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Getting Ready to Teach the Pearson Edexcel International GCSE Further Pure Mathematics (9 – 1) (4PM1)

16IOAM12

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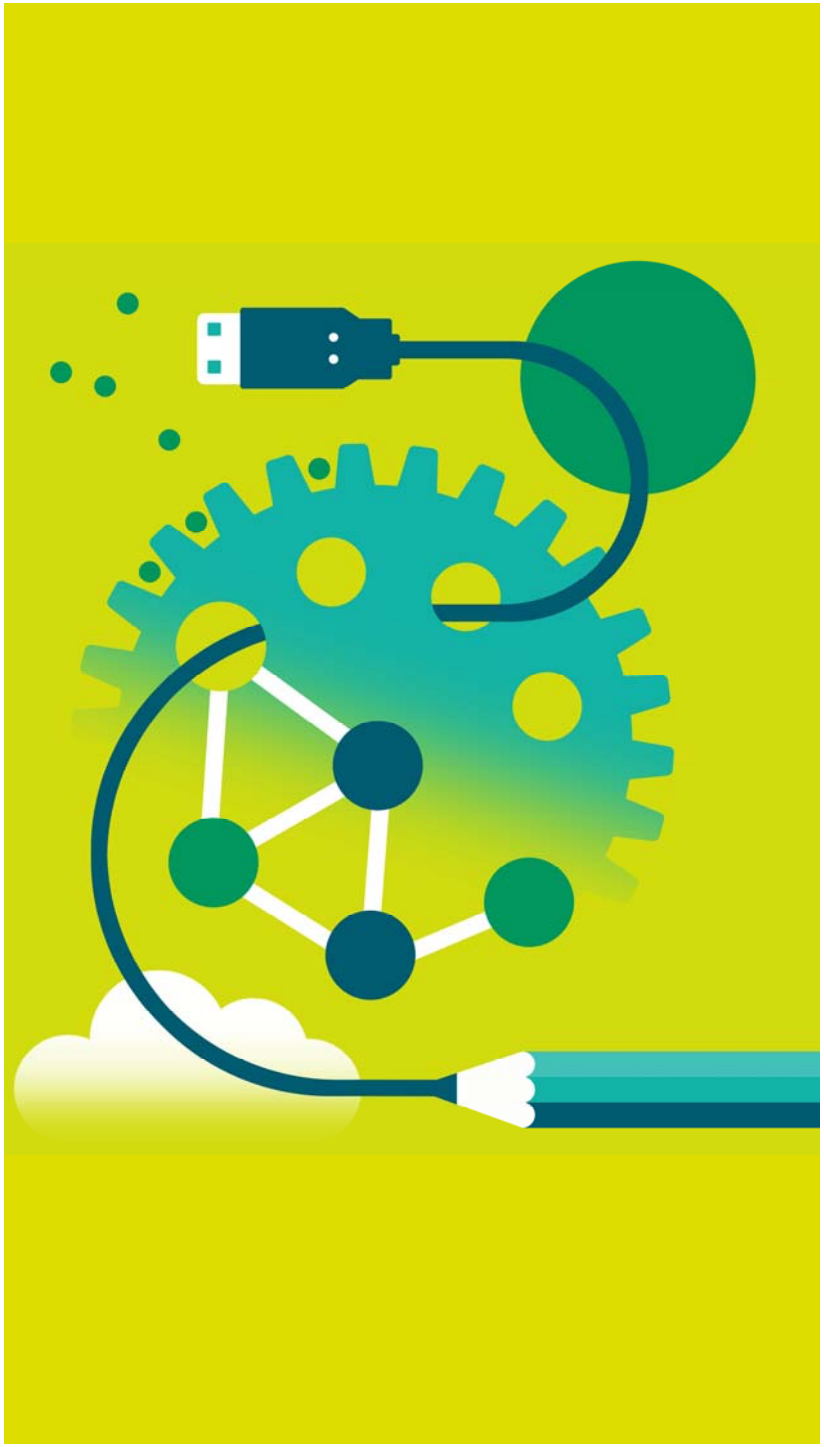

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Aims and Objectives

- This session is designed to give you information about the changes to International GCSE Further Pure Maths.

By the end, you should know about,

- changes in the grading system
- changes in specification content
- important dates
- and feel happy about starting to teach Edexcel International GCSE (9-4) Further Pure Mathematics 4PM1

Session Agenda

Please amend the below

16:10 Welcome
Overview of changes to International GCSE Further Pure Mathematics, including grading and structure
16:45 Content changes
17:00 Comfort break
17:10 Content changes continued
17:55 Resources from Pearson
18:00 Finish

Introduction to the Assessment

Content

There are some minor updates to the present specification, rather than large-scale changes to the specification.

Assessment Objectives / Skills Tested

AO1 Demonstrate a confident knowledge of the techniques of pure mathematics.

AO2 Apply a knowledge of mathematics to the solutions of problems for which an immediate method is not available.

AO3 Write clear and accurate mathematical solutions.

Structure of Assessment

Both papers are each 50% of the total International GCSE.

Each paper is assessed through a 2-hour examination set and marked by Pearson and consist of around 11 questions with varying mark allocations per question which will be stated on the paper.

The specification will have approximately 40% of the marks distributed evenly over grades 4 and 5, and approximately 60% of the marks distributed evenly over grades 6, 7, 8 and 9.

Information gained from our consultations and the changes we are making

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Information gained from our consultations

- International GCSE Maths is valued by teachers and learners as an attractive equivalent to GCSE Maths and an alternative preparation for A level
- Centres would welcome some updates, rather than large-scale changes to the specification
- Centres generally would like grades to be on the same scale as for the new GCSE (9 - 1) Maths

Following consultations we are making the following changes to the International GCSE

- A move from the current A*-G to the new 9 – 1 grading structure to maintain comparability with GCSE 9 – 1 Maths

- Some minor additions to the content assessed to reflect this new 9 – 1 grading structure

…but…

- The changes are natural extensions of the current content
- The changes should not involve a large amount of extra teaching time
- Questions requiring the use of problem solving and mathematical reasoning are nothing new to the International GCSE specification – there is just a slight increase in these
- Question types and language used will be very similar to those on the current specification

International centres

The FINAL assessment date for Further Pure Mathematics 4PM0 specification will be January 2019.

The first assessment of International GCSE Further Pure Mathematics will be June 2019.

Assessment Structure

Assessment Structure

Paper number	Assessment information	Number of raw marks allocated in the paper
Paper 1 Calculator allowed	Assessed through a 2 hour examination set and marked by Pearson. The paper is weighted at 50% of the qualification, targeted at grades 9 – 4 with 3 allowed.	100
Paper 4H (calculator allowed)	Assessed through a 2 hour examination set and marked by Pearson. The paper is weighted at 50% of the qualification, targeted at grades 9 – 4 with 3 allowed.	100

Assessment Objectives and weightings

A01 (30 - 40%)

Demonstrate a confident knowledge of the techniques of pure mathematics required in the specification.

A02 (20 - 30%)

Apply a knowledge of mathematics to the solutions of problems for which an immediate method of solution is not available and which may involve knowledge of more than one topic in the specification.

A03 (35 - 50%)

Write clear and accurate mathematical solutions

Relationship of assessment objectives to units

Unit Number	Assessment Objectives		
	AO1	A02	A03
Paper 1	15 – 20%	10 – 15%	17.5 – 25%
Paper 2	15 – 20%	10 – 15%	17.5 – 25%
Total for International GCSE	30 – 40%	20 – 30%	35 – 50%

Content Summary

Questions will be set on the following four general topics;

- **Number**
- **Algebra and Calculus**
- **Geometry**
- **Trigonometry**

Marks allocated to Grades

40% marks distributed evenly over grades 4 & 5

60% of marks distributed over grades 6, 7, 8 & 9

Note: Grade 3 will be awarded as a safety net, but **no questions will be set at grade 3.**

Types of marks

M – Method mark; is awarded for a correct method.

Note: the method must be complete of the award of this mark.

A – Accuracy mark; is awarded for a correct answer.

Note: If the method mark has not been awarded, for example and incorrect method has been used, the **A** mark is automatically not available, even if the final answer is correct.

B - Independent mark; is awarded for a correct answer seen.

Advice to candidates

- Candidates would be well advised to **state** formulae before using them.
- Candidates should be very careful in their use/omission of brackets
- In ‘show that’ questions **all necessary steps** must be shown.
- The rubric clearly states that answers without working may not gain full marks.
- A final point is that candidates should be encouraged to work neatly. This will not only help the candidate organise their thoughts, but help the examiner to award marks.

