Senior secondary

Maths: Tutorial plans 1–15

Tutor handbook

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'Keeping Girls in School' Scholarship Programme

Tutor's Folder MSCE Resources: 2014–15

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MSCE M1: Numeracy and Probability: Tutorial 1

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- know what to expect from the tutorial sessions
- be able to solve problems involving direct proportion
- be able to solve problems involving other types of proportion
- know what work they will need to have done for the next tutorial.

2. Introduction to the course and outline of the purpose and structure of the tutorials (15 minutes)

3. Warm up* Number/algebra task: either a group or a paired activity (15 minutes)

The aim of this activity is to give Scholars an opportunity to work together and also to allow the Tutor to begin to get an idea of what level the Scholars are working at.
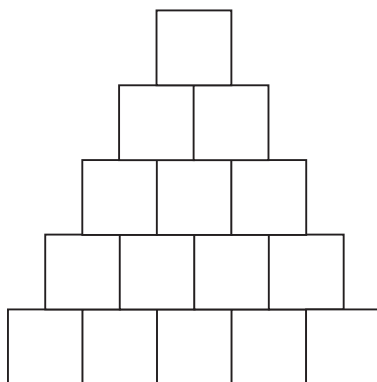
One possibility is a number pyramid, shown above, where the number in a box is the sum of the two boxes immediately below. Arrange the numbers 1, 2, 3, 4 and 5 in the bottom row to give: the biggest possible number at the top; the smallest possible number at the top; 55 at the top, etc.

An alternative would be to populate some of the boxes with algebraic expressions and ask the Scholars to find the missing expressions.

In the first instance Scholars can work with the person or people sitting next to them.

4. Direct proportion: recap (20 minutes)

Group discussion on direct proportion with Scholars giving examples where possible such as changing quantities to feed more or fewer people. Clarification of the correct notation through an example such as perimeters of rectangles.

*Warm up or starter activities: Tutors may have their own or they can use the one suggested. It is generally good to have a starter activity at the beginning of a maths tutorial session so Scholars have the chance to warm up and start thinking in a mathematical way. It is good to have one that links to the topics being covered, but that is not always possible or necessary.

5. Paired differentiated problems activity (30 minutes)

In order to select pairs in this first session, names can be selected randomly by drawing them out of a bag. This is a good opportunity to talk about probability which is to be studied in this unit. Each pair is given one question to start with. Subsequently Scholars select a new question from a selection presented on a table at the front of the room. Each sheet of paper or card has just one question on it. The level of difficulty is indicated in some way; using colour is nice if possible. Scholars can then work on one problem and solutions are self checked before moving on to a more challenging question, or if necessary selecting another question at a similar level. This activity will also give the Tutor the chance to see how individuals are coping and in future paired-activity pairs could be selected so that a stronger Scholar supports a weaker one, or Scholars who are at a similar stage in their understanding and knowledge might work together. Giving the Scholars an opportunity to move around at this point in the tutorial will help to keep energy levels up.

6. Exemplification of other types of proportion (20 minutes)

Group discussion on other types of proportion such as area and speed, distance, time problems. More time can be given to this as the algebra is more challenging. If any Scholars are confident enough they can work through the problems for the whole group on the board or flipchart.

7. Exam question practice: paired activity (20 minutes)

Scholars practise exam type questions on a mix of proportion questions. Scholars stay in the same pairs for this section, but make it clear that they will not always work in the same pairs. As there is less time given to this section working on three or four questions rather than individual questions on sheets may work better, but the technique in Section 5 could be used.

8. Recap on terminology and basic idea of arithmetic and geometric progressions and set Scholars their self-study tasks for the next fortnight (25 minutes)

Pairs combine to form groups of four; then each group is asked to write down as many facts as they can recall on a poster or flipchart paper if possible. Information is then pooled and any gaps can be filled in and notation clarified.

Tasks to be completed are the sections direct and inverse proportion in M1 in the Scholar's MSCE Resources Folder, but as this is very brief, if possible direct Scholars to relevant pages of any textbooks they have access to.

MSCE M1: Numeracy and Probability: Tutorial 2

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to successfully complete exam questions on arithmetic progressions
- be able to successfully complete exam questions on geometric progressions
- know what work they will need to have done for the next tutorial.

2. Warm up activity (15 minutes)

Scholars find the next three terms of each sequence and state which are arithmetic and which are geometric. These can be written on the board or flipchart and Scholars work individually.
For example,   3, 7, 11, 15, _, _, _

3. Arithmetic progressions: selecting the correct formula or formulae to use (30 minutes)

The Tutor pairs the Scholars so that a more confident person is working with someone that will need more support. Each pair is given a selection of questions on arithmetic progressions (AP). These should progress from relatively straightforward problems to more challenging ones and should include the proof of the sum of n term of an AP. The summary of the formulae for progressions produced in the previous session can then be given back to the Scholars. In the first instance Scholars select the appropriate formula or formulae to use. This is an opportunity to demonstrate to the Scholars that producing summaries and posters is a useful thing to do because, if they have not worked in this way before, they can sometimes be sceptical.

At the end of this process a short plenary session is held to ensure that each pair has selected appropriately.

4. Scholars work in pairs on exam type questions (30 minutes)

Each pair now finds solutions to the problems. In this section the Tutor can check that solutions are being set out correctly and work with any individuals who may require extra help.

Once a pair finishes these, they can go on to the next activity or take a break.

5. Geometric progression (40 minutes)

The pairs are now given questions on GPs. This time they select the formulae they want to use and continue to solve the problem. Solutions are self-checked before moving on to a more challenging question. One question should include the proof for n terms of a GP. Again this is an opportunity for the Tutor to identify and work with any Scholars who would benefit from extra help.

