# Examiner's Report
# Principal Examiner Feedback

## Summer 2018

### Pearson Edexcel International A Level
### In Core Mathematics C34 (WMA02/01)

**Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

**Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2018
Publications Code: WMA02_01_1806_ER

**General**

This paper proved to be a good test of students' ability on the WMA02 content and plenty of opportunity was provided for them to demonstrate what they had learnt. There was no evidence that students were pressed for time. Examiners reported that they saw some very good work but also that some of the algebraic processing was weak and there were a significant number of careless errors in places. Marks were available to students of all abilities and the questions that proved to be the most challenging were, 5(ii)(b), 6(c), 10, 11, 13 and 14.

**Question 1**

(a) Most students successfully answered this part of the question by dividing each term of the numerator by $x^2$ with some minor errors such as a sign error with the $\frac{1}{x}$ term. A few students incorrectly integrated the $5x^{-1}$ term by adding one to the power to get 0 and then effectively multiplying by 0. There were also a few answers in which the student had tried to apply ln when integrating $x^{-2}$. A few attempted to use integration by parts leading to even fewer completely correct solutions. Those students, few in number that attempted to use either partial fractions or long division were generally unsuccessful. Students were let down by their poor algebra skills leading to a loss of marks.

(b) Most successfully recognised the need to integrate by parts and efficiently obtained a correct solution. Very few students quoted the formula for integration by parts with a few misquoting it. The majority of errors were either with signs integrating sin $2x$ to ½ cos $2x$ rather than –1/2 cos $2x$ or multiplying by 2 rather than dividing (muddling integration and differentiation). There were a few students who tried to convert cos $2x$ to an expression in sin $x$ or cos $x$. This strategy was not successful.

**Question 2**

Most students were successful with both parts of this question involving parametric equations, with many scoring full marks or just losing the final mark in part (b).

(a) Most students successfully differentiated the parametric equations to find $\frac{dx}{dt}$ and $\frac{dy}{dt}$ correctly. After dividing their expressions correctly to form $\frac{dy}{dx}$, $t$ = 3 was substituted to find the final answer $\frac{4}{9}$. The most common error was in differentiating the expression for $y$ in terms of $t$, with a good number of unsuccessful students having a factor of 2 appearing.
A less common error was seen by the students who having found $\frac{dx}{dt}$ also found $\frac{dt}{dx}$ but then incorrectly divided their $\frac{dy}{dt}$ by their $\frac{dt}{dx}$ . Rarely students failed to make the substitution and left their answer as $\frac{dy}{dx} = \frac{4}{t^2}$ .

(b) Finding the Cartesian form of the curve was very well done by the majority of students. The most common approach was to rearrange the equation for $x$ in terms of $t$ to make $t$ the subject. This expression for $t$ was then directly substituted into $y = 4 - \frac{6}{t}$ giving $y = 4 - \frac{6}{\frac{x+5}{1.5}}$ or the equivalent. The majority of students were able to rearrange this correctly to reach the required form. The mark for finding integers $a$ and $b$ was given directly from the student's final expression without being stated. However, even very competent students forgot to state the value of $k$. The most common error in the rearranging of the equation was with a sign error at this stage in some of the solutions: $y = \frac{8x+40-18}{2(x+5)}$ with a significant number of students giving the next step as $y = \frac{8x-22}{2(x+5)}$ .

In addition to failing to state $k$, some students stated both $x \neq -5$ and $k \neq -5$. There was no mark for this contradictory statement. The mark was awarded to those students who understood that the expression was undefined for $x \neq -5$.

## Question 3

This question was found to be reasonably straightforward with many students scoring full marks or gaining full marks on parts (b) and (c). There were very few non attempts or zero scores.

(a) Most students managed to achieve the M mark by equating to zero and proceeding to make $1.5x$ the subject. There were several attempts to fudge the working to fit the given answer.

A few students who lost marks had often missed the $f(x) = 0$ and started directly from the second step. A few students set $f(x) = 0$ but tried to use ln in order to make $x$ the subject.

Some mistakes were made in the manipulation of $2^{x-1}$. Common errors were: $2^{x-1}$ divided by 2 is $1^{x-1}$ and $2\text{x}2^{x-1}$ equals $4^{x-1}$ A few students lost the A mark because of sign or multiplication errors.

