Principal Examiner Feedback

Summer 2016

Pearson Edexcel Level 3 Award
in Algebra (AAL30)

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Introduction

There were many excellent scripts in this Level 3 examination and centres are to be congratulated on the performance of their students. Few students seemed completely out of their depth. There were good answers to questions set from all parts of the specification though for questions 2, 4c, 6, 8, 13, 15, 16a, 19 and 20bc success was not as widespread.

Most students showed a good knowledge of standard techniques and formulae, though there was a significant number of students who confused the two results for the sum and product of the roots of a quadratic equation or the formulae for the *n*th term and the sum of *n* terms of an arithmetic series. It is interesting to note that these topic areas are not generally covered at GCSE level and it may therefore be to students' benefit to spend a little more time on these topics. It was surprising and disappointing to note that a significant number of students entered did not know the formula for solving a quadratic equation.

The ability of students to evaluate numerical expressions without a calculator was generally good. This was demonstrated, for example, by the accuracy with which many students calculated the area under the graph in question 20c.

The design of this paper was consistent with previous papers and the performance of students on this paper was consistent with that expected when the paper was set so that a pass mark of about 66% of the total mark could be considered as showing proficiency in Algebra at
Level 3

Reports on Individual Questions

Question 1

Many students scored full marks on this question. However, some students appeared not to have access to a pair of compasses. In response to part (b)(i) of this question students often drew both the tangent and the normal to the curve at the point (3, 4) but did not indicate or label which was the tangent so could not be awarded the mark assigned for this. Various angles were measured to answer part (b)(ii) though the majority of students could state the correct answer.

Question 2

An appropriate first operation in this question requiring the subject of formula to be changed was usually successfully carried out but some students wrote $wt^2 + 2$ instead of either
$w(t^2 + 2)$ or $wt^2 + 2w$. Fewer, though still a significant proportion of students, were able to get as far as a correct expression for t^2. It was not common to see a fully correct answer including the ± sign.

Question 3

This question was well done with most students scoring at least 4 marks. However, it was very common to see students shading the region corresponding to the three inequalities
$x + y < 5$, $y > 2x + 1$ and $y > -3x$ rather than to the three inequalities given in the question. It appeared that students may have assumed that the region required would be a closed region and had not checked whether points in their region satisfied the inequalities given.

Question 4

The first two parts of this question proved to be straightforward to most students. The weakest students sometimes incorrectly simplified their expanded quadratic expression in part (a) or only partially factorised the expression in part (b). Part (c) provided much more of a challenge with many students recognising that 3 was a factor but then did not realise that the remaining part of the expression would factorise further using the difference of two squares.

Question 5

Manipulating and using the equation of a straight line in different forms is a key area of the specification and examiners would expect students to be able to write such an equation in the form $ax + by + c = 0$. Many students who successfully found a correct equation in part (a) of the question did not write their equation in this form as required so could only be awarded 2 of the 3 marks available. Some students made errors in working out the gradient of the line, for example by working out the difference in x values divided by the difference in y values or because they made an arithmetic error.
Many students found part (b) to be straightforward and gave a correct answer usually in the form $y = -4x + c$, either with a "c" or by assigning a particular value to c, eg $y = -4x + 2$. Some students assumed the gradient of the line $4y = x + 8$ was 1 presumably because they had picked out the coefficient of x in the equation. A common error seen in this part of the question was for students to use $\frac{x}{4}$ and $\frac{-4}{x}$ when trying to find the gradient of the line perpendicular to the given line. No credit could be given for this.

Question 6

An encouraging number of students found this question to be routine and scored full marks. Examiners accepted formulae and numerical expressions left in a clumsy form. For example, $y = \frac{½}{x^3}$ in part (a) and $\sqrt[3]{0.125}$ in part (b) were awarded full marks though $y = \frac{1}{2x^3}$ in part (a) and 0.5 in part (b) might be expected at Level 3.
Students often gave their answer to part (a) with a proportional sign instead of an equals sign, however, sometimes they corrected themselves in part (b).
Some students did not read the question carefully enough and used "T is inversely proportional to x" or "T is proportional to the cube of x". These students obviously restricted the number of marks which could then be awarded for their responses, though examiners did give some credit for the substitution of $T = 4$ in part (b) when students substituted this value into their answer for part (a).
Working was usually, but not always, clearly set out.

