GCSE EXAMINERS' REPORTS

MATHEMATICS
GCSE

NOVEMBER 2023

Introduction

Our Principal Examiners' reports offer valuable feedback on the recent assessment series. They are written by our Principal Examiners and Principal Moderators after the completion of marking and moderation, and detail how candidates have performed.

This report offers an overall summary of candidates' performance, including the assessment objectives/skills/topics/themes being tested, and highlights the characteristics of successful performance and where performance could be improved. It goes on to look in detail at each question/section of each unit, pinpointing aspects that proved challenging to some candidates and suggesting some reasons as to why that might be.[i]

The information found in this report can provide invaluable insight for practitioners to support their teaching and learning activity. We would also encourage practitioners to share this document – in its entirety or in part – with their learners to help with exam preparation, to understand how to avoid pitfalls and to add to their revision toolbox.

Further support

Document	Description	Link
Professional Learning / CPD	WJEC offers an extensive annual programme of online and face-to-face Professional Learning events. Access interactive feedback, review example candidate responses, gain practical ideas for the classroom and put questions to our dedicated team by registering for one of our events here.	https://www.wjec.co.uk/home/professional-learning/
Past papers	Access the bank of past papers for this qualification, including the most recent assessments. Please note that past papers are published to WJEC and WJEC Eduqas public websites between 1st and 31st December, the year after the examination has taken place.	www.wjecservices.co.uk or on the WJEC subject page
Grade boundary information	Grade boundaries are the minimum number of marks needed to achieve each grade. For unitised specifications grade boundaries are expressed on a Uniform Mark Scale (UMS). UMS grade boundaries remain the same every year as the range of UMS mark percentages allocated to a particular grade does not change. UMS grade boundaries are published at overall subject and unit level. For linear specifications, a single grade is awarded for the overall subject, rather than for each unit that contributes towards the overall grade. Grade boundaries are published on results day.	For unitised specifications click here: Results, Grade Boundaries and PRS (wjec.co.uk)

Exam Results Analysis	WJEC provides information to examination centres via the WJEC secure website. This is restricted to centre staff only. Access is granted to centre staff by the Examinations Officer at the centre.	www.wjecservices.co.uk
Classroom Resources	Access our extensive range of FREE classroom resources, including blended learning materials, exam walk-throughs and knowledge organisers to support teaching and learning.	https://resources.wjec.co.uk/
Bank of Professional Learning materials	Access our bank of Professional Learning materials from previous events from our secure website and additional pre-recorded materials available in the public domain.	www.wjecservices.co.uk or on the WJEC subject page.

Subject Officer's Executive Summary

The examination papers in GCSE Mathematics were generally of a similar standard to previous examination series. As is always the case, some questions were more demanding in some topics than in previous series, whereas others were less demanding. What was noticeable this is that it is clear that many candidates in year 11 this year have been severely impacted by the pandemic, and there are gaps in their knowledge and understanding, which then cause problems with more demanding topics and skills. This is especially true of candidates hoping to achieve the middle grades in the grade range (E to B). There are some areas of the subject content that are not well-understood year on year. This year was no exception. Topics such as forming and solving linear equations, bearings, working with decimals and fractions, circle theorems have a great need for improvement. Other topics that are specific to units and/or tiers are listed in the individual unit reports.

Similarly, there are skills that are also lacking across tiers, such as non-calculator methods, e.g. cancelling, and multiplying and dividing large numbers.

What is also evident is how little time many candidates spent learning facts and rules in preparation for these examinations. These include metric to Imperial conversions, formulae for perimeter, area and volume of shapes.

There was also evidence of candidates not using the calculators to their full potential on the calculator-allowed papers. There is a difference between showing your working and using non-calculator methods to carry out calculations. Candidates should remind themselves of this difference before taking these examinations.

There were many candidates who scored very low marks on the exam papers, especially at Foundation Tier. This could be because they were entered for examinations that they were not ready for. However, many candidates who were entered for Higher Tier, in particular, produced some excellent work in topics such as, for example, probability, quadratic equations, indices and higher-level trigonometry.

Our digital resources website has many blended learning lessons and knowledge organisers, amongst other things: Mathematics - Educational Resources - WJEC
You can filter to help find what you want. Some examples of blended learning lessons and knowledge organisers are listed below, as they have been indicated as areas for improvement.

Areas for improvement	Classroom resources	Brief description of resource
Linear equations and inequalities	Linear equations and inequalities - Blended Learning	Blended learning
	ko-solving-linear-equations-wjec.pdf	Knowledge organiser
Circle Theorems	Circle theorems - Blended Learning	Blended learning
	ko-the-circle-intermediate-wjec.pdf	Knowledge organiser
Probability	Probability - Blended Learning	Blended learning
	probability-foundation-and-intermediate.pdf	Knowledge organiser

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UNIT 1 FOUNDATION TIER

Overview of the Unit

The demand of the questions was comparable to those tested in previous papers and the paper was a suitable and fair test for the candidates at Foundation level. Later questions in the paper proved more challenging than the earlier ones. It was important to read the questions very carefully as some instructions were written in words instead of numerical terms. Consequently, essential parts of the question, e.g., Qn. 2(a) "… doubles …", were missed.