Content

1. Logarithmic functions and indices

A	The functions a^x and $\log_b x$ (where b is a natural number and $b > 1$)
B	Use and properties of indices and logarithms, including change of base
C	Simple manipulation of surds
D	Rationalising the denominator

We now expect candidates to be able to rationalise the denominator for expressions such as $\frac{1}{2-\sqrt{3}}$ as well as those with a denominator that is a pure surd. This brings the specification into line with 4MA1 and 4MB1.

SAM Question 8 part (d) Paper 2

(d) Express $\frac{1}{\sqrt{10}-3}$ in the form $a\sqrt{10}+b$, where a and b are integers.

(2)

1. Logarithmic functions and indices

SAM Question 6 Paper 2

6 Solve the equation $\log_2 x + 6\log_x 2 = 7$ (7)

Candidates are expected to be able to use the properties of indices and logarithms, including change of base of the logarithm.

This question will develop into a quadratic equation so that specification reference **2A** (manipulation of quadratic equations) will also be tested here.

1. Logarithmic functions and indices

At its very simplest, questions such as

Find the value of $\log_3 9$

could be asked.
(Paper 2 June 2015 Q 10 (a))

This is a 1 mark question as it is expected that candidates are able to ‘write down’ the correct value.

1. Logarithmic functions and indices

This is an example of a ‘show’ question

(c) ‘Show that’

$$2x\log_3 x - 3\log_3 x - 4x\log_9 4 + 6\log_9 4 = \log_3\left(\frac{x}{4}\right)^{(2x-3)} \quad (6)$$

The instruction ‘show that’ means that candidates must show EVERY step in their working, and note that there are 6 marks available in this part. This is an indication that a lot of work is required for that many marks. Candidates must demonstrate they understand logarithmic rules.

(Paper 2 June 2015 Q10 (a))

2. The Quadratic function

There is no new content in this section.

A	The manipulation of quadratic expressions
B	The roots of a quadratic equation
C	Simple examples involving functions of the roots of a quadratic equation

2. The Quadratic function

A The manipulation of quadratic expressions

Candidates are expected to be able to recognise applications where quadratic equations require to be solved as part of the problem.

For example; **SAMs Question 4 (a) Paper 1**

A particle P is moving along the x-axis.

At time t seconds ($t \geqslant 0$) the velocity, v m/s, of P is given by $v = 4t^2 - 19t + 12$

(a) Find the values of t for which P is instantaneously at rest.

(2)

2. The Quadratic function

Candidates should be able to use the discriminant to identify whether the roots are equal, real or not real as in this part question in the SAMs.

SAMs Question 4 part (c) Paper 2

4 $f(x) = 2x^3 + px^2 + qx + 12 \quad p, q \in \mathbb{Z}$

Given that $(x + 3)$ is a factor of $f(x)$ and that when $f'(x)$ is divided by $(x + 3)$ the remainder is 37

(a) show that $p = 1$ and find the value of q

(6)

(b) hence factorise $f(x)$ completely

(2)

(c) show that the equation $f(x) = 0$ has only one real root.

(2)

2. The Quadratic function

SAMs Question 9 Paper 1

Here is a question involving functions of the roots of a quadratic equation

9 The roots of a quadratic equation are α and β where $\alpha + \beta = -\frac{7}{3}$ and $\alpha\beta = -2$

(a) Find a quadratic equation, with integer coefficients, which has roots α and β

(4)

Given that $\alpha > \beta$ and without solving the equation,

(b) show that $\alpha - \beta = \frac{11}{3}$

(2)

(c) form a quadratic equation, with integer coefficients, which has roots

$$\frac{\alpha + \beta}{\alpha} \text{ and } \frac{\alpha - \beta}{\beta}$$

(7)

3. Identities and Inequalities

There is no new content in this section

A	Simple algebraic division
B	The factor and remainder theorems
C	Solutions of equations, extended to include the simultaneous solution of one linear and one quadratic equation in two variables
D	Simple inequalities, linear and quadratic
E	The graphical representation of linear inequalities in two variables

3. Identities and Inequalities

SAMs Question 4 Paper 1

4 $f(x) = 2x^3 + px^2 + qx + 12 \quad p, q \in \mathbb{Z}$

Given that $(x + 3)$ is a factor of $f(x)$ and that when $f'(x)$ is divided by $(x + 3)$ the remainder is 37

(a) show that $p = 1$ and find the value of q

(6)

(b) hence factorise $f(x)$ completely

(2)

(c) show that the equation $f(x) = 0$ has only one real root.

(2)

This questions also brings in specification **9A** (differentiation)

3. Identities and Inequalities

This question comes from January 2016

Solving simultaneous equations of one linear and one quadratic in 2 variables.

3 Solve the equations

$$3y = 12 - 4x$$

$$(x + 1)^2 + (y - 2)^2 = 4$$

(7)

The next slide is a copy of the examiners report from this question.

3. Identities and Inequalities

Here is a quote from the Principal Examiners report for this question.

Question 3:

Forming and substituting an equation with y as the subject was the most popular choice and this usually resulted in candidates earning at least the first three marks. A variety of algebraic errors were seen including failing to divide both terms by 3 (or 4) when making y (or x) the subject, errors on substitution such as the +1 or -2 being omitted, poor expansion of the bracketed terms and careless collection of like terms after expansion. Each of these errors meant the A mark for a correct 3-term quadratic was lost along with the final two A marks for the correct values of x and y.

Any prior algebraic errors resulted an incorrect quadratic which was usually dealt with by using the quadratic formula. This meant that candidates still had a chance to earn the final M mark for solving their quadratic with an appropriate method. However, there were some incorrect expressions for the quadratic formula or errors on substitution without a correct formula which mean the M mark was also lost.

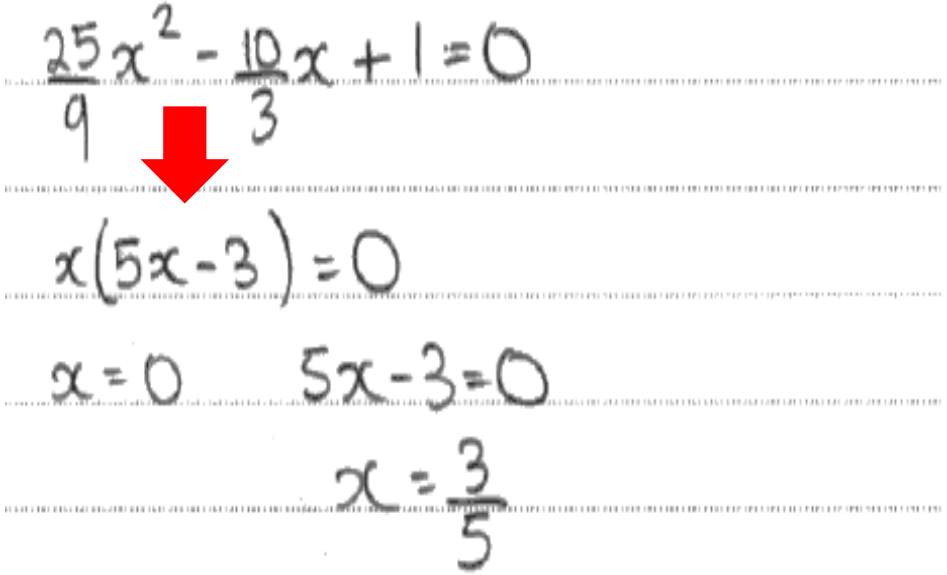
3. Identities and Inequalities

Here is an example of a candidate ‘solving’ their **correctly found** quadratic equation.

The correct solution of this quadratic is indeed $x = \frac{3}{5}$

but because the method is incorrect and x = 0 is **not** a root, then the 2 available marks (M1A1) were lost here.

Neither did the candidate go on to find a value for *y*, and so lost the final mark as well, and having completed the ‘difficult’ part of the question correctly achieving only 4/7 available marks.



3. Identities and Inequalities

SAMs Question 2 Paper 2

In this question candidates have to find a simple linear inequality in part (a), a quadratic equality in part (b), and combine the result for part (c).

