Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2019

Pearson Edexcel GCE AS Mathematics

In Core Pure Mathematics 1 (9FM0/01)

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General

This is the first paper in the new A level Further Mathematics specification and overall candidates were well prepared. There were questions, parts of questions where the majority of candidates were successful and other questions, parts of question which were more challenging.

Candidates need to review the mark scheme to see what is required for the explanation questions which are common in the new specification, for example Q5 (a), Q5 (d) and Q8 (e). The quality and neatness of some candidates writing made it difficult at times and candidates need to assist examiners.

Candidates are advised to read the question carefully, for example Q4 sum of a series, many candidates started from r = 1 instead of r = 0 as stated in the question.

Overall this paper differentiated well and gave all candidates the opportunity to demonstrate their mathematical knowledge and problem-solving skills.

Question 1

Parts(a) was accessible to almost all candidates, with most gaining full marks. A handful of candidates thought the conjugate was 1 + 2i and – 3 – i, and a few candidates lost marks because of a poor diagram, failing to indicate a scale or labelling or with -1 + 2i closer to the real axis than 3 + i

Part (b) proved to be more challenging for some candidates. The most common approach was attempt to find the sum, pair sum, triple sum and product of the four roots. Most were able to find a correct sum and product, but errors were sometimes made when attempting to find the pair and triple sums. Some errors were due to a missing pair or triple sum, but most errors occurred in the algebraic manipulation of the terms. Most candidates realised they needed a = -sum, but a few candidates omitted the minus on the triple sum, and so lost the last M mark.

A significant number of candidates attempted to find two quadratics using the sum and product of conjugate pair roots. Most were able to form correct quadratics and then go on to multiplying these out to obtain a quartic. Common errors with this approach were to make a sign error when attempting to apply $i^2 = -1$, or to apply "+ sum" rather than "- sum" for the x-term in the quadratic. Some candidates made slips when multiplying out the quadratic factors, and one or two lost the final A mark for stating a quartic in term of x and not z.

A few chose to substitute roots into a general quartic obtained two or more simultaneous equations, but often these contained errors. Most then failed to correctly solve their equations to find a, b, c & d.

Question 2

This question was attempted by the majority of the candidates but caused difficulties for a significant number of candidates

Most candidates realised that they needed to use partial fractions to attempt this question. Those that did not usually scored 0/7.

The question was answered quite well by candidates who chose the correct form of the partial fractions $\frac{Ax+B}{2x^2+3}+\frac{C}{x+1}$ usually scored the first three marks. Most were then able to integrate correctly, though some had the wrong coefficient for the $\ln(2x^2+3)$ term

Many candidates chose the incorrect partial fraction either $\frac{A}{2x^2+3}+\frac{B}{x+1}$ or $\frac{Ax}{2x^2+3}+\frac{B}{x+1}$ and consequently lost the first four marks.

Candidates who chose $\frac{Ax}{2x^2+3}+\frac{B}{x+1}$ sometimes managed to continue to score the M1B1. Incorrect partial fractions often led to an incorrect arctan integral.

Many candidates missed the next key stage of working for applying the log rules- either before substituting or by substituting the variable 't' then collecting their log functions in terms of 't' before an attempt to simplify. Some of those candidates who did manage to combine their log terms then failed to deal with the limit correctly, believing that this simplified to ln(1). A small number of candidates who had successfully dealt with the limit left their final answer as 2ln(2/3) rather than putting this in the required form.

Many candidates failed to obtain the B1 mark (and hence the final A1 mark) by not recognising the dominant terms. A very common incorrect answer was ln(1/9)

There were some, concise, completely correct attempts at this question.

Question 3

This question proved to be accessible to most candidates. The majority of candidates gained full marks in part (a). One or two lost both marks for using $\theta = 2\pi$ which is not a valid angle for the model.

