy entry code | New 2018 Code |
|----------------------|-------------------|---------------|
| C12                  | WMA01             | WMA11         |
|                      |                   | WMA12         |
| C34                  | WMA02             | WMA13         |
|                      |                   | WMA14         |
| D1                   | WDM01             | WDM11         |
| M1                   | WME01             | No change     |
| M2                   | WME02             | No change     |
| M3                   | WME03             | No change     |
| S1                   | WST01             | No change     |
| S2                   | WST02             | No change     |
| S3                   | WST03             | No change     |
| FP1                  | WFM01             | No change     |
| FP2                  | WFM02             | No change     |
| FP3                  | WFM03             | No change     |
| Cash-in codes        |                   |               |
| IAS MATHEMATICS      | XMA01             | No change     |
| IAL MATHEMATICS      | YMA01             | No change     |
| IAS FURTHER MATHS    | XFM01             | No change     |
| IAL FURTHER MATHS    | YFM01             | No change     |
| IAS PURE MATHEMATICS | XPM01             | No change     |
| IAL PURE MATHEMATICS | YPMO1             | No change     |

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## 7. Unit examination unit availability table

Please continue to refer to the <u>Information Manual</u> for update unit availability for all series.

| Specification        | Level   | Units      | Jun<br>2018  | Oct<br>2018 | Jan<br>2019 | Jun<br>2019 | Oct<br>2019  | Jan<br>2020  | Jun<br>2020  | Oct<br>2020  | Jan<br>2021  |
|----------------------|---------|------------|--|-------------|-------------|-------------|--|--|--|--|--|
| MATHEMATICS 2013 S   | PECIFIC | ATION      |  |             |             |             |  |  |  |  |  |
| Core Maths           | AS      | WMA01      | <ul> <li>Image: A second s</li></ul> | 1           | 1           | 1           | 1  | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> | х  | х  |
| Core Maths           | A2      | WMA02      | <ul> <li>Image: A second s</li></ul> | 1           | 1           | 1           | 1  | 1  | 1  | х  | х  |
| Mechanics 1          | AS      | WME01      | <ul> <li>Image: A second s</li></ul> | 1           | ~           | <           | 1  | <  | 1  | 1  | <  |
| Mechanics 2          | A2      | WME02      | 1  | 1           | 1           | 1           | 1  | 1  | 1  | 1  | <ul> <li>Image: A second s</li></ul> |
| Mechanics 3          | A2      | WME03      | <ul> <li>Image: A second s</li></ul> | х           | 1           | 1           | х  | 1  | <ul> <li>Image: A second s</li></ul> | х  | <ul> <li>Image: A second s</li></ul> |
| Statistics 1         | AS      | WST01      | 1  | 1           | 1           | 1           | 1  | 1  | 1  | 1  | 1  |
| Statistics 2         | A2      | WST02      | 1  | 1           | 1           | 1           | 1  | 1  | 1  | 1  | 1  |
| Statistics 3         | A2      | WST03      | 1  | х           | х           | 1           | х  | х  | 1  | х  | <ul> <li>Image: A second s</li></ul> |
| Further Pure Maths 1 | AS      | WFM01      | 1  | х           | 1           | 1           | х  | 1  | 1  | х  | <ul> <li>Image: A second s</li></ul> |
| Further Pure Maths 2 | A2      | WFM02      | <ul> <li>Image: A second s</li></ul> | х           | х           | 1           | х  | х  | 1  | х  | <  |
| Further Pure Maths 3 | A2      | WFM03      | 1  | х           | х           | 1           | х  | х  | 1  | х  | <ul> <li>Image: A second s</li></ul> |
| Decision Maths 1     | AS      | WDM01      | 1  | х           | 1           | 1           | х  | 1  | <ul> <li>Image: A second s</li></ul> | х  | х  |
| NEW MATHEMATICS      | 2018 SP | ECIFICATIO | DN   |             |             |             |  |  |  |  |  |
| Pure Maths 1         | AS      | WMA11      | х  | х           | 1           | 1           | 1  | <ul> <li>Image: A second s</li></ul> | 1  | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> |
| Pure Maths 2         | AS      | WMA12      | х  | х           | х           | 1           | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> |
| Pure Maths 3         | A2      | WMA13      | х  | х           | х           | x           | x  | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> |
| Pure Maths 4         | A2      | WMA14      | х  | х           | х           | x           | x  | х  | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> | <ul> <li>Image: A second s</li></ul> |
| Decision Maths 1     | AS      | WDM11      | х  | x           | x           | 1           | x  | 1  | 1  | х  | 1  |

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## 8. Transferable skills

#### 8.1 Why transferable skills?

In recent years, higher education institutions and employers have consistently flagged the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work. Ensuring that IAL qualifications will help improve student outcomes through the acquisition of these transferable skills, as well as subject content and skills, is a key aim for Pearson.

