GCSE

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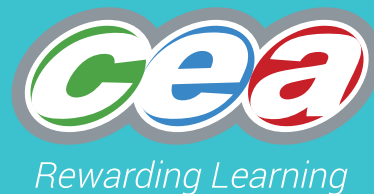## Chief Examiner's Report
Mathematics

Foreword

This booklet outlines the performance of candidates in all aspects of CCEA's General Certificate of Secondary Education (GCSE) in Mathematics for this series.

CCEA hopes that the Chief Examiner's and/or Principal Moderator's report(s) will be viewed as a helpful and constructive medium to further support teachers and the learning process.

This booklet forms part of the suite of support materials for the specification. Further materials are available from the specification's microsite on our website at www.ccea.org.uk.

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The majority of candidates completed all of the paper in the time allowed and most were able to attempt questions throughout the paper. The paper was constructed to allow candidates to be differentiated across the ability spectrum and partial marks for appropriate method and understanding were awarded in many questions. It was pleasing to note that many candidates are showing working out and recording their calculator steps throughout the paper. However, there was evidence that some candidates did not have some or all of the required equipment (calculator, ruler and protractor). Questions, such as 1(c) and 4(b), asking candidates to give a reason to support their thinking are generally poorly answered at this level.

Comments on individual questions follow.

Q1 The majority of candidates had no problem with Parts (a) and (b) of this question on bar charts. The vertical scale was accessible to practically all candidates and most gained both of the available marks. The quality of response to Part (c) was mixed. While a minority of candidates gained 2 marks for this part many were only awarded one mark for 'Mary' with an incorrect reason. At this level candidates often express difficulty in providing appropriate reasons for their answers. Some candidates, despite clearly interpreting the vertical scale correctly in Parts (a) and (b) answered 'Joe because Ben Gorm is three and a half times as high', contradicting their earlier understanding.

Q2 In Part (a) (i) a majority of candidates were successful in selecting 'litres' as the metric unit of measure for the amount of water in a bath. Part (a) ii was less successful with roughly 40% of the candidates failing to choose 'metres' for the height of a tree. Part (a)(iii) was rarely answered correctly with a majority of candidates unable to provide 'm^2' as the unit measuring the area of a football pitch. In Part (b) there were many correct responses to changing 2.4 tonnes into kilograms but at this level it is disappointing to find that so many candidates are either unaware that there are 1000 kg in a tonne or are unable to multiply a decimal number such as 2.4 by 1000, either with or without a calculator.

Q3 A minority of candidates were awarded full marks in Part (a) but a large number either misread or misinterpreted the question and found one third of the car's cost and neglected to then take this away from the original value to find the sale price. Candidates should be reminded to reread questions when they have their answers. A minority of candidates left this part blank, attempted to divide 11985 by 3 without a calculator or simply subtracted one third of £1 from the original cost. In Part (b) the majority of candidates were able to correctly divide £197.60 by 4 to find the cost of one tyre but a sizeable number of candidates lost a mark for inaccurate money notation if they answered £49.4 a number of candidates misinterpreted the information in the question and multiplied £197.60 by 4. Candidates should be encouraged to read questions carefully. In Part (c) many correct answers to this rounding question were seen. Common incorrect responses included £300 when candidates rounded to the nearest £100 or £307.70 if they rounded to the nearest 10 pence.

Q4 Just over three-quarters of candidates identified Down as the county containing about 30% of the population in Part (a). The most common incorrect response was Antrim, which has a population of around 34%, which is closer to 35% rather than 30%.

Part (b) proved challenging for a significant majority of pupils who clearly misinterpreted the information given. Most candidates answered 'Luke' with a reason relating to Antrim being the most populous county shown. Few correct responses were seen and only a handful of candidates answered 'Kate' with a clear and unambiguous reason.

Q5 Many candidates, in Part (a), were able to produce the fraction $\frac{12}{30}$ which earned 1 mark or 2 marks if they correctly reduced it to $\frac{2}{5}$. Common incorrect responses of $\frac{3}{5}$ or $\frac{18}{30}$ were seen when candidates failed to read the question carefully and provided the fraction of passengers that are children rather than that of those who are not. A significant number of candidates failed to produce a fraction and 12 was seen either in the workspace or on the answer line frequently. This could be due to careless reading of the question rather than a lack of understanding of fractions. Part (b) proved to be less successful than anticipated. Only about 40% of candidates were able to find 18p for 10% of £1.80 Many candidates who knew to divide by 10 to find 10% ended up with 0.18 and failed to change their answer into pence. Few correct answers to Part (c) were given though many candidates were awarded 1 mark for providing a 3 digit answer made up of a multiple of 4 followed by a square number and a factor of 10. A common mistake was to confuse multiples of 4 with factors of 4 and answers were often seen with a first digit of 1 or 2.

Q6 Half of the candidates correctly found the perimeter of the rectangle in Part (a)(i) as 20 cm. The most common incorrect response given was 21 which may indicate that an area of 7 × 3 has been found. It was also clear, from other scripts with an answer of 21, that candidates incorrectly calculated the perimeter by counting their starting position as 1 rather than moving 1 cm from their start position. Part (a)(ii) was very poorly answered with few candidates showing understanding of either the meaning of the word 'perpendicular' or the naming of sides appropriately. Some candidates named pairs of parallel sides while the most common responses were of the form 'P' and 'S'. Listing the coordinates of 'U' in Part (b)(i) was successfully answered by the majority of candidates with the most common error being to reverse the x and y ordinates. Some responses, which were not given credit, included '5 across, 6 up' and '$x = 5, y = 6$'. In Part (b)(ii) it was pleasing to note that many candidates were able to identify a correct vertex to complete a trapezium according to the given instructions.

