Examiners' Report

Summer 2016

Pearson Edexcel GCE in Core Mathematics 1 (6663/01)

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Mathematics Unit Core Mathematics 1

Specification 6663/01

General Introduction

There was a very wide range of mathematical ability displayed across this paper. There were some excellent attempts at the paper resulting in full marks in many questions.

A significant number of students were unable to accurately manipulate fractions and in some cases unable to multiply integers together. When fractions were multiplied together it was very common for no cancellation to be attempted before multiplication. The resulting numerators and denominators after multiplication were very large and the subsequent cancellation of the final fraction usually failed. This was particularly evident in Q10(c). The ability to deal effectively with indices was weak in a significant number of cases.

Writing and the layout of working was seen to be poor in a significant number of scripts, thus making the work more challenging to mark. Overwriting of incorrect answers, making the intended answer ambiguous was all too common. Students should be encouraged to cross work out neatly and rewrite it on the next line. This will also help to avoid transcription errors. Solutions frequently started with writing in the middle of the page leading to answers being "squeezed" into the right margin.

Report on Individual Questions

Question 1

This was completed very well by the majority of students. Very few differentiated and almost all students included a constant of integration. The term which caused the most difficulty was $\frac{-4}{\sqrt{x}}$ where the most common errors were $\frac{-4}{\sqrt{x}}$ re-written as $-4x^{\frac{1}{2}}$ or $-4x^{\frac{-1}{2}}$ but then integrated to either $-2x^{\frac{1}{2}}$ or $+8x^{\frac{1}{2}}$.

Question 2

The solutions to this question were generally completely correct or completely wrong. Most solutions hinged on recognising $9 = 3^2$, with a surprising number of students incorrectly thinking $9 = 3^3$. Some common errors showed that manipulating powers proved difficult for some. A lot of students reached $2(3x + 1)$ but then removed the brackets to give $6x + 1$.

Question 3

Q3(a) was generally well answered with the vast majority of students arriving at $2\sqrt{2}$. Only a very small proportion mistakenly thought $\sqrt{50} - \sqrt{18} = \sqrt{32}$.

In Q3(b) a frequent error in execution was writing $\sqrt{2}\sqrt{3} = \sqrt{5}$. By far the easiest simplification was to replace $\sqrt{50} - \sqrt{18}$ in the denominator by $2\sqrt{2}$. In addition, many students rationalised the denominator by multiplying top and bottom by $k\sqrt{2}$, whereas it would have been far simpler to rationalise using just $\sqrt{2}$. There was, of course, nothing wrong in multiplying numerator and denominator by the conjugate of $\sqrt{50} - \sqrt{18}$, but it was long winded and therefore more error prone.

There was a significant number of students who left their answer as $\frac{6\sqrt{3}}{\sqrt{2}}$.

Question 4

Most answers were correct with clear, well labelled sketches.

In Q4(a) the majority gained full marks. Errors were in drawing the graph of $y = \mathrm{f}(3x)$ rather than the required graph or errors in their multiplication of 4 or –8 by 3.

In Q4(b), most drew the correct graph with maximum and minimum in the correct positions. Errors were either in forgetting to mark at which point the graph crossed the y-axis or in assuming all graphs must go through the origin.

Question 5

The majority of students obtained the correct answers for x. Errors were made from not rearranging the linear equation correctly. Quite a few students made an error in making y the subject, eg using $y = 4x + 1$. There were sometimes errors in expanding $(-4x - 1)^2$. Some struggled to solve the quadratic equation by factorising and attempted to use the formula often making arithmetic errors with its use. Some followed correct factorisation with $x = +\frac{1}{3}$ and $x = +\frac{1}{7}$. Common errors were sign errors when substituting x back into y and there were some issues multiplying $\frac{1}{7}$ or $\frac{1}{3}$ by 4. A number of students substituted their values of x into an incorrect equation for y, usually $y = -4x + 1$, even though they had rearranged correctly at the start.

Very few rearranged to make x the subject before solving. A few students used both methods to check their answers and some students substituted their values back into both equations to check their answers. Most students paired their solutions and wrote their fractions in the simplest form.