6. Mixed exam type questions (30 minutes)

Scholars work in groups of three. (Alternate pairs split so each group has at least one confident student.) Each group is given a different exam type question to solve. Scholars will have to select the correct formula or formulae to use. Solutions are written out on large sheets of paper then put up on the walls so Scholars can then walk around to look at the solutions done by different groups.

7. Wrap up and set Scholars their self-study tasks for the next fortnight (15minutes)

All probability sections of Unit M1 in the Scholar's MSCE Resources Folder.

MSCE M1: Numeracy and Probability: Tutorial 3

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to successfully complete exam questions on probability
- have had the opportunity to practise exam questions under timed exam conditions
- know what work they will need to have done for the next tutorial.

2. Warm up activity (20 minutes)

Prepare a number of true/false statements and ask Scholars to decide whether or not each statement is true. Allow 10 minutes for this. Then spend 10 minutes discussing the answers.

True/false statements   If a is showing when a fair coin is flipped, the next time it is flipped a tail is more likely.

3. Probability: recap on notation and layout of tree diagrams (20 minutes)

A collective memory activity is a good way of reviewing topics such as this. There are a number of ways this activity can be used; one example is given below.

Scholars are divided into teams of four. A poster on a flipchart or on a wall is then revealed. The poster in this instance is a summary of how probability notation works; examples of probability calculations and use of tree diagrams. Scholars are allowed to look at the poster for 15 seconds only and in silence. The teams then work together to reproduce the information on their own large sheet of paper. They have just 1 minute to do this. The poster is then revealed for another 15 seconds and the process repeated. Three or four cycles will probably be needed to produce complete and correct reproductions. The discussion that this activity generates is key. Communicating what is being remembered aids retention and gives an opportunity to correct any misconceptions. It is also an activity that students find enjoyable and engaging.

4. Scholars work in pairs on questions (30 minutes)

Scholars work on a selection of questions on probability where information is given very clearly.

5. Less straightforward exam questions (40minutes)

Scholars practise analysing questions to identify the given information and formulate a strategy for solving each problem.

The acronym RUCSAC is useful for students to solve wordy problems. This is a good time to introduce it so they use it on all subsequent topics when confronted with questions that need breaking down.

Read

Underline

Calculate

Solve

Answer

Check

Scholars work in pairs on exam type questions.

7. Timed exam questions (30 minutes)

Scholars work individually without notes or any assistance. Questions should be on M1 topics totalling less than 40 marks. Scholars will benefit from having the chance to do questions under exam conditions in preparation for the exams and the Tutor will be able to evaluate how the Scholars are progressing. Feedback will be given in the next tutorial.

8. Wrap up and set Scholars their self-study tasks for the next fortnight (20minutes)

Work on powers, Activity 1, surds and Activity 2 (excluding rationalising the denominator). As the Tutor, do take this opportunity, while the Scholars are all working, to sign off Unit M1 in each of their Scholar's MSCE Resources Folder.

MSCE M2: Basic Algebra and Logarithms: Tutorial 4

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- have received feedback from the timed exam questions completed in the previous tutorial

- be able to use the rules of powers to simplify algebraic expressions and solve equations

- be able to simplify numbers written in surd form

- know what work they will need to have done for the next tutorial.

2. Warm up activity (20 minutes)

Scholars work in mixed ability groups of three. Each group is given the powers and surds sheet which is then cut up. The group arranges the cards into equivalent pairs. During this time the Tutor can give marked exam questions back to the Scholars.

3. Feedback to the group on practice exam questions (20 minutes)

4. Use of rules of powers (20 minutes)

Scholars are asked to write down as many rules of powers as they can in a table with an example of how they are used using numbers only without using a calculator.

For example:

Rule	Example
$a^m \times a^n = a^{m+n}$	$2^3 \times 2^5 = 2^8$
$\vdots$	

The full list is then given and the ones most commonly remembered and forgotten are noted. Scholars then complete their list. This is a good opportunity to clarify negative and fractional powers as these are most likely to be forgotten or remembered incorrectly. Scholars then check that their examples are correct using the calculator. This also acts as a reminder to Scholars that they can use their calculators in the exam to do these kinds of calculations.

5. Multiplying powers and surds activity (20 minutes)

In groups of three, Scholars use the cards from the warm up activity.

The aim is to find pairs of cards which multiply together to give x^2, $3x$, $2x^{-3/2}$, $x^{1/2}/3$ and 2.

Extension activity: as groups finish, they can produce new expressions using multiplication and division.

6. Solving equations involving powers (40 minutes)

Scholars work on a selection of questions on simplifying expressions and solving equations using the rules of powers.

7. Surds (15 minutes)

True or false statements involving surds are written on the board, e.g. $\sqrt{10} = 2\sqrt{5}$

Scholars in pairs then discuss each statement.

8. Manipulating surds (20 minutes)

The aim of this activity is to give Scholars practice at manipulating surds as well as preparation for the self-study task. In pairs Scholars multiply out expressions such as $(\sqrt{2} + 1)(\sqrt{2} - 2)$ some of which give a rational number and some of which don't. Pairs are then asked to describe what the brackets that have a rational product have in common. Even if a pair knows the result they will gain experience of multiplying out brackets and working with surds. If any individuals are confident enough they can explain how this idea is used to rationalise the denominator. If not, this can be done by the Tutor in order to ensure that the entire group will be able to attempt the self-study tasks.

9. Wrap up and set Scholars their self-study tasks for the next fortnight (15minutes)

Finish Activity 2 on rationalising the denominator in Unit M2 of the MSCE Resources. Work on logarithms, Activities 3 and 4 excluding solving equations involving logs in Unit M2 of the MSCE Resources.