Q7 It was clear that many pupils were unfamiliar with the term 'vertices' in Part (a). Common incorrect answers included 6 and 12 where the number of faces or edges may have been counted. In Part (b) a small minority of pupils correctly calculated the area of the base of the podium. Some candidates found the area of the front or side faces while others calculated the volume of the podium. A common wrong response was 80 + 75 = 155 where candidates added rather than multiplied the dimensions. Very few fully correct responses to finding the volume in Part (c) were seen. A common incorrect response was 75 + 80 + 60 = 215 where candidates again added rather than multiplied the dimensions. A significant number of candidates were, however, awarded one of the two available marks for finding the volume accurately in cm^3. Finding the area of rectangles and the volume of cuboids is basic functional mathematics and candidates at this level should be familiar with the methods to find them.

Q8 It was pleasing to see so many correct responses to Part (a) where pupils correctly divided the total number of passengers by the capacity of each bus and rounded their answer up. Some candidates were fortunate that the correct answer of '5' also resulted from dividing 143 by 32 and rounding up if they ignored the 8 leaders in their calculation. A number of candidates lost the final mark for leaving their answer as a decimal number of buses or rounding down to the nearest whole number of buses. It was clear that a minority of candidates either had no calculator or chose not to use one throughout this question as a number of repeated addition or subtraction calculations were shown, often with arithmetical errors in Parts (a) and (b), and various non-calculator methods were employed, all unsuccessfully, to divide 700 by 143 in Part (c). In Part (b) a significant number of pupils gained both of the available marks while many were awarded one mark for showing the total number of available seats as 160. A common incorrect response was 17 where candidates ignored the 8 leaders and subtracted 143 from 160. Part (c) was answered well by stronger candidates but many candidates were awarded at least one of the three available marks, often for calculating the cost of the five buses correctly as £700. Common incorrect responses included £4.89 or £5 where the final mark was lost for incorrect rounding.

Q9 Both parts of this question on temperature and negative numbers were very well answered with the majority of candidates identifying April's –5°C as the warmest in Part (a) and correctly finding the difference as 10 in Part (b). Some candidates answered January as the warmest month in Part (a) thinking –15°C is warmer than the other temperatures given, which ranged to –5°C. In Part (b) a common response was '–10' for the difference and although this was awarded the mark it is not best practice to quote a difference as negative. A frequent incorrect response to Part (b) was '9' or '–9' where candidates may have been unsure of how to use their calculator to find the difference between two negative numbers and found the difference using an incorrect mental mathematics method.

Q10 This question, testing the mean and range of four hourly rates of pay, was well answered by many candidates who clearly knew the appropriate methods. Some candidates confused the mean with the median in Part (a) while others summed the four rates but failed to divide their total. In Part (b) it was clear that a minority of candidates were unfamiliar with finding the range even though this, along with calculating means, is basic knowledge at this level. Some candidates added the lowest and highest values while others attempted to find the median or calculated the mean.

Q11 A significant number of candidates showed understanding of this question on angles with a number correctly answering all three parts correctly. Although it was clearly stated that diagrams were not drawn accurately it was evident that some candidates measured the missing angles. A small minority of candidates left all three answers blank. In Part (a) despite realising that angles on a line sum to 180° some candidates lost the mark due to careless subtraction of 132 from 180. Other candidates subtracted 132 from 360. Part (b), testing knowledge of angles at a point, was the most involved of the three parts and it was pleasing to see 40% of the cohort giving correct responses. A common incorrect response was 241° where candidates neglected to deal with the right angle which was marked on the diagram with a right angle symbol rather than marked as 90°. Part (c) on vertically opposite angles was answered correctly by 41% of candidates though a common incorrect response saw candidates subtract 24 from 180 leading to 156°.

Q12 This three part question on algebra, despite being a non-functional question, was well answered in general and shows that many candidates at this level can cope with the idea of basic algebraic convention and solve simple equations for one unknown. In Part (a) almost half of the candidates were awarded the available mark for correctly simplifying the given expression to '6a'. Common incorrect responses included '6' or

answers such as '4a + 2a'. Part (b) was also well answered with many candidates able to find the correct value of '15' for y. A common incorrect response was '56' where candidates subtracted 4 from 60 rather than divide 60 by 4. Part (c) was successfully answered correctly by 70% of the cohort. A common incorrect answer was '5' where candidates subtracted 4 from 9 rather than adding 4 and 9 to produce 13.

Q13 This question on equipment hire was misunderstood by many candidates who summed together the fixed charge and the daily fee which they then divided into the total cost. This led to 274.50 ÷ 58.50 = 4.69 which was then rounded up to 5 days. None of the three available marks were awarded for this response. The correct answer of 17 was seen in a minority of scripts and other candidates were awarded part marks for showing an appropriate method. Some candidates correctly subtracted the fixed charge from the total charge, earning the first mark, and then attempted to solve the problem using repeated addition or repeated subtraction. It appeared as if candidates employing this method did not have access to a calculator and none successfully found the correct answer of 17.

Q14 In Part (a) it was pleasing to see many candidates able to produce an accurate and correctly labelled pie chart. A minority of candidates were awarded at least one of the four available marks with many gaining two for correctly finding the angles. It was clear that a small number of candidates did not have a protractor and in a number of scripts sectors were drawn freehand, suggesting candidates did not have a ruler either. Some candidates who may not have had a calculator made arithmetical errors when completing their table. A minority of candidates were awarded three marks when one of their sectors was out of tolerance. Candidates should be reminded to check their measurements carefully. Candidates should also be encouraged to complete the angle column of the table provided as in a number of cases where the angles were not shown poor use of the protractor led to the award of no marks. A small minority of candidates left this question blank. Most candidates realised they had to find the product of the 'number of tubs sold' and the 'number of scoops per tub' in Part (b) and the majority of candidates gained both of the available marks. Arithmetical errors led to the loss of at least one mark on a number of scripts and in some cases it was again clear that candidates did not have a calculator.

Q15 This question on order of mathematical precedence was answered well by a minority of candidates. Part (a), inserting 3 digits correctly, proved to be more challenging than Part (b) where a pair of brackets had to be added. In Part (a) a common wrong answer was '2 + 5 × 3 = 21'. Part (b) was answered correctly by almost half of the cohort.

