Pearson Edexcel

Principal Examiner Feedback

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Pearson Edexcel GCE AS Mathematics

Pure Mathematics (8MA0/01)

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Introduction

This was the first AS level Pure paper for the new specification. The paper seemed accessible to the vast majority of students. Evidence suggests that the paper stretched the brightest students but gave weaker students the opportunity to score a reasonable number of marks. Many students had clearly been well prepared for the examination but others floundered on some of the new style questions such as questions 2, 6 and 10.

Students need to take care when using a calculator to find the solutions of a quadratic equation. Unless their solutions are correct, it is very difficult to award a mark for their method if all they give are solutions and no working shown.

Trigonometric identities need to be learned. Too often, incorrect identities were quoted or used.

The answers to questions requiring explanations were often the weakest. Clearly this will improve over time as schools gain more experience in preparing students for this type of question. There were many examples where students had a vague idea of 'the answer', but many were unable to express themselves with sufficient accuracy or clarity to gain any credit. This was particularly relevant in question 5 where many students could do part (b) but gain no credit in part (a).

Comments on individual questions

Question 1

A good starting question. Almost all students attempted this question with some success. Students who scored no marks often differentiated instead of integrating. A significant number of students scored full marks. For students who integrated, the majority scored at least one mark for increasing one of the powers by one. The most common error was to forget the '+*c*'.

Other errors included:
(1) Incorrect simplification of the coefficients with the first term having a coefficient of 8/3 or the second term having a coefficient of 9
(2) Incorrect index work especially on term two
(3) Incorrect sign on term two.

Question 2

Most students gained marks in at least one part of this question. However, the rigorous approach required to achieve full marks was generally lacking.

In part (i), most attempted to complete the square but a common error was to state that a square number must be positive, with no reference to the possibility of it being zero. Those who found the discriminant rarely scored more than the first mark as they did not realise the need to consider the shape of the curve. A small number attempted differentiation and whilst they stated (4,1) was a minimum it was very unusual to have this confirmed (e.g. using the second derivative). It was rare to see a fully graphical approach but those who tried usually gained two marks for a correct sketch with the correct minimum shown.

A few students tried to give an explanation in words or used a few numerical examples.

In part (ii), most students used a numerical approach and the majority concluded that the statement is 'sometimes true'. It was common, however, to show working for a negative value only, for which the statement is not true. Some attempted a true and a false value, as required, but failed to conclude that the statement is 'sometimes true'. Many students unsuccessfully tried to write general statements referring to positive and negative values being used, but only scored marks if they produced a counter-example.

Of those who attempted an algebraic approach, many reached $6x + 9 > 0$ but tended to stop there and did not gain the final mark for a correct conclusion.

Question 3

This question was very accessible to the vast majority of students with many scoring full marks. Errors seen in part (a) included finding the sum of the two vectors instead of the difference, or, finding the difference 'the wrong way around'. Correct vector notation was seen in all but a few cases with incorrect notation such as (-9i,3j) being penalised.

Part (b) was more successful with the vast majority of students knowing how to calculate the length of a vector and simplify the surd. A follow through on their vector from part (a) enabled most students access to both marks.

Question 4

Most students attempted this question and many gained all marks. The majority of students rearranged the given equation to make *y* the subject and hence found the gradient. Those who did not, often stated + or – 3 as the gradient. Most correctly found the gradient of the second line using the two coordinates. There were occasional sign slips. Many students unnecessarily continued to find the equation of the line for these coordinates after working out their gradient.

The comment on parallel, perpendicular or neither was attempted by most students with varying success. Explanation on why they were not perpendicular was often unclear and errors included stating that they should be reciprocals but omitting the word negative and that the sum of the gradients should be -1. For parallel, a small number of students stated that the gradients should be multiples of each other. A few students stated neither but no reasons were given.

Question 5

Students found it difficult to explain the errors in part (a) even though fully correct answers were seen in (b). The error in line 2 caused the most problems with many students failing to mention the subtraction law. The second error $\log_2 x = 3$ should be 2^3 not 3^2 was more successfully dealt with. It is really important in questions such as these that a full explanation is given.

Students were much more successful in part (b). Log work, in general, remains a difficult topic for less able students.

Question 6

Success on this question was partially determined by students realising that P was measured in thousands of pounds. Additionally, students should be aware that units are necessary in modelling questions and in particular the answer to (c)(i) is £100 000 and not 100, £100 or 100 000 as commonly seen.

(a) Most students gained at least one mark on this part. The easiest method is to substitute x =15 into the given equation and explain that it isn't a sensible selling price as the company would be making a loss of £125 000. The most common errors in this part were:
(1) substituting in P = 0 and finding x,
(2) stating that the company would not make any money or "may/could" make a loss.