The Alternative method of working backwards was rarely, if ever, seen.

(b) Almost all students answered this part correctly. In general, finding the values of $x_1$ , $x_2$ and $x_3$ was well done and it is clear that most students understood what was required.. The ones who didn't get full marks on this part usually rounded incorrectly or to a wrong degree of accuracy. A very small number were using their calculator incorrectly.

(c) This was answered well by the majority of students. Most of the students chose a suitable interval for $x$, substituted both values, evaluated $f(x)$ values correctly and then gave a good reason and conclusion.

Very few failed to find a suitable interval. A small number found a suitable interval but then substituted the $x$ values into the iteration formula instead of $f(x)$. Only a small number of students didn't understand the question and tried to find the root by continuing iteration. Most students knew to say that there was a change of sign or $f(1.6325) \times f(1.6335) < 0$ or equivalent, but some didn't follow with an acceptable conclusion thus losing the A mark.

**Question 4**

Overall the question was accessible to nearly all students with many students gaining full marks.

(a) For those students who failed to gain all three marks, common errors were: Powers of $p$ were missing and instead of $(px)^2 = p^2x^2$ they had for example $(px)^2 = px^2$ or sign errors were seen in the binomial coefficients.

A few calculated (-4)(-3) or (-4)(-3)(-2) for the $x^2$ and $x^3$ terms instead of (-4)(-5) and (-4)(-5)(-6). Sometimes students did not fully simplify their solution, losing the final mark.

(b) For those students who failed to gain all marks, common errors were:

Calculation errors in expanding the brackets and students missing terms or having wrong coefficients and/or signs, sometimes because of incorrect work in part (a).

Students confused the relation between coefficients of $x$ and $x^2$ and they doubled the wrong terms.

Some just used the coefficients from the expansion from (a) instead of the required expansion of f($x$).

Students didn't pay attention to the fact that $p$ was positive and didn't reject -2/3 as a solution, or they rejected 2/5 and kept -2/3.

Others failed to solve the quadratic equation correctly and obtained p = -2/5 and 2/3.

The solutions to the 3TQ were often written down with no calculations shown. Although not penalised if the working was correct the M mark could also be lost if there was an error.

(c) Usually students that scored full marks in (a) and (b) would get full marks here also. A few gained the M mark by using their incorrect value of $p$ in their incorrect term in $x^3$ if they had 2 terms.

Most common errors were: Errors in expanding the brackets and getting the wrong coefficients either by having the wrong sign or by having the wrong power on $p$ or substituting the wrong value of $p$ or both values of $p$.

**Question 5**

Almost all students achieved some success on this question. The most successful part was finding the composite function part (i b)and the least successful, handling the moduli in part (ii b).

Part (i a)

Finding the inverse function was often well done by most students. However, stating the domain was far less successful. The most common error with finding the inverse function was a sign error. However, a small number of students lost the accuracy mark here for

omitting brackets in the expression $\frac{1}{2}\ln(x + 5)$ or for leaving the inverse function in terms of $y$. Common errors in stating the domain were to use an incorrect f($x$), $f^{-1}(x)$ or $y$ instead of "$x$". Also, there was an issue for a significant number of students who gave the domain as "$x \geq -4$". A few students incorrectly gave the domain as $x \neq 5$ and others as $-5 < x < 0$.
A significant number of students made no attempt to give the domain.

Part (i b)

Almost all students understood how to find the composite function fg($x$) and substituted $x = 3$ as required, reaching the result 59. Common errors were in evaluating g(3) as ln8 but then using a rounded value to substitute into f. Another less frequent but common error was with incorrect bracketing of the power of e in the term "$e^{2\ln(3x-1)}$" . Another less frequent but common error was in omitting the "-5" term after substituting ln(8) for g(3).

Part ( ii a)

This part of the question was usually well done. Occasionally there was clear asymmetry and the mark for the graph was withheld and some students terminated the graph before it crossed into the second quadrant losing the first mark. Occasionally, students presented a "$y$" shaped graph with no indication that any part of it was only "work in progress". These students also lost the first mark. The coordinates were almost always given correctly but sometimes students gave a numerical value to $a$, losing this mark.