2 Find the set of values of x for which

(a) $3 + x < 2x - 1$

(1)

(b) $x(x - 1) > 6$

(3)

(c) **both** $3 + x < 2x - 1$ **and** $x(x - 1) > 6$

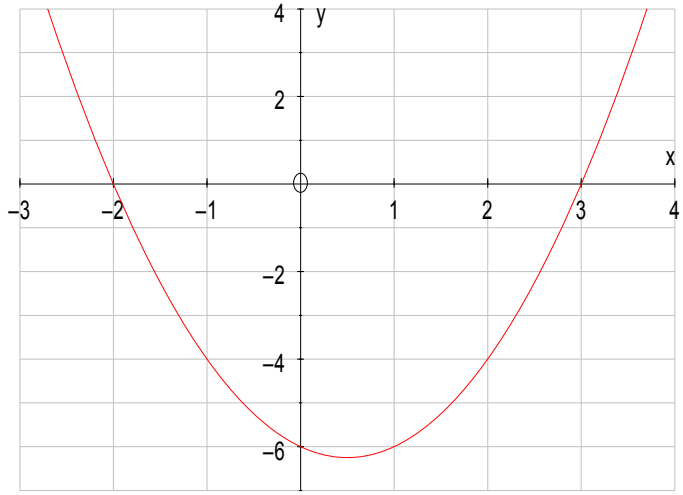
(1)

3. Identities and Inequalities

Teaching quadratic inequalities

e.g. $x^2 - x - 6 < 0$

- Find critical values: solve $x^2 - x - 6 = 0 \Rightarrow x = 3, -2$
- Sketch or table?
- So $-2 < x < 3$



- For $x^2 - x - 6 > 0$
- $x < -2$ OR $x > 3$
- **Do Not Write** $3 < x < -2$

3. Identities and Inequalities

SAMs Question 1 Paper 1

Candidates are expected to be able to plot straight lines from the equation of a straight line given in any form, and to identify a region defined by inequalities.

1 (a) On the axes below, sketch the lines with equations $2x + 3y = 8$ and $2y = 4x + 1$

On your sketch, show the coordinates of the points where the lines cross the coordinate axes.

(2)

(b) Show, by shading on your sketch, the region R defined by the inequalities

$$2x + 3y \leqslant 8 \qquad 2y \leqslant 4x + 1 \qquad y \geqslant 0 \qquad x \leqslant 2$$

(2)

4. Graphs

There is no new content in this section

A	Graphs of polynomials and rational functions with linear denominators
B	The solution of equations and transcendental functions by graphical methods

4. Graphs

SAMs Question 7 Paper 2

The concept of asymptotes parallel to the coordinate axes is expected as in this question.

7 The curve C with equation

$$y = \frac{ax - 5}{x - b}$$

where a and b are integers, crosses the x-axis at the point (2.5, 0). The asymptote to C which is parallel to the y-axis has equation $x = 1$

(a) (i) Show that $a = 2$

(ii) Find the value of b.

(3)

(b) Find the coordinates of the point where C crosses the y-axis.

(1)

(c) Find the equation of the asymptote to C which is parallel to the x-axis.

(1)

(d) Using the axes below, sketch the curve C showing clearly the asymptotes and the coordinates of the points where C crosses the coordinate axes.

(3)

4. Graphs

SAMs Question 7 Paper 1

This question follows on the next slide.

Part (c) of the question links in to specification reference **1B** (Use and properties of indices and logarithms)

4. Graphs

7 (a) Complete the table of values for

$$y = 2^{\left(\frac{x}{2}+1\right)} + 1$$

giving your answers to 2 decimal places where appropriate.

(2)

x	0	1	2	3	4	5
y	3				9	12.31

(b) On the grid opposite, draw the graph of $y = 2^{\left(\frac{x}{2}+1\right)} + 1$ for $0 \leqslant x \leqslant 5$

(2)

(c) By drawing a suitable straight line on the grid, obtain an estimate, to 1 decimal place, of the root of the equation $\log_2(4x-6)^2 - x = 2$ in the interval $0 \leqslant x \leqslant 5$

(4)

5. Series

There is no new content here, but the formulae for the sum to *n* terms of an Arithmetic series and of a Geometric series will now be given in the formula sheet. The formula for the sum to infinity of a geometric series will also be given. (The formulae for the *n*th terms will **NOT** be given).

A	Use of the $\sum$ notation.
B	Arithmetic and Geometric series.

Use of the sum to infinity of a convergent series, including the use of $|r| < 1$ is required.

Note: Proofs of the summation formulae are not required – although they are beautiful mathematics and are well worth discussing with students.

5. Series

Arithmetic series

SAMs Question 8 Paper 1

8 The sum S_n of the first n terms of an arithmetic series is given by $S_n = 2n(n + 3)$

(a) Find the first term of the series.

(1)

(b) Find the common difference of the series.

(2)

The nth term of the series is T_n

Given that $6S_{(n-4)} = 7T_{(n+3)}$

(c) find the value of n.

(6)

5. Series

Geometric series – sum to infinity

SAMs Question 1 Paper 2

1 The nth term of a geometric series is $3e^{(1-2n)}$

Find the sum to infinity of this series.

Give your answer in the form $\frac{ae}{e^b - 1}$ where a and b are integers to be found.

This is an example of an AO2 question.
In order to start it is necessary to find the first term and the common ratio as shown on the next slide, although no indication of this is given in the question.

5. Series

It is always useful to write out a few terms of the sum of a series given in $\sum$ form.

For example;

n	1	2	3	4	5
U_n	$3e^{-1}$	$3e^{-3}$	$3e^{-5}$	$3e^{-7}$	$3e^{-9}$

$\Rightarrow$ First term $= 3e^{-1}$

$$\Rightarrow \text{Common ratio} = \frac{3e^{-3}}{3e^{-1}} = e^{-2}$$

5. Series

The question asks for the sum to infinity in a specific form, so candidates should always look at the given form at every stage to make sure they are working in the correct direction.

$$S = \frac{3e^{-1}}{1-e^{-2}} = \frac{\frac{3}{e}}{1-\frac{1}{e^2}} = \frac{\frac{3}{e}}{\frac{e^2-1}{e^2}} = \frac{3e}{e^2-1}$$

6. The binomial series

There are no changes in this section but the formula for the Binomial expansion of $(1+x)^n$ will now be given in the formula sheet.

A Use of the binomial series $(1+x)^n$

Questions can be set for the use of the series when:

(i) n is a positive integer

(ii) n is rational and $|x| < 1$

The validity condition for (ii) is expected.

6. The binomial series

SAMs Question 8 Paper 2

This question is on the next slide.

It includes specification reference **1C** and **1D** in parts (c) and (d)
(Simple manipulation of surds and rationalising the denominator)

6. The binomial series

8 (a) Expand $\frac{3}{\sqrt{1-2x}}$ in ascending powers of x up to and including the term in x^3 and simplifying each term as far as possible.

(4)

(b) Write down the range of values of x for which this expansion is valid.

(1)

(c) Show that $\frac{3}{\sqrt{0.9}} = \sqrt{10}$

(1)

(d) Express $\frac{1}{\sqrt{10}-3}$ in the form $a\sqrt{10}+b$, where a and b are integers.

(2)

(e) Hence, using your expansion with a suitable value for x, obtain an approximation to 5 decimal places of $\frac{1}{\sqrt{10}-3}$

(3)

7. Scalar and vector quantities

There are no changes in this section

A The addition and subtraction of coplanar vectors and the multiplication of a vector by a scalar.
B Components and resolved parts of a vector
C Magnitude of a vector
D Position vector
E Unit vector
F Use of vectors to establish simple geometrical properties of geometrical figures.

7. Scalar and vector quantities

SAMs Question 3 Paper 2

3 O, A and B are fixed points such that

$$\overrightarrow{OA} = 4\mathbf{i} + 3\mathbf{j} \qquad \overrightarrow{OB} = 8\mathbf{i} + p\mathbf{j} \qquad \text{and} \qquad \left|\overrightarrow{AB}\right| = 2\sqrt{13}$$

(a) Find the possible values of p.

(3)

Given that $p > 0$

(b) find a unit vector parallel to $\overrightarrow{AB}$

(2)

7. Scalar and vector quantities

Vector questions always clearly differentiate between the strongest and the weakest candidates.

Many marks in questions in vectors are lost due to two reasons;

1. candidates do not have a consistent approach to directions which are so crucial in this work, and
2. candidates use poor notation.

Questions frequently begin with fairly routine demands.

The next slide gives a typical example.