(b) Many students attempted this part. The most common error was to use 80,000 rather than 80. This error resulted in a score of 000. Students who did use 80 usually attempted to solve the quadratic, but many by expanding and factorising rather than by using the form given. Some students only found one solution, rather than the two required. Very few students gained the final accuracy mark, with most students incorrectly stating £7.21 as the final value, not taking into account the need to round up. A small number of students used a trial and improvement method, which was often more successful in achieving the correct answer. Others used their graphical calculators to gain the correct answer with limited working.

(c) Most students attempted this part but were unable to use the given equation to just state the answers. Some students used differentiation to find the maximum. Common errors were omitting units, giving the answers in the wrong order (with no labelling) and giving the answer for the maximum profit as £100 instead of £100,000.

Question 7

This proved to be a very demanding question. The idea of there being two values for θ or $\cos\theta$ was lost on many students. Most students ignored the need for two values in (a) and hence in part (b), which involved choosing the obtuse angle, no marks could be awarded.

In (a) almost all students were able to apply the area formula to achieve an acceptable answer for sin θ or θ. However, few then had a strategy for obtaining cos θ. Even those who produced the two correct angles often failed to find the values of cos θ. The use of $\cos^2\theta + \sin^2\theta = 1$ was quite rare.

Another acceptable method was to sketch a right angled triangle and use trigonometric ratios. Perhaps because of the request for values for cos θ some students incorrectly quoted $\frac{1}{2}ab\cos C$ for the area.

In (b), few responses demonstrated the need to select the obtuse angle (or negative cosine) to ensure *BC* was the longest side. Some substituted both angles (acute and obtuse) but needed to compare their lengths to gain credit. The most common response seen was simply to use $\theta = 36.9$ in the cosine rule which scored zero for this part. A surprising number of otherwise correct solutions lost the final mark by giving a decimal answer rather than $\sqrt{205}$.

Question 8

This proved to be a challenge and a large number of students did not recognise that it was a differentiation problem until asked to find the second derivative in (b).

In (a), the common error was to set $C = 0$ and solve the resulting quadratic equation. A few tried to start with $1500/v + 2v/11 = 0$. Some used trial and improvement to find the minimum cost, even arriving at $v = 91$ and C=93; this achieved no marks as the question did state that '*Solutions based entirely on graphical or numerical methods are not acceptable*'. Many of those who did differentiate struggled with the negative index.

In (a)(ii), students usually recognised the need to substitute their value of v into the original equation. Some obtained unrealistic values from (i) and did not consider their answer in the context of the question. (e.g. $v = 0.06$ km/h). It was not uncommon to find this part omitted even by good students; perhaps they had not read the question carefully enough.

In (b), it was disappointing to see so many students successfully find the second derivative but gain no marks as they failed to find a value for it at their v or establish that it would be positive.

Part (c) was sometimes the only mark collected in this question by less able students. Some simply re-stated the model's assumption of a constant speed without reference to this not being possible. Others gave vague or irrelevant statements such as "there might be different routes".

Question 9

This question on the factor theorem proved to be a good source of marks for many students. Clearly they had been well prepared for this kind of question.

In part (a), most students correctly substituted $x = -2$ into the function and obtained the answer 0. A few students incorrectly used $x = 2$. The accuracy mark was often not awarded as explanations were insufficient or indeed absent. Many failed to use the correct terminology g (-2) = …, just substituting $x = -2$ into the "expression" rather than the function. Additionally, a significant minority of students did not state any conclusion. A small number of students incorrectly used long division rather than the factor theorem but these students were allowed to score the marks in (b) following this approach.
The majority attempted part (b) using long division or inspection with most obtaining the correct quadratic expression $4x^2 - 20x + 25$. Most then correctly factorised this quadratic. A small number did not state a final, fully factorised solution. Common errors of $(x - 2.5)^2$ and $(4x - 10)^2$ probably came from students using their calculators to find the solutions then attempting to work backwards.

Part (c) was usually attempted, but with limited success. In part (i) many achieved one mark, usually for $x \leq -2$ (or $x < -2$ which was condoned for the M mark). Errors from part (b) were often followed through correctly. Only more able (and careful) students gained full marks. In part (ii) many correctly use transformations to state x = -1 and x = 1.25. Some students multiplied the critical values by 2 (instead of dividing by 2) or in other cases they wrote down just one of the two solutions.

Question 10

This is a new topic on the specification. There were some very good solutions, showing full understanding of limits with all necessary steps shown. However, several students did not understand what was meant by 'prove from first principles' and simply stated and applied the general rule: if $y=x^n$, $dy/dx= nx^{n-1}$ or wrote comments such as 'multiply by the power and subtract one from it'. Those who knew what was required usually gained the first two marks but poor algebra often cost the third (and hence the fourth) mark. The final mark was frequently lost by failing to link the gradient of the chord and the gradient of the curve in some way.

