Pearson Edexcel

Examiners' Report

October 2020

Pearson Edexcel GCE Advanced Subsidiary Level

Paper 01: Core Mathematics (8MA0/01)

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Introduction

This was the third AS level Pure Mathematics paper for the new specification. The paper seemed to be of an appropriate standard, although a large number of this cohort who sat the paper found this paper particularly challenging. Centres are clearly getting used to the new style questions as there were some pleasing attempts at questions 4 and 8. It is clear that candidates still struggle with how to approach proof as question 13 was very poorly attempted by the vast majority of candidates. Question 14 was not attempted by a large number, but this was possibly due to a combination of exam fatigue and high demand for the more able candidates.

The answers to questions requiring explanations were varied. Question 8c seemed to be well answered, however, question 4b and 12b required explanations which candidates either did not fully engage with the model or did not provide enough detail. Clearly this will improve over time as centres gain more experience in preparing candidates for these types of question. Candidates would benefit from becoming more familiar with the different types of model such as the linear model in question 4 and the exponential model in question 8. Candidates should also still take care in writing down their answers to ‘modelling’ questions. In question 8, for example, units were required to score the mark.

It is also important that candidates do not rely on calculator technology too much, as certain questions require them to show full methods in order to score full marks. Examples of this included questions 1, 3, 9c and 10b and 10c.

Comments on individual questions

Question 1

This question was generally answered well with most candidates scoring full marks.

Most candidates were confident in differentiating the cubic correctly and substituting in $x = 2$ to find the gradient, although a few incorrectly set their gradient equal to 0 and attempted to solve to find *x*. The majority of candidates were then able to use their gradient and the given point to correctly find the equation of the tangent, although a few candidates incorrectly thought that they needed to use the negative reciprocal of their gradient instead to find the equation of the normal at *P*.

Question 2

Candidates found the first part of this question challenging, but they were more successful with the second part, with many fully correct responses.

There were a number of common mistakes in candidates’ approaches to part (a). Firstly, many candidates tried to find the resultant vector by adding the two given vectors, rather than subtracting them. Secondly, candidates seemed unclear on exactly what angle the question was looking for, with lots of time being spent on finding various different (but unfortunately not relevant) angles in their diagrams. Finally, some candidates took a rather long-winded approach to find the correct angles (through use of the cosine rule to find one part of the required answer, then additional work using tan) as they had not spotted the more straightforward use of $\arctan\frac{7}{3}$. Even those who found a relevant angle were often unable to proceed to find a bearing.

Part (b) was generally answered successfully, with a few candidates mistakenly stating that 2 hours and 45 minutes was equal to 2.45 hours, rather than 2.75 hours.

Question 3

This question really highlighted the dependence on calculators amongst candidates. Part (a) required simple rationalisation of a denominator and part (b) wanted candidates to work with indices/bases. In part (a) they perhaps did not fully appreciate the wording at the top of the question 'Solutions relying on calculator technology are not acceptable', whilst in part (b) they did not have the algebra skills to solve on their own.

In part (a), when squaring both sides many candidates squared each individual term before combining the x^2; they seemed happier factorising the x out when the coefficients were rational numbers. In a similar vein, many instead simplified the $\sqrt{18}$ and then factored out a common $\sqrt{2}$, leaving multiple x terms in the equation.

Some candidates opted to square both sides. Where a correct quadratic was built and solved, candidates gave both roots and lost the final mark.

Where x was found with an irrational denominator, most candidates then went on to rationalise the denominator, but neglected to show the steps. In many cases it was clear they had typed into the calculator and read off the simplified display. When the question says 'not relying on calculator technology' candidates should be showing each step to secure the marks. The $\sqrt{18}$ must also be simplified when writing in simplest form.

In part (b) log base 10 or natural logs were commonly used, and these could only be evaluated on the calculator. These scored no marks. Even where attempts were made to use logs to base 4 or 2 there was an over reliance on calculators to find $\log_4 \frac{1}{2\sqrt{2}}$. The most common approach was to immediately take log base 4 and simplify the left-hand side. There was then often little evidence of how they got from $\log_4 \frac{1}{2\sqrt{2}}$ to $-\frac{3}{4}$.

Those who chose to rewrite as common bases more often led to full marks; base 2 was most common. Whilst the use of calculator technology is encouraged on the new specification, candidates should make sure that they are confident of working without one when required.

Question 4

This question focussed largely on the problem-solving assessment objective, AO3, and was those candidates who were familiar with linear models scored full marks. The algebra was generally well done, whilst the written component in part (b) really assessed who knew what the modelling aspect was all about.