$\dfrac{1}{x^2}$	$x^{\frac{3}{2}}$	$2x^{\frac{1}{2}}$	$\sqrt{x}$	$x^{-\frac{1}{2}}$
$\dfrac{3}{x^2}$	$x^{\frac{1}{2}}$	$3x^{-2}$	$x\sqrt{x}$	$\sqrt[3]{x}$
$\dfrac{\sqrt{x}}{x}$	$\dfrac{x^{-1}}{3}$	$(3x)^2$	$x^{\frac{1}{3}}$	$2\sqrt{x}$
$\dfrac{1}{\sqrt{x}}$	$\dfrac{1}{3x}$	$9x^2$	x^{-2}	$\sqrt{4x}$

MSCE M2: Basic Algebra and Logarithms: Tutorial 5

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to rationalise the denominator of an algebraic fraction
- write expressions in log form and use the rules of logarithms
- know what work they will need to have done for the next tutorial.

2. Warm up activity (15 minutes)

Prepare a number of true/false statements on powers and surds or similar and ask Scholars to decide whether or not each statement is true.

3. Rationalising the denominator practice (30 minutes)

Scholars can be paired so that those with good skills in this area can work together and progress quickly while others have the opportunity to get support from the tutor. Each pair is given a set of questions which become increasingly hard. This will allow the Tutor to give support at the point Scholars start to have problems. Those who mastered this skill quickly can come up their own questions to give to their partner. They must however have worked out the answers before giving their partner the question.

4. Writing statements in log form (40 minutes)

The aim of this activity is to ensure Scholars can correctly convert between log and power forms of a statement as well as understanding:

If $b = a^x$ then x is the logarithm of b to the base a, and vice versa for a > 0, b > 0 and a not equal to 1.

It also reinforces the results $\log_a a = 1$ and $\log_a 1 = 0$.

Scholars should work in groups of three on this matching activity. Note that the sheet of expressions will need to be copied and cut up so that each group of Scholars has its own set. As there are a lot of pieces which should be shuffled before being matched, a whole table will be required. During this activity there is a lot of opportunity for Scholars to develop their understanding of logs through discussion in their groups and with the Tutor if required. Once the groups have matched the statements, the Tutor asks them to group the pairs in a way they think is appropriate. This should reveal the results above and discussion about why the statements are true should be encouraged.

This section should end with a check that Scholars can convert without the answer. Ten questions of the type: write $2^x = 0.125$ in log form and find the value of $\log_{10} 10$ would be sufficient.

5. Recap of rules of logs (40minutes)

Scholars are asked to write down the rules that they can remember and give an example of how it may be used, in the same way as they did for rules of powers in Tutorial 4. These are then written on the board so any Scholars who have forgotten any can complete their own list.

In pairs where one Scholar may be able to support the other, Scholars can now practise using these rules. The Tutor can work with individuals or small groups who find this type of question challenging. These questions should be on simplifying expressions such as $3\log_2 5 - \log_2 0.2$.

6. Scholars work in pairs on exam type questions (30 minutes)

In the same pairs as in the previous section, practise exam questions on powers, surds and the logs covered so far.

7. Wrap up and set Scholars their self-study tasks for the next fortnight (15minutes)

Finish the logarithm sections in Unit M2 of the MSCE Resources.

$2^3 = 8$	$\log_2 8 = 3$
$4^2 = 16$	$\log_4 16 = 2$
$2^4 = 16$	$\log_2 16 = 4$
$3^3 = 27$	$\log_3 27 = 3$
$\left(\dfrac{1}{2}\right)^3 = \dfrac{1}{8}$	$\log_{\frac{1}{2}} \dfrac{1}{8} = 3$
$5^1 = 5$	$\log_5 5 = 1$
$10^1 = 10$	$\log_{10} 10 = 1$
$2^1 = 2$	$\log_2 2 = 1$

# MSCE M2: Basic Algebra and Logarithms: Tutorial 6

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to solve equations using logs

- have had the opportunity to practise exam questions under timed exam conditions

- know what work they will need to have done for the next tutorial.

2. Warm up activity (20 minutes)

Scholars are asked how many different numbers they can make using the number 8 and what they know about powers. Activities like this are good done in groups of three in order to promote discussion. If possible use large sheets of paper to draw a spider diagram on with 8 at the centre, as shown below.
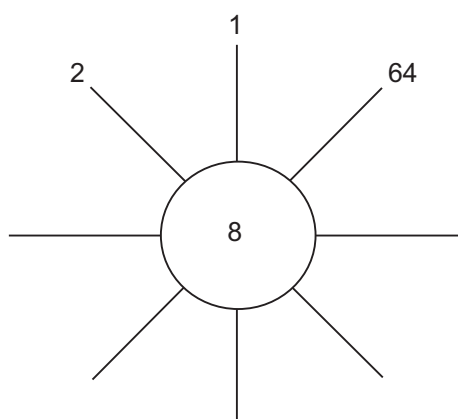
Their diagrams are then passed on to another group and they identify how each number was made and write this calculation on the 'legs' of the spider, e.g. $8^{2/3} = 4$; surd notation can also be used.

3. Selecting the correct method to solve equations involving logs (60 minutes)

On the board the Tutor writes down an example of each of the types of equations that they are likely to face in the exam. Scholars are then asked how they would approach each type. This could be done using directed questions or asking for volunteers depending on how the Tutor feels the group would respond best. Likewise if there are any Scholars who are confident enough, they could come and work through the solutions on the board; this should be encouraged. Scholars are then paired so that those with good skills in this area work together and can progress quickly, while others have the opportunity to get support from the Tutor. Each pair is given a set of questions which become increasingly hard. This will allow the Tutor to give support at the point Scholars start to have problems.