Q16 In Part (a) candidates generally struggled to substitute $x = -1$ into $y = 5 \times -4$ correctly but had more success with $x = 2$. Unfortunately as only one mark was available both values needed to be correct. Only better candidates gained the available mark. It was pleasing to see a number of correct responses to Part (b) where candidates were asked to draw the linear graph. Candidates with an incorrect table from Part (a), in many cases, were able to plot the values that were given and produce the correct straight line. A number of candidates correctly plotted at least 4 points and were awarded 1 mark if they failed to join their points with the required line.

Q17 This question on elevations was generally well answered with most candidates scoring at least one of the three available marks for showing understanding of drawing front and side elevations. Many candidates were awarded two marks for completing the front elevation correctly while a very significant minority of candidates were awarded full marks for producing two accurate elevations. Some incorrect approaches saw candidates draw cubes as they failed to appreciate the two-dimensional requirement of elevations. Others drew partial squares to represent hidden faces and showed little understanding of the topic.

Q18 This question on summing fractions and giving an answer as a percentage proved challenging for many candidates at this level. Although a minority of responses were fully correct the majority of candidates gained no more than one or two of the four available marks for changing $\frac{2}{5}$ or $\frac{1}{4}$ into percentages. Some candidates lost the final two marks for not subtracting their total from 100% which again highlights the importance of careful reading of questions and rereading the question once an answer has been found. An incorrect approach saw a minority of candidates add $\frac{2}{5} + \frac{1}{4}$ as $\frac{3}{9}$ while others erred when converting $\frac{2}{5}$ into a percentage with 4% appearing frequently.

Q19 A very challenging question for candidates at this level with few marks awarded in either part. Finding the area of the circular pond in Part (a) was beyond all but the very best candidates. Throughout the cohort only a few candidates attempted to use the correct area formula of πr^2. A common incorrect response was to simply square the diameter and give an answer of 1.44 A small minority of candidates were awarded 1 mark for providing correct units. In Part (b) candidates were asked to calculate the cost of paving a rectangular section with a semi-circular area removed. A minority of candidates were awarded one of the four available marks for finding the area of the rectangle correctly and a couple of candidates were awarded a mark for finding half of the area of the circular pond they calculated in Part (a). The final two marks were inaccessible to the majority of candidates who were unable to find an appropriate area to round up and multiply by £30 per square metre.

Q20 Part (a) was well answered by many candidates who knew to divide 275 miles by 22 litres to find the car's fuel economy. Some misunderstanding of the problem was evident in a minority of scripts where the given numbers were multiplied or subtracted. Again it was clear that some candidates did not have a calculator and they were unable to correctly apply non-calculator methods to resolve 275 ÷ 22. It was pleasing to see a number of completely correct responses for the average speed in Part (b). However there are a sizeable number of candidates who are unable to change 5 hours 30 minutes into a decimal number of hours and many divided 275 by 5.3 rather than 5.5 A generous 1 mark was awarded, in these cases, for showing understanding of the method of calculating average speed. Some candidates changed 5 hours 30 minutes into 330 minutes and divided this into 275 miles, giving $0.8\dot{3}$ A mark was lost if they then rounded this value and multiplied 0.83 by 60 which resulted in an average speed of 49.8 miles per hour.

Q21 Better candidates generally answered this question on percentages well and full marks were awarded to almost 15% of the cohort. Careless reading of the question cost a number of candidates 1 of the 3 available marks when they failed to remove the 15% off value they had calculated from the original price of the photocopier. At this level a minority of candidates are unable to work with functional percentage problems and two common incorrect methods included subtracting 15 from 489 and dividing 489 by 15, then subtracting this from 489, leading to answers of £474 and £456.40 respectively.

Q22 A minority of candidates were able to successfully express 54 out of 75 as a percentage. The most common incorrect response seen was '21' where candidates subtracted 54 from 75.

Q23 This question on multiplying out brackets and factorising was challenging for a majority of candidates with few marks awarded for either part. In Part (a) some of the better candidates were able to multiply out $5(2t + 7)$ correctly but there were many inappropriate approaches shown and a significant number of blank responses. Common incorrect answers included '17' and '45', where the 't' was ignored, or '45t'.

Part (b) proved to be inaccessible to all but a few candidates sitting this paper. As only 1 mark was available several candidates were not rewarded for removing '4' as a common factor despite showing an understanding of factorisation.

Q24 In general, candidates struggled to gain more than one or two of the available five marks on this unstructured contextual problem relating to buying a car. However it was pleasing to note that a small minority of candidates did answer the question completely correctly. A variety of approaches were seen and partial marks were awarded to many of candidates. A significant number of candidates were able to calculate the monthly VAT correctly as £44 which gained a mark. Others, who ignored the VAT, were awarded a mark for correctly multiplying the monthly rate of £220 by 36 leading to £7920. Additional mileage charges led to confusion in many cases with candidates commonly multiplying 37200 by 8 or 0.08 rather than the excess miles of 7200. Candidates who used the correct value of 7200 often failed to ensure they were working with consistent units and added £9504 and 57600p together to produce £67104. Others divided the additional miles by 8 or 0.08 rather than multiplying. A minority of candidates applied VAT to the additional miles charge.

Q25 It was clear that candidates at this level, for the most part, have limited knowledge of questionnaires. In Part (a)(i) only a small minority of candidates answered appropriately with few answers given that related to the lack of a time period. Most candidates decided the question was inappropriate because personal information was being sought or because the students would not be able to remember how many days they had been absent. Part (a)(ii) was more successful with many candidates gaining at least one of the two available marks for their reasons why the sample may not be representative of the whole school. A common incorrect response was 'she only asked year 12 and not the whole school' showing a lack of understanding of the problem. There was a significant number of blank responses to this part of the question. In Part (b) candidates were asked to draw an ordered stem and leaf diagram and many candidates were awarded at least one of the three available marks. A minority of candidates provided completely correct diagrams while a significant number omitted a key and lost one of the marks. It was apparent that candidates, in many cases, failed to check their work and ended up with less than 14 entries in their leaves. A minority of candidates made no attempt to order their leaves but were still awarded at least one mark for showing understanding of the topic.