In part (a) the first part of the question was generally well done with most finding at least the gradient or the intercept. Some candidates worked using x and y, although they should make sure that their final answer is in terms of the given variables. One area of confusion was in the definition of the variable n. Some candidates did not read the detail of the question which stated that n was the number of years past 1997- not simply the date (number of years AD). Whilst they still found a linear equation, it was not the correct one linking A and n. There were some candidates who tried to form an arithmetic sequence, too.

In part (b) the common approach was to substitute $n = 19$ in to the model found in part (a), scoring 2 marks for a correct answer. Where candidates used the dates in part (a), they could still find the correct value for the year 2016 with their model. When commenting on the suitability of the model candidates need to make sure they comment on the model, as opposed to explaining what external factors may have been resulted in the figures being different. It was pleasing to see that less candidates made the comment that the model is not suitable because the value predicted and the actual value are not the same which does not demonstrate an understanding of a model. Equally, just comparing the values without making a judgement on suitability is also insufficient.

Question 5

With the exception of the first 2 marks, this was quite a polarising question that either scored very well or little at all. Those who went through to part (b) with an incorrect diagram and understanding of the question found it very difficult to make sense of the sides. It was only after abandoning this line of thought and starting afresh did some candidates manage to salvage the question.

In part (a), the first couple of marks were scored by the vast majority of candidates using the sine rule to find 51.1 degrees. From there, an overwhelming number neglected to solve for the obtuse angle; those who did left both answers. Many even labelled their obtuse angle on the diagram as 51.1 degrees. Candidates should always be checking solutions to equations to ensure they make sense in context and are well defined._As the 128.9 degrees was appearing as a complementary angle in part (b), it was important to state it unambiguously here as credit could not be gained for it seen later in the question.

In part (b), depending on the answer to part (a), there were a couple of possible configurations that would lead to different answers. After labelling the triangle, candidates had the choice of the sine rule or cosine rule to find the missing side AD. Those who mislabelled in part (a) tended to over work this, believing they had only found *AC* and still had to find another side, so it was condoned that they may have started again, allowing full marks to be achieved if they reached the answer of 42 m.

Candidates should keep sight of the bigger picture by looking at the sum of angles in the right most triangle. Hardly any noticed that they had two base angles of the isosceles triangle of 128.9 degrees. There should always be an internal consistency, even when some individual value might have been calculated incorrectly.

Question 6

The binomial expansion seemed a welcome relief with many candidates achieving full marks in part (a). The usual problems with exponents crept in but fortunately there were no 'negatives raised to powers' to contend with. The simple equation in part (b) was not answered quite as well but coefficients were followed through from part (a) allowing some marks if they multiplied the correct expression by 3.

In part (a), candidates answered this well with a mix of methods due to the expression being of the form $(1+...)^n$. The most common mistake was to not raise k to the various powers as well as the x. Some candidates were one step out in their binomial expansion such that the coefficients did not match the term. A few candidates found expansions in decreasing powers of x and could not score any marks.

In part (b), those who got an answer for part (a) would usually achieve at least the first mark in part (b). Some candidates were unable to form a correct equation for the coefficients and simply set them equal to each other without multiplying the linear term by 3. There was a small number of cases where the wrong side was multiplied by 3.

It was disappointing that a large number are still uncomfortable with the term "coefficient" as there were a lot of scripts that kept the x and x^3 in the equation and even tried to solve to find x. Others removed the x and x^3 later on, but this should be discouraged as a general approach.

Question 7

The first part of this question was generally answered well with many candidates scoring full marks, but the second part proved to be more challenging for a disappointing number of them.

In part (a), some candidates struggled with either rearranging the $\frac{5}{2\sqrt{x}}$ term to the form $\frac{5}{2}x^{-\frac{1}{2}}$ or with getting the correct coefficient when integrating this to $5x^{\frac{1}{2}}$. However, the majority of candidates were then confident in substituting both limits into their expression, subtracting and setting their result equal to 4, then rearranging correctly to get the required equation.

In part (b), some candidates struggled with identifying the given equation as a hidden three term quadratic, with a few trying unsuccessfully to simplify by multiplying every term by k, for example. Some candidates tried to square both sides but were mostly let down in this approach by mistakes in expanding out the brackets or simply squaring individual terms. Those candidates who were successful often proceeded by setting $y = \sqrt{k}$, for example, and proceeding correctly to two values, which they then squared, but a number did not realise that they needed to discard the solution of $\sqrt{k} = -3$. Some candidates confused themselves by setting $\sqrt{k} = k$ to produce a three term quadratic in k but then failed to realise they had not found the actual value for k.

Question 8

This question was another which focussed on problem solving, with the majority of candidates only able to score around half of the marks available. Part (d), in particular proved to be too difficult for most candidates so it was rare to see full marks.

In part (a), many candidates could score at least one mark here by calculating the value of 83, however, it was not uncommon for units to be omitted which meant that the mark was not awarded.