4. Timed exam questions (30 minutes)

Scholars work individually without notes or any assistance. Questions should be on M2 topics totalling less than 40 marks. Scholars will benefit from having the chance to do questions under exam conditions in preparation for the exams and the Tutor will be able to evaluate how the Scholars are progressing.

5. Marking exam questions (30 minutes)

Scholars are given copies of the answers and mark their solutions. This activity gives an opportunity to address any common issues and for the Tutor and Scholar to assess how they are progressing through the course. If Scholars have calculators which allow them to evaluate logs to different bases, this is a good opportunity to make sure they can use this feature.

As the Tutor, do take this opportunity, while the Scholars are all working, to sign off Unit M2 in each of their Scholar's MSCE Resources Folder

6. Wrap up and set Scholars their self-study tasks for the next fortnight (20 minutes)

Self study for the next fortnight: factorising quadratic expressions, solving quadratic equations using factorisation, and Activities 1 and 2 of Unit M2 in the MSCE Resources.

Scholars draw up a table like the one below with the terms given in Unit M2.

Term	Definition and/or example 1	Definition and/or example 2	Final definition
Factorising			
Quadratic			
Expression			
Solve			
Equation			

Scholars work individually for about 5 minutes and write in the second column of their table a definition for as many of the terms that they can. An example can be used to help in the explanation.

In groups of three, Scholars discuss the definitions they have produced individually and give revised versions in the third column.

Each group then offers a definition to the whole group and any changes can be made in the final column.

MSCE M3: Algebra 2: Tutorial 7

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

• be able to factorise quadratic expressions

• be able to solve quadratic equations using factorisation

• be able to use the quadratic formula to solve quadratic equations

• be able to solve quadratic equations written in completed square form

• know what work they will need to have done for the next tutorial.

2. Warm up activity (15 minutes)

This activity focuses on numeracy skills for factorising quadratic expressions. Scholars are given ten pairs of numbers. For each pair they must find two numbers whose sum and product give the original numbers. For example, which two numbers have a product of −10 and a sum of 3? Answer is −2 and 5.

3. Categorising quadratic expressions (45 minutes)

This is an activity for groups of three. Groups are selected so there is a range of skills in algebra within the group. A list of quadratic expressions is written on the board. Each group puts the expressions into categories: i.e. those that do not have a constant; those that are the difference of two squares; those that have an x-squared coefficient which is not one; perfect squares; those that will not factorise. The groups can decide on their own categories; for example, some may have a category which mentions negative numbers.

Once the groups have completed this part of the task, one group writes their categorised lists on the board. Other groups then compare the lists on the board with their own. This is a good opportunity to check that Scholars have a good understanding of the mathematical meaning of the terms constant and coefficient. Scholars can also be asked which types of expression they find most difficult to factorise and why.

Scholars can now proceed to factorise where possible. Checking can be done by multiplying out the brackets and simplifying. The Tutor can then work with individuals or groups that need help.

One type of expression that may cause difficulty is where the x-squared coefficient is not equal to one. They may also have a variety of approaches to these types of questions depending on how they were taught at school. If this is the case, these different methods can be written on the board, preferably by the Scholars and there may be a discussion on which one is easiest to use.

4. Solving quadratic equations by factorisation (30 minutes)

Scholars now solve quadratic equations. Some of the later questions will require rewriting of the equations before factorising. A discussion point here is the difference between an expression and an equation. Scholars can work independently on this task, allowing those who are confident to move on to the more challenging questions.

At the end of this activity Scholars can mark each other's work and should be encouraged to discuss how the problems are set out in order to make it easy to see the method and avoid mistakes.

5. Solving equations using the formula (30minutes)

Return to the quadratic expressions in Section 2. Scholars are asked in their groups to discuss how they would solve a quadratic equation involving a quadratic expression which cannot be factorised. They should come up with using either the formula or by completing the square. There may be a number of different ways that they use completing the square depending on how they were taught at school. This part of the tutorial is going to focus on using the formula correctly. Most students can remember the formula but do not always use it correctly. Each group is then given five equations to solve. Scholars can check each other's solutions when the problems have been completed. There is opportunity for peer teaching at this point and the Tutor can check that all Scholars are writing down what they are going to do with their calculators before entering the values in the calculator. There may also need to be some clarification about rounding the answers.

6. Solving equations written in completed square form (20 minutes)

As students sometimes find it hard to write expressions in completed square form it is a good idea at this point in the tutorial to give equations already written in completed square form, e.g. solve the equation $2(x^2 - 3) = 5$.

7. Wrap up and set Scholars their self-study tasks for the next fortnight (20 minutes)

Practise writing expressions in completed square form. Also study simultaneous equations up to Activity 4 in Unit M3 of the MSCE Resources.

MSCE M3: Algebra 2: Tutorial 8

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to write quadratic expressions in completed square form

- be able to solve quadratic equations by completing the square

- be able to solve simultaneous equations

- know what work they will need to have done for the next tutorial.

2. Warm up activity (15 minutes)

Matching activity on quadratic expressions. Pairs of Scholars cut the sheets into pieces and then match the quadratic expressions. Some expressions can also be written in factorised form as well as completed square and $ax^2 + bx + c$ forms. Discussion points include: how the coefficient of the x term helps to identify which completed square term it may match. Is it easier to convert from completed square form to $ax^2 + bx + c$ form, or vice versa? What do you notice about the expressions which can be factorised and the completed square form?

