Examiners' Report
Principal Examiner Feedback

Summer 2017

Pearson Edexcel GCE Mathematics

Core Mathematics C1 (6663)

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Core Mathematics 1 (6663) – Principal Examiner's report

General introduction

In general, there was a very wide range of mathematical ability displayed.

Writing and layout of working was poor in a significant number of scripts. Examiners commented on seeing almost illegible handwriting which made the work very difficult to mark. As in previous years, students lost accuracy marks due to poor arithmetic, not checking that they had carried the same figures from one line of work to the next and not checking that their answers were sensible. This was particularly evident in question 4. There was some poor curve sketching and some ignorance as to the appearance of simple functions when represented graphically.
For the more able, however, the examination gave plenty of opportunities to use their knowledge of mathematics effectively. There were some excellent attempts at the paper resulting in full marks in many questions.

Question 1

This question was done well by virtually all students. Most could increase the power of at least one of the terms, and most included a constant of integration in their final answer. A common error was to write the second term as $-4x^{-3}$ before attempting to integrate it. A significant number of students did not give their final answer in a fully simplified form, often leaving the first term as $\frac{2}{6}x^6$, or were unable to deal with $\frac{-\frac{1}{4}}{-2}$.

Question 2

This question was generally done well, but relatively few were able to achieve full marks. Most students were able to find a correct expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ and substitute $x = 8$ correctly. A small number of students left +4 in their differentiated expression. Most students were able to use $\sqrt{8} = 2\sqrt{2}$ at some point in their working but many were unable to deal with both the fractions and the surds to express their final answer in the required form. A common error here was to incorrectly evaluate $\frac{1}{4\sqrt{2}} - \frac{1}{8\sqrt{2}}$ as $\frac{1}{-4\sqrt{2}}$. A significant number of students were unable to rationalise the denominator of their expressions, often writing $\frac{1}{8\sqrt{2}}$ incorrectly as $\frac{1}{8}\sqrt{2}$.

Question 3

This question was answered better than similar questions in previous sessions with almost all students understanding the notation.

In part (a) $a_2 = 2k$ was given by almost all, although a few left their answer as $k2$ or $\frac{2k}{1}$ and so lost this B mark. The method mark for finding a_3 was usually obtained however, students had difficulty simplifying their expression when dividing the terms in the numerator by $2k$. Answers such as $k^2 + \frac{1}{2}$, $k^2 + \frac{1}{2k}$, $k + \frac{1}{2k}$ or even $2k + k$ were seen frequently.

In part (b), the first method mark was usually obtained although a few wrote the first term incorrectly as k. The second method mark was also commonly scored although problems sometimes resulted for students who were using an un-simplified form for a_3 as they often obtained a quadratic equation. With a linear equation, students generally went on to achieve the accuracy mark, although $\frac{8.5}{3}$ was seen as the final answer and this form was not allowed for the final mark in this part.

Question 4

This arithmetic progression question set in a practical context was tackled better than in previous sessions. Almost all students realised that they could use arithmetic progression formulae with only a small minority resorting to making numerical lists. Many completely correct answers were seen. Some simple arithmetical errors were seen which students could have corrected with a quick check of their working (examples below).

(a) Most used a correct method to find d and scored both marks, but $66 \div 11 = 11$ was surprisingly common and $66 \div 11 = \frac{11}{6}$ was also seen.

(b) Most students solved this part successfully by calculating the total for weeks 1 - 12 first and then calculating 40×206 for the remaining 40 weeks. A few used the AP formula for these 40 weeks but some wrongly used $d = 6$ instead of the correct value $d = 0$. Also a few calculated 39×206 or even 30×206, thus losing the last three marks.

Many students performed the calculations accurately but some examples of poor arithmetic were seen including 52 - 12 = 30 and 2076 + 8240 = 10310.

Some used the AP formula for the full 52 weeks but could score 2 marks as a special case if they obtained a total of 15 236.

Question 5

(a) The majority of students achieved both marks for completing the square correctly and the vast majority achieved at least 1 mark for obtaining at least $(x \pm 4)^2$. Occasionally marks were lost for incorrect values of b coming from 19 + 16 or 16 – 19 instead of 19 – 16.