A small number of students failed to find any y values, having found the x values.

Question 6

Q6(a) was well attempted with the majority gaining both marks. The accuracy mark was achieved for an unexpanded $a_3 = 5 - k(5 - 4k)$ but this was often incorrectly multiplied out to give $5 - 5k - 4k^2$, which lost an accuracy mark in Q6(b). Another common error seen was $a_3 = 5 - k(4k)$.

In Q6(b), most students achieved the method mark for adding a_1, a_2 and a_3 but a large number of students ignored the +1 part of the summation. Those who did use it often just added 1 somewhere in their summation of the three required terms, obtaining $4k^2 - 9k + 15$. Others set their summation of the three terms equal to $a_r + 1$ and then subtracted 1 from their expression to obtain $4k^2 - 9k + 13$. Some attempted to use the formula for the sum of an arithmetic series and gained no marks and some students wasted time by equating their answer to zero and solving the resulting quadratic.

Many students did not attempt Q6(c) but a few answered this correctly - some with very neat solutions. Some got as far as realising each term was 5, but then didn't realise there were 100 terms and gave an answer of 5. Others tried to use the formula for S_n and obtained a variety of expressions in terms of k.

Question 7

Apart from a few students who integrated, the majority obtained the 6x term and so gained two marks. Some students had issues with subtracting 1 from indices that were fractions.

The main problem seemed to be with splitting up the algebraic fraction part of 'y' correctly. Many students wrote the 3 in the numerator and expanded the expression $(2x^3 - 7)(3x^{\frac{1}{2}})$ or $(2x^3 - 7)(3x^{-\frac{1}{2}})$, or else had issues with the laws of indices but they often still managed to gain the method mark.

Even students who split up the fraction correctly and differentiated correctly often left the third term as $\frac{10}{6}x^{\frac{3}{2}}$, despite the question stating that each term in the answer was required in its simplest form. Other common errors were, working out $\frac{1}{3} - 1 = -\frac{1}{3}$ for the power of the second term, the fourth term being negative, and having $2\frac{1}{2}$ for the last term when a student could not cope with the 3 in the denominator of the algebraic fraction part of 'y'.

A very small number of students used the product rule to differentiate $(2x^3 - 7)(3x^{\frac{1}{2}})^{-1}$ rather than simplifying the fraction; a few used the quotient rule. Both techniques were applied with mixed success.

Question 8

This proved to be one of the more challenging questions on the paper although most students were able to score at least half of the available marks.

Most students recognised that the first part needed the use of the discriminant of a quadratic. Unfortunately this was often applied to the given quadratic, with no attempt to involve the line. When the two equations were connected and terms brought to one side, sign errors were relatively common. A few solutions had a discriminant involving x and a common error was to use $b = 6p - 3$. There were, however, a fair number of efficient and accurate solutions.

The best solutions for the second part of the question used factorisation, and a sketch was often drawn to decide on the correct region. Those who used the formula made work for themselves and often lost accuracy, while only a few students managed to complete the square and obtain the right answer. Some students just gave the critical values without trying to find a region. Of those who attempted an inequality, many wrote it in a correct form but a few used x instead of p and some omitted to write 'and' when expressing the final answer as two separate inequalities.

Question 9

Listing methods alone were quite rare in this question. Many produced very good solutions but a large number of students failed to match John's age to the arithmetic sequence. It was pleasing to see that, on the whole, students realised when to use u_n and when to use S_n.

In Q9(a) correct solutions were equally split between adding the first three terms and using the sum formula. A very common error was to evaluate the 12th term as 225.

In Q9(b) a correct formula was invariably used for u_n and most gained full marks. However, many forfeited the marks by using $n = 18$. Occasionally $n = 8$ was used and merited a method mark only.