3. Writing expressions in completed square form (45 minutes)

This is an activity for groups of three. Groups are selected so there is a range of skills in algebra within the group. Quadratic expressions that are to be written in completed square form are written on the board. Each group is then asked to puts the expression in order starting from which ones they think will be easiest to do with the hardest one last. A Scholar from one group then writes her list on the board. The other groups then compare their lists with the one on the board. Each group is then asked how they made their decisions. This is a good opportunity to check understanding of vocabulary such as coefficient, divisible, denominator, etc.

Scholars can now proceed to rewrite the expressions in completed square form. Checking can be done by multiplying out the brackets and simplifying. During this time the Tutor can work with individuals or groups that need help.

4. Recap on simultaneous equations (30 minutes)

Scholars are given the problem below or a similar one.

There are some cows and some chickens in a field. Altogether there are 59 heads and 190 legs. How many cows and how many chickens are there in the field?

Scholars are given 5 minutes to answer the question and they may work together to solve the problem This then leads to a discussion on how this problem was solved. There will be a variety of approaches, most of which will probably be some form of trial and improvement method. These should be praised. Hopefully however one or more Scholars will have attempted to use simultaneous equations. They can be invited to show how they solved the problem on the board. Otherwise this can be done by the tutor. Discussion here can arise on whether to use the elimination or substitution method.

Scholars then work in groups of three on approximately five linear simultaneous equations to solve. They can check their own solutions by substitution into the original pair of equations. The Tutor has the opportunity to help any individual or group that are having difficulty.

5. Algebraic vocabulary game: Splat (20 minutes)

Invite students to suggest terms that they have used in their study of algebra. Twelve is a good number. Write these terms up on the board in a random manner. Next ask two Scholars to come up and stand either side of the board. Now ask a different Scholar to give a definition, description or example of one of the words on the board. The two Scholars at the board then compete to splat the correct term. This can be done either with a rolled-up newspaper or simply with her hand. The Scholar who gets to the correct term first is the winner and the other sits down and is replaced by the Scholar who asked the question. Repeat until all the terms have been correctly described.

6. Simultaneous equation involving one quadratic equation (45 minutes)

An example of the above is written on the board and Scholars are asked how it is different from the ones they did earlier. If any Scholars are confident enough they can come to the board and work through the solution; otherwise it can be done by the Tutor.

In groups of three, Scholars work on a differentiated set of problems of this type. Checking is done by substitution into the original equations.

7. Wrap up and set Scholars their self-study tasks for the next fortnight (20 minutes)

Complete Activities 5 and 6 in Unit M3 in the MSCE Resources

MSCE M3: Algebra 2: Tutorial 9

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- Be able to solve problems involving algebraic fractions

- Be able to change the subject of a formula.

- Have had the opportunity to practice exam questions under timed exam conditions.

- Know what work they will need to have done for the next tutorial.

2. Warm up* activity (15 minutes)

Which operation? Scholars work individually and calculators are not allowed to be used. Attach my worksheet.

3. Plenary from warm up (15 minutes)

Check scholars' solutions and clarify any problems with addition and subtraction in particular.

4. Working with algebraic fractions (30 minutes)

Scholars are asked to write down an example of an algebraic fraction. Scholars are then grouped into 3s with a spread of ability in algebra in each group. Each group then compares their algebraic fractions. They can amend what they have written down if needed. This way of starting the session checks that each scholar understands what is meant by an algebraic fraction. The group is then asked to make new algebraic fractions with their 3 algebraic fractions using addition, subtraction, multiplication, division and squaring. They can also use a combination of these operations. The tutor checks the results and picks up any problems. Groups are told to simplify where possible and this can lead on to discussions about simplifying before multiplying. This is a very open ended task so stronger students can carry on producing more complex algebraic fractions while those that need it can get extra help.

5. Solving equations involving algebraic fractions (20 minutes)

Exam type questions on solving equations involving algebraic fractions emphasising that .a different approach in needed than for question on expressions using algebraic fractions.

*Starter activities – tutor may have their own or can use the one suggested. It is generally good to have a starter activity at the start of a maths tutorial session so scholars have the chance to 'warm up' and start thinking in a mathematical way. It is nice to have one that links to the topics being covered, but that is not always possible or necessary.

6. Changing the subject of the formula (40 minutes)

Scholars work in pairs with a more confident scholar paired with one who is less confident. First the scholars solve a few linear equations and quadratics involving no factorising or that are already written in completed square form.

Then they are given problems involving changing the subject of formulae. This will emphasise that they are doing the same thing as when solving equations just working with letters.

7. Timed exam questions (30 minutes)

Scholars work individually without notes or any assistance. Questions to be on M3 topics totalling less than 40 marks. Scholars will benefit from having the chance to do questions under 'exam conditions' in preparation for the exams and the tutor will be able to evaluate how the scholars are progressing. Feedback to be given in the next tutorial.

As the Tutor, do take this opportunity, while the Scholars are all working, to sign off Unit M3 in each of their Scholar's MSCE Resources Folder.

8. Wrap up and tasks set for the next fortnight (15 minutes)

M4 Three dimensional shapes exercises 1-4. Also simultaneous equations up to exercise 4.

Fraction Arithmetic ×,-,+ or ÷ ?