The following topics were well-understood or well-answered:

- Writing numbers given in words, in figures (Qn. 2(a))
- Rounding a number to the nearest 100 (Qn. 2(b))
- Using probability words (Qn. 3)
- Drawing a further pattern in a given sequence (Qn. 4)
- Coordinates in the first quadrant (Qn. 6(a))
- Solving simple equations (Qn. 7(a)(i))

Some candidates found some Geometry and Measure questions difficult.
(Questions 5(a), 7(b), 9, 17)
Areas for improvement include:

- Drawing four lines of symmetry on a given shape.
- Drawing the fourth vertex of the parallelogram of which three vertices had been given.
- Knowing the difference between perimeter and area.

Some candidates found working with topics involving algebra difficult.
(Questions 7(a)(ii), 11, 18)
Areas for improvement include:

- Setting up and solving linear equations.
- Substituting numbers in an expression.
- Collecting like terms.

Comments on individual questions/sections

When a question or part-question is not listed, there are no areas to highlight.

Q.1 Some candidates found it difficult to use a ruler or a protractor accurately.
In Question 1(a), some candidates wrongly measured the length of the radius instead of the diameter.
In Question 1(b), it would have helped some candidates if they had used the fact that if the angle to be measured looks like an acute angle, then the answer must be less 90°.

Q.2 In Question 2(c), very many candidates wrongly evaluated $6 + 4 \times 9$ as 90, as they didn't know that multiplication must be done before addition in this calculation.
In Question 2(d), frequently, candidates were unable to make sensible estimates for 103 and 9·8 (100 × 10 or 100 × 9·8 or 103 × 10 were allowed, one of which gained B1). The second mark was awarded for doing their estimated multiplication correctly. Many tried to multiply the given numbers together which gained 0 marks.
To gain any marks in Question 2(e), the answer should have included a division calculation showing either a remainder or a digit in the first decimal place (208 r2 or 208·6…). Alternatively, stating that '6 + 2 + 6 = 14 and 14 is not divisible by 3' gained 1 mark.

Q.5 The vertical and horizontal lines of symmetry were more commonly drawn correctly than the two diagonal lines.
The order of rotational symmetry (5) was not obvious to many candidates. Wrong answers included different incorrect numbers, 90°, the word 'round'.

Q.6 Most candidates knew that the coordinates of point B were (6, 4) but some used incorrect notation, e.g. (x6, y4), (6 – 4). These were awarded B0. Frequently, the brackets were omitted.
Very many found it difficult to draw the fourth vertex of the parallelogram of which three vertices were given. Counting the number of horizontal squares was the easiest way to place *D* relative to *A* as *BC = AD.*

Q.7 In Question 7(b), there were many candidates who did not know that 1m = 100cm. Many of those who did try to multiply 24·8 by 100 were unable to do so correctly, sometimes inserting a 0 randomly between the other digits or placing the decimal point wrongly.

Q.9 Candidates needed to work out the lengths of the two unmarked sections of the edges of the rectangles; these were 2cm each and this was awarded 1 mark. Very many wrongly added all the numbers written on the diagram. This was awarded 0 marks. Frequently, 6 cm was wrongly added to the perimeter.
The OC strand needed a conclusion which stated 'perimeter = … ', as well as showing clear working with labels of the work being done.
W1 was awarded for correct mathematical form with full workings and units shown.

Q.10 It is important to read the question very carefully. Many didn't realise that the number of pupils was 200. Consequently, many bar charts were drawn with the heights of the bars half the heights they should have been.

Q.11 In Question 11(a), incorrect answers included $5x + 2y = -54 + 29$, wrongly substituting for $x = -4$ and $y = 9$, and not understanding that $5x$ means $5 \times x$ and $2y$ means $2 \times y$. Others were able to substitute correctly but were unable to add positive and negative quantities together correctly.
In Question 11(b), many still do not appear to realise that a sign is attached to the following term.

Q.12 Candidates found it difficult to express decimals, fractions and percentages in a common form. Many did not attempt to do this but randomly wrote the given quantities in any order. Changing the fraction to a decimal or percentage was difficult for many candidates.
The correct answer with no working was awarded 1 mark only.

Q.13 **(b)** Many did not realise that the volume given allowed them to form the equation $p \times 3 \times 5 = 90$, which they could solve to find $p = 6$cm. Very many wrongly gave the answer as $3 + 5 = 8$cm.

Q.14 Question 14(a) was challenging for most candidates. They needed to divide 9·17 by 7 and then multiply that answer by 3. This involved less-demanding calculations than doing these operations the other way round. The final mark was awarded for converting their answer correctly from km to metres.
In Question 14(b), many candidates were awarded 1 mark for writing 2 hours 5 minutes correctly as 125 minutes, but they weren't able to go on to express 25 minutes as a percentage of 125 minutes.

Q.15 In Question 15(a), many candidates did not know to multiply 4 by 9 to find the total of four numbers with a mean of 9.
In Question 15(b), the first condition used the answer to part (a). So, the four numbers should have totalled 36. This was awarded 1 mark. The other mark was awarded for a mode of 11, meaning that there should have been at least two 11s.