Question 11

Part (a) was standard 'book work' on the binomial expansion. This was usually well done but applying this expansion within a new expression was met with limited success. Many students did not attempt parts (b) and (c).

The majority of students attempted part (a) of this question. Most were able to apply the binomial expansion and gain the correct unsimplified quadratic form. Common errors included missing out the negative in the expansion, so $512+144x+18x^2$ was a common incorrect answer. Some students failed to simplify correctly leaving their coefficients as fractions.

A common error in parts (b) and (c) was to set up a pair of (incorrect) simultaneous equations in a and b. Solutions of this type, that is via attempting to solve $512(a + bx) = 128$ does show a lack of understanding between constants and variables. Students who did successfully find a = 0.25 rarely could handle the more complex process required to find b. Students scoring full marks in this question were rare.

Question 12

Overall this question was well done, with many students taking advantage of being able to attempt (b) without completing (a). The few who restarted unnecessarily in (b) lost valuable time in the examination.

In (a) almost all students substituted for tan θ correctly, with just a few using the identity upside down or attempting some version of $\sin\theta = \tan\theta \cos\theta$. It was common for the first accuracy mark to be lost for $4\cos^2\theta - 1$ instead of $4\cos^2\theta - \cos\theta$ after multiplication by $\cos\theta$. Whilst many correctly used $\sin^2\theta+\cos^2\theta=1$ it was disappointing to see $\sin\theta+\cos\theta =1$ being quoted. The final mark was sometimes lost through bracketing errors or poor notation e.g. $\sin\theta^2$ for $\sin^2\theta$.

In (b) students generally managed to solve the quadratic, often using a calculator to find the two roots. The most common error was to give the signs of the roots the wrong way around, even after correct factorisation in some cases. Almost all found solutions for $3x$ but many failed to divide by 3. A substantial number of students who went on to find values for x missed a solution (often the 80°) or gave extra solutions outside the range e.g. 103.9°

Question 13

Although this was another new question, it was less well attempted than others with more students leaving this question blank, or starting the question but not gaining any marks.
(a) where students correctly identified the link with p, q and the formula, they were able to correctly work out the values of p and q. The most common method was to convert to powers of 10. A common error was incorrectly rounding p = 63095. to 6310, instead of 63100. Although this was not penalised in part (a), it did often lead to a wrong answer in part (c). A small number of students converted the question into logs and a few also substituted values in for t and used logs to solve.

Part (b) was attempted by the majority of students, even for those who failed to attempt part (a). Part (i) was well answered with the majority of students identifying p as the initial value of the painting. A few students did not put their statement in the context of the model. In part (ii) common mistakes were to state it was the increase in value, rather than to link it to the rate or proportional increase, or to state it was the gradient of the line. Very few students explained that the value of the painting would rise by 12.2% a year or that 1.122 was the decimal multiplier representing the year on year increase in value.

Part (c) could be answered without values for p and q and some students scored just marks in this part of the question. When attempted it was generally done well. The follow through error mentioned in part (a) often led to the loss of the accuracy mark here.

Question 14:

Part (a) was very accessible, part (b) less so.

Hence in part (a) there were a large number of students who scored full marks. There were however occasional sign errors witnessed when the students completed the square.

In (b), the first method mark was scored by the majority of students who showed their substitution of $y = k\ x$. Those who substituted into the equation given in the question rather than their (a) answer often coped better with the less challenging algebra. Collecting terms to reach a correct three term quadratic was a significant hurdle for many, although the most common error was to write kx^2 for $(kx)^2$. Most students correctly quoted $b^2 - 4ac$ before using it. Having done this they were usually able to factorise their expression to obtain $k = 0$ and another critical value. Having done the bulk of the work, many spoiled an otherwise perfect solution by stating the inside region.

Question 15

Some students were clearly running out of time when they reached this question, as there were many unfinished answers and some blanks. However, there were a great many accurate, concise and well written solutions. Few attempts at the line minus the curve approach were seen.

This was an unstructured question in which the students were required to find their own route through the problem. There were two discrete elements to the solution, one via differentiation and one via integration that were required to be tied together to show the given answer.
A good number completed the differentiation part correctly. There were slips in the differentiation of x^{-2} , but generally the method of finding the equation of a normal was well known. An equal number completed the integration part finding the area under the curve between 2 and 4. Similar slips were made on the integration of x^{-2}.

Tying up these two techniques into finding the area of *R* was less well done. Standard errors seen here involved:
(1) attempting the area of a triangle between 2 and 16
(2) integrating under the curve from 2 to 16
(3) finding the equation of the tangent to the curve at *P*.

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