Assessment Unit M2   Foundation Tier

This was the second sitting of this new assessment unit and it contained a wide range of functional questions testing a variety of mathematical skills. There was no evidence to suggest that any of the questions had been misinterpreted, while the vast majority of candidates completed the paper within the time allocated.

There was less evidence of candidates scoring very low marks, although it did appear that some would have been better entering for M1 instead, as they experienced little or no success beyond the opening few questions.

With neither of the newer topics (Venn diagrams and real-life interpretation of gradient) being assessed, this paper had more of a 'traditional' feel, with no surprises in either the context or setting of the questions.

Given the increased emphasis on functional skills in schools, it was disappointing that in, arguably, the most functional question of all (Question 15), a significant number of candidates were unable to differentiate between working in pence and pounds, nor were they able to deal with the fact that 36 monthly payments were required.

There was clear evidence that candidates are being told to show their working, with many picking up method marks even where they failed to obtain the correct answer.

Q1 In Part (a) a common incorrect answer was 6. This may be because 7 were visible in the diagram, but one was possibly obscured by the winner's foot. Given the fact that the question stated the shape was a cuboid, it was disappointing that more correct answers weren't seen.

Some candidates appeared to think that, for Part (b), the base of the podium was at the front, with 80 x 60 = 4800 a common response. In the main, however, most candidates obtained the correct answer.

The vast majority of candidates failed to correctly convert the measurements to metres in Part (c) and, as a result, obtained an answer of either 360 000 (by keeping them in cm) or 3600 by incorrectly dividing by 10 rather than 100. Very few correct answers were seen.

Q2 In Part (a) most candidates had the right general idea of division and then rounding their answer. Many incorrectly divided 143 by 32, rather than realising that 151 people needed a seat. As it still meant that 5 buses were needed, they were not penalised at this stage.

However, in Part (b) those who thought only 143 were going on the trip stated that there were 17 spare seats, which was not the case.

Part (c) was generally well done, the main error being the failure of some candidates to realise that when their answer was 4.895….. they should have rounded to £4.90

Q3 This was very straightforward with only a handful of incorrect answers to Part (a) seen, where pupils stated January was the warmest as they saw it as the 'biggest' number.

The most common error in Part (b) was that candidates simply used the two 'end' values in the table, giving an incorrect answer of 9.

Q4 It was evident that some candidates simply do not know the definitions of the three averages and the range. They should be encouraged to use their calculator to check answers as in Part (a) some tried to add them using pencil and paper methods, resulting in numerical errors.

Q5 This was very well answered, with the vast majority of candidates recalling and using the basic angle facts.

Q6 A surprising number of candidates left the answer to Part (a) as 4a + 2a, rather than simplifying it to 6a. In general there were few problems with Parts (b) and (c).

Q7 This was very poorly answered by a large number of candidates. Many started by adding the fixed charge to the daily fee, then dividing the total cost by their answer. Candidates should be taught that any fixed charge is paid only once, and that it must be deducted first before attempting to divide.

Q8 As always Part (a) was well answered with many candidates drawing the pie chart accurately. Most were also able to correctly complete the table in Part (b) without difficulty.

Q9 Candidates tended to score either 2 marks or 0 marks, with little evidence of them trying different combinations in the large working space. It is disappointing that many failed to realise that BIDMAS was being tested. In a small number of cases, candidates used alternative numbers or added their own brackets, neither of which were allowed.

Q10 While there were some errors in Part (a), the majority of candidates went on to plot at least 4 points correctly in Part (b) to secure the first mark. It is disappointing that so many fail to join the points. It is equally disappointing that when they do, some fail to realise that they must have made an error somewhere as they have one or more points lying off the line they have drawn.

Q11 This was well answered by the majority of candidates. In a very small number of cases an attempt at a 3D drawing was made, while some drew the left side elevation, rather than the one indicated on the right of the shape.

Q12 The most successful candidates in this question immediately changed the given fractions to percentages and easily secured the first 2 marks. Some failed to realise that they needed to take their 65% away from 100% in order to get the answer. Those who added the fractions generally did it correctly, with a lack of working suggesting that they were able to use their calculator effectively.

Q13 This very functional question was poorly answered in the main, with a disappointing number of candidates not even picking up the units mark in Part (a), which was clearly indicated in the question. Use of incorrect formula was the most common error, as was candidates' failure to use the radius rather than the given diameter.

Many obtained the first mark in Part (b) for calculating the area of the rectangle, but then completely failed to deal with the circle in the centre. While some obtained the correct answer of £300, this was often more by luck than by design and received no credit when it followed from clearly incorrect working.

Q14 Part (a) was a slightly different type of question than usual, but that didn't stop the majority of candidates securing the mark.

It is clear from Part (b) that candidates have great difficulty realising that 30 minutes is 0.5 hours. While most realised they needed to divide distance by time, many used either 330 (minutes) or 5.3 hours (rather than 5.5) for the time and could gain a maximum of 1 mark.

Q15 This was one of the most disappointing questions on the paper. It was a real-life, common functional scenario which many candidates will have to deal with at some point in time. The addition of the 20% VAT proved surprisingly difficult. Many were able to work out that it was £44, but chose to multiply only this by 36, rather than working out the monthly payment of £264 and then multiplying by 36.

Those who realised that they needed to multiply the 7200 extra miles by 8p failed to convert their answer into pounds, resulting in a huge answer which they should have realised was incorrect.

Q16 This question was reasonably well done, although a significant number of candidates decided to subtract 54 from 75 to get 21. It appears that they confused this type of question with percentage increase or decrease.

Q17 While Part (a) was often correct, many candidates lost the mark in Part (b) by failing to take out the highest common factor of 8, rather than 2 or 4.