Part (b) Almost all candidates realised they needed to use the correct area formula and then went on to expand the expression for r. Candidates appeared to be familiar with the method needed for integrating $\cos^2 x$ and most used a fully correct double angle formula in their integral. One or two attempted the double angle formula but then substituted an expression in terms of 2θ rather than 4θ and so lost the second M mark. The majority integrated their expression correctly, although one or two made sign errors or slips when finding the coefficients. Most candidates then went on to substitute the correct limits for their integral. Almost all candidates gained the B1 mark for correctly finding the area of the table top (the mixed of units was dealt with), and most realised they needed to subtract their area enclosed by the curve from the area of the rectangle.

Although most candidates were able to make good progress on this question, sign or arithmetic errors were often made along the way resulting in the A marks being lost.

Question 4

This question differentiated well and many candidates found it challenging.

Most candidates realised they needed to split the fraction into partial fractions, and most found correct values for the constants. Most then realised they needed to apply the method of differences. An extremely common error at this point was to start with r = 1, omitting r = 0, and thus only gaining a maximum of two marks for this question. Some candidates struggled to see how the fractions were cancelling and gave up before considering r = n – 1 and r = n, and so could only gain the first M1. Candidates should be encouraged to set out a sufficient number of terms in a clear list and indicating clearly which terms remained about differencing, as candidates who did this tended to make better progress. When candidates had algebraic terms they were generally successful in combining them with a correct common denominator. Errors were sometimes made in simplifying the numerator. A few struggled to combine the numerical fraction, and errors were much more common where the candidate didn't attempt to simplify fractions or where they keep 3 algebraic fractions and did not combine $\frac{1}{2(n+2)}-\frac{1}{n+2}$

Question 5

In this question, part (b) and (d) were answered very well by the majority of candidates, but significantly fewer managed to answer (a) and (c) successfully.

In part (a) many candidates struggled to explain the model successfully. References to the context of the model were required by using words such as "salt in", "volume" and "concentration". There was also some confusion between the salt and salt water that entered the tank. There seemed to be a reluctance by many candidates to use words as opposed to symbols and they need to practise these explanation skills There were some excellent fully coherent explanations, but these were relatively rare. The most common correct explanations are volume = 100 + 3t – 2t = 100 + t and that the rate of salt in = 3. Whilst showing where $\frac{2S}{100+t}$ came from was very poor with candidates just writing $2\times\frac{S}{100+t}$ with no reasoning where they have come from.

Part (b) was generally attempted correctly with the vast majority of candidates recognising the type of differential equation and correctly using the integrating factor. A small number of candidates omitted the constant of integration and lost the subsequent marks.
Common errors when attempting to find the constant of integration are using S = 100 or using $0=100+0+\frac{c}{100}$ instead of $0=100+0+\frac{c}{100^2}$ or achieving c = +1000000 instead of c -1000000.

Most candidates made an attempt at part (c) although only the minority identified the concentration of salt as the mass of salt divided by volume. The units of grams per litre stated in the question could have been used to guide those who were unsure of this relationship. Successful candidates then generally used their calculators efficiently to solve the resulting cubic equation and find the value of t. Common incorrect approaches were setting S or even dS/dt equal to the value for concentration.

Part (d) was often answered correctly with the most common answer relating to the fact that the mixing would not occur instantly. Many candidates tried to comment on the volume of water or the amount of salt tending to infinity, but did not explain how this contradicted the model. Some candidates noted that the capacity of the tank was 250 litres, but did not always highlight that the tank would become invalid once the tank was full.

Question 6

In this question, the majority of the candidates manage to score the first three marks by showing the basis step, make a correct assumption for n = k and giving an expression for n = k+1, but accuracy marks proved harder to score.
Virtually all candidates seemed familiar with the method required for this type of proof by induction. They tested the n = 1 case and concluded that this case was true. Occasionally some candidates failed to draw a conclusion. Again, almost all made an assumption for n = k case and then considered f(k + 1) or f(k