In part (b), the majority of candidates scored full marks here and seemed very comfortable with the fact that ln is the inverse. There were some slips with rearrangements of the equation, which was often dividing by 8 rather than multiplying by 8. It was evident that some candidates used their calculators to solve the equation without demonstrating any method. Candidates should be encouraged to show all of their working, to ensure that full marks can be scored.

Most candidates were successful in part (c), which may have been due to the graph having been provided. Many stated $18\,^\circ\mathrm{C}$ as being the minimum temperature of the model which was condoned for the mark, although a significant number stated that "$15\,^\circ\mathrm{C}$ is the room temperature" which did not show an understanding of the model. The other most popular way to answer the question was to substitute 15 into the equation and concluded that you cannot log a negative. Just stating that "you can't log a negative" without providing the working to back this up was not sufficient as it was not enough evidence that the candidate had engaged with the model.

Part (d) caused more issues than the rest of the question for candidates. Several of them assumed *A* was equal to 94 and therefore did not score highly in this part. Some candidates attempted to find the gradient between the given coordinates and therefore did not score any marks. However, once candidates formed the two simultaneous equations, they seemed to find it quite easy to use the elimination method to eliminate *A*, and then go on to correctly solve for *A* and *B* and therefore work out the equation of the asymptote.

Question 9

This question was attempted by most candidates with many being able to secure nearly all the marks in part (c). It was rare, however, for full marks to be scored overall, with most struggling with the transformations in part (b).

In part (a), candidates occasionally got their signs mixed up, or did not appreciate the vertical stretch of scale factor 3 and therefore $d = -1$. Some even had their *d* being positive, despite the diagram showing that *P* was below the horizontal axis.

In part (b), candidates could still score marks for acceptable follow throughs as long as *d* was a negative value. This enabled some candidates to score usually one of the marks. Some mixed up the horizontal stretch of scale factor 4 and scale factor $\frac{1}{4}$ in part (i) and mixed up a translation of 36 units in the positive *x*-direction with 36 units in the negative *x*-direction. There were some candidates who only stated the *x* coordinate whereas the question asked for the coordinates, so they were unable to score in this part.

Part (c) proved to be high scoring for many candidates, however, some did not recall the identities correctly and made little progress. In particular, candidates made errors with rearranging $\sin^2 x + \cos^2 x = 1$ or missing the square from either or both terms. The given interval was unusual, although it was pleasing to see many of the candidates who proceeded to find a value for θ were able to find the one that was in the required interval.

Question 10

This question was answered well by the majority of candidates. However, the question highlights the need for detail in proof and 'show that' questions which candidates are clearly still getting used to; it appeared to be even the more able candidates were neglecting to state facts that were needed. Candidates should be encouraged to make sure they provide sufficient reasoning when demonstrating a result or writing a proof.

The final part requiring integration, whilst not penalised, brought out a lot of poor notation. Candidates were able to score most marks, however. Those who understood the nature of the curve and the importance of the factors and roots found earlier were able to choose the correct bounds and, usually, go on to achieve full marks.

In part (a), there were 2 main errors on this question, with almost all candidates getting only 1 mark. The question asked candidates to use the factor theorem, however, there were a significant number who still chose to use polynomial division and could not score marks in this part. Those who found g(5) to equal 0 then stopped (or simply stated hence it is a factor) were also not actually answering the question. This was about divisibility which was a slight change to many of the questions on this topic in the past. Therefore, not only did candidates need to show that $g(5) = 0$ means that $x - 5$ is a factor, but also some acknowledgement and understanding that a factor divides perfectly and without this the answer was incomplete.

In part (b), whether they used polynomial division or used their calculator to solve and work back, most candidates were able to find the 3 factors. The biggest problem was when candidates worked backwards from the roots given by their calculator and did not expand to check. They wrote $(x + 3.5)$ rather than $(2x + 7)$ (or equivalent). The question clearly asked candidates to use algebra and they should make sure their working demonstrates that.

In part (c), those who attempted the question typically integrated correctly; however, it was very mixed when it came to evaluating. There were a number of poor graph sketches and some did not recognise which area they were actually finding and chose the wrong bounds for the integral. When evaluating the integral there were solutions lacking brackets which resulted in sign errors.

Although the integral evaluates to be negative, the area is the magnitude of this. If the bounds were used in ascending order, then it was expected to see the negative answer before the positive solution. It was acceptable, following candidates carrying out algebraic integration visibly, that they used their calculator to substitute in their limits and could still score full marks.

Question 11

Candidates were generally successful in answering the first part of this question, but found the second part more challenging, with only a few gaining full marks.

In part (i), most candidates were confident in completing the square to find the coordinates of the centre of the circle, and many could then successfully find the gradient of the line from the centre to the given point. There were still a number of candidates who made sign errors when finding the gradient, however. Some candidates forgot to then find the negative reciprocal of this gradient in order to find the tangent, and a few did not give their final answer in the requested form, but this was generally answered well. Candidates should be reminded to check the form that the answer should be given in to ensure that they score marks that they are more than capable of achieving.