Question 7

In this question, testing the simplification of algebraic expressions, most students scored at least 4 of the 6 marks available.
Part (a) was nearly always answered correctly.
Part (b) was answered less well with many students not able to identify a clear strategy to deal with the negative power and the squaring in an accurate logical way. Students were often awarded 1 mark for a partially correct procedure but fewer students gave a fully simplified and correct answer.
The great majority of students scored at least 2 of the 3 marks available for answers to part (c) for showing that they could identify a common denominator and write the two fractions with this common denominator. A considerable number of students gave a correct and fully simplified expression which would have been awarded all 3 marks if only they had not tried to simplify it

further, resulting in their giving an incorrect final expression. For example, $\frac{2x^2+x+21}{(x+3)(x-3)}$ was often followed by a final answer of $\frac{2x+7}{(x+3)}$ or $\frac{2x+7}{(x-3)}$.

Question 8

More able students scored full marks on this question though some students who found the correct values for x and y did not clearly show their solutions as two distinct pairs at the end of their working. The question was generally not well done and answers seen exposed many weaknesses in algebraic manipulation. For example, many students chose to write x in terms of y from $x - y = 3$ and then they attempted to substitute in $y = x^2 - x - 6$ rather than the easier route of adding the two equations. Those students who did this often wrote
$y = (y + 3)^2 - y + 3 - 6$ instead of the correct $y = (y + 3)^2 - (y + 3) - 6$ and went on to build the sign error into the rest of their working. Other students wrote $x - x^2 - x - 6 =3$ and again followed through with a sign error. Some students started by factorising $x^2 - x - 6$. This rarely provided the start to a fully correct solution.

Question 9

Most students knew the quadratic formula and successfully used it to find the roots of the quadratic equation by the required method. Working was generally accurate and so most students were awarded both marks. The most common error seen was missing off the negative sign from the 4. Students who gave a correct answer, for example $\frac{-4\pm\sqrt{76}}{6}$ or $\frac{-2\pm\sqrt{19}}{3}$, and then tried to simplify it further were not penalised.

Question 10

This question, on solving inequalities, was not answered well by many students. In part (a) many more students than expected did not reverse their inequality sign when they divided each term by a negative number. As a result, a surprisingly small proportion of students scored both of the 2 marks available in part (a). A better approach would have been to add $3y$ to both sides of the inequality. Many students gave a fully correct answer to part (b) and of those who did not score full marks the great majority of students could find the critical values correctly and so scored 2 marks.

Question 11

This question was a good discriminator and was better answered than similar questions in previous series. A high proportion of students showed an understanding of the trapezium rule and were able to identify the ordinates needed in the calculation. Most students used the correct number of strips and many completed the question routinely. The calculations seen were generally accurate.

Question 12

Most students scored at least half marks in this question. Part (a) was very well answered.
Most students showed some ability to write the square roots in part (b) in the form $a\sqrt{3}$ before further simplifying the expression. However, a significant proportion of students either made an arithmetic mistake or mishandled one of the square roots and so only gained 1 of the 2 marks. For example $\sqrt{27} = 9\sqrt{3}$ was commonly seen.
In part (c), most students knew that they should multiply by $\frac{7-\sqrt{3}}{7-\sqrt{3}}$. However, carrying out the subsequent multiplications often saw errors creeping in and not all students recognised that

$\frac{14-2\sqrt{3}}{46}$ could be further simplified. Students who did not multiply by $\frac{7-\sqrt{3}}{7-\sqrt{3}}$ usually multiplied by either $\frac{7+\sqrt{3}}{7+\sqrt{3}}$ or by $\frac{\sqrt{3}}{\sqrt{3}}$ and, of course, gained no credit for their response to this part of the question.

Question 13

It was clear from the responses to this question that some students had a really good knowledge and understanding of this topic. However, for the majority of students there is still a lack of confidence in dealing with the use of and manipulation of the relevant formulae.
Part (a) of the question was answered correctly by a small minority of students though a much larger proportion were able to score at least one mark for a correct substitution into a formula for the sum to three terms or for the ninth term of the series.
A similar situation arose in part (b). The most successful students worked out and wrote down the first few terms of the series so as to understand the series better before applying an appropriate formula for the sum.
Unfortunately, many students stated incorrect formulae or were unable to use correctly stated formulae with ease. For example, it was disappointing to see so many students unable to find the first term of the series correctly or use a common difference of −6 in part (b).