Fill in the missing operation

$$\frac{1}{3} \quad \frac{3}{5} = \frac{14}{15}$$

$$\frac{1}{5} \quad \frac{1}{3} = \frac{8}{15}$$

$$\frac{1}{3} \quad \frac{3}{5} = \frac{1}{5}$$

$$\frac{1}{3} \quad \frac{3}{5} = \frac{5}{9}$$

$$\frac{3}{5} \quad \frac{1}{3} = \frac{9}{5}$$

$$\frac{2}{3} \quad \frac{1}{6} = \frac{5}{6}$$

$$\frac{2}{3} \quad \frac{1}{6} = \frac{1}{2}$$

$$\frac{2}{3} \quad \frac{1}{6} = \frac{1}{9}$$

$$\frac{1}{6} \quad \frac{2}{3} = \frac{1}{4}$$

$$\frac{2}{3} \quad \frac{1}{4} = 4$$

$$\frac{1}{2} \quad \frac{1}{3} = \frac{1}{6}$$

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to identify and sketch 3D shapes
- be able to the find surface area and volume of 3D shapes
- know what work they will need to have done for the next tutorial.

2. Warm up activity (15 minutes)

Sketch the following on the board and, for each one, Scholars are asked:

It is a net of a cube? Is it a net of a die? (Opposite sides add up to 7.)
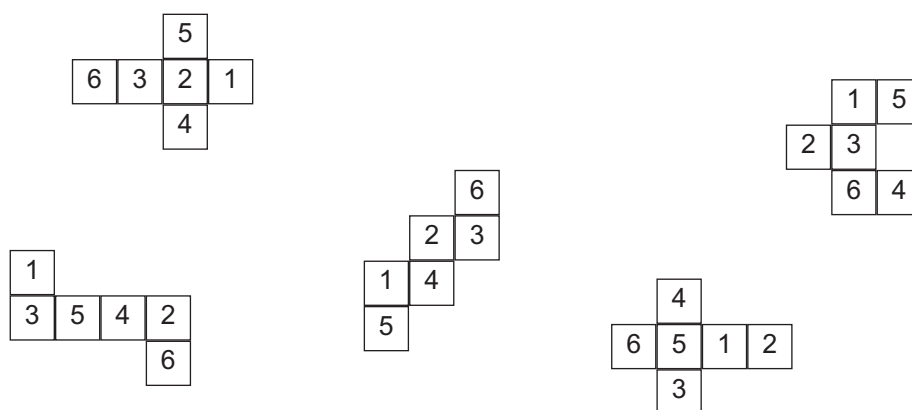
3. Nets and surface area and volume of cubes, cuboids and prisms (45 minutes)

Scholars work in groups of four with a range of abilities. Each group is given nets of a cube, cuboid, triangular prism and a prism with a cross-section of a trapezium. Scholars then work together to:

a. identify the 3D shape that each net will produce
b. work out the area of each net
c. make the 3D shapes (scissors and sticky tape will be needed)
d. work out the volume of each of the 3D shapes.

The Tutor will need to check that the shapes have been correctly identified and calculations done correctly. Hopefully at least one of each group will be able to work out the area of trapeziums. If not, the Tutor will need to clarify this.

4. Other 3D shapes (15 minutes)

Recapping on the other 3D shapes that may be examined is a good opportunity to use a collective memory activity similar to the way it was used in Tutorial 3. This time there is one poster with sketches of a pyramid, cone, sphere and cylinder. Formulae for working out surface area and volumes for these shapes that are not going to be given in the exam are also on the poster. One Scholar from each group then comes to the desk with the poster on and is given 15 seconds to memorise as much of the information on the poster as possible. This Scholar then goes back to her group and has 1 minute to reproduce as much of the information on the poster as she can.

At the end of the minute another member of the group comes to look at the poster for 15 seconds and then goes back to the group and fills in any missing information. If necessary the other two members of the group repeat this process.

5. Practice exam type questions (45 minutes)

Scholars are paired so that stronger Scholars work together. This will allow those who are working quickly to move on and those who need more time will be able to get help. Pairs are given exam type questions on surface area and volume of 3D shapes.

6. Recap on Pythagoras and trigonometry (30 minutes)

A number of right-angled triangles are drawn on the board with the lengths of two sides given. Scholars are asked to find the length of the third side and the acute angles in the triangle. If any Scholars do not remember how to use Pythagoras' Theorem and trigonometry correctly they can be prompted by either the other Scholars or the Tutor.

7. Wrap up and set Scholars their self-study tasks for the next fortnight (15 minutes)

Revisit three dimensional shapes Exercise 5 and Questions to

practise in the M4 of the MSCE Resources.

MSCE M4: Measuring geometric shapes and solids: Tutorial 11

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to identify and find angles between lines
- be able to identify and find angles between planes
- be able to identify and find angles between lines and planes
- know what work they will need to have done for the next tutorial.

2. Warm up activity (15 minutes)

Sets of three numbers are written on the board. Scholars are asked to identify which sets would produce a right-angled triangle if each set were the lengths of the sides of a triangle.

3. Angles between lines (30 to 40 minutes)

The longer time will be needed if Scholars make models of the prism.

Scholars work in pairs for this activity. A sketch of the prism is drawn on the board with the lengths of some sides given. If possible, Scholars make a frame of a right triangular prism from thin wire. Scholars are then asked to find the distance between one vertex of the prism and all the other vertices. Once these have been correctly found, Scholars then find the angles between all the lines whose lengths are known.

Scholars are asked to sketch a cuboid labelling the vertices A, B, C, D, E, F, G and H, and the length, breadth and height are given. The exercise above is then repeated.

4. Angles between planes (20 minutes)

Scholars are asked to name all the sides of the triangular prism. They are then asked to find the angle between the planes. Some may be written down directly if they are perpendicular. If wire frames have been used Scholars can cover the sides with paper so they can better visualise what is meant by a plane.

This exercise is then repeated for the cuboid above.

5. Angles between lines and planes (20 minutes)

Using the two shapes above Scholars are asked to find angles between lines and planes. If models have been used Scholars can draw the lines on the paper sides if they are finding it hard to visualise the difference between a plane and a line.