Through our teaching materials and support offered we want to:

- 1. increase awareness of transferable skills that are already being assessed (for both students and teachers)
- 2. indicate where, for teachers, there are opportunities to teach additional skills that won't be formally assessed, but that would be of benefit to students
- 3. ensure these opportunities are embedded in the teaching and learning, so that they are not an additional burden or requirement for teachers and students.



#### 8.2 Defining transferable skills

The Organisation for Economic Co-operation and Development (OECD) defines skills, or competencies, as 'the bundle of knowledge, attributes and capacities that can be learned and that enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning.'[1]

To support the design of our qualifications, the Pearson Research Team selected and evaluated seven global 21st-century skills frameworks. Following on from this process, we identified the National Research Council's (NRC) framework [2] as the most evidencebased and robust skills framework, and have used this as a basis for our adapted skills framework. The framework includes cognitive, intrapersonal skills and interpersonal Skills.

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<sup>&</sup>lt;sup>[1]</sup> OECD – *Better Skills, Better Jobs, Better Lives* (OECD Publishing, 2012)

<sup>&</sup>lt;sup>[2]</sup> Koenig J A, National Research Council – *Assessing 21st Century Skills: Summary of a Workshop* (National Academies Press, 2011)



## 9. NRC framework skills – IAL Mathematics skills interpretation

Sources: Cognitive/Intrapersonal and Interpersonal skills adapted and taken from the NRC framework

| NRC framework skill                   | Skill interpretation in this subject   | Where the skill is covered in content  |
|---------------------------------------|--|--|
| Cognitive skills                      |  |  |
| Cognitive Processes and<br>Strategies |  | Cognitive Process and strategies are a key focus<br>of Mathematics. All of the maths content could<br>be cited for each of these skills. |
| Critical thinking                     | Using <b>many</b> different pieces of mathematical information (sometimes seemingly  | Aims: Bullet point 2, 5, 8   |
|                                       | unrelated) and synthesising this information to arrive at a solution to a mathematics-based problem. Evaluating the suitability and (or limitations of | A02, A03   |
|                                       | models used. Evaluating the reasonableness of information/data given and that  | Pure Maths 2: section 1  |
|                                       | found.   | Pure Maths 4: section 1  |
| Problem solving                       | Assimilating information given, or data found, determining the goal and  | Aims: Bullet point 2, 3, 4, 5, 8   |
|                                       | establishing at least one route from the one to the other. Combining information   | A01, A02, A03, A04, A05  |
|                                       | notation. Selecting the most efficient route to the solution from other possible   | This is a key focus of all Pure Mathematics and the  |
|                                       | routes. Checking that the answer is reasonable. Selecting and realising an elegant solution  | Applied mathematics options ( - Statistics,<br>Mechanics and Decision Mathematics.)  |
| Analysis                              | Analysing given information and data, determining if it is relevant of irrelevant  | Aims: Bullet point 5   |
|                                       | to the solution of the problem. For the information/data that is relevant  | A02, A03, A04, A05   |
|                                       | Using formal methods of mathematical analysis e.g. considering limits as   | Pure Maths 2: 4.4  |
|                                       | variables tend to infinity or zero.  | Pure Maths 3: 3.4; 6.1, 6.2  |