Q.16 Those who knew what they had to do in this question were more successful in adding the probabilities than in previous exam series, but many did not engage with the question at all.
Many of the candidates who attempted the second part of this question wrongly gave the number of red socks in the drawer as 30 as they tried to use P(red sock) = 0·3, multiplying this by 100 instead of the correct number of 80 socks. To find how many socks there were altogether, it was necessary to realise that P(pink sock) = 0·25 meant that a quarter of the socks were pink. So, multiplying the number of pink socks, 20, by 4 gave the total number. This was difficult for most candidates.

Q.17 This multi-step problem was challenging for very many candidates. Few realised that it was necessary to square root the area of each shaded square to find the length of a side. From these dimensions, the area of each unshaded rectangle could be found. The final mark was awarded for adding these two equal areas together to find the required total area.
A very common error was to divide the area of each square by 4 and assume that the answer was the length of the side of each square.

Q.18 Very many candidates were unable to form the necessary equation in this question. A very common mistake was to write $7y - 2$ incorrectly as $5y$, and $4y + 1$ as $5y$. Then $5y + 9$ became $14y$.
Occasionally, the correct solution of $y = 4$ was found using a trial-and-improvement method. This was awarded 1 mark only.

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UNIT 1 INTERMEDIATE TIER

Overview of the Unit

Overall, the questions were comparable with those asked on previous papers that have been sat, and the paper was a suitable and fair test for the candidates at the Intermediate level. Some questions proved more challenging than others, whilst some candidates lost marks because of incorrect numerical evaluations or giving unsupported incorrect answers. This is a common issue from series to series.

The following topic areas were generally well-understood or well-answered:

- Completing a sequence, substitution and collecting like terms (Qn. 1)
- Interpreting 2D representation of 3D solid (net) (Qn. 2(a))
- Finding the volume of a cuboid (Qn. 2(b))
- Working with the mean and mode (Qn. 5)
- Finding the *n*th term of a sequence (Qn. 11(a))
- Completing the branches on a tree diagram (Qn. 16(a))

Some candidates found working with fractions, decimals and percentages difficult. (Questions 2, 4, 9, 13, 14(b))
Areas for improvement include:

- Converting between fractions, decimals, and percentages.
- Expressing one number as a percentage of another.
- Finding a fraction or percentage of a quantity.
- Finding the original quantity given the result of a proportional change.

Some candidates found working with topics involving algebra difficult. (Questions 8, 11(b), 17, 19)
Areas for improvement include:

- Avoiding presenting embedded answers in questions such as those in Question 8.
- Solving linear equations with letters on both sides.
- Substituting numbers into a quadratic expression.
- Factorising and solving quadratic equations.
- Solving linear equations with fractional coefficients.

A lack of knowledge or application of the facts, formulae and definitions that need to be learned was evident in some questions. (Questions 4, 10, 12(c), 18)
Areas for improvement include:

- Learning the standard metric units of length, mass, capacity and time.
- Understand what is meant by HCF.
- Learning all the conversions listed the specification.
- Learning all the Circle Theorems listed the specification.

A number of arithmetical errors were made by candidates in some questions.
(Questions 10, 12(a)+(b))
Areas for improvement include:

- Adding, subtracting, multiplying, and dividing whole numbers, decimals, fractions, and negative numbers.
- Expressing numbers as the product of their prime factors, especially when the number is not even.
- Finding the square and cube root of a number.

Comments on individual questions/sections

When a question or part-question is not listed, there are no areas to highlight.

Q.2 Candidates continue to lose mark as they had not shown all their working.
To be awarded all three marks a full comparison needed to be shown. Many candidates had difficulty converting $\frac{7}{20}$ to a decimal or percentage.
Candidates should be reminded to show $\frac{7}{20}$ as 40% and not $\frac{40}{100}$, if comparing all the values as percentages.

Q.4 This question involved two steps. Finding the fraction of an amount and conversion between metric units. These steps could have been done in any order. Usually, candidates successfully found $\frac{3}{7}$ of an amount but converting either 3·93 km or 9·17 km into metres was answered incorrectly. Many place value errors were seen.

Q.6 In Question 6(b), some candidates thought that the total number of socks in the drawer was 20. Many candidates found the total number of socks to be 80, and this gained 1 mark. Those that correctly found the number of red socks used many different methods.

Q.7 Many candidates did not correctly find the side of either square by finding the square root of the length. 144 ÷ 4 was commonly seen. Follow through marks were available for working with their length and width of the non-shaded rectangles. Many candidates correctly found the area of one or both of the non-shaded rectangles, but then failed to add them to find the total area.
This was the OCW question. Candidates should present their response in a structured way and use appropriate labels to be awarded the OC mark. All workings should be shown, and the correct mathematical form was required for the W mark. Many did not label their stages of workings and common mathematical form errors, included the incorrect use of the '=' sign.