6. Questions on other types of 3D shapes (20 minutes)

In pairs, Scholars practise similar questions about finding angles between lines and planes but with other shapes such as pyramids. During this time the Tutor can work with any Scholars who are finding these 3D questions challenging.

7. Exam question practice (30 minutes)

This could be done either as a paired activity where individual questions are written on cards which are completed one at a time and then returned to the front table fromwhere a new one is selected as in Tutorial 1, or as timed exam practice.

As the Tutor, do take this opportunity, while the Scholars are all working, to sign off Unit M4 in each of their Scholar's MSCE Resources Folder.

8. Wrap up and set Scholars their self-study tasks for the next fortnight (15 minutes)

Revise Statistics, in Unit M5, MSCE Resources.

MSCE M5: Statistics: Tutorial 12

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- be able to draw pie charts, bar charts, line graphs, histograms and frequency polygons
- be able to interpret pictograms, bar charts, line graphs, histograms and frequency polygons
- be able to group larger sets of data
- know what work they will need to have done for the next tutorial.

2. Warm up activity (15 minutes)

A list of types of data is written on the board. Scholars are asked to decide if they are continuous or discrete data.

3. Drawing pie charts and bar charts (40 minutes)

Scholars work in pairs for this activity so that the stronger Scholar can support the weaker one. Each pair is given two sets of data, one in the form of a pictogram and one in the form of a bar chart. They are asked to draw two pie charts from this data. They will need to draw up frequency tables in order to do the calculations. Within each pair, each Scholar does the calculations and drawing for one set while being directed by the other, they then switch round. This will ensure that the stronger one does not do all the work. If neither of the Scholars in a pair are sure how to calculate or draw the angles correctly the Tutor can then help.

Once the diagrams are complete pairs are given some questions on the sets of data.

As a plenary to this activity, Scholars are asked to say which representation of the data they used to answer each question.

4. Line graphs (30 minutes)

Scholars work in their pairs to draw a line graph from a given table of data. Half the group is given one set of data, the other half a different set. Once the line graph has been drawn they then compose questions on their graph.

Pairs then swap their graphs and questions. Pairs then answer questions on the other set of data.

5. Grouping data (50 minutes)

Staying in their pairs Scholars are given two sets of ungrouped data. Each works with one set of data and draws tally charts and groups the data. (Groups should be set by the Tutor and a check done to make sure Scholars are aware of the notation for the groups.)

Once the tallies have been completed they work together to produce a histogram and a frequency polygon.

Extension: If any groups finish before the others (which is often the case with this topic), they can again compose questions based on their tables or graphs. Some may start thinking about averages at this point which leads in nicely to the next part of the unit.

6. Notation needed to find means from tables (20 minutes)

Using the data in the table that Scholars used to draw the frequency polygon, they are asked to find $\sum f$, $\sum fx$ and $\sum fx^2$ where x is the mid-point of each class. Writing these expressions on the board can prompt a discussion about what the $\sum$, f and x mean. Hopefully some Scholars will remember this from their previous study; if not this can be clarified before they use this notation in the next part of the unit.

7. Wrap up and set Scholars self-study tasks for the next fortnight (15 minutes)

Statistics in Unit M5, MSCE Resources.

MSCE M5: Statistics: Tutorial 13

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- calculate the mean and standard deviation for a list of numbers

- calculate the mean and standard deviation from a frequency table

- know what work they will need to have done for the next tutorial.

2. Warm up activity (20 minutes)

Scholars are asked to write down sets of five numbers which:

    a. Have a range of 10
    b. Have a mode of 3
    c. Have a median of 6
    d. Have a mean of 4
    e. Have a mean of 8 and a range of 5

Scholars can check each other's answers

3. Terminology and formulae for statistics (30 minutes)

In this version of Splat, the Scholars write down as many terms and formulae as they can on the board. The Tutor checks for repeated words and formulae and adds any missing ones. This is a good opportunity to ensure that the group knows what the terms variance and standard deviation mean and when each formula should be used. As previously, two Scholars start at the board. The Tutor then selects one of the rest of the group to give a definition or description of one of the terms or formulae on the board. The first of the two at the board to splat the correct work or formula wins and the loser is replaced by the Scholar who asked the question.

A recap on how to calculate the variance may be needed.

4. Calculating the mean, variance and standard deviation (45 minutes)

Scholars are given a list of values, a frequency table and a grouped frequency table. For each they are asked to work out the mean, variance and standard deviation. The aim of this task is to ensure that Scholars know which formula to use when, as well as knowing the formula and being able to accurately do the calculations. Scholars work in pairs in which the stronger Scholar can peer teach the weaker one.

5. Mixture of exam type questions on statistics (45 minutes)

Scholars are now put in different pairs so that Scholars of similar ability are working together. Each pair is given one question to start with. Subsequently Scholars select a new question from a selection presented on a table at the front of the room. Each sheet of paper or card has just one question on it. The level of difficulty is indicated in some way; using colour

is nice if possible. Scholars can then work on one problem and solutions are self checked before moving on to a more challenging question, or another question at a similar level. Giving the Scholars an opportunity to move around at this point in the tutorial will help to keep energy levels up. This is an opportunity for the Tutor to work with any individual students who are finding this topic difficult or possibly work with a small group on one problematic area.

As the Tutor, do take this opportunity, while the Scholars are all working, to sign off Unit M5 in each of their Scholar's MSCE Resources Folder.

6. Wrap up and set Scholars their self-study tasks for the next fortnight (15 minutes)

Revise Angles and Circles, Unit M6, MSCE Resources, if needed. Possibly Scholars could be lent the equipment they need to practise the constructions.