In part (ii), again most candidates were confident in completing the square and finding the radius of this circle in terms of *k*, but a number then stated this radius needed to be less than 6, rather than saying it needed to be less than 4. There were a large number who made errors just rearranging the equation resulting in the radius as $\sqrt{52+k}$. Only a very small number of candidates picked up the final mark for realising that, in addition to $k > 36$, we also required $k < 52$ in order for the circle to actually exist.

Question 12

This question proved to be more challenging for candidates than was anticipated. There were a large number of candidates who did not attempt the question at all, or of those who did, most seemed to struggle with showing the relationship between the log form of the equation and $V = ab^t$. It was very rare for full marks to be achieved, with most securing around half of the available marks in total for the question.

In part (a) many candidates were able to correctly calculate the value for '*a*' and '*b*', however, they lost marks due to the fact that they did not appreciate the "show that" nature of the question. Missing out writing both $\log V = \log a + \log b^t$ and $\log V = \log a + t \log b$ was common and this resulted in the first mark. As it was an incomplete solution, candidates also lost the final mark, too. A number of candidates rounded both of their values to the nearest whole number, which was only required for *a*. This was only penalised if they never had $b = 1.18$ at some point. Usually, candidates had lost the first mark anyway from insufficient working, so it rarely was the reason for not achieving full marks.

Very few candidates were successful in part (b). Most went with a standard response of stating it was the "the initial number of views" which was incorrect as *t* could not be 0. Had they just copied the relevant part at the start of the question replacing *t* with one, they would have scored the mark.

In part (c) candidates could either use their formula from part (a) or use the formula given in the question, so it did not rely on the candidates getting correct answers to part (a) or (b). The majority of candidates who attempted this question were successful, or at least gained the method mark, if their values for *a* and *b* were incorrect. When using the given formula, several candidates were able to calculate the value of $\log_{10} V$, however, they did not know how to then proceed to calculate the value of *V*.

Question 13

This proved to be a challenging question with only a few candidates scoring full marks in the first part, although more candidates were successful with the second part.

In part (a), the expected approach was to begin with some known true statement, such as $(2a-b)^2 \geq 0$, and then to argue logically, step by step, until you arrived at the statement given in the question. Most candidates incorrectly began by using the given statement and then proceeding, which meant that they could not score full marks. The algebraic processing was generally well done, meaning most candidates scored 2 out of the available 4 marks, but most lost the final mark by not including full detail of their reasoning (squaring a real number will always give an answer greater than or equal to zero and, since both *a* and *b* are positive, multiplying the inequality through by *ab* will not change the inequality sign).

In part (b), many candidates realised that the result does not hold if one value is positive and one is negative. However, a calculation is not enough for a proof, and a conclusion in words was necessary in order to obtain the mark. It was disappointing that many still opted to just state the inequality the other way round or not provide a conclusion at all. Other candidates did not substitute their values in correctly, or their answer for the expression on the left-hand side was incorrect.

Question 14

The final question was not attempted in a significant number of cases. This may have been due to the demand of the question for the majority of candidates. Of those candidates who did attempt this question, it was rare for full marks to be achieved.

In part (a), candidates struggled with getting started which then cost them dearly. They seemed to struggle with forming an equation without being given one, despite it being a cubic equation, which then meant they lacked the confidence to pursue any further. Common errors were not appreciating that there was no constant term which meant they produced simultaneous equations with too many unknowns. Others knew they needed to differentiate g(x) and sub in $x = 2$ but then they equated it to 9 and not 0. Clearly having lots of information provided at the same time and having to select which is appropriate for each stage of their working the majority of candidates found difficult. The lack of understanding surrounding coefficients may have led to not being able to set up the cubic with the coefficients for x^3 and x being the same. Some even assigned numerical values rather than unknowns.

There were some candidates who were able to form two simultaneous equations, however, and most of these successfully found a and b. They were asked to find the function, so it was essential that they did state their answer at the end to score full marks in this part.

In part (b), if candidates were able to come up with a cubic for part (a), they usually appreciated the need to differentiate to find the second derivative and substitute in $x = 2$. Their knowledge on second derivatives meant they knew it would need to be negative to prove it was a maximum. However, there were a number of candidates who had incorrect derivatives or evaluated incorrectly and still stated they had a maximum, even though their answer would have been positive. This, for some, should have prompted further investigation into their earlier work. Some candidates still substituted in a value of x either side of $x = 2$ into either $g(x)$ or $g'(x)$. This was far more working to score both marks, so candidates should be encouraged with this type of question to prove the nature of the turning points using second derivatives.

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