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| Reasoning/argumentation | Constructing a reasoned, logical argument and being able to defend it if<br>necessary. Being able to deduce additional information from given information.<br>Thinking logically and precisely and being able to prove, justify or argue that the<br>approach taken is valid. Detecting any flaws, omissions or errors in reasoning.   | Aims: Bullet point 2, 3, 4, 5, 6, 7, 8, 9<br>A01, A02, A03, A04, A05                         |
|-------------------------|--|--|
| Interpretation          | Assimilating information given in a variety of ways, text, diagrams, charts, tables, graphs etc, and in a variety of forms. Being able to explain solutions and reasoning in a variety of ways, producing, as appropriate, their own text, diagrams, charts, table, graphs etc. Interpreting the precise meaning of technical terminology and its implications. Choosing to use, and using, technical terminology correctly in their own work. | Aims: Bullet point 5, 6, 7, 8, 9<br>AO3, AO4, AO5  |
| Decision making         | Comparing possible solutions or routes to solutions and making a choice about<br>their preferred route or solution. Using formal mathematical decision- making<br>algorithms Evaluating the reasonableness of solutions or hypotheses and<br>deciding if they should be accepted or not.   | Aims: Bullet point 2, 5, 8<br>AO2, AO3, AO4, AO5<br>(Very formally in Decision Mathematics.) |
| Adaptive learning       | Responding to unfamiliar contexts and situations. Being able to adapt standard techniques to non-standard situations. Understanding when special situations may enable a more elegant or efficient solution. Checking that the solution is plausible. Determining how a model could be refined to make them more realistic.  | Aims: Bullet point 1, 2, 3, 4, 5, 7, 8, 9, 10<br>AO2, 3, 4,                                  |
| Executive function      | Carrying out successfully a planned approach to the solution of a problem.<br>Understanding the situation, planning a route through the problem and<br>following it accurately to find the solution. Reviewing the solution to see if the<br>solution is plausible and to see if there is a more efficient route.  | Aims: Bullet point 2, 3, 4, 5, 6, 7, 8, 9, 10<br>A01, A02, A03, A04, A05                     |

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| Creativity                         |   | When solving problems students are required to<br>be creative. In Mathematics, students are mostly<br>asked to solve problems. So all of the content<br>could be listed here.  |
|------------------------------------|---|--|
| Creativity                         | Creating problem solving routes through unfamiliar problems. Showing insight<br>in dealing with unfamiliar situations, contexts or problems. Producing elegant,<br>efficient methods of solution, or in presenting a solution or display of data                                    | Aims: Bullet point 2, 3, 4, 5, 6, 8, 9<br>A02, A03, A04  |
| Innovation                         | Using insight to find the links between two situations or topics. Exploiting these links to use, or adapt, techniques, methods, strategies learnt in one situation to the other, seeing isomorphisms. Understanding when the situations are so different that this is not possible. | Aims: Bullet point 2, 3, 4, 5, 6, 8, 9<br>AO2, AO3, AO4  |
| Intrapersonal skills               |   |  |
| Intellectual openness              |   | Students of Mathematics require intellectual<br>openness as one of the core skills. Students are<br>exposed to new ideas, new approaches to<br>solutions, new problems every time they<br>study/explore. The whole of the content could<br>therefore be listed here. |
| Adaptability                       | Respond to a new concept, idea, topic, model or scenario in an open and positive spirit, showing the ability to broaden conceptual horizons in interpreting and understanding the new material.   | Aims: Bullet point 3, 4, 5, 8, 9, 10<br>AO3, AO4, AO5  |
| Personal and social responsibility | Use mathematics to undertake a specific task for which one is accountable or<br>which develops social awareness in response to ideas. Use Mathematics to<br>communicate social ideas and to analyse claims made by others.  | Aims: Bullet point 5, 6, 7, 8, 9, 10<br>AO2, AO3, AO4, AO5   |
| Continuous learning                | Reflecting on ideas learnt, problems met, whether solved or not, and using these to improve on one's own performance in the future. Taking an active role in planning one's own learning. Setting goals and meeting them in a continually   | Aims: Bullet point 1, 2, 3, 4, 5, 8, 9, 10<br>AO2, AO3, AO4, AO5   |

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|  | developing fashion. Understanding how ideas, such as rigorous logical thought, can be applied to future decision-making situations, used to assess the credibility of arguments and validate claims.   |  |
|--|--|--|
| Intellectual interest and curiosity                      | Undertake a research or learning task which is self-directed. Pursuing a line of personal interest through appropriate research methods, including using information and computer technology and wider reading. Exploring further ideas met during the course of study. Seeing how mathematics can be applied to other fields of study | Aims: Bullet point 2, 3, 4, 5, 7, 8, 9, 10<br>A02, A03, A04, A05 |
| Work ethic/conscientiousness                             |  |  |
| Initiative   | Showing a willingness to undertake self-motivated lines of enquiry and go<br>beyond the given parameters. Study material prior to a lesson on that topic.<br>Decide to challenge oneself by tackling more challenging problems on a topic  | Aims: Bullet point 2, 3, 5, 6, 7, 8, 9, 10<br>A02, A03, A04      |
| Self-direction   | Planning and carrying out tasks under one's own direction.   | Aims: Bullet point 2, 10<br>A02, A03                             |
| Responsibility   | Take responsibility for any errors or omissions in work and create a plan to improve.  | Aims: Bullet point 2, 9, 10<br>A02, A03                          |
| Perseverance   | Actively seek new ways to continue to improve own learning, despite setbacks, with willingness to re-try, start again, try a different approach, undertake further learning or keep at a task until completed.   | Aims: Bullet point 1, 2, 3, 8, 9, 10<br>A02, A03                 |
| Productivity   | Working effectively and to a high standard in response to mathematical problems.   | Aims: Bullet point 1, 2, 10<br>A02, A03                          |
| Self-regulation (metacognition, forethought, reflection) | Developing strategies over time, including self-assessment and critical review, for reflecting on the success or otherwise of the work.  | Aims: Bullet point 2, 3, 5, 9, 10<br>A01, A02, A03, A04, A05     |
| Ethics   | Producing output with a specific moral purpose or exploring the ethical intentions of a piece of mathematics.  | Aims: Bullet point 2, 3, 5, 6, 9, 10<br>A02, A03                 |

