Level 2 Certificate

Further MATHEMATICS

83601 Paper 1 non-calculator

Report on the Examination

Specification 8360

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General

Most students seemed well prepared and made a good attempt at all the questions in the time allowed. Most work was presented clearly but there were exceptions and some working was difficult to decipher, often quite faint, and, although the space allowed for each answer was generous, some candidates used all the space in such a way that made it difficult to follow the thread. There were instances of good responses to questions being let down by careless arithmetic. The gradual progression of difficulty of questions meant that a number of students struggled with the more challenging questions towards the end of the paper, but there were still some very good attempts at these questions and some elegant solutions. Questions that ask students to 'Show that' need to be approached in a way that does not assume the answer given and such that all steps of working clearly shown.

Topics that were well done included:

- simple differentiation
- simple matrix equation
- equation of a circle
- circle geometry
- expanding a cubic expression.

Topics which students found difficult included:

- algebraic identity
- quadratic inequality
- negative indices
- minimum point from function after completing the square
- minimum point/tangent problem
- trig/surd problem
- cosine rule problem.

Question 1

This question was well answered although there was some carelessness in expanding the bracket.

Question 2

This question was well answered, apart from those students who forgot the factor of 4.

Question 3

In part (a), the most common error was to put $n = \frac{1}{2}$ into the given expression. Students who set up an equation by equating the given expression for the nth term to $\frac{1}{2}$ had little trouble getting to n = 12, although 0.5n = 6 sometimes led to n = 3. Part (b) had a significant number of non-attempts.

Question 4
Part (a) was well answered. Some students forgot the square root sign for the radius of the circle in part (b).

Question 5
This question was well answered. Some students thought that the two angles given were part of a cyclic quadrilateral, which led to formulating an incorrect equation. Those who realised that the first step was to use a circle theorem property, usually $(x + 24)$ or $(180 - 3x)$ for angle *ABC,* were able to set up a correct equation and solve to get $x = 39°$

Question 6
This question was a good discriminator. There were mistakes in expanding the brackets and in collecting together and simplifying the x terms and constant terms on either side of the identity. Those students who realised they had to equate coefficients usually got as far as $m = 8$ but some did not obtain $p = -1$ due to an earlier sign error in the expansion.

Question 7
This question was well answered. Many students realised they had to factorise the quadratic expression but did not connect the factorised version with what a sketch of the curve would look like. Some of those students who realised that the required region lay between the two zero solutions, left the answer as an inequality when the question asked for the integer solutions.

Question 8
There were some good answers to this question. Success depended on understanding that the power meant cube root, so cubing both sides of the equation was an essential first step. There were errors in working out $(-2)^3$ and sign errors in manipulating the terms before finally squaring to solve for x.

Question 9
This question was well answered. There were errors, usually sign errors, but most students realised to square first and then multiply by the remaining single bracket. Some students tried to take short cuts to the answer. Writing out the product of the quadratic and linear factors term by term and then collecting like terms might have taken a little longer, but would have avoided many of the errors that were made.

Question 10
The problem for most students in this question was how to handle the negative index. It was common to see $y^2 = -25$ (as if this could be true!) or $y^2 = 25$, so $y = \pm 5$. Those students who successfully arrived at $y^2 = \frac{1}{25}$ forgot that the negative square root was the one to choose in this case. There were many answers of 80.

Question 11
This question was a good discriminator. Almost all students chose to use gradients rather than Pythagoras' theorem, but were sometimes careless, writing (x-step) ÷ (y-step) or missing off a negative sign for the gradient of *AB*. It is worth writing out the gradients as the division of the two subtractions of fractions e.g. $\dfrac{\left(1\frac{4}{5}-3\frac{4}{5}\right)}{\left(2-1\frac{1}{5}\right)}$ rather than trying to do the subtraction mentally and making a mistake, which was common. The gradients resulting from the division of the fractions or decimals did not need to be simplified at this stage because they still needed to be either multiplied to give −1 (which had to be clearly shown) or to be written in a form where it is clear that one is the negative reciprocal of the other. The result was given, so the final step had to be fully explained.

Question 12
Part (a) was reasonably well done, either by completing the square on the left hand side, giving the values of h and k directly, or by expanding the bracket on the right hand side and then equating coefficients ... in a similar way to the method used in question 6. Part (b) was not well done, the minimum point for a curve expressed in the form $y = (x + h)^2 + k$ is $(-h, k)$, so in this case the minimum point was (−3, −7). Some students elected to differentiate and work out the minimum point this way, with some degree of success. Part (c) could be done by using the completing the square expression from part (a) or by using the quadratic formula. Answers were not always given in fully simplified form, and sometimes the ± sign was missing.