7. Scalar and vector quantities

Example Question January 2016

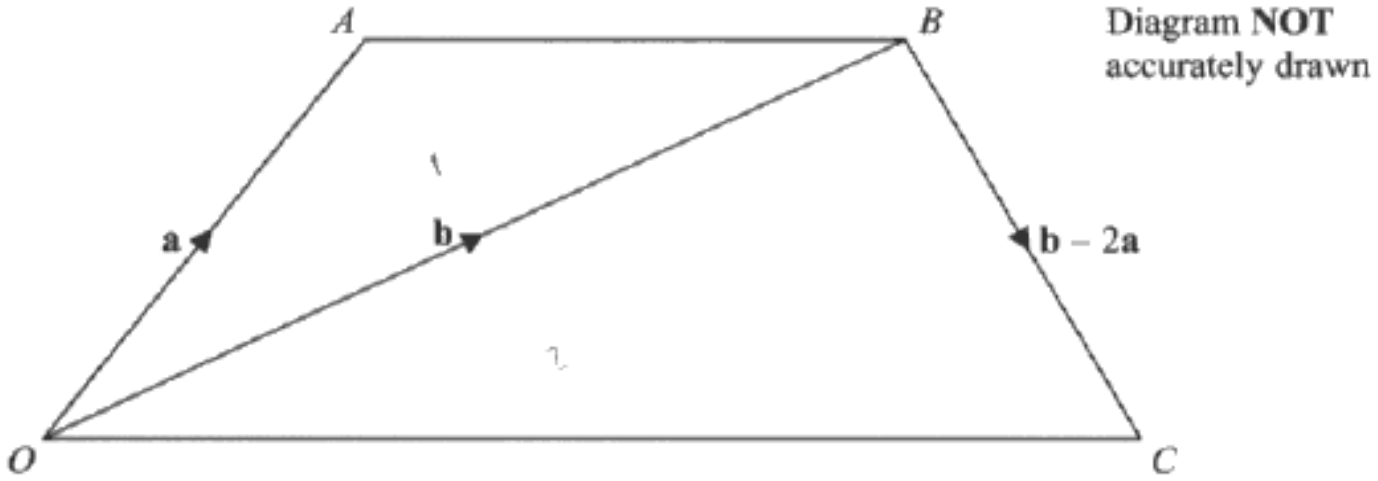


Figure 2

Figure 2 shows a quadrilateral $OABC$

$$\overrightarrow{OA} = \mathbf{a},\ \overrightarrow{OB} = \mathbf{b} \text{ and } \overrightarrow{BC} = \mathbf{b} - 2\mathbf{a}$$

(a) (i) Prove that $\overrightarrow{AB}$ is parallel to $\overrightarrow{OC}$

(ii) Show that $AB : OC = 1 : 2$

7. Scalar and vector quantities

Vector question from previous slide continued

It is always advisable to establish correct vector statements **first.**
This will help the candidate **AND** crucially score the Method mark.

$$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB} \Rightarrow -\mathbf{a} + \mathbf{b}$$

$$\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC} \Rightarrow \mathbf{b} + \mathbf{b} - 2\mathbf{a} = 2(-\mathbf{a} + \mathbf{b})$$

In a proof, a conclusion is required;

$\overrightarrow{OC} = 2\overrightarrow{AB}$ so same direction,

and the ratio is $\overrightarrow{AB} : \overrightarrow{OC} = 1 : 2$

7. Scalar and vector quantities

The second part of the question increases the level of demand and it continues with;

The point D lies on OB such that $OD:DB = 2:3$

(b) Find the ratio of the area of $\triangle ODC$: the area of $\triangle OAB$.

(6)

These parts of vector questions are usually amongst the most challenging in the whole paper, but they need not be so.

The most common error in vector questions involving length or area is to attempt to use vectors instead of lengths.

In this case, the solution is straightforward when areas of triangles are used;

either $\frac{1}{2}ab\sin C$ or half x base x height.

8. Rectangular Cartesian coordinates

There are no changes in this section

A	The distance between two points
B	The point dividing a line in a given ratio
C	Gradient of a straight line joining two points
D	The straight line and its equation
E	The condition for two lines to be parallel or to be perpendicular

8. Rectangular Cartesian coordinates

SAMs Question 10 Paper 2

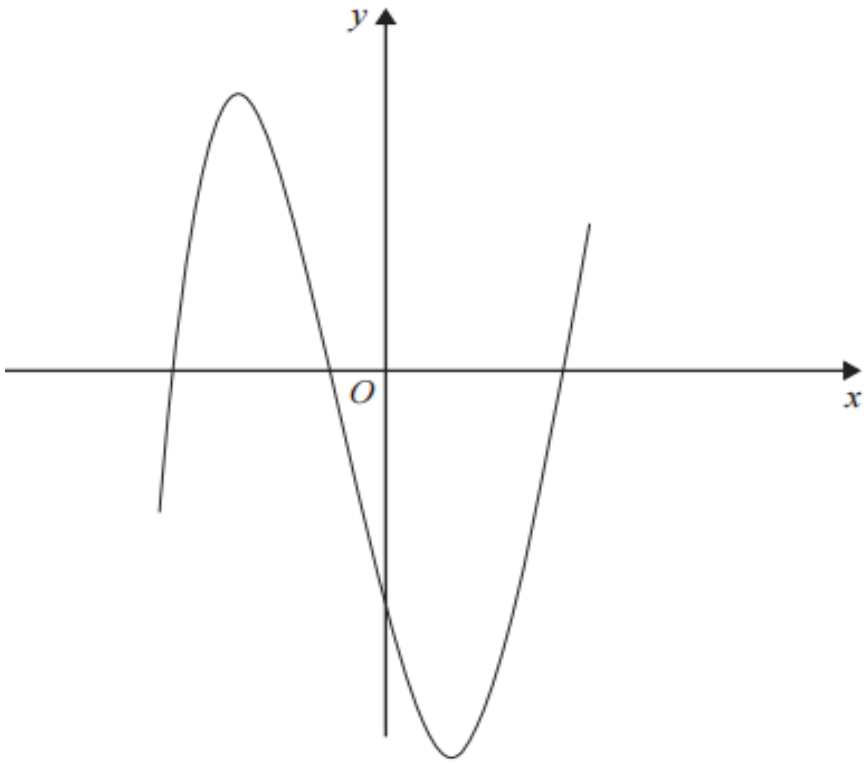


Figure 1

The question follows on the next slide

8. Rectangular Cartesian coordinates

SAMs Question 10 Paper 2

Figure 1 shows the curve M with equation $y = x^3 - 13x - 12$

The point P, with x coordinate -2, lies on M and line l_1 is the tangent to M at the point P.

(a) Find an equation for l_1

(5)

The point Q lies on M and the line l_2 is the tangent to M at the point Q.

Given that l_1 and l_2 are parallel,

(b) find an equation for l_2

(4)

The normal to M at P meets l_2 at the point R.

(c) Find the coordinates of R.

(4)

(d) Find the exact length of the line PR.

(2)

The tangent and normal at P and the tangent and normal at Q form a rectangle.

(e) Find the exact area of this rectangle.

(3)

8. Rectangular Cartesian coordinates

These questions are always generally well attempted.

Key points which candidates would do well to note.

1. Always draw a sketch, or annotate and add the sketch if one is given in the question. A common feature of poor attempts at these questions is the lack of a good careful sketch.
2. Dividing a line in a given ratio – those candidates who attempt to use the formula often make mistakes. Those who use similar triangles nearly always get it right.

8. Rectangular Cartesian coordinates

And finally:

Many candidates do not read questions carefully and find the equation of the normal when the tangent is required, and vice versa.

Please encourage your students to read these questions very carefully to avoid losing marks needlessly.

9. Calculus

There are no changes in this section.

However, the formula for Quotient rule will now be given in the formula sheet.

The formulae for Product and Chain rules will be expected to be known.

9. Calculus

A	Differentiation and integration of sums of multiples of powers of x (excluding integration of $\frac{1}{x}$), sin ax, cos ax, e^{ax}
B	Differentiation of a product, quotient and simple cases of a function of a function.
C	Applications to simple kinematics and to determination of areas and volumes.
D	Stationary points and turning points
E	Maxima and minima
F	The equations of tangents and normals to the curve $y = f(x)$
G	Application of calculus to rates of change and connected rates of change.

9. Calculus

SAMs Question 6 Paper 1

An example of a question involving specification reference **9A** and **9B**

6 $y = e^x\left(x^2 - 3x\right)$

Show that $y - 2\frac{dy}{dx} + \frac{d^2y}{dx^2} = 2e^x$

(8)

Spec 9B – Differentiation of a quotient
Note this is another example of a show question. Encourage your students to show every step of working.

9. Calculus

SAMs Question 4 Paper 2 Spec 9C – Applications to kinematics

4 A particle P is moving along the x-axis.

At time t seconds ($t \geqslant 0$) the velocity, v m/s, of P is given by $v = 4t^2 - 19t + 12$

(a) Find the values of t for which P is instantaneously at rest.

(2)

When $t = 0$, the displacement of P from the origin is -4 m.

(b) Find the displacement of P from the origin when $t = 6$

(4)

At time t seconds the acceleration of P is a m/s^2.