In Q9(c) almost all students were able to pick up the first mark but again many lost subsequent marks as result of using an incorrect value for n (usually 21, 22, 20 or 11). Most students favoured using $S_n = \frac{n}{2}(2a + (n - 1)d)$ but a few preferred to work out the last term, and used $S_n = \frac{n}{2}(a + l)$. Some students missed out on full marks for this part because of arithmetic mistakes: 6×285 and $120 + 165$ caused particular problems.

Even students who struggled to pick up marks in Q9(a), Q9(b) and Q9(c) due to the incorrect value for n, generally managed Q9(d) well. The majority equated their summation formula in terms of n to the value given, and most, with considerable effort in some cases, managed to simplify their expressions. The most common reason for losing the final mark was to omit a connecting statement between 3375 or 6750 and the final 25×18.

In Q9(e) students seemed to ignore the given factors and embark on the quadratic formula, thus struggling with the square root of 1849. Some students factorised incorrectly to give an answer of 25 (discarding 18 for being negative). Most appreciated their value of –25 was a false solution of the equation in the context given, but once again many students failed to distinguish between the term number 18 and the age 27. Other common incorrect answers were 28, 29 and 17.

Question 10

Q10(a) and Q10(b) were accessible to almost all the students, with nearly all the students achieving at least the first two marks in Q10(a). In order to find the equation of a line, centres should be encouraging their students to use the formula $y - y_1 = m(x - x_1)$ and quote the formula first. Correct substitution would have scored students two marks, whereas there is more work to do when using $y = mx + c$, and it is more error prone. Many students made errors when rearranging their equation, in particular, it was common to see 9 added to –35 rather than subtracting.

In Q10(b) a significant number of students scored no marks as they incorrectly substituted $x = 0$ rather than $y = 0$.

Q10(c) discriminated well between students. Completely correct solutions were relatively rare but some correct solutions were concise and well explained. It was fairly common for an attempt to be difficult to follow, with many students not labelling any of the areas they were finding or explaining any of their steps. In most cases the final answer was wrong because the separate areas were inaccurately calculated, or else an invalid approach to splitting the quadrilateral area was used. In contrast, those solutions where the provided diagram was clear split into triangles and labelled usually had more success in reaching the correct final area. The ease or difficulty of calculating the areas depended on how the quadrilateral *OPQR* was split. A vertical line dropped through *Q* to the *x*-axis being the most common and most successful. Arithmetical work involving fractions was weak for a significant number of students and many students over-complicated the problem by using Pythagoras' theorem to find unnecessary lengths.

Question 11

In Q11(a) most students differentiated correctly, with occasional errors, including $6x$ as the first term or $2k$ or 2m as the second term in the answer.

In Q11(b) many students knew that the equation $2y - 17x - 1 = 0$ needed to be rearranged to find the value of the gradient, but some just stated that $m = \frac{17}{2}$ and did not use it in the rest of their solution. Instead, having correctly evaluated $29 - 4k$ as the gradient at $x = -2$, they set it $= 0$, producing $k = \frac{29}{4}$ as their answer. Less common errors included the gradient of the line taken as 17 or –17 and the use of gradient of a normal instead of tangent. A small minority attempted to equate the curve and the line rather than the derivative of the curve and the gradient of the line.

In Q11(c) many students were unable to correctly use $k = \frac{41}{8}$ in their attempt to evaluate y with $x = -2$. Another error was to use the substitution of $x = -2$ in the equation of the line $2y - 17x - 1 = 0$, rather than in the curve, resulting in the most common incorrect answer of $y = -\frac{33}{2}$.

In Q11(d) some students did not realise that the gradient of the tangent was what they had used in Q11(b) and so they substituted $x = -2$ and their k back into $\frac{dy}{dx}$ from part Q11(a), often not reaching the correct gradient of $\frac{17}{2}$.

A small minority used their k value rather than their gradient of tangent in their equation $y - y_1 = m(x - x_1)$ and a very few used a normal gradient. Just occasionally, final answers were left in non-integer form, e.g. $y = \frac{17}{2}x + \frac{35}{2}$ but most were in the required form. Within Q11(c) and Q11(d) the method marks were frequently awarded but errors in Q11(b) resulted in the loss of accuracy marks.

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