Q.8 Candidates were expected to form an equation to find the value of y. An unsupported answer of 4 or an answer following trial and improvement without showing $7y - 2 = 4y + 1 + 9$ or equivalent gained 1 mark only. The addition of adding 9 counters to Bag B proved particularly challenging for candidates. Common errors seen were adding 9 counters to Bag A, taking 9 counters from Bag B, or not engaging with the 9 extra counters at all. Follow through marks were available if candidates continued to solve their equation correctly before an additional error was made.

Q.9 It was pleasing to see the different methods used to find how much tea was in Elsie's cup by equating 44 ml to $\frac{2}{7}$ of the original amount of tea.
Some candidates did not engage with the requirements of the question, and just calculated $\frac{5}{7} \times 44$ ml.

Q.10 This question involved candidates following instructions to multiply two or three numbers, which included decimals and then taking the square or cube root. Many value place errors were seen when attempting 100 × 0·3 × 0·9. Few candidates thought that finding the square root involved dividing the answer by 2, and the cube root involved dividing the answer by 3.

Q.12 Most candidates knew the method for starting to find the prime factors of 495, however as 495 was not an even number, some had difficulty dividing 495 by 5 or 3 or 11 as the first step. Very few candidates could explain why 495 is not a square number by giving a valid reason referring to not all the indices being even.
Some candidates could list the prime factors of 60 which gained 1 mark, but then could not use this to find the HCF of 495 and 60.

Q.13 Some candidates found that 24 people owned a dog. However, 24 was usually put incorrectly into the 'just dog' section of the Venn diagram. In this case, candidates usually then continued by placing 8 (from 32 – 24) in the 'just cat' section.

Q.14 In Question 14(b), candidates, on the whole, found it difficult to comprehend the concept of 'reverse percentage'. Instead of equating 34·2 to 90% of the original number, most candidates found 10% of 34·2 and then added this onto 34·2.
Many arithmetical errors were seen by candidates in this question.

Q.15 Those who knew that in similar shapes, corresponding dimensions are in the same ratio, scored well on this question. Many candidates at the intermediate level did not use this fact and hence did not gain any marks for this question. Most candidates did not give a full valid explanation with reference to one or both correct scale factors in part (a). Many candidates referred to the area of the rectangles being different or referred to the difference between the corresponding sides (10 – 8 = 2, compared to 9 – 6 = 3). Very few answers were seen in part (b).

Q.17 Some factorised correctly but then did not proceed to solve the equation. Many tried to solve by 'trial and improvement'. Usually, this method let to no marks being awarded, as candidates did not realise that there were two solutions. Some candidates gained a mark for giving two brackets that multiply to give $x^2 - 8x + k$ or $x^2 + kx - 20$.

Q.18 Recognising geometrical situations and using associated terminology continue to be a problem for candidates. Few candidates correctly stated that the 'The tangent at any point on a circle is perpendicular (or equivalent) to the radius at that point'. Similar wording was accepted, however candidates had to use tangent and radius by name.

Q.19 The solution of linear equations with fractional coefficients is a challenging topic for candidates at this level. Many candidates did not engage with clearing the fractions. In some cases, candidates just ignored the denominators. Where candidates did manage to clear the fractions, subtracting a negative term ('minus a minus') did lead to arithmetical errors.

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UNIT 1 HIGHER TIER

Overview of the Unit

The paper provided a fair test at this tier, with candidates' performances reflecting the increased demand as they progressed through the paper. Very few questions were left un-attempted, indicating that the entries were generally appropriate for this tier.

The following topic areas were generally well-understood or well-answered:

- Recognising a cube number (Qn. 2(a)).
- Finding or using the *n*th term of a sequence (Qn. 3).
- Finding a product of primes in index form (Qn. 4(a)).
- Completing a Venn diagram (Qn. 5).
- Completing the branches on a tree diagram and using the diagram to calculate a probability (Qn. 8).
- Factorising and hence solving a quadratic equation (Qn. 9).
- Calculating with fractional indices (Qn. 16(a)).
- Calculating a conditional probability (Qn. 21(a)).

Some candidates found working with fractions, decimals and percentages difficult.
(Questions 1, 2(b), 6, 7, 13(b), 14)
Areas for improvement include:

- finding the original quantity given the result of a proportional change
- using correct place values when multiplying or dividing decimals
- comparing fractions by using a common denominator or converting into decimals
- simplifying fractions in order to ease calculations.

Some candidates found working with topics involving algebra difficult.
(Questions 11, 12, 13, 17, 18)
Areas for improvement include:

- solving linear equations with fractional coefficients
- constructing equations of straight lines (including horizontal and vertical lines)
- understanding and using inverse proportion
- changing the subject of a formula involving roots.

A lack of knowledge or application of the facts, formulae and definitions that need to be learned was evident in some questions.
(Questions 4(c), 10, 14, 15, 16(d), 19)
Areas for improvement include:

- understanding what is meant by HCF
- understanding, learning, and using all the Circle Theorems listed in the specification
- calculating an arc length
- understanding how to identify a case of congruency and how to present a formal proof
- identifying rational and irrational numbers

understanding and using the properties of trigonometric graphs

A number of arithmetical errors were made by candidates in some questions.
(Question 2, 7, 14, 16(c))
Areas for improvement include:

- multiplying and dividing whole numbers, decimals and fractions
- working with multiples of π in exact calculations
- developing fluency in manipulating surds.