(c) Find the value of t when $a = 0$

(3)

Note: When integrating the velocity to find the displacement, a very common error is to omit $+c$

9. Calculus

SAMs

Question 11

Paper 1

Part (a) is an example of a question aiming for Grade 9

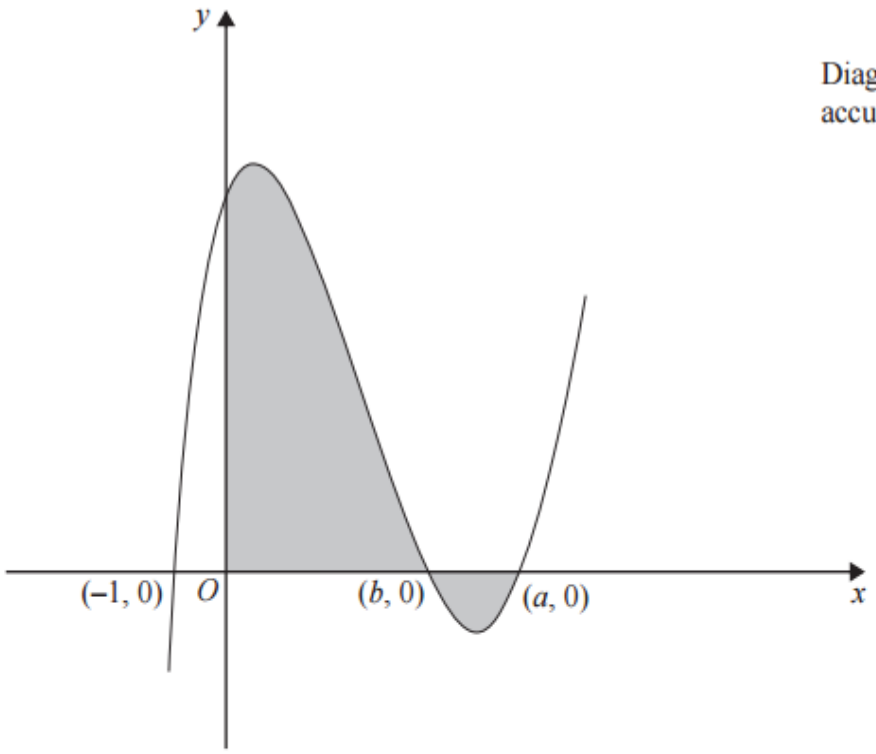


Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows a sketch of the curve with equation $y = f(x)$, which passes through the points with coordinates $(-1, 0)$, $(b, 0)$ and $(a, 0)$ where $0 < b < a$.

Given that $f'(x) = 6x^2 - 26x + 12$

(a) find,

(i) the value of a,

(ii) the value of b.

(8)

(b) Use algebraic integration to determine the exact value of the total area of the shaded regions shown in Figure 3.

(5)

9. Calculus

SAMs Question 5 Paper 1

5 Two numbers x and y are such that $2x + y = 13$

The sum of the squares of $2x$ and y is S.

(a) Show that $S = 8x^2 - 52x + 169$

(3)

Using calculus,

(b) find the value of x for which S is a minimum, justifying that this value of x gives a minimum value for S.

(4)

(c) find the minimum value of S.

(2)

Spec 9E – Maxima and minima may be set in the context of a practical problem. In this case this is set in the context of an algebraic problem

9. Calculus

SAMs Question 10 Paper 2

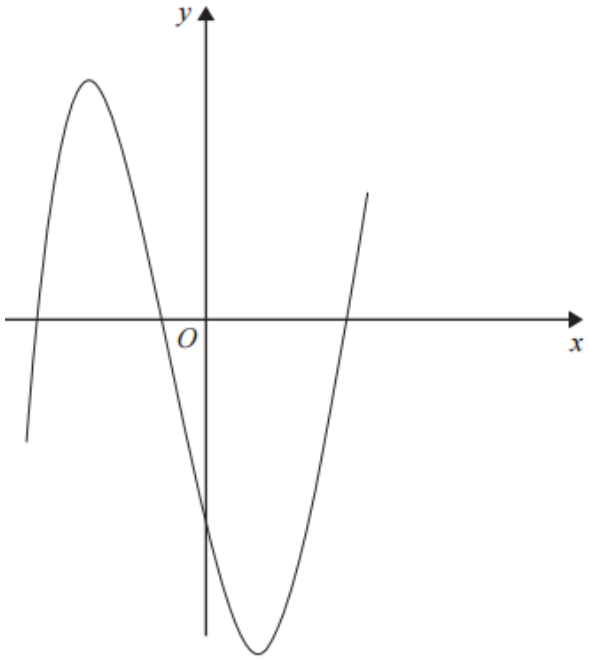


Figure 1

Figure 1 shows the curve M with equation $y = x^3 - 13x - 12$

The point P, with x coordinate -2, lies on M and line l_1 is the tangent to M at the point P.

(a) Find an equation for l_1

(5)

The point Q lies on M and the line l_2 is the tangent to M at the point Q.

Given that l_1 and l_2 are parallel,

(b) find an equation for l_2

(4)

The normal to M at P meets l_2 at the point R.

(c) Find the coordinates of R.

(4)

Spec 9F – The equations of tangents and normals

9. Calculus

SAMs Question 11 Paper 2

Spec 9G Application of calculus to connected rates of change

11

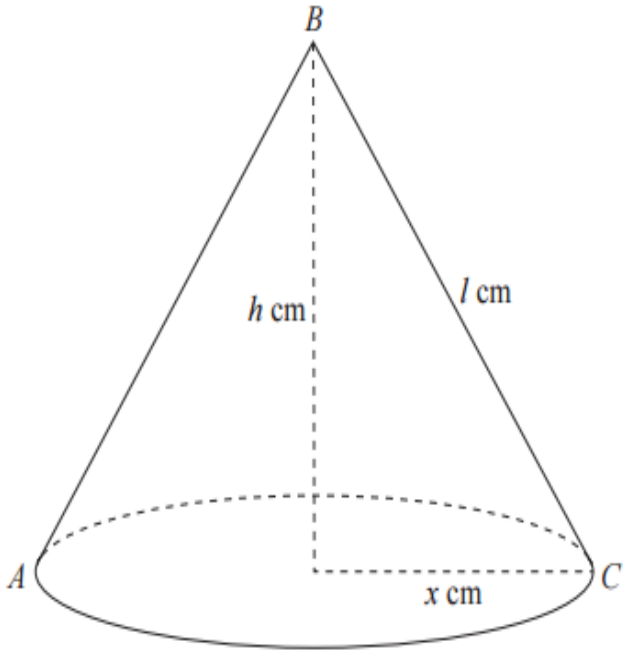


Figure 2

Diagram **NOT** accurately drawn

This is an example of a question aiming for Grade 9

The question follows on the next slide

9. Calculus

SAMs Question 11 Paper 2

Figure 2 shows a right circular cone with a base radius of x cm. The slant height of the cone is l cm and the height of the cone is h cm. The vertex of the cone is B and the points A and C, on the base of the cone, are such that AC is a diameter of the base.

The cone is increasing in size in such a way that the size of the angle ABC is constant at $60°$ and the **total** surface area of the cone is increasing at a constant rate of 10 cm^2/s.

Find the exact rate of increase of the volume of the cone when $x = 6$

(11)

The formula for the curved surface area of a cone is given in the formula sheet. This question also includes specification **10C** (Trigonometry)
The model answer to this question is given in the next two slides.