Part (ii b)

This part of the question was found to be more challenging and many students were unsuccessful. The students who were successful in this part solved $4x - a = 9a$ to get $x = \frac{5}{2}a$ and solved $-4x + a = 9a$ to get $x = -2a$ , which they then substituted into $|x - 6a|+3|x|$ to get both x=11a and x=14a respectively. Common errors were to only find the first value of $x$ from $4x - a = 9a$. Many students who had found $x = \frac{5}{2}a$ , were unable to interpret $|x - 6a|$ correctly, many simply removing the modulus signs. Some unsuccessful students formed an equation with $x - 6a + 3x = 0$ which they then solved by substituting their value of $x$ in terms of $a$. A significant number of unsuccessful students reached $-4x = 8a$ but incorrectly found $x = -0.5a$. It was extremely rare to see students attempting to square to remove the modulus signs. These students were not usually successful.

A few students found values for $a$ in terms of $x$ and were able to earn the first three marks in this part.

A significant number of students tried every permutation of signs for $x$ and $-6a$ – often obtaining one of the required results by chance.

## Question 6

(a) The vast majority were able to obtain R and $\alpha$ correctly. Those who got $\alpha$ wrong usually got it from $\tan\alpha = \frac{\sqrt{5}}{2}$ or gave $\alpha$ in degrees.

(b) Many lost marks due to insufficient accuracy when finding the inverse cosine value (giving the answer as 0.673). Quite a few then lost then the next 2 marks either by not attempting to find another solution, or discarding an answer greater than pi and not finding the equivalent solution in the given range. Another error was to give the second solution as the negative of the first.

(c) This was badly answered, with a lot of students not gaining any marks. Some did not attempt it at all. Others did not seem to recognise that they were able to use the maximum and minimum values for cosine here and so had equations that still contained cosine. Some who did realise this, then failed to use their value for *R* and so were still not successful or had an incorrect value for the minimum. Sadly there were some who had the correct equations but solved them incorrectly. Only a few students found both values for *A* and so achieved full marks. A small minority of students realised they could use transformations of $3\cos(\theta + 0.7297)$ with *A* and *B* as a scale factor of the amplitude and a vertical translation.

## Question 7

This was answered well by the students with the majority gaining full marks. A significant number gained no marks however, sometimes just substituting $h = 15$ into the formula for $V$.

The most popular method for finding d$V$/d$h$ was to first expand the formula for $V$ and then differentiate. One error that sometimes occurred was for students to approximate $\pi \approx 3$ which meant they had $\mathrm{d}V/\mathrm{d}h = 180□ - 3□^2$ which only gained the M1 mark for differentiating. The alternative method for differentiating $V$ using the product rule was quite popular, even though this is a more difficult approach. They understood the product rule formula well, but sometimes mistakes were made in simplifying the terms or multiplying by 2/3 which could affect their final answer. A few differentiated to $2/3\pi h(90 - h)$ leaving the bracket untouched and so gained no marks.

For applying the chain rule correctly to gain the M1 mark, some students made an error by multiplying d$V$/d$h$ by 180, or by writing the fraction the wrong way around. Almost all students realised they needed to substitute $h = 15$. Sometimes they would calculate d$V$/d$h$ when $h = 15$ first, and then calculate 180 divided by this value instead of showing the actual formula for d$h$/d$t$. Quite a number of students thought the answer should be rounded to 0.08 or even 0.1.

**Question 8**

There were wide variations in the content and the clarity of presentation of the work. The better students included a diagram in their answer.

(a) Most students scored full marks in this part. For many it was the only part attempted. Most started by writing down the three equations in $\mu$ and $\lambda$ and then attempted to solve two of the equations simultaneously. Most found the values of $\mu$ and $\lambda$ for their pair of equations correctly and attempted to show a contradiction by substituting their values into the third, unused, equation. It was rare to see an attempt at showing a contradiction using the alternative method given in the scheme.

Where marks were lost this was usually due to:

Arithmetic errors in solving the simultaneous equations.

Substituting their first value of $\mu$ or $\lambda$ into the incorrect equation to find the other value.

Using an equation which had already been used to find $\mu$ and $\lambda$, to show a contradiction.

Making errors in substituting into their third equation to show the contradiction so gaining the M mark but losing the A mark.

Failing to write a conclusion.

A few students found $\mu$ and $\lambda$ and concluded the lines did not meet because $\mu$ and $\lambda$ were not equal.