Comments on individual questions/sections

When a question or part-question is not listed, there are no areas to highlight.

Q.1 A good number of candidates were able to correctly reverse the fractional change. However, some candidates misunderstood the question and calculated $\frac{7}{5} \times 44$ ml. The response to the OCW requirement was usually good, with relevant working shown together with a suitable conclusion, and a final answer using correct units. One widespread issue was the misuse of the 'equals' sign to mean 'represents' (e.g., $\frac{2}{7}$ = 44 ml); the W mark was not penalised on this occasion if this was the only error (in mathematical form).

Q.4 In Question 4(b), few candidates showed understanding of the need for even powers for a square number. Finding the HCF was often well done in Question 4(c), although 5 was a common incorrect answer.

Q.6 There was a mixed a response here, with many candidates finding 10% of 34·2 and adding, rather than appropriately dividing by 0·9.

Q.7 In Question 7(a), while some full statements demonstrated thorough understanding, some were penalised for numerical errors e.g., giving $\frac{10}{8}$ as 1·2. Weaker candidates thought that there needed to be constant differences in lengths in order for the rectangles to be similar. Some made irrelevant statements about areas of the rectangles.
In Question 7(b), many correct pairs of lengths were given, but again there were misunderstandings about differences in lengths or about areas.

Q.8 In Question 8(b), of those who knew to multiply $\frac{3}{5}$ and $\frac{5}{7}$, some insisted on cross-multiplying in order to obtain common denominators before multiplying.

Q.11 While some fully correct solutions were seen, there was often a disappointing response. Many were unable to fully clear the fractions, and those who did often made errors in expanding the brackets. It was also common to clear the fractions on the left-hand side, then equate the numerator to 9.

Q.12 Usually well done, although a surprising number of candidates were unable to deal with the horizontal and vertical lines correctly.

Q.13 Plenty of fully correct solutions were seen, however some missed the fact that x needed to be squared. A minority worked only with direct proportion. Errors in calculation were frequent in part (b), particularly when dividing by $0{\cdot}1^2$.

Q.14 This question caused difficulty for most candidates. Widespread errors included: working with the minor arc only; confusion between radius and diameter; working with area instead of arc length. Even those who started with a fully correct method were often unable to process the calculations e.g., even having initially included the fractional multiplier of $\frac{300}{360}$, some simply proceeded to ignore it in their subsequent working.

Q.15 The requirement to 'prove' congruency meant a need for formality in setting out working. While many candidates applied the appropriate condition (ASA), poor or inadequate notation was widespread in specifying angles. Unfortunately, some concluded that three pairs of equal angles provided a sufficient condition for congruency.

Q.16 Question 16(b) was usually well done (with occasional place value errors when multiplying).
Question 16(c) was disappointing, with relatively few candidates recognising the need to start by converting $11\frac{1}{4}$ into $\frac{45}{4}$ (or 2·25×5).
Only a small proportion gave an appropriate irrational number in Question 16(d), with frequent answers being recurring or terminating decimals between 6 and 7.

Q.17 Many started well by attempting to expand the brackets. However, only a few gave a convincing conclusion for the final mark. (No credit was given for a solution which involved only trials of specific integers e.g., n = 1,2,3.)

Q.18 Significant difficulty was apparent here. A large proportion of candidates started by incorrectly splitting the cube root of the sum of two terms into a sum of two cube roots. Follow through marks could not then be awarded as there were no terms in t^3.

Q.21 Question 21(a) was usually well-answered, particularly so at this late stage of the paper, although errors included the use of an incorrect total or mis-handling the non-replacement of the counters. A few candidates arrived at a final answer of $\frac{49}{110}$ (from giving $\frac{1}{11} \times \frac{0}{10}$ to be $\frac{1}{110}$).
In Question 21(b), the majority were able to construct the first fraction of $\frac{n}{2n+1}$, but few could correctly express the second fraction. Only a very small minority gained the final mark, as those who did multiply fractions often failed to eliminate the common factor of n.

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UNIT 2 FOUNDATION TIER

Overview of the Unit

Overall, the questions were comparable with those asked on previous series and the paper was a suitable and fair test for the candidates at the Foundation level.
Some questions proved more challenging than others, particularly those common with the intermediate tier paper. Whilst non-calculator methods can yield correct responses, they often increase the difficulty of the question and result in unnecessary errors. Candidates should be encouraged to use a calculator as much as possible on Unit 2 but must remember to show their working where appropriate.

The following topic areas were generally well-understood or well-answered:

- Finding the next term in a linear sequence (Qn. 1(a))
- Using a probability scale to represent an even chance (Qn. 3(a))
- Writing a time in seconds (Qn. 7)
- Knowledge that total probability = 1 (Qn. 11(a))

Some candidates found working with topics involving algebra difficult.
(Questions 9, 12(a), 18)
Areas for improvement include:

- Forming expressions
- Solving two-step equations

A lack of knowledge or application of the facts, formulae and definitions that need to be learned was evident in some questions. (Questions 4(b), 10, 20)
Areas for improvement include learning:

- the common properties of numbers, including multiples and squares
- the formulae for finding the area of circles
- all the conversions listed the specification.