Question 13
Students who knew how to approach this question were very successful. The surds could all be expressed as multiples of $\sqrt{5}$ and arriving at $\sqrt{x} = 3\sqrt{5}$ was reasonably straightforward. There were some errors in squaring to get $x = 45$, but most students managed this.

Question 14
Part (a) of this question was a good discriminator. In part (a) some students assumed that $a = 1$ and went on to verify the result. Others correctly substituted $x = 3$ in the expression and equated to zero using the factor theorem. This gave an equation which simplified to $3a - 3 = 0$, hence $a = 1$
Part (b) was sometimes done using long division of polynomials or by substituting values of x into the cubic expression to find other values that gave $f(x) = 0$, hence identifying other linear factors. The simplest way, and probably the most common, was to write the polynomial equal to the product of the linear factor that was given i.e. $(x - 3)$ and the quadratic factor, working out the missing coefficient, i.e. $x^3 - 8x^2 + x + 42 \equiv (x - 3)(x^2 + ?x - 14)$.
Students who adopted this approach were usually successful in working out ? = −5 and went on to deduce the other two linear factors.

Question 15
Although a significant number of students did not seem to know the standard technique of rationalising the denominator in an expression involving surds, those who did multiply numerator and denominator by $\left(\sqrt{7}-2\right)$ made good attempts to expand and simplify the numerator and

denominator. There were some errors, usually in getting a denominator of 3, but on the whole this question was well answered.

Question 16

This question was not well answered and there were a significant number of non-attempts. Students who were successful were fairly evenly split as to the method they adopted. Some decided to sketch a right-angled triangle with $\sqrt{11}$ on the opposite and 6 on the hypotenuse, then used Pythagoras' theorem to work out the adjacent side as 5. Others used the trig identity $\sin^2\theta + \cos^2\theta = 1$ Either method gave the numerical value of $\cos\theta$ as $\frac{5}{6}$, but many students failed to take note of the fact that θ was an obtuse angle, meaning that $\cos\theta$ must be negative, hence the answer $-\frac{5}{6}$

Question 17

This was not well answered and there were a significant number of non-attempts. The clue to how to start was in the wording of the question. Students were given information about the tangent at the minimum point, so differentiating the expression and equating to zero was the way to go. The constant term, k, will disappear. A good number of students did this and factorised the resulting quadratic to get the x-coordinates of the turning points, −1 and 3. Although the sketch graph was 'not drawn accurately', most students who got this far correctly deduced that the minimum point corresponded to $x = 3$. All that remained was to substitute $x = 3$ and $y = 0$ in the equation of the curve to give the answer $k = 9$.

Question 18

This was a difference of two squares question in which it was necessary to apply the factorisation twice, $x^4 - 81 = (x^2 + 9)(x^2 - 9)$. Many students got this far but $x^2 - 9$ can be factorised further to give the final fully factorised answer of $(x^2 + 9)(x + 3)(x - 3)$. This result was achieved by relatively few students.

Question 19

This question depended on knowing the values of sin, cos and tan of 30° and 60° in surd form. There were a significant number of non-attempts. Part (a) was a 'show that' question, but many students failed to realise that and simply assumed the answer, verifying the result using Pythagoras' theorem. A minority of students correctly assumed that we do not know the length of the side of the square so let it be x. Then, also using Pythagoras' theorem, $x^2 + x^2 = (3\sqrt{2})^2$, so $2x^2 = 18$, hence $x^2 = 9$ and $x = 3$. Part (b) was also a 'show that' question. Some students assumed the result, guessed the lengths of *DE* and *AE*, and proceeded to check the result, giving no calculations to support their answer. A small number of students realised they had to use triangle *ADE* and work out the lengths of *DE* and *AE* using trigonometry. There were various approaches, but the simplest was to write an equation for either *DE* or *AE* using either the tangent ratio or the sine ratio.

Question 20

The quality of algebraic manipulation on this question was poor and there were a significant number of non-attempts. Very few students realised that the given information, cos $P = 1/3$, $PQ = 3n$ and $PR = 2n$, suggested that the Cosine Rule was the method to use to show that the triangle was isosceles. Of those who did, some chose to use the 'work out a side' version and some chose the 'work out the angle' version, both with varying degrees of success.

Many students did not use brackets. $(3n)^2$ was thought to be the same as $3n^2$ and there were careless mistakes such as $2 \times 3n \times 2n = 12n$ (instead of $12n^2$). A few students dropped a perpendicular from Q to PR and used trigonometry in the resulting right-angled triangle to show that the perpendicular bisected the base, PR, hence the triangle was isosceles. Correct solutions by this method were few and far between. Students often assumed that the perpendicular bisected the base and merely verified the result.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.