It was pleasing to see responses where the statement e.g. 8 = 4 was followed by a comment to say "not true" followed by a conclusion e.g "so lines do not meet".

(b) Around half of students obtained full marks. Those attempting this part were able to find the position vectors of P and Q correctly and many showed the substitution of $\lambda = 0$ and $\mu = -1$ in the lines which, if errors were made, meant that credit could be given for later work. Most found the vector PQ correctly by subtraction. Occasionally vector **QP** was found. Most realised that the scalar product was needed to find the angle required and many used correct vectors. Unfortunately, incorrect vectors were often chosen, e.g. **OP** and **OQ**, or **OP** and **PQ**. They found the angle between these vectors so losing 3 marks (or all 5 marks if they had not found vector **PQ**). A very small number of students found another arbitrary point on $l_1$, called it M, say, found the lengths of PM, QM and PQ and used the cosine rule to obtain the angle. A very few gave the angle in radians or made numerical errors so giving an incorrect angle in degrees. A few rounded to 53.6.

(c) A minority of students obtained full marks. Many thought they were just finding the length of PQ. Most correct answers included a diagram. Many did not attempt this part including ones who had scored full marks on (a) and (b).

There were some (mostly unsuccessful) attempts to use the scalar product to find the value of $\lambda$ (8/7) which identified the point on $l_1$ closest to Q. Until they used this value to find the length of the shortest distance they gained no marks. Sometimes having found $\lambda$ they used it in the equation of the line and so found the magnitude of the wrong vector.

A few gained one mark if they wrote a correct trigonometric equation involving the shortest distance (d). If they had obtained the correct angle in (b) they were able proceed to d = 5.81. A few made correct use of the sine rule with sin 90 but others chose an incorrect trigonometric ratio. Some attempted an incorrect use of Pythagoras. Many gave a surd as their answer having found the magnitude of an incorrect vector.

## Question 9

The majority of students attempted this question well and got some marks although many completely ignored the cylinder. There were very few non attempts. However, it was quite common to see either full marks or no marks for this question.

(a) In general, if they found the answer as $-(2x - 1)^{-1}$ or sometimes $-2/(2x - 1)^{-1}$, they lost a number of accuracy marks unless they recovered in part b). Some students think that if there is an $x$ term on the denominator of a fraction the answer will always be in terms of ln( ). Sometimes they got the correct integral but then attempted to simplify and got confused, meaning they scored full marks for (a) but had problems in (b).

(b) Students who struggled in (a) did not do well in (b) especially if the result of their integration was not in the correct form. Students who spotted the link between parts (a) and (b) and had integrated correctly in (a) finished the question well, but those who didn't, struggled with the integration in (b).
Most students scored the first B mark. Most included the $\pi$ and often the correct limits, even though they weren't required for the mark. A few students who wrote the formula for the volume of revolution with $2\pi$ instead of $\pi$ lost the B mark. Quite a few did not know how to progress correctly beyond this step as they didn't see the connection with their integral in (a). Some students used their answer from the integration in a) but then tried to integrate again. Many students struggled with combining the full 3-d rotated shape and the cylinder into one process. The majority of successful students calculated the two volumes separately then subtracted. There were a few who put the formulae together into one integral. To get a correct answer they had to find the integral of the difference of the squares. Some wrongly subtracted first then squared and so they lost marks and had to integrate a complicated expression. Students who forgot to find the volume of the cylinder failed to gain the last three marks. Some omitted it altogether and others treated the cylinder as a cuboid or even a rectangle. Some did not use the correct formula for the volume of a cylinder or used the wrong $r$ (often 2/3) or the wrong $h$.

In some cases where $\pi$ was stated earlier on in their working it was 'forgotten about' in one or both of their volumes and omitted from the final answer. Almost all successful students left their answer as an improper fraction.