Comments on individual questions/sections

When a question or part-question is not listed, there are no areas to highlight.

Q.2 Only around one-third of candidates were able to recognise a radius and even less could recognise a tangent. There was some confusion with radius and diameter in Question 2(a) and between tangent and circumference in Question 2(b).

Q.5 The three parts of this question assessed candidates' knowledge of averages and were poorly answered. Candidates were most successful at Question 5(b), where they simply needed to find the median from a list of seven numbers. There was confusion between mode and mean in Question 5(a) and some candidates simply worked out the mean of 2 and 7 in Question 5(c).

Q.6 This question was poorly answered, with very few fully correct responses seen. Few candidates were able to state the volume of Dylan's cuboid, even though a diagram of the cuboid was provided so candidates could simply count the cubes in the diagram.
Some candidates didn't read the question carefully and thought that Angharad's cube was the diagram of the centimetre cube at the top of the page.

Q.9 Each of the three parts were answered correctly by fewer than one-fifth of candidates.
In Question 9(b) some candidates gave answers of $x - 3$ instead of $3 - x$.

Q.10 It was evident in this question that many candidates had not learnt that 1 litre $\approx$ 1.75 pints and 5 miles $\approx$ 8 km.
Selecting 2 pints to be equal to 2 litres and selecting 32 miles to be equal to 32 km were common incorrect answers.

Q.13 This question was both poorly answered and poorly attempted by candidates. Candidates engaged well with clue 2 which told them that the number is a multiple of 2.3 (although some made numerical errors) but struggled with clue 3 which gave conditions relating to the square of the number.

Q.15 A common incorrect method was to think that the number of hours worked on Monday, Tuesday or Wednesday was 7·2 hours (from 36 ÷ 5) leading to Friday to be 3·6 hours.

Q.16 **(b)** Many candidates simply chose to reflect the triangle in the x-axis or y-axis.
A mark was available for those who drew the line $y = 1$, but this rarely seen.
Most candidates who drew this line were able to reflect the triangle correctly, but this was very rare.

Q.17 Some candidates were able to complete the first step of this problem which required them to find the fraction of an amount.
The second step required candidates to divide the remaining length in the given ratio and very few candidates attempted to do this.

Q.19 Very few fully correct answers were seen to this question Some candidates found the missing 10% and £92, but very few were able calculate 13.5% of £36.

Q.20 Some candidates were able to pick up a mark for finding the correct radii of the circles. A few even went on to find the width and length of the rectangle, but typically that was it. It was very unusual to see the correct formula to calculate the area of a circle.

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UNIT 2 INTERMEDIATE TIER

Overview of the Unit

Overall, the questions were comparable with those asked on previous papers that have been sat, and the paper was a suitable and fair test for the candidates at the intermediate level. Some questions proved more challenging than others, whilst some candidates lost marks because of incorrect numerical evaluations or giving unsupported incorrect answers. Unit 2 is designed to assess the use of the calculator. Although non-calculator methods can yield correct responses, they often increase the difficulty of the question and result in unnecessary errors. Candidates should be encouraged to use a calculator as much as possible on Unit 2 but must remember to show their working where appropriate.

The following topic areas were generally well-understood or well-answered:

- Knowledge that total probability = 1 (Qn. 2(a))
- Solving simple linear equations and calculating the output using a function machine (Qn. 3)
- Using the common properties of numbers, including multiples and squares (Qn. 4)
- Using the facilities of a calculator to evaluate expressions and rounding to the nearest 10 and one decimal place (Qn. 5)
- Writing the coordinates where two lines intersect (Qn. 9(b))
- Drawing a graph of a quadratic equation (Qn. 13(b))

Some candidates found working with topics involving algebra difficult.
(Questions 3(b)(ii), 6, 18, 22)
Areas for improvement include:

- Substituting negative values into a quadratic equation.
- Forming expressions ad equations using the correct notation and using brackets where appropriate.
- Multiplication of two linear expressions $(ax + by)(cx + dy)$, where a, b, c, d are integers.
- Solving simultaneous equations that are in context.

Some candidates found working with topics involving probability difficult.
(Questions 2(b), 15)

- Identifying all the outcomes of a combination of two experiments.
- Calculating theoretical probabilities based on equally likely outcomes.

A lack of knowledge or application of the facts, formulae and definitions that need to be learned was evident in some questions. (Questions 1, 11, 14)
Areas for improvement include learning:

- the formulae for finding the area of rectangles, circles and trapeziums
- the formula for finding the volume of prisms
- the formula for the relationship between mass, density and volume
- all the conversions listed the specification.

Comments on individual questions/sections

When a question or part-question is not listed, there are no areas to highlight.

Q.1 It was evident in this question that many candidates did not know or had not learnt that 1kg ≈ 2·2 lb and 5 miles ≈ 8 km or equivalent. Candidates should be reminded that the metric and Imperial conversions listed the specification should be learnt.