(b) A large majority of students drew a U shape with only the occasional straight line, upside-down U shape, V shape or cubic shape. The y-intercept was also generally marked correctly as (0, 19) or just 19. (19, 0) was also accepted provided it was marked in the correct place. A few students misread 19 as 9. The most common error was the position of the turning point with (4, -3), (-4, 3), (4, 0), (3, 4) or (4 + √3, 0) all seen fairly frequently. Many students, despite correctly completing the square in part (a), unnecessarily used calculus to find the coordinates of the minimum.

(c) This part was usually well answered. Drawing the right-angled triangle helped many with their working and communication, but most managed without. There were a lot of responses gaining full marks, with others gaining two marks for 2√68 or √272. The question clearly asked for a simplified surd. Some introduced the √ very late in their calculations and so did not achieve the first accuracy mark for a correct un-simplified expression for PQ. Those who had made mistakes with the coordinates of P and/or Q were able to gain the first mark for the method. The incorrect coordinates $P(0, 3)$ and $Q(4, 0)$ produced an answer of 5. Given that a simplified surd was asked for in the question, this should have alerted the students to a possible error. Very few students used Pythagoras' Theorem incorrectly.

Question 6

(a) Many students clearly knew the rules being tested here (addition and power law of indices) but applied them in combination without demonstrating what was required in this show that question. Some students simply stated $2^{2x+1} = 2\left(2^x\right)^2$ and had effectively just written down the answer with insufficient explanation. Others just stated that $2^{2x} = y^2$ without explicitly stating the power rule. The best attempts had two explicit statements for the power law and addition law or used reasoning such as $2^{2x+1} = 2^x \times 2^x \times 2^1 = 2 \times y \times y = 2y^2$.

(b) Most students achieved the two correct values of y from the quadratic in y but many of these then stopped and did not go on to evaluate x. Most used the method of inspection of powers of 2 to find x although a few students resorted to the use of logs with varying degrees of success. Some students were unable to solve $2x = ½$ or stated that there were no solutions to this equation.

Question 7

Part (a) was generally done well. Most students substituted x = 4 into $\mathrm{f}'(x)$ but a surprising number of students were unable to obtain a correct value for $30+\dfrac{6-80}{2}$. The method for finding the equation of a straight line was well known although some students found the equation of the normal. Some students made sign errors in simplifying $y+8=-7(x-4)$, and some did not write the equation in the required form.

Part (b) was done quite well with many students achieving a fully correct answer. Common errors include simplifying $\frac{5x^2}{\sqrt{x}}$ as $5x^{\frac{5}{2}}$ and evaluating $\frac{6}{\frac{1}{2}}$ as 3. Most students knew that they had to find the constant of integration and knew how to proceed although some stopped after they had integrated. Of those who went on to find a value for the constant, a significant number were unable to do this accurately, often making errors in substituting values and in rearranging their equations to find c, for example, solving $-8=80+c$ to give $c=72$. Some students, having found c, did not use it to write a final expression for f(x) and so lost a mark unnecessarily.

Question 8

(a) This part was answered well with many gaining full marks. Those who wrote the equation of the line in the form $y-6=-\dfrac{5}{4}(x-5)$ tended to make fewer mistakes than those who used $y=-\dfrac{5}{4}x+c$ and then found the value of c.

Examiners commented on common errors that included, incorrectly identifying gradient of l_1 as 4 and using $-\dfrac{1}{4}$ as the gradient of l_2, incorrectly rearranging l_1 as $y=\dfrac{4}{5}x+10$ resulting in y = 14 at P, incorrectly rearranging $4y-24=-5x+25$ to give an incorrect constant term and failing to give the equation in the required form with integer coefficients.

(b) Most earned the first two marks for finding the coordinates of T and S by substituting y = 0 into their equations even if their equation of l_2 was incorrect. There were only a few instances of the use of x = 0.

The variety of methods seen after this point was diverse, but the most successful by far was dealing with a single triangle with its base along the x–axis with various equivalents of 36.9 for the final answer. In this method the most frequently seen errors were 9.8 – 2.5 giving an incorrect base length and using 5 instead of 6 for the height. On a non-calculator paper it was surprising to see so many students using Pythagoras theorem to find PS and PT resulting in complicated square roots. These attempts generally ground to a halt, and may have wasted a considerable amount of time.

Question 9

This was a challenging question and very few completely correct answers were seen.