9. Calculus

SAMs Question 11 Paper 2 Model answer

Let the total surface area of the cone be S.

$$\frac{\mathrm{d}S}{\mathrm{d}t} = 10 \text{ cm/s}^2 \qquad \text{B1}$$

First part – deal with the surface area. Do not forget the base!

$$S = \pi x l + \pi x^2 \quad \text{but} \quad l = \frac{x}{\sin 30} = \frac{x}{0.5} = 2x \qquad \text{B1}$$

$$\text{so} \quad S = 2\pi x^2 + \pi x^2 = 3\pi x^2 \qquad \text{M1A1}$$

$$\text{and} \quad \frac{\mathrm{d}S}{\mathrm{d}x} = 6\pi x \qquad \text{M1}$$

9. Calculus

SAMs Question 11 Paper 2 – Model answer continued

Second part – deal with the volume

$$h = \frac{x}{\tan 30} = \sqrt{3}x \qquad \text{B1}$$

$$V = \frac{1}{3}\pi x^2 h = \frac{\sqrt{3}}{3}\pi x^3 \Rightarrow \frac{\mathrm{d}V}{\mathrm{d}x} = \sqrt{3}\pi x^2 \qquad \text{M1A1}$$

Final part – apply Chain Rule

$$\frac{\mathrm{d}V}{\mathrm{d}t} = \frac{\mathrm{d}V}{\mathrm{d}x} \times \frac{\mathrm{d}x}{\mathrm{d}S} \times \frac{\mathrm{d}S}{\mathrm{d}t} \qquad \text{M1}$$

$$\Rightarrow \frac{dV}{dt} = \sqrt{3}\pi x^2 \times \frac{1}{6\pi x} \times 10 = \frac{5\sqrt{3}}{3}x = 10\sqrt{3} \ \text{cm}^3/\text{s} \qquad \text{M1A1}$$

10. Trigonometry

A	Radian measure including use for arc length and area of sector
B	The three basic trigonometrical ratios of angles of any magnitude (in degrees or radians) and their graphs.
C	Applications to simple problems in two or three dimensions (including angles between a line and a plane and between two planes)
D	Use of sine and cosine formulae
E	The identity $\cos^2 A + \sin^2 A = 1$
F	Use of the identity $\tan A = \dfrac{\sin A}{\cos A}$
G	The use of the basic addition formulae of trigonometry
H	Solution of simple trigonometric equations for a given interval

10. Trigonometry

There is no new content here. However, the cosine rule formula will be given in the formula sheet, but sine rule and the area of a triangle $A = \frac{1}{2}ab\sin C$ will be expected to be known.

$\tan A = \frac{\sin A}{\cos A}$ will be given on the formula sheet.

The summation formulae for $\sin(A \pm B)$, $\cos(A \pm B)$ and $\tan(A \pm B)$ will be given in the formula sheet.

There is no new content in **10H**, but we have clarified the specification to explicitly include equations such as;

$$\sin(3x - 30^\circ) = \frac{1}{4} \quad \text{for} \quad -90^\circ \leq x \leq 90^\circ$$

10. Trigonometry

SAMs Question 2 Paper 1

Diagram **NOT** accurately drawn

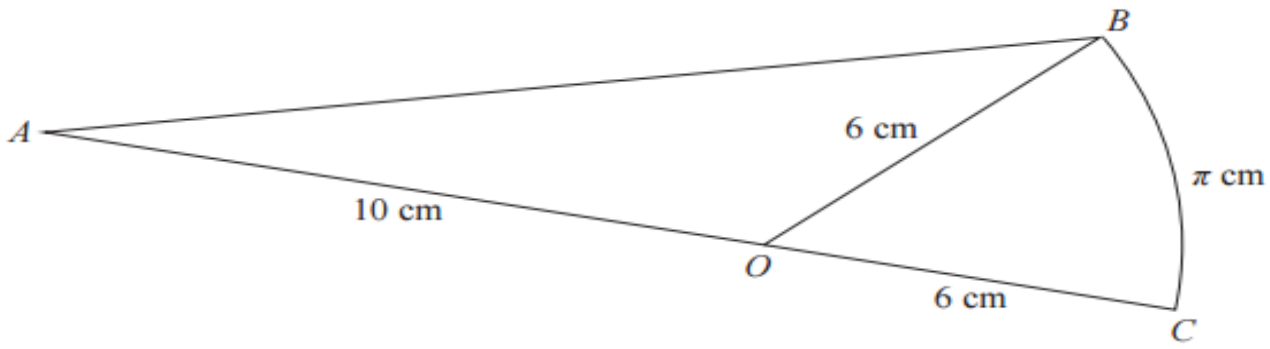


Figure 1

Figure 1 shows a shape ABC in which AOB is a triangle, AOC is a straight line and OBC is a sector of a circle with centre O.

$AO = 10$ cm, $OC = OB = 6$ cm and the length of arc $BC = \pi$ cm.

Find, to 3 significant figures,

(a) the length of AB,

(3)

(b) the area of the shape ABC.

(3)

This question combines Spec **10A** and **10D** (Radians and sine/cosine formulae)

10. Trigonometry

SAMs Question 3 Paper 1

3 Solve, in degrees to 1 decimal place, for $0 \leqslant \theta < 180$

$$2\cos(2\theta + 30)° + \tan(2\theta + 30)° = 0$$

(6)

This question combines specifications **10D, 10E, 10F** and **10H** and also quadratic equations **2A.**

Please remind your candidates that it is very important to find **all** the values for what will be $\sin\left(2\theta + 30^{\circ}\right)$ **before** subtracting 30° and dividing by 2.

10. Trigonometry

SAMs Question 10 Paper 1

Diagram for the question

Parts (d) and (e) are example of parts a question aiming for Grade 9

10

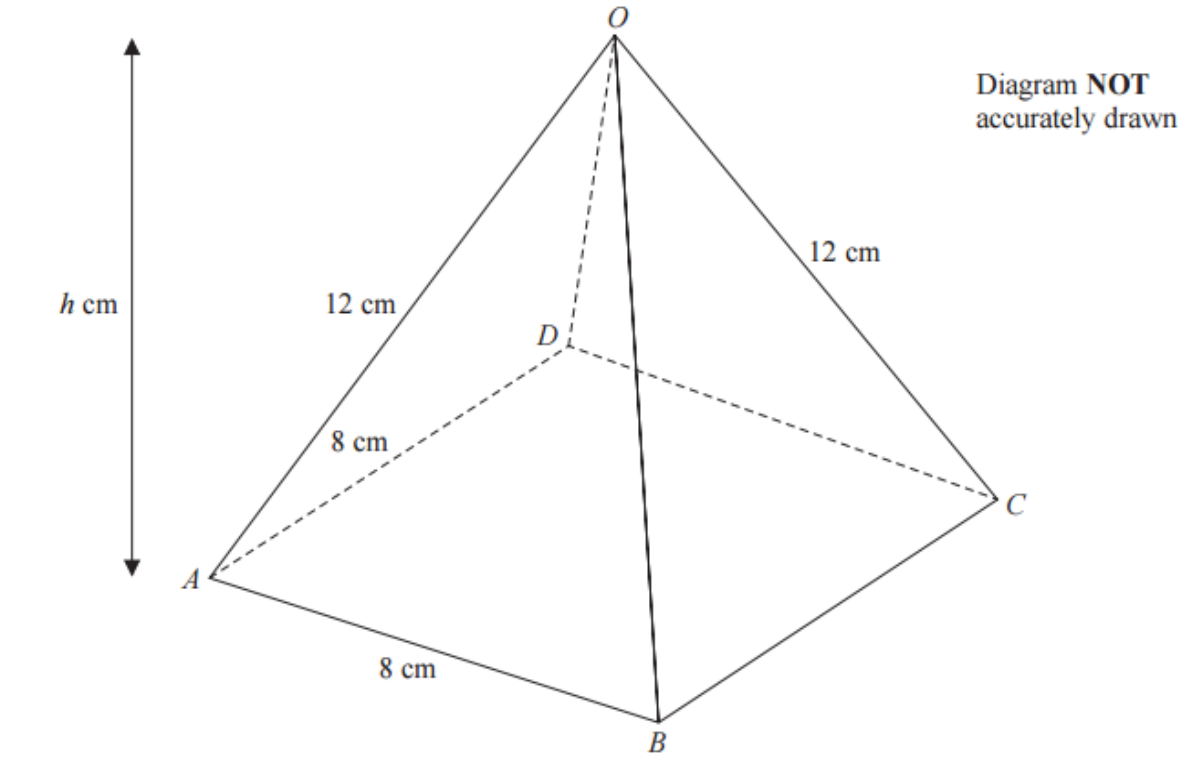


Figure 2

10. Trigonometry

SAMs Question 10 Paper 1 Text of the question

This question is ramped in difficulty and becomes gradually more demanding

Figure 2 shows a right pyramid $ABCDO$ with a horizontal square base of side 8 cm. The vertical height of the pyramid is h cm and $OA = OB = OC = OD = 12$ cm.

(a) Find the exact value of h.

(3)

(b) Find, to 1 decimal place, the size of the angle between OA and the plane $ABCD$.

(2)

(c) Find, to 1 decimal place, the size of the angle between the plane AOB and the plane $ABCD$.

(2)

The midpoint of OA is P and Q is the point on BC such that $BQ : QC = 3 : 1$

(d) Show that $PQ = 4\sqrt{5}$ cm.

(4)

(e) Find, to 1 decimal place, the size of angle PQA.

(4)

10. Trigonometry

SAMs Question 5 Paper 2

5 (a) Show that $\cos(A - B) - \cos(A + B) = 2\sin A \sin B$

(2)

(b) Hence express $2\sin 5x \sin 3x$ in the form $\cos mx - \cos nx$ where m and n are integers, giving the value of m and the value of n,

(1)

(c) (i) Find $\int 4\sin 5\theta \sin 3\theta \, d\theta$

(ii) Hence evaluate $\int_0^{\frac{\pi}{6}} 4\sin 5\theta \sin 3\theta \, d\theta$, giving your answer in the form $\frac{a\sqrt{b}}{c}$ where a, b and c are integers.