Q.2 Question 2(b), a multiple-choice question, was not well answered.
The most common incorrect answers were $\frac{2}{3}$ (including 1 as a prime number) or $\frac{1}{6}$ or $\frac{5}{6}$ (sight of 6 as a denominator).

Q.3 In Question 3(b)(ii), many candidates gained 1 mark for an answer of $5 \times n - 6$, where brackets were omitted. Many candidates find forming an expression from the information given in the question challenging. Candidates were far more comfortable using numbers as was required in Question 3(b)(i).

Q.6 Many different methods were used by candidates to find the number of hours worked on Friday. It was unusual to see algebraic methods being used. A common incorrect method was to think that the number of hours worked on Monday, Tuesday or Wednesday was 7·2 hours (from 36 ÷ 5) leading to Friday to be 3·6 hours. The answer was needed to be given in hours. Time continues to be challenging to some candidates, with many giving 4·3 hours as a final answer.

Q.7 In Question 7(b), a mark was available for those who drew the line $y = 1$, or who reflected the triangle in the line $x = 1$ rather than the line $y = 1$. However, many candidates chose to reflect in the y-axis, for which there were no marks awarded, whilst others reflected the shape into each of the four quadrants.

Q.8 There were three steps to this question. Candidates needed to:

- calculate $\frac{2}{5} \times 35$ to find the length of part A
- find the total length of parts B + C
- sharing the total length of parts B + C in the ratio 1 : 6.

The first step was well answered.
Many did not engage with the second step and either used 14 cm or 35 cm as 'their 21 cm'.
This was the OCW question. Candidates should present their response in a structured way and use appropriate labels to be awarded the OC mark. The lengths A, B and C needed to be labelled as well as a label to show what the 21 cm represented.
All workings should be shown, and the correct mathematical form was required for the W mark. Common mathematical form errors included the incorrect use of the '=' sign or not including units.

Q.11 Candidates find any questions involving calculating the area of the circle challenging. Marks were mostly awarded for showing the correct radii of the circles, finding the width and length of the rectangle and finding the area of either circle. Many candidates did not then continue to find the total area of the shaded parts of the rectangle.

Q.12 Even though a straightforward question, candidates find any question involving bearings difficult. It was evident that many did not know where to place the protractor to measure the angle. Understanding all aspects of bearings, including interpreting and drawing bearings, is a definite key area for improvement.

Q.14 Many candidates did not answer this question correctly, with few candidates showing awareness of the formula to calculate the area of a trapezium, despite it appearing on the formula list at the front of the paper. In some cases, candidates did write a correct method but arithmetical errors were evident. Those that split the shape into a rectangle and triangles usually resulted in errors.
In Question 14(b), candidates were able to follow through whatever answer they had for a volume in part (a). Few knew the correct relationship between mass, volume and density and many thought that 1 kg = 100g when converting grams to kilograms.

Q.15 Some candidates found the lack of structure in the question challenging.
Those candidates that listed all the possible combinations and then went on to identify the combinations (e.g. 2 × 6) or products (e.g.12) that form factors of 36 that can be achieved by the two spinners combinations were usually more successful.
Some candidates only identified 4 × 9 = 36 as the only factor of 36.

Q.18 This question was not well answered. Some candidates were awarded S1 for the intention of working with width × length (e.g. sight of $(5x + 3)(2x - 1)$ with or without brackets). Many errors then occurred when multiplying two linear expressions. A few candidates only found the expression for the area of one rectangle.

Q.19 A very accessible three marks for those who were familiar with using trigonometric relationships in a right-angled triangle. It appeared, however, that many candidates had not covered this part of the specification.
Of those candidates who engaged with the question and wrote the correct first step of $\tan 40° = \frac{18.6}{YZ}$, a number then continued to calculate $\tan 40° \times 18.6$.

Q.20 60 × 7 = 420 mm was a common incorrect answer, where candidates had not engaged with bounds at all. Many candidates at the Intermediate tier find questions dealing with bounds to be challenging.

Q.21 In this question, 1 mark was awarded for sight of the midpoints and another for showing that a = 10. Extending the table was usually a good strategy.
Many candidates missed the missing value in the table which then usually caused problems. Some candidates could find the sum of midpoint × frequency but then went on to divide by 6 (from the number of rows in the table) instead of 32.

Q.22 Candidates needed to form two equations from the information given in the diagrams. The simultaneous equations then needed to be solved using a valid and algebraic method (as the question specified). As this question was on a calculator paper, no marks were awarded to those who used a form of 'trial and improvement' method to find the value of x and the value of y.
Follow through marks were available if candidates used 'their equations' as long as they were of an equivalent difficulty.
Many candidates find this topic extremely challenging.

MATHEMATICS

GCSE

November 2023

UNIT 2 HIGHER TIER

Overview of the Unit

Overall, the questions were comparable with those asked on previous papers sat. The paper was a suitable and fair test for the candidates at the higher level. As expected, candidates generally performed better over the first half of the paper and performed well on some of the standard Unit 2 topics. Candidate found some of the non-standard AO3 type questions quite challenging, especially the multi-stage questions.