Question 14

This question was well answered by the great majority of students. The most common error seen in part (a) was for students to translate the graph parallel to the *y*-axis but not by the correct number of units. These students scored 1 mark.
In part (b) the vast majority of attempts seen consisted of a translation parallel to the *x*-axis but again, not always in the right direction or by the correct number of units.
Some students changed the shape of the object, leaving examiners thinking that this was because of a lack of care, something which could have been avoided.

Question 15

Most students drew and completed a table of values before drawing the graph. These were usually accurate but a significant number of students could not cope with the negative powers generated for $x = -2, -3, -4$. Graphs were usually well drawn with most students making sure that their axes covered the entire set of values of *x* needed and drawing smooth curves through all their plotted points. It was unusual to see students not scoring at least 2 marks in this part of the question.
Part (b), a straightforward use of the graph, was well answered.

Question 16

Part (a) of this question was one of the least well answered questions on the paper. It combined the need to know the result "$b^2 - 4ac \geqslant 0$" with accurate handling of the resultant inequality to find the range of possible values of *c*. Only the best students could do this successfully. The students who knew the condition usually scored at least 1 mark but many of them could not manipulate the inequality successfully to give the inequality "$c \leqslant 4$". It was quite common to see attempts at this part of the question based on "$b^2 - 4ac = 0$".
In part (b) the success rate was higher. There were many good sketches showing all the information needed to score full marks. There were few instances where students did not attempt to show any points at which the graph met the coordinate axes. Some weaker students drew a general parabolic shape incorrectly placed with respect to coordinate axes. Students who drew a parabola incorrectly placed on or placed above the *x*-axis were given some credit for their sketch.

Question 17

Completing the square is a routine procedure and most students found part (a) of this question straightforward. However, this was not always the case and there were many students who could make some progress using $(x + 2)^2$ but were unable to find a correct value for q. A significant number of students expanded $(x + p)^2 + q$ but then seemed unclear about how to progress from there. Similarly, some students substituted a value for x into the given identity but could make no further progress.
Part (b) offered students the opportunity to solve a quadratic equation by whatever means they preferred. The simplest way to proceed was to factorise the expression and the best students did this with ease and accuracy, writing down the correct solutions to the equation. It is disappointing to report that the question was not attempted by some students. This does not augur well for success in a Level 3 algebra examination.

Question 18

This question was very straightforward for those students who knew the standard results involved. Some students did not attempt the question, whilst other students used incorrect formulae or confused the result for the sum of the roots with the result for the product of the roots. Those students who did not know the formulae sometimes attempted to solve the equation and then use their solutions to work out the sum and product of the roots. Few students following this approach gained any marks.

Question 19

Sketches seen showed a significant improvement on those seen to similar questions in past series. There were many fully correct, clear and carefully drawn sketches showing the asymptotes, the intersection of the y-axis and the curve. However, there was still a significant number of students who seemed to be unfamiliar with this topic.
Common errors included using an asymptote of $x = 2$ and not clearly representing the way in which the curve approached its the asymptotes.

Question 20

This question was not generally well done though part (a) was nearly always answered successfully. In part (b), the majority of students showed that they understood that the gradient of a speed-time graph could be used to calculate acceleration. These students were awarded at least 1 mark. However, most of these students did not deal with the units correctly. They often calculated 90 km/h ÷ 15 mins and gave “6” as their answer. Part (c) was poorly completed and a fully correct method to find the relevant area under the graph was not often seen. Here again, students often used inconsistent units.

Summary

Based on their performance on this paper, students are offered the following advice:

- ensure you have an accurate knowledge of standard results and formulae, particularly relating to the *n*th term and sum of an arithmetic series, to finding the sum and the product of the roots of a quadratic equation and to establishing the nature of the roots of a quadratic equation

- make sure you are familiar with the different forms of an equation of a straight line

- remember, when taking the square root of an algebraic expression, to use the $\pm$ notation to indicate that there are two values

- in questions involving linear inequalities to define regions, make sure that you have identified the correct region, by testing a point in your region

- practise the factorisation of expressions involving the difference of two squares

- practise the solution of simultaneous equation where one equation is quadratic, particularly where the correct use and expansion of brackets is needed in order to avoid sign errors

- ensure that you know what needs to be labelled when curve sketching

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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