(4)

This question tests specification **10G**, **9A** and **1C.**

Part (c) is an example of a question aiming for Grade 9

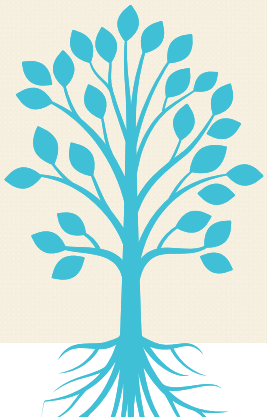
9-1 grading scale (1)

Awarding

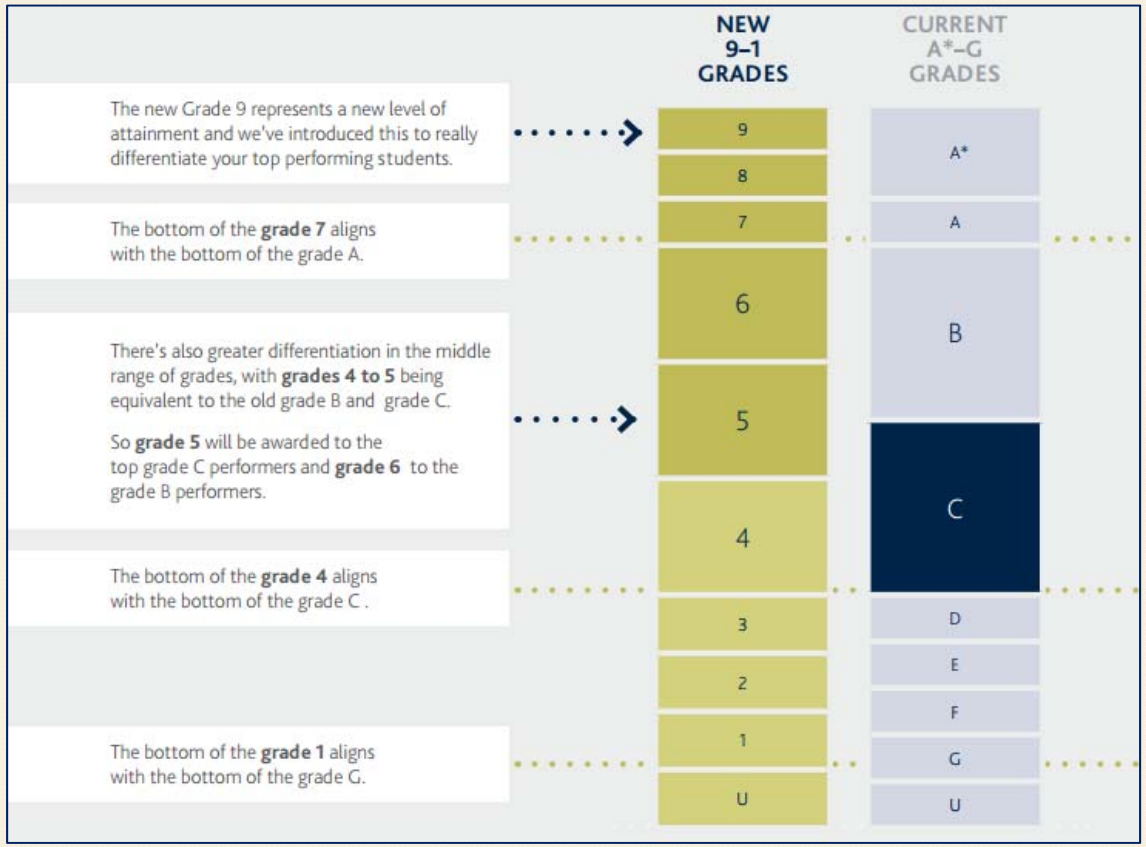
- The grading system is changing but our commitment to awarding grades that accurately reflect learner exam performance remains the same.
- We set new grade boundaries (minimum number of marks needed to achieve each grade) for each assessment of each qualification.

Benefits

- Greater differentiation across levels of attainment e.g. 2 grades where the current C grade is
- Rewards truly outstanding achievement with the grade 9
- Provides more information about student attainment to help progression to A Level
- Same scale for Pearson Edexcel GCSE and International GCSE allows clear comparison with English standards, unlike old A* to G grading



9-1 grading scale (2)

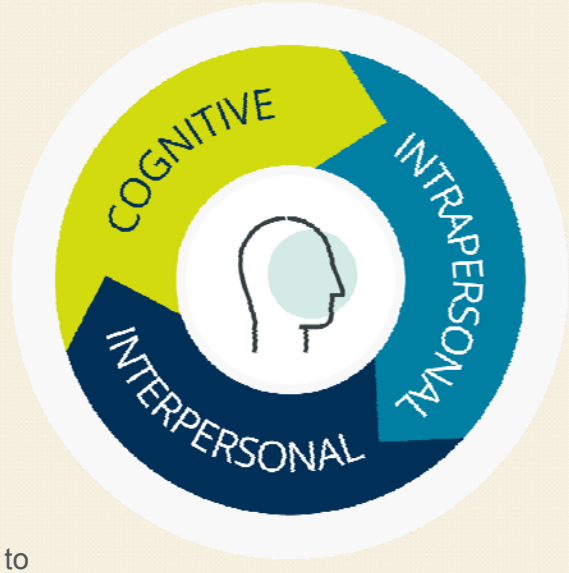


World Class Qualifications

- Pearson's World Class Qualification design principles mean all Edexcel qualifications are developed to be **Rigorous**, **Demanding**, **Inclusive** and **Empowering**
- Externally approved by the Expert Panel for World Class Qualifications

Transferable Skills

- Skills frameworks adapted to support design of new
  Edexcel International GCSEs
- Ensure learners acquire skills needed to access Higher Education and fulfilling careers



Cognitive skills

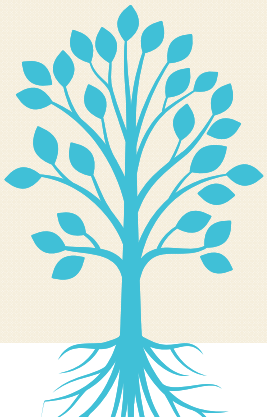
Core skills brain uses to think, learn and reason – used to carry out any task.

Intrapersonal Skills

Emotional intelligence, ability to know, understand and manage own emotions and learning.

Interpersonal Skills

Life skills used every day to communicate and interact with others, individually and in groups.



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Resources

We offer a range of free and paid for resources for International GCSEs. These have been designed to support teachers to improve learner outcomes

Pearson

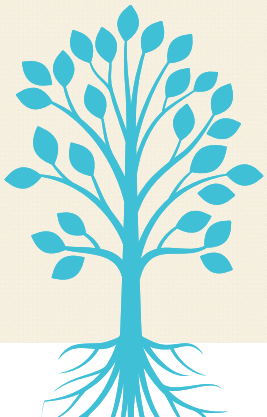
Support overview

Support for all subjects

- Getting Started Guide & Scheme of Work
- Getting Ready to Teach Events
- Subject interpretation of transferable skills
- Subject Advisor
- Results Plus
- Regional Support Manager

Additional support for selected subjects

- Curriculum Matched Publishing
- Additional SAMs
- Exam Wizard
- Lesson plans



Free support

Getting Started Guide *includes mapping of changes, content and assessment guidance, course planner and resource list*

Editable Scheme of Work *includes activities to support transferable skills development*

Exam Wizard *a free exam preparation tool containing a bank of past Edexcel exam questions*

Results Plus *free online service giving instant and detailed analysis of your students' exam and mock performance*

Regional support manager *access to a regionally based support manager for any query*

Subject Advisor *For any subject related query you have. Sign up to mailing list*

Exemplar *Marked student responses to SAMs questions*

Additional SAMs *An additional set of Sample Assessment Material available as a secure download*

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Pearson Publishing Further Pure Maths

Integrated exam practice throughout, with differentiated revision exercises, exam practice and learning summary sections.

Provides free access to an ActiveBook, a digital version of the Student Book, which can be accessed online, anytime, anywhere supporting learning beyond the classroom.

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Reviewed by a language specialist to ensure the book is written in a clear and accessible style for students whose first language may not be English.

Glossary of key terminology.

Online teacher support materials to support planning and assessment.