The following topic areas were generally well-understood or well-answered:

- Drawing a graph of a quadratic equation (Qn. 1)
- Using Pythagoras' theorem to find the length of the hypotenuse (Qn. 4)
- Finding an approximate solution to a cubic equation by trial and improvement (Qn. 5)
- Using intermediate tier level upper and lower bounds in accuracy of measurement to find the length of combined sides (Qn. 8)
- Simple use of the cosine rule to find the missing length of a triangle (Qn. 12)
- Factorising quadratic expressions with all positive coefficients, e.g., $6x^2 + 19x + 10$ (Qn. 11(a))
- Calculating the probability of one permutation of three independent events (Qn. 17(a))

Some candidates found working with topics involving algebra difficult.

- Expanding brackets involving extra steps of algebraic manipulation (Qn. 6)
- Setting up and solving simultaneous equations (Qn. 10)
- Harder factorisation (Qn. 11(b)&(c))
- Drawing and interpreting cubic and reciprocal graphs (Qn. 16)
- Solving equations with algebraic fractions (Qn. 19)
- Solving quadratic equations (Qn. 19)

A lack of knowledge or application of the facts, formulae and definitions that need to be learned or used from the formulae page was evident in some questions.
Areas for improvement include learning:

- the formulae for finding the area of rectangles, circles and trapeziums
- the formula for finding the volume of prisms
- the formula for the relationship between mass, density and volume
- all the conversions listed in the specification.

Comments on individual questions/sections

When a question or part-question is not listed, there are no areas to highlight.

Q.2 In Question 2(a), although the formula for calculating the area of a trapezium, along with the formula for calculating the volume of a prism, are both given in the formulae page, many candidates seemed to not know this and failed to gain the opening mark. In Question 2(b), the majority of candidates attempted to calculate the mass first. It was clear that some of these candidates forgot to convert their answer into kg, as the question stipulated. Other candidates attempted to convert the density first into kg/cm^3 as their initial step. A significant number of candidates did not use the density/mass/volume formula correctly even though the given units for density, g/cm^3, could be used as an aide memoire to recall the formula. With regard to converting either their answer, in grams, or the given density into kg/cm^3, an incorrect calculation was often seen, for example dividing by 100, or multiplying by either 100 or 1000.

Q.3 The main reason candidates lost marks here was either because they could not identify all of the relevant factors of 36, or that they failed to realise that a product of 18 could be achieved in two ways, 2 × 9 and 3 × 6.

Q.6 Common errors were either in expanding the brackets or collecting the terms in x. Further errors were seen when doubling, as often not all three, or four, terms were doubled.

Q.7 The unknown length of YZ was in the denominator of the equation tan 40° = 18.6/YZ, and therefore many candidates from this point on rearranged the equation incorrectly.

Q.8 A significant number of candidates failed to identify the greatest possible height of one of these cubes to be 60·5 mm, with many simply multiplying 7 × 60 = 420.

Q.9 The majority of candidates knew to identify the midpoints of each class interval, but then continued to either work with the frequency a for the class interval 50 $\leq$ t < 60 or decided to ignore it completely. A further common error was dividing their total for the sum of the midpoints and respective frequencies, fx, by the number of class intervals, 6 in this case, rather than the number of data values.

Q.10 The first equation from the left-hand diagram, $12x + 4y = 180$, was generally correctly identified. However, many candidates incorrectly treated the right-hand quadrilateral as a cyclic quadrilateral which in turn resulted in the second equation being incorrect. Many candidates were proficient at solving their simultaneous equations with two unknown variables.

Q.11 In Question 11(b), many candidates stopped after factorising m from the expression, not realising that the difference of two squares was also involved.
In Question 11(c), many candidates first expanded the expression into a quadratic before attempting to factorise it into two brackets, instead of initially factorising the common factor of $(p + 7)$.

Q.13 Many incorrect answers were selected in this multiple-choice question, the most common being 2 x 10^6 which was finding the cube root of both 8, and 216 which was the power.

Q.14 Many candidates only used the linear scale factor instead of the area scale factor to answer this question.

Q.15 Many candidates incorrectly divided the greatest value of c by the least value of d for the subtracted fraction. Also, a significant number of candidates did not know how to identify the upper bound more than the lower bound.

Q.17 In Question 17(b), many candidates lost marks because they did not identify all the different permutations for a child not receiving a ball (or of a child receiving 2 balls).

Q.18 Many candidates were not able to identify either an appropriate angle of 30°, or the base angles of the isosceles triangle OCG. This precluded those candidates from working out the appropriate angles in triangle CEG to use the sine rule.

Q.19 Many candidates failed to clear the denominator correctly on both sides of the equation. A common mistake was the correct intention of multiplying through by x, but not multiplying the '+5' term as well.
If the candidates got as far as forming a quadratic equation, either equal to 0, or implied as being equal to 0, errors were still seen in substituting into the quadratic formula, usually by incorrectly substituting and evaluating a negative number in the b^2 term of the discriminant.

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[i] ***Please note that where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.***