Q18 The main difficulty for candidates was knowing the difference between an expression and an equation, with many giving an equation in Part (a). Common errors were obtaining $3x$ rather than $4x$ (probably due to counting the $2x$ as just 'an x') and failing to simplify.

Most candidates who had an expression in Part (a) went on to set up an equation in Part (b)(i), although some couldn't access Part (b)(ii) as they only had a one-step equation, for which no follow was allowed (as it simplified the question).

Q19 It is clear that many candidates are simply given some 'prepared answers' to questions such as this, with many stating in Part (a)(i) that it was 'a personal question', which was irrelevant. Another common answer was that 'the pupils may not know'. Candidates should be taught to look for the problem with the actual question, which was clearly that it did not specify a time period. Very few got this correct.

In Part (a)(ii) a significant number of candidates simply restated what they had been

told in the question, giving answers like 'She asked the first 20 Year 12's'. They should realise that a sample size of less than 30 is generally too small and that all year groups must be asked in order for it to be representative.

Part (b) was well done, although some candidates could not deal correctly with the single digit '8' which was often written as a stem. A missing or incorrect key was the other main cause of losing a mark here.

Q20 As often happens with questions like this, use of incorrect formula or failure to correctly distinguish between the radius and diameter were common. Of those who did manage to find the circumference of the circle, they either didn't go on to divide by 4, or forgot to add on the 18. Very few fully correct answers were seen.

Q21 This question provided evidence, if it were needed, that many candidates do not know the difference between mean, median and mode. A number attempted to rearrange the numbers into order and find the median, although most did correctly find the boys' mean to be 6.5 Only a relatively small number realised that they needed to add on the girls total of 40 and then divide the overall total by 15, so the most common mark by far here was 1 out of 3.

Q22 In Part (a) very few candidates opted to do prime factor decomposition, suggesting that they did not realise this was the topic being tested. A significant number used 'trial and improvement' techniques until they stumbled on the correct answer. It was interesting to note that many did not realise that the requested values of 'a' and 'b' were the indices, so instead gave their answers as '2^2' and '5^3'

Part (b) was poorly answered with very few correct answers seen. Even for those who were successful, there was little evidence that they realised the connection to Part (a).

Q23 Part (a) was surprisingly poorly answered, and in Part (b) most stated the modal group rather than that which contained the median. For Part (c) the extra blank columns in the table seemed to prompt some candidates into finding the midpoints and totals, with 1910 seen regularly. It was disappointing that many went on to divide by 5 rather than 50.

Q24 The majority of candidates correctly stated that the increase was 7 and secured the first mark. A variety of different approaches followed, with division by 91 rather than 84 the most common. Almost no candidates gave the answer as a fraction, with 8.3 the most frequent of the acceptable answers.

Q25 It was pleasing to see that a substantial number of candidates correctly realised that this question was testing Pythagoras' Theorem and many found the correct length of AC. There were some rounding issues with many opting for 8.48 rather than 8.49 A number also failed to find the difference in the lengths and lost the final mark.

Assessment Unit M3   Higher Tier

The performance by candidates on this paper was generally good. It was notable that previous T3 topics were well responded to, whereas some new topics feeding in from earlier modules M1 and M2 were not as well answered despite them being a lower level of question. There was evidence to suggest some of these topics had not been addressed, in particular the early questions on order of operations and pie charts. There were enough straightforward questions to enable weaker candidates to experience success across a range of topics, balanced with more challenging questions to stretch and distinguish the better candidates. Topics which showed improvement included Pythagoras' Theorem and Trigonometry. There continues to be improvement in the methodology and presentation of pupil work, allowing many partial marks to be awarded. This was very much evident in multistep questions such as Question 5 – percentages, Question 10 – finance, Question 13 – perimeter of quadrant and Question 20 – percentages. There was a positive response to

most Geometry and Measures questions with a significant weakness in the area of Algebra. Questions which were challenging and were answered with varying levels of success included Question 6 – area, Question 10 – finance of car, and Question 14 – combined means. Other questions where there some difficulties included Question 7(b) – using correct units within speed calculation and Question 17 – percentage increase, despite these being standard mathematically posed problems. Questions 6, 10, 13, 14, 20 and 23 differentiated well between the very best.

Numeracy skills were tested directly and indirectly (through data, geometry or algebra) in Questions 1, 2, 5, 6, 7, 8, 10, 13, 14, 15, 17, 20 and 23. Questions with a functional element were reasonably well answered including Question1, Question 5, Question 6 and Question 13 with perhaps Question 10 and Question 20 producing more varied responses. Literacy and communication were a feature of Questions 12 and 19 and many did find it difficult to articulate their thinking in clear mathematical language.

Q1 The opening question on finance nearly always either resulted in full marks or no marks for candidates. For those who took the first correct step of subtracting the fixed charge, reaching a successful conclusion was generally the norm with all marks secured. The incorrect approach of dividing by the fee per day before eliminating the fixed charge resulted in no marks.

Q2 There was limited recognition of the topic being assessed here, as the most common response offered was 5 + 2 x 3 thus not recognizing the need for order of operations to be applied. Where it was recognized there were three correct acceptable solutions offered.

Q3 In Part (a) the inclusion of a pie chart in on this M3 paper appeared to catch out a significant number of candidates who either struggled to deal with the given information and convert to angles or more so those who could complete the table but did not seem to be equipped with a protractor to draw the actual pie chart. Relatively easy marks were lost by many on this question. However, for candidates who were familiar with constructing pie charts this question was most accessible and securing full marks was easy. There was much greater success in Part (b) with the vast majority of candidates able to successfully complete the table.

Q4 In Part (a) very many recorded the two correct y values in the table. Unfortunately some did not then link Parts (a) and (b) and made no attempt at drawing the straight line graph. Also, too many simply plotted the points from the table in Part (a) but did not join them by a straight line.

Q5 The percentage question was well answered with many gaining the full 4 marks. Occasionally the last step of the question was overlooked with candidates adding the two fractions and converting the total to a percentage but forgetting to subtract to find the remaining percentage that went to the first aid group.