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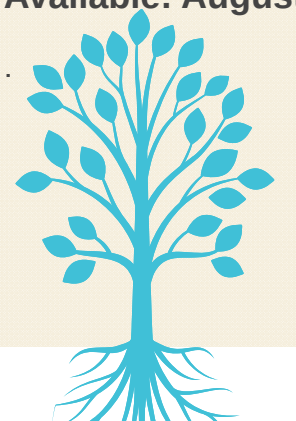

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For your subject specific enquiries

Subject advisor:
teachingmaths@pearson.com

Grade 9 questions

What does grade 9 look like?

Examples of questions and part questions that are targeting grade 9.

Questions in the SAMs papers are as follows;

Question 10 paper 1 parts (d) and (e) 3D Trigonometry 8 marks
Question 11 paper 1 part (a) Problem solving/integration 8 marks

Question 5 paper 2 part (c) Integration of a trig function 4 marks
Question 11 paper 2 whole question Connected rates of change 11 marks

Common Issues

Common Issues

1. Incorrect answers without working will lose all marks associated with the question.

   Encourage your students to show all working.

2. Please emphasize the importance of reading the demands in the question. If a question requires a simplified answer then that is what the candidate should leave as their final answer.

3. Candidates must read rounding requirements carefully and give their answers to the required degree of accuracy.

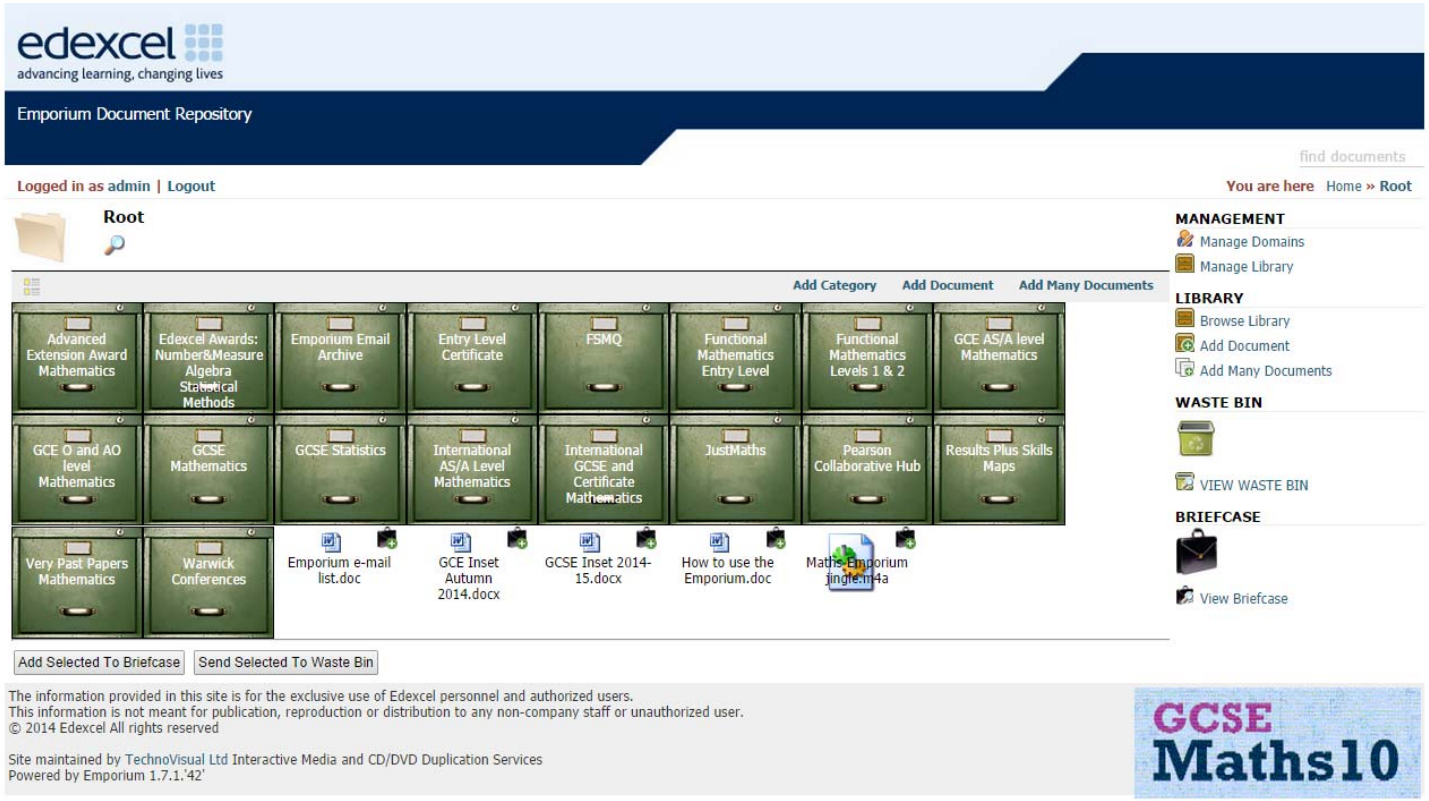
Support materials for International GCSE Maths (9-1)

Free support materials for International GCSE Maths (9-1)

- Specification
- Sample Assessment Materials
- Courses from Pearson
- Exam Wizard
- Getting Started Guide and the Scheme of Work which are included in your packs.

Mathematics Emporium

- Website at www.edexcelmaths.com



- Email updates from mathsemporium@pearson.com

Statistics

ResultsPlus

www.edexcel.com/resultsplus

- **Edexcel's free online service giving instant and detailed analysis of your students' exam and mock performance**

- **see your students' scores for every exam question**

- **understand how your students' performance compares with Edexcel national averages**

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WHAT OTHER TRAINING WOULD YOU FIND USEFUL?

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Subject Advisor: Graham Cumming

- email: TeachingMaths@pearson.com
- telephone: 020 7010 2174
- Twitter: @EmporiumMaths

Pearson Paid-For Published Resources

We are committed to helping teachers deliver our Edexcel qualifications and students to achieve their full potential. To do this, we aim for our qualifications to be supported by a wide range of high-quality resources, produced by a range of publishers. However, it is not necessary to purchase endorsed resources to deliver our qualifications.

Maths Student Book A & B now available to buy from:
http://www.pearsonglobalschools.com/

Hodder

- International GCSE Mathematics for Edexcel, 3rd edition, available this summer.
  Fully revised for the new Spec and question types.
  www.hoddereducation.co.uk**

GCSE Reform – what's changing?

New GCSEs for 2017

- Business, Economics, Design & Technology, Statistics, Astronomy, Psychology, Urdu, Arabic, Japanese, Modern Greek, Italian, Chinese, Russian, PE short course, *Sociology, Geology, Classical Civilisation, Ancient History, Engineering, Electronics, Film Studies, Media Studies*
- Subjects not offered by Pearson Edexcel are shown above in italics
  - First teaching - Sept 2017 : First assessment summer 2019
  - New specifications on our website

Main changes

- New grade structure of 9 - 1 replacing current A* - G grades
- A fully linear structure, all assessments taken at the end of the course
- Exams will be the preferred method of assessment, except where they can not provide valid assessment of the skills.
- Most subjects will see a reduction in NEA (coursework)

A level Reform – what's changing

New A levels and AS qualifications for 2017

- Mathematics, Further Mathematics, Design & Technology, Politics, Music Technology, Chinese, Italian Russian, *Statistics*, *Law*, *Accounting, History of Art, Ancient History, Philosophy, Environmental Science, Archeology, Geology, Electronics, Film Studies, Media Studies*
- Subjects not offered by Pearson Edexcel are shown above in italics
  - First teaching - Sept 2017 : First A level assessment summer 2019
  - New specifications now on our website

Main changes

- AS is a standalone qualification.
- AS work and grades no longer contributes to A level grade, but can be designed to be co-taught
- A fully linear structure, all assessments taken at the end of the course
- Exams will be the preferred method of assessment, except where they can not provide valid assessment of the skills.
- Most subjects will see a reduction in NEA (coursework)

Other useful links

1. **Grade Boundaries**

   This page shows the minimum marks needed to achieve a certain grade for all UK and international examinations. Also refer to the examiners report which is available for download with other documents.

2. **Examination Results Statistics**

   Results statistics summarise the overall grade outcomes of candidates sitting Edexcel examinations.

3. **Results Plus**
   - Edexcel's free online service giving instant and detailed analysis of your students' exam and mock performance.
   - See your students' scores for every exam question.
   - Understand how your students' performance compares with Edexcel national averages.

Any questions?

Thank you for attending this event.

How did we do?
Please fill in the ***evaluation form*** *that you'll receive via e-mail in a few minutes.*

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Thank you

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