(a) (i) A straight line with a negative gradient was the most common answer with the y intercept correctly labelled as (0, c) or just c marked on the positive y-axis. Only sometimes was the y intercept not correctly labelled. Other occasional errors seen in this part of the question included a straight line with a positive gradient, a straight line going through the origin, a straight line crossing the negative y-axis, a quadratic U shape or upside down U shape drawn and a specific point e.g. (0, 3) marked as the y-intercept rather than (0, c).

(ii) The first B mark for either sketching the correct shape or stating the asymptote $y = 5$ was often obtained although sometimes $x = 5$ was written instead of $y = 5$. Some translated the standard curve horizontally instead of vertically. Students who had a correct horizontal asymptote sometimes failed to label or state it as an equation and just wrote 5 on the y-axis. For the sketch, the branches of the hyperbola were sometimes carelessly drawn with the ends moving away from or 'overlapping' the asymptotes.

(b) Most students understood that they needed to set $\frac{1}{x} + 5 = -3x + c$, but many then made no further progress. Some made errors when multiplying by x, obtaining $1 + 5 = -3x^2 + cx$ instead of $1 + 5x = -3x^2 + cx$. Some students multiplied correctly, but then failed to gather all the terms on to one side of the equation and therefore were not able to use the discriminant correctly. It was however pleasing to see that $b^2 - 4ac > 0$ was quoted by many before use.

Some students ended up with the quadratic equation $-3x^2 - 5x + cx - 1 = 0$ and subsequently made slips with signs when substituting into $b^2 - 4ac$. This also lead to the inequality $(c-5)^2 > 12$ rather than the one required in the question. Another mistake which resulted in the loss of the accuracy mark in this part of the question was to have > 0 instead of = 0 for their quadratic before the substitution into the discriminant.

Another common mistake was to collect the terms to one side as $-3x + 5 - c + x^{-1} = 0$ and then to apply $b^2 - 4ac$ without first multiplying by x. Many of those who were able to put the correct values into the discriminant were able to correctly prove the required result.

(c) Many students could find a version of the critical values, including those who were unsuccessful in (b) although many did not make use of the given answer to (b). A significant number of students multiplied out $(5 - c)^2$ and solved a quadratic using the quadratic formula. Of these, some found a correct expression for the critical values but sometimes made slips when simplifying.

Those who did use the answer to part (b) usually obtained the correct critical values and went on to state $c < 5 - 2\sqrt{3}$ or $c > 5 + 2\sqrt{3}$. Although there are no marks awarded for drawing a sketch, it does help students to select the correct region if they do. Some students did not select the outside region or stopped after finding the critical values. Of those students who selected the outside region, only a few were able to achieve the final mark for taking into account the fact that c was a positive constant which meant $0 < c < 5 + 2\sqrt{3}$ was needed rather than just $c < 5 + 2\sqrt{3}$.

Question 10

(a) Those who understood the simple transformations involved could just write down *k* and *c* but these responses were rare. Sign errors were introduced in the final answers to both parts as students struggled with the link between the translations and the given equations. Many expanded f(*x*) to give a constant term 75 but often stated *k* = -75. Some wrote $(-5)^2(3)$, but then made a sign error or even proceeded to give *k* = 25 + 3 = 28. There was some confusion between parts (i) and (ii) and $k = \frac{5}{2}$ was not uncommon. The value of *c* eluded many, with few recognising that the repeated factor $(2x-5)$ should be used to give the minimum. A common incorrect answer was $c = -\frac{5}{2}$ and some included $c = -3$.

(b) Virtually all students knew how to multiply out the cubic and differentiate correctly. Many had already carried out some of the expansion in part (a). However, the omission of brackets when expanding cost many students the final mark here.

(c) There were many good solutions to this final part. Most gained the first mark for substituting 3 into their or the given $\mathrm{f}'(x)$. Some then stopped completely, suggesting they were short of time or they did not know how to proceed. Of those who continued, a few found the equation of the tangent, but most produced a three term quadratic equation using the correct method and many simplified the equation by dividing throughout by a factor of 4. As usual, some students opted to use the quadratic formula or tried to complete the square without considering whether or not it was the most appropriate method to use in this case. Of those who used factorisation it was apparent many did not realise that (*x* – 3) would automatically be one of the factors, given that *x* = 3 was one of the roots. An encouraging number of students recognised that only one solution to their equation was valid and clearly identified $x = -\frac{5}{3}$ as the correct and only answer.

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