Q6 This question proved a good discriminator between candidates of varying abilities. In Part (a) the requirement to calculate the area of the pond caused the usual difficulties where candidates could not quote the correct formula for the area of the circle or could not decipher the correct value for the radius. However, very many did score all the available marks including the units mark. Proceeding to Part (b) it was only the very best who interpreted the information correctly and reached the correct final solution. A large proportion of candidates interpreted the paving to be half the area of the full rectangle but took no account of the semicircle which had to be removed. Others halved the rectangle but not the circle whilst others didn't half either area. The requirement to round the calculated area up to the nearest square metre before calculating the cost was well acknowledged.

Q7 In Part (a) calculating the number of miles travelled per litre was very well answered with nearly all gaining the mark. In Part (b) calculation of average speed proved problematic for many, in terms of units. Whilst very many knew the required knowledge that speed equalled distance/time, dealing with the given time of 5 hours and 30 minutes was challenging. Too many substituted the time as 330 minutes or 5.3 hours and were unable to reach the correct speed. Candidates must be encouraged to look at all units involved within a compound measure and also the necessity to deal with time in sixtieths not hundredths.

Q8 Calculating the percentage from the values given produced a strong response with very many gaining the two marks. Occasionally candidates recorded the percentage who did not have breakfast.

Q9 Expanding the bracket in Part (a) was answered very well. Factorising in Part (b) was acknowledged by many but a significant number of candidates did not remove the largest common factor and so incorrect responses of $2(8r - 4)$ or $4(4r - 2)$ were often recorded.

Q10 This multistep functional question was probably the most challenging question for candidates. However, all candidates offered some attempt and so partial marks were awarded to many. Only the best managed to reach a successful conclusion. Too many saw this as some form of compound interest question and so from the outset produced an invalid method. Others were unsure at which point to include the VAT and then there was the usual confusion where the cost per mile was in pence and all other calculations were in pounds. It was more alarming when candidates did know to change units but converted from pence to pound incorrectly by dividing by either 10 or 1000. Overall, there was a very varied outcome in this question.

Q11 Despite the fact that the algebraic question was structured into stages, few distinguished clearly between the various steps. In Part (a) many recorded an equation or a formula rather than an expression. For those who did record a correct expression in Part (a) most went on to record and solve the correct equation in Part (b). If the expression in Part (a) was incorrect, it often created greater difficulty in Part (b).

Q12 In the survey question, like in previous exam series candidates are not reading the requirements of the question carefully. In Part (a)(i) the assessment objective was to state one criticism of the question. However, the vast majority responded with a criticism of the sample of students used or a lack of response boxes. Only the best recognized that without a timeframe in the question posed there would be no validity to the survey. In Part (a)(ii) there was a better response with many recording two correct reasons why the sample would not be representative of the whole school population. Construction of the stem and leaf in Part (b) was good, however there are still some centres where this topic is simply not recognized by candidates. The lack of a key still results in some candidates losing a relatively straightforward mark.

Q13 Calculating the perimeter of the badge in the quadrant shape proved a very good discriminator question and allowed candidates of varying level of ability to respond accordingly. There were those who could not present a correct circumference formula or those who knew the formula but could then not distinguish the correct radius or diameter. If the formula and values used was correct many then did proceed to divide by 4 to get the required quarter. However, only the best recognized the need to include the two radii as part of the overall perimeter.

Q14 There was a very disappointing response to the calculation of the overall mean where the information was presented separately for boys and girls. It seemed that too many candidates only read the test scores for the boys and calculated their mean with no attention given to the remainder of the information provided in the question. Where

the further information was read, few were able to process it correctly. The most common wrong approach was to add the mean of the boys and the mean of the girls and half the answer. Overall, there were very few correct solutions seen here.

Q15 Whilst Part (a) was a product of primes question, the novel way in which it was assessed proved difficult for some. Most candidates approached the question via the usual method of decomposition and were generally successful in recording the correct answers. However, some who had all the correct work, presented their final solutions as 4 and 125 or 2^2 and 5^3 as opposed to the correct solutions of a = 2 and b = 3. For those who used the given knowledge that 4500 divided by 9, many did not then know how to proceed with the remaining 500. There seemed to be limited familiarity with the product of primes function on the calculator which would have led straight to the required answer. There was only a minority of candidates who scored the marks in Part (b). Few were able to connect their solution in (a) to what was required in (b). Several who did secure the marks in (b) did so by a trial and improvement approach leading to 4500 × 6 leading to the cube number of 27000.

Q16 Reading from the grouped frequency table in Part (a) was good. Recording the median class interval was not good and more often the modal class interval was given. Calculation of the mean in Part (c) produced a reasonable response; a few are still unnecessarily rounding their final answer. Unfortunately there were candidates who had correctly filled in the midpoints and fx values in the table but then embarked on a completely different incorrect method for trying to find the mean.

Q17 For a standard percentage question there was a poor response to finding the percentage increase. Nearly three quarters of the candidates gained the first mark by recording an increase of 7cm. Only the best knew the subsequent correct arrangement to find the percentage increase.

Q18 There was generally a positive response to the Pythagoras question with very many gaining the full 4 marks. Occasionally a candidate stopped when they calculated the hypotenuse and failed to interpret the requirement of the question which was to calculate how much longer AC was than AD, so unfortunately an easy mark was lost.

Q19 The topic of bounds was either very well acknowledged or not at all. Where a candidate recognized that 2cm and 4cm could have varied between their lower and upper bounds any correct combination which led to an area not rounding to 8cm^2 secured the marks. Some candidates were too general in their response and did not secure both marks. Many simply did not recognize the topic being assessed here.

Q20 The multistep percentage question was a good question at differentiating between candidates of varying ability. Nearly all were able to reach the point where Colin had paid 32.5% of the total. Some however felt the need to round Jack's percentage to 38% rather than the accurate 37.5% and so incurred an accuracy penalty. Many then did equate the 32.5% to £520 for a third mark but after this dealing with the reverse percentage calculation caused the usual difficulties. The best candidates had no difficulties with this question and gained full marks.