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- know angle properties of parallel lines and triangles and solve problems using them

- be able to construct angles of 30°, 45°, 60° and 90° using only a ruler and compasses

- know what they need to have done before the next tutorial.

2. Starter activity: How many triangles? (15 minutes)

Ask the Scholars to count the number of triangles in the diagram below.
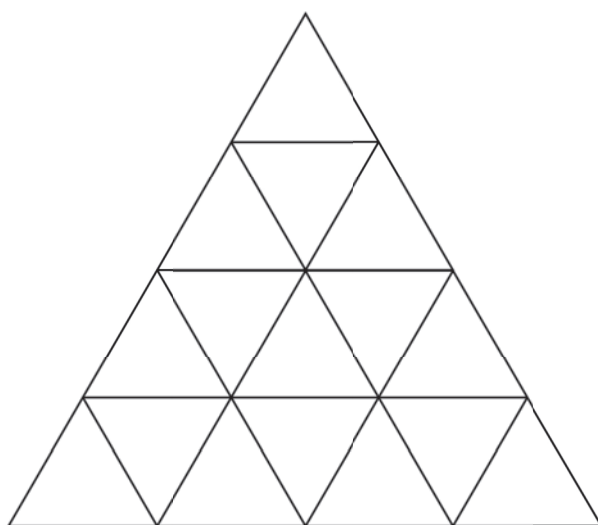
3. Review of angle properties of parallel lines and triangles (20 minutes)

Scholars work in groups of three or four to produce a poster showing the angle properties of parallel lines and triangles. Each property should be illustrated with a diagram and a written explanation. The aim of this task is to recall the properties correctly and fully without referring to the Scholar's MSCE Resources Folder. By working in groups all the relevant detail should be included. Tutor should check each poster and any misconceptions can be addressed. The posters that are produced can then be displayed around the room and Scholars given 5 minutes to walk around and look at each other's. The posters can be used as prompts in the next exercise.

4. Identifying angles and parallel lines in diagram (40 minutes)

Scholars work in pairs of similar ability on questions of the type *similar* to Activities 2 and 3 and the Practice questions, Unit M6 in the Scholar's MSCE Resources Folder, but involving *only* triangles, other polynomials and parallel lines. Questions should become more challenging as the exercise progresses, so that Scholars gain confidence and the more able are challenged. Answers are checked by the Tutor as the Scholars are working to ensure progress is being made by all and there is an opportunity to support individuals and ensure answers are set out in the correct way.

5. Construction of angles of 30°, 45° 60° and 90° (45 minutes)

Tutor can start this session with a demonstration of one of the constructions in order to model how to use the instruments effectively. Scholars can then work individually on reproducing the given constructions. Once they have carried out the basic constructions, they could construct designs such as the one used in the starter activity.

6. Splat activity on the terminology involved in M6 (15 minutes)

As in Tutorial 8, invite students to suggest terms that they have used in their study of angles and circles. Twelve is a good number. If any key words are missing the Tutor can add them to the board. Write these terms on the board in a random manner. Next ask two Scholars to come up and stand either side of the board. Now ask a Scholar from the rest of the class to give a definition, description or example of one of the words on the board. The two students at the board then compete to splat the correct term. This can be done with a rolled-up newspaper or simply with her hand. The Scholar who gets to the correct term first is the winner and the other sits down and is replaced by the Scholar who asked the question. Repeat until all the terms have been correctly described.

7. Collective memory activity to recap circle theorems and tangents to circles (15 minutes)

This activity can be done either as in Tutorial 3 with the poster being shown to the whole group or as in Tutorial 10 with one Scholar from each group looking at the poster and then reproducing what she saw to the whole group. The poster should show diagrams of the circle theorems and also rules about tangents to circles.

8. Wrap up and set Scholars self-study tasks for the next fortnight (15 minutes)

Ask Scholars to complete Angles and circles, Unit M6, Scholar's MSCE Resources Folder

MSCE M6: Angles and Circles: Tutorial 15

1. Aims of the tutorial

By the end of this tutorial, Scholars will:

- know chord, angle and tangent properties of circles and solve problems using them

- be able to construct a tangent to a circle and tangents from an external point.

2. Starter activity (15 minutes)

Matching activity on circle theorems. Copy and cut the sheet into pieces. Scholars work in pairs to match the diagram to the correct theorem.

3. Review of circle theorem questions given to Scholars for their self-study at the end of the last tutorial (30 minutes)

In pairs Scholars compare their solutions to Practice questions in Unit M6 in the Scholar's MSCE Resources Folder (written solutions only, not the constructions at this stage). By pairing Scholars so that one of the pair is stronger than the other peer tutoring may be possible. If there are common problems the Tutor could review them with the whole group.

4. Exam practice questions on chord, angle and tangent properties (45 minutes))

Scholars work in groups of three. Each group works on a different exam type question. When all the groups have completed their problem, one member of the group presents her solution to the whole class. If one or more group finishes before the rest they can be given one of the other problems to do. As each group finishes their question the Tutor checks the solution is correct and gives prompts if necessary.

5. Practising constructions (30 minutes)

Scholars working in pairs are given a number of constructions to complete. These constructions will be used in the next activity. The accuracy of the construction is checked by the Scholar's partner.

6. Designing exam questions (30 minutes)

Scholars working in the same pairs choose one of the diagrams they have constructed and write an exam style question of the type they worked on in Section 4. They must work out the solution to their problem. Each pair then passes their question to another pair to complete.

As the Tutor, do take this opportunity, while the Scholars are all working, to sign off Unit M6 in each of their Scholar's MSCE Resources Folder.

7. Wrap up of the course and give revision advice (30 minutes)

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