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|  | Use mathematics (such as logical reasoning, statistics etc) as a tool to communicate, evaluate and debate ethical issues.   |  |
|--|---|--|
| Integrity  | Taking ownership for one's own work and willingly responding to questions and challenges; employing working methods which are honest and appropriate. Crediting other's input as appropriate.         | Aims: Bullet point 2, 5, 6, 7, 8, 9, 10<br>A02, A03, A04, A05    |
| Positive Core Self Evaluation                          |   |  |
| Self-monitoring/self-<br>evaluation/self-reinforcement | Developing the self-motivated habit of planning, completing and reviewing one's own work as a matter of habit, critically and constructively.   | Aims: Bullet point 1, 2, 3, 5, 8, 9, 10<br>A02, A03, A04, A05    |
| Interpersonal skills                                   |   |  |
| Teamwork and collaboration                             |   |  |
| Communication  | Use mathematics as an effective medium of communication of ideas, concepts<br>and solutions to problems. Use questioning skills appropriately to elicit further<br>information or information needed. | Aims: Bullet point 2, 5, 6, 7, 8, 9<br>A02, A03, A04, A05        |
| Collaboration  | Sharing work with others to break down a mathematical task, or separate cases, into more manageable pieces.   | Aims: Bullet point 2, 4, 5, 6, 7, 8, 9, 10<br>A02, A03, A04, A05 |
| Teamwork   | Working with other students to solve mathematical problems, explore strategies or pool ideas.   | Aims: Bullet point 2, 4, 5, 6, 7, 8, 9, 10<br>A02, A03, A04, A05 |
| Co-operation   | Sharing resources, ideas, strategies and results with other students.   | Aims: Bullet point 2, 4, 5, 6, 7, 8, 9, 10<br>A02, A03, A04, A05 |
| Interpersonal skills                                   | Use verbal and non-verbal communication skills in a discussion.   | Aims: Bullet point 2, 5, 6, 7, 8, 9, 10<br>A02, A03, A04, A05    |
| Empathy/perspective taking                             | Advocating the position of another in a discussion. Being sensitive to the feelings of others when correcting their mathematical work.  | Aims: Bullet point 2, 5, 6, 7, 8, 9, 10<br>A02, A03, A04, A05    |

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| Negotiation             | Attempting to reach shared conclusions with others, compromising, where appropriate by using negotiation skills.                              | Aims: Bullet point 2, 3, 5, 6, 7, 8, 9, 10<br>A02, A03, A04, A05         |
|-------------------------|---|--|
| Leadership              |   |  |
| Leadership              | Taking a leading part in a group task, assigning sub-tasks, considering representations and different viewpoints. Resolving conflict.         | Aims: Bullet point 2, 3, 5, 6, 9, 10<br>A02, A03, A04, A05               |
| Responsibility          | Taking responsibility for delivering, within agreed time constraints, one's own part within a group task.                                     | Aims: Bullet point 2, 5, 6, 8, 9, 10<br>A02, A03, A04, A05               |
| Assertive communication | Directing work to a conclusion and addressing conflicting viewpoints. Using persuasive techniques effectively to convince of a point of view. | Aims: Bullet point 2, 3, 5, 6, 7, 9, 10<br>A02, A03, A04, A05            |
| Self-presentation       | Presenting a topic, idea or solution to the class.  | Aims: Bullet point 2, 3, 4, 5, 6, 7, 8, 9, 10<br>A01, A02, A03, A04, A05 |

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