Q21 The factorization question produced a varied response. In Part (a) whilst very many recognized common factors as the method, too often the largest combination of factors was not removed. A large proportion of candidates who did remove the correct factor to the front as 2cp then proceeded to record (5cp − 2) in the bracket. There seemed to be a perception that 10cp^2 included the c term as squared. Difference of two squares was only successfully answered by under a third of the candidates. Factorising the quadratic in Part (c) proved problematic for many. Only the better candidates gained the marks here. In Part (d) only a few candidates dealt with this by recognizing $(x − 2)$ as a common factor. More often it was approached by expanding the brackets and whilst this could have led to a correct solution, too many stopped on reaching the quadratic expression and failed to factorise it at the end.

Q22 There was widespread recognition of the need for trigonometry in this multistep question, however too many offered all sorts of approaches without commitment to which angle they were actually trying to calculate. Again, like Question 18 even where correct high level mathematics was offered many compromised the last mark here by not giving their answer to the nearest degree. Also any early rounding of the angles in this question led to the incorrect solution of 40° and not 41°

Q23 Despite the algebraic fractional equation being presented in an easier form, many struggled to solve this. The easiest approach of cross multiplying was not well recognized. When it was used many secured the 4 available marks. Where candidates tried to find a common denominator or multiply across by a suitable value to eliminate the fractions, many incorrect expansions resulted and so only part marks were gained.

Q24 Drawing the correct cumulative frequency curve from the given values was easily accessible to all. Often a point was plotted incorrectly or an inaccurate curve presented. A very small number of candidates offered a bar chart rather than a cumulative frequency curve. The use of the graph in Part (b) was less well answered. Whilst many read their graph correctly at 47 or 48 few went on to interpret that this meant either 3 or 2 took longer than 40 minutes and then the final step to convert this to a percentage was very often overlooked.

Assessment Unit M4   Higher Tier

The performance of candidates in this paper was of a much higher standard than the first sitting of M4 in June 2018. The paper was successful in allowing candidates of differing abilities to respond positively across a good variety of topics. That said, there were still a lot of candidates losing a large number of marks in the C grade questions yet proceeding to answer B, A and in some cases, A* questions well. The latter questions did stretch the more able students and allowed them access to the higher grade boundaries whilst the majority of candidates were still able to attempt most questions.

Presentation of work was also generally of a better standard than the first sitting last June. However, some candidates did lose easy marks in Question 10 (a) for not drawing their curve/line through their plotted points or for having multiple curves/lines.

Questions/topics which seemed to cause most problems in general were 8 (d) (factorising), 12 (equation of a perpendicular line), 14 (angle of depression), 16 (c) (stratified sampling), 16 (e) (median from a histogram), 17 (b) (reasoning for circle theorems & algebra expressions), 18 (surface area of frustum), 19 (setting up an equation and solving).

Q1 The majority of candidates answered this question on the perimeter of a quadrant well. Compared to circle questions which were assessed in June 2018, this question had a more positive outcome in terms of responses. However, there are too many candidates who do not know their formulae, confusing the radius for the diameter or working with area rather than perimeter – all of which obtained zero marks. A significant number successfully calculated the length of the arc and forgot to add the two straight edges.

Q2 Surprisingly this averages question was poorly answered, despite being a C grade question on a higher paper. The most common answers were 6.5 or 14.5 (both obtaining 1/3). The number of incorrect answers confirmed an underlying lack of understanding of the concept of the mean and how it is calculated.

Q3 **(a)** This prime factorisation question was answered to a high standard with most candidates able to get the correct answers. The poorer responses involved candidates dividing 4500 by 9 to get 500 and failing to know how to proceed from here. Those who are aware of the FACT button on their calculators should have had little trouble in answering this. A few candidates left their answer as 22 and 53 and obtained 2 marks out of 3.

(b) Some candidates simply did not know what they were supposed to do here. Whilst many were successful in reaching the correct answer, some attempted to carry out trial and improvement to find a cube number which satisfied the question.

Q4 **(a)** This reading from a grouped frequency question was answered very well in general.

(b) This median class interval question was also answered very well in general.

(c) This mean from a grouped frequency table was answered well in general. Candidates who got this wrong generally made the question more difficult than it was by trying to work out frequency density or cumulative frequency. A minority rounded their answer to 38 and obtained 3 of the 4 marks available.

Q5 This percentage increase question was answered to a high standard, with the majority of candidates reaching an answer of 8.3% or equivalent. The weaker responses indicated that candidates did not know the basic starting point of subtracting 84 from 91. A small number of candidates appeared to attempt a trial and improvement method in order to find the percentage increase. For those that didn't get full marks most were able to at least achieve the 1st mark for recognising the increase of 7.

Q6 This Pythagoras' Theorem question was the best answered question on the paper with the majority of candidates using Pythagoras' Theorem correctly, then subtracting 6. Common mistakes were incorrect rounding, simple arithmetic errors or forgetting to find the difference.

Q7 In this number question involving fractions and percentages the majority of candidates reached the correct answer, with most working with the percentage values, rather than fractions. Of those who failed to answer this correctly, most tried to find 67.5% of £520 then add this on. For lower ability candidates the question was accessible and allowed nearly all students to gain some or all of the first 3 marks. Some misunderstood the question and treated the $\frac{3}{8}$ element as $\frac{3}{8}$ "of the rest" of the money.

Q8 **(a)** A basic factorisation question that was answered well in general. Common mistakes were partially factorising or writing the answer as 2cp(5cp – 2). Both these obtained 1 of the 2 marks.

(b) This difference of two squares question was answered very well in general.

(c) A basic factorising of a quadratic question that was answered well in general. A common mistake was mixing up signs.