## Question 10

Students generally found this question quite challenging. A number of students did not know how to begin. Of those who started, most used implicit differentiation on the curve in its given form and generally recognised the need for, and made some attempt at using the quotient rule. Common errors included missing out the d$y$/d$x$ when differentiating $e^{5-2y}$ or $y$ with respect to $x$ and sign slips. Some students tried to rearrange the expression before differentiating. Those who used $y = xe^{5-2x}$ seemed to find it easier to apply the product rule successfully. Other rearrangements tended to go wrong before the students even began their differentiation. There were many algebraic errors in both rearranging the differentiated expression and substituting the coordinates of P to evaluate d$y$/d$x$. Some of the algebra seen when substituting P($2e^{-1}$, 2) into their gradient function left a lot to be desired. Many students find it difficult to manipulate exponential expressions (also seen in Q3). A common incorrect gradient was $\frac{e}{3}$. There were also a few students who "lost" a 2 when substituting $x = 2e^{-1}$ into 2$x$.

Those students who managed to successfully find d$y$/d$x$ = e/5 tended to complete the whole question successfully gaining full marks.

Students were generally able to use their gradient to find the equation of a tangent and knew to substitute $y = 0$ and $x = 0$ to find A and B and hence the required area. However, earlier errors in d$y$/d$x$ led to some cumbersome expressions that were difficult to negotiate and students often gave up or resorted to decimals at this stage losing the final marks which required exact values.

## Question 11

Many students achieved full or almost full marks on this question. However, a significant number of students failed to score any of the seven marks in part (b).

(a) Most students used the quotient rule successfully to obtain $\frac{dx}{d\vartheta} = \frac{3sin\vartheta}{cos^2\vartheta}$ and then split this into the product of two fractions each with a denominator of cos$\vartheta$ to reach the required result. Students who used the chain rule having written the denominator as $(\cos\vartheta)^{-1}$ were equally successful. The most common error was in failing to show sufficient working and this was usually by not showing the split into the product of two fractions. A few students used inconsistent variables and a few students used incorrect notation such as $\cos\vartheta^{-2}$ , but these occurrences were rare. A few students tried to use trigonometric identities instead of differentiating.

(b) For those students who understood that part (a) was connected, a full substitution was usually made. Those students who made the full substitution were often successful and obtained full marks in this part. Those students who failed to make a full substitution rarely scored any marks in this part. The most common error, which occurred quite a significant number of times, was in taking the square root of "$(3\sec\vartheta)^2$ -9". Students who square rooted each term individually to obtain "3sec$\vartheta$ – 3", failed to score any more marks.

The majority of students went on from their substitution to reach $\int 3tan^2\vartheta \ d\vartheta$, replaced this with $\int(sec^2\vartheta - 1) \ d\vartheta$ and then integrated successfully to reach $[3tan\vartheta - \ \vartheta]$ with limits of

$\frac{\pi}{3}$ and 0. A few students mistakenly thought that they could use 60˚ rather than $\frac{\pi}{3}$, which, whilst acceptable for the trigonometric function did not apply with the algebraic function of ϑ. Some students wrote the limits as 60 and 0 but actually applied limits of $\frac{\pi}{3}$ and 0; these students were awarded full marks.

Common errors were failing to replace d$x$ in the original substitution and in using tan2ϑ = $\sec^2$ϑ +1. A few students tried to integrate by parts rather than use the substitution suggested. These students were rarely successful.

## Question 12

Many students were successful on this question and of those who did not achieve full marks, many scored 8 out of 9.

(a) The majority of students were able to show that cot$x$ - tan$x$ ≡ 2cot(2$x$). All approaches offered in the mark scheme were used in equal numbers of attempts. The students who tried to use the double angle formula for tan(2$x$) had more difficulties due to the factor of 2 but most of them succeeded.
Only a few students used the “meet in the middle” approach, which requires a conclusion in addition to both routes ending in the same expression. Often these students lost the final mark because the conclusion was lacking.
Common errors were with random factors of 2 being put in either numerators or denominators especially at the stage where the double angle formulae were applied.

(b) Many students used the given result for part (a) to simplify the equation and were successful on this part; with occasional slips in forgetting to find the second solution.
The most common error was a slip in expanding 2(ϑ - 15˚) to give 2ϑ - 15˚. This cost the student the final three marks, which all require the correct angle to be used.
There were a few students who rounded their intermediate answers incorrectly resulting in the loss of one or sometimes two marks.
There were a few students who reached tan(2ϑ- 30˚) = $-\frac{2}{5}$ but then used +21.8 rather than – 21.8 to work out the value of ϑ. A few students failed to show sufficient working and had wrong values for ϑ and it was not possible to award method marks to these students.
A few students multiplied the original equation throughout by tanϑ to form a quadratic equation in tanϑ. These students occasionally achieved full marks but many became confused as to what they were actually working out and often left the answers to the quadratic as their values of ϑ.