(d) A slightly different factorising question that threw the majority of candidates. Very few candidates used the first method on the mark scheme. Quite a number of candidates made silly mistakes multiplying out the double brackets and a majority left the answer as the expanded quadratic - not going on to factorise it and obtaining half marks.

Q9 This linear equation question was answered to a high standard by the vast majority of candidates. Some made a critical error when dealing with the denominators – they rearranged to have both fractions on the left and when multiplying across by 12 to remove the fraction, they incorrectly stated that $0 \times 12 = 12$.

Q10 (a) This drawing of a cumulative frequency graph question was answered well by the vast majority of candidates. The most common error was plotting a bar graph but only by a small minority. Most graphs were of good quality; however, a minority of candidates lost one mark for missing a plotted point with their curve/ line or having multiple curves/lines.

(b) The majority of pupils could read their graphs correctly and change their reading to the correct percentage. Common mistakes were not changing to a percentage or writing the answer for a time less than 40 minutes.

Q11 The vast majority of candidates were able to achieve at least 4 out of 5 marks in this basic trigonometry question. Quite a large number lost the final mark for failing to round to the nearest degree or by rounding too early or incorrectly in their working and then reaching an answer of 40°. Notation in working could be a focus for improvement – many don't use the letters given in the diagram, preferring to use x for both angles instead; in some cases, candidates don't even use a letter, writing statements such as cos = $\frac{5.4}{13}$ Quite a few candidates used Pythagoras as well as trigonometry here – this was totally unnecessary and affected accuracy of the final answer in some cases.

Q12 In general a lot of candidates struggled with this question on finding the equation of a perpendicular line with only a small minority able to rearrange the equation to identify the gradient, apply the relationship between the gradients of perpendicular lines and complete the question successfully. Very few candidates recognised that c = –4 from the given coordinate and used y = mx + c to find c.

Q13 This question on simplifying an algebraic fraction was answered poorly by many candidates. Whilst most were capable of factorising the numerator, there were major difficulties in factorising by grouping for the denominator. A common error was to see an answer of $\frac{3x}{4x-3}$

Q14 This trigonometry question involving angles of depression was poorly answered by the majority of candidates. The most common mistake was confusing angles of depression with angles of elevation and, as a result, gained no marks. The actual trigonometry did not cause problems in this question, but too many candidates were unable to start correctly and in doing so obtained zero.

Q15 In this bounds question candidates were more successful in identifying the correct bounds than in previous years, with fewer including ".4" as part of their upper bounds. Good candidates were clear in their method and knew to use max/min and min/max in order to find the correct values. However, quite a few did not grasp this concept and they achieved 1 mark for their bounds only.

Q16 (a) This straightforward histogram graph question was answered well by the majority of candidates. The graph paper provided matched the 'Frequency Density' and 'Weight' readings which made the scale easy. Common mistakes included: not working out frequency densities and just plotting the frequencies; not labelling each axis correctly; not scaling the x-axis and using the groups instead; drawing a bar graph.

(b) This question on reading from their histogram was answered poorly in general. The majority of candidates struggled to interpret the frequency required in splitting a bar with a common answer of 145 by just adding the last three frequencies.

(c) This stratified sampling question was poorly answered by the majority of candidates. Most could get the 139 that were less than or equal to 95g for $\frac{1}{3}$ but could not get anything else. The majority who did know what to do also rounded their answer to obtain full marks.

(d) This was a standard question on setting up a grouped frequency table given a histogram to find the mean and was answered poorly by the majority of candidates. Most candidates could find the frequencies but then just did $\frac{145}{7}$

Another common mistake was instead of using midpoints candidates used the class width and multiplied by the frequency.

(e) This question on finding the median from a histogram was the one of the most poorly answered questions on this paper. Candidates who gained some marks were able to find the correct group for the median but did not know what to do next. The best candidates answered well.

Q17 (a) This basic question on circle theorems was well answered in general, with part (iii) probably being the most successfully answered. Those who got part (i) incorrect were able to get a follow through mark in (ii) for subtracting their incorrect answer from 90.

(b) (i) In this question on circle theorems involving reasoning most candidates were able to identify 59° as the required angle but many were unable to achieve all three marks by clearly articulating their reasons. Language used by candidates needs to be more accurate – there were too many instances of candidates losing marks for failing to use the words/terms "tangent", "radius", "alternate segment", "centre" and "circumference". Some simply provided calculations rather than reasons. Many assumed that triangle ABC was isosceles.

(b) (ii) Quite a few candidates identified the fact that BAC= x. Many were unable to provide a suitable answer for (ii). Despite the question being clear regarding the expectation of the angles being written in terms of x, many resorted to stating numerical answers, often under the illusion that $x = 59$. Some candidates who did try to use x in their answers failed to simplify their answer for BCA.

Q18 This was a standard frustum question in which the question even explains what a frustum is and gave all the measurements required. However, it was answered poorly by the majority of candidates who did not find the curved surface areas of the two cones correctly. Common mistakes were: finding the curved surface area of the large cone and adding it to the area of the large circle and then finding the curved surface area of the small cone and adding the area of the small circle, then subtracting these two answers – obtaining 2 marks of the 4; using 10 for the slanted edge of a cone; finding the circumference of the circles or finding the volume of cones.

Q19 The majority of candidates struggled with this question on setting up an equation involving algebraic fractions with a very small minority obtaining full marks. Many of the weaker responses demonstrated difficulties in writing fractions A and B in terms of x, with many using $\frac{x}{3x}$ and $\frac{x+4}{3x+4}$. Some wrote fraction B as $\frac{x+4}{x+3+4}$ and never simplified it, leading to major issues later on in the question. For those who did state their fractions correctly, many failed to create a correct equation, with some omitting $\frac{1}{8}$ from their working, some adding it to the wrong fraction and others multiplying one side by $\frac{9}{8}$. Algebra issues when expanding and simplifying meant that of those who had received the first three marks, few went on to form the correct quadratic equation to be solved. Of those who did score full marks here, they tended to show clear, well-presented working.

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