## Question 13

Overall, most students were able to make a good attempt at parts (a) and (c) of this question but part (b) proved challenging for many.

(a) Almost all were able to form a correct identity and solve to find A and B. A few lost the A mark because they reversed the constants in their final answer or because they found the constants correctly but did not write out the partial fractions in full.

(b) A significant number of students did not attempt this part. Of those who did, most separated the variables correctly, with just a few trying to integrate the RHS of the differential equation with respect to $x$ and so gaining no marks. Almost all then integrated to achieve a log expression, though some missed the minus signs. Quite a large number multiplied out the denominators of the partial fractions, making the working more difficult and sometimes losing the divisor of 2 in the integration. Some brought the $k$ to the LHS, sometimes even multiplying the denominators of the partial fraction by $k$, which made their integration more complicated. However, the majority of those who attempted a correct integration gained the first 3 marks.

A significant minority missed out the constant of integration and so lost the final 4 marks. Most who attempted to find 'c' did so immediately after integrating, and these mostly proceeded to the correct expression for $e^{kt}$. Of those who removed logs before evaluating 'c', dealing with $e^{kt+c}$ proved a challenge for some, though many were successful, especially those who used the c = lnA form for the constant.

The majority of those who arrived at an expression for $e^{2kt}$ in the required form were able to rearrange it correctly to make $x$ the subject and more able students often gained full marks. There were a significant number who attempted to 'fix' their answer to get the correct result, having got incorrect signs or other errors earlier.

(c) This was accessible to students who had not attempted part (b), though a few did not realise this and left out both parts. This was successfully attempted by almost all students. Most started from the given answer for $x$ and rearranged to find $e^{2kt}$, usually correctly. The rest, who had been successful in (b), returned to their expression for $e^{2kt}$ or even $kt$, a more straight forward method. A few gave a final answer of 5ln(3/2) or equivalent and so lost the final mark.

**Question 14**

It was good to see very few totally blank scripts for this question indicating that most students had allowed sufficient time to reach the end of the paper.

(a) Most students used the quotient rule to answer this question with a few using the product rule and the occasional attempt at chain rule leading nowhere.Most students that attempted this question were successful in differentiating $(x^2 - 4)^{1/2}$ with errors of factors of either 2 or an $x$ missed in unsuccessful scripts. The majority went on to apply the quotient rule correctly, obtaining the correct solution in an unsimplified form. Many students struggled with simplification of their expressions. Many students did not deal with the factor of $(x^2 - 4)^{-1/2}$ correctly and although they somehow arrived at the correct value of A, the algebra that got them there was not correct. Oddly, those that used the product rule found it easier to simplify their expressions for the derivative. Disappointingly there were a few students that felt they could apply the power of ½ to each individual term in the bracket.

Some undertook quite complicated algebra to get to the end result, however the fact they still reached the result in a convoluted way was impressive.

(b) The students that were successful with the differentiation almost always went on to make a good attempt. Setting their $\frac{dy}{dx}$ equal to 0 and arriving at a value for $x$ was commonly achieved. However, a lot of students either used the value of $x$ found as their range or substituted their value into the expression for $y$ rather than for f($x$). Also quite a few gave their answer as a rounded decimal which lost them the accuracy marks. A few students having obtained full marks so far then gave their range as a strictly less than rather than less than or equal to. There were also a few that found $x$ correctly but then substituted $x = 2$ into the function to find $y$, or just used their $x$ value to define the range. A few did not use exact values. A few students who did not obtain a value of A in the first part attempted to use $Ax^2$ - 12 for part B, finding everything in terms of A.

(c) Many students got this correct but it was difficult to interpret the students' language with the feeling that they knew the correct things but couldn't always communicate it. Student responses to this question were varied and many used 'it' to mean the original function which lost them the mark. A handful of students tried to suggest that the inverse did not exist due to the restricted domain of the original function or because of being unable to reflect in $y = x$. Some mentioned asymptotes as the reason for no inverse function. A significant number made reference to the graph but did not give an appropriate reason to score the mark whilst others confused 'many-to-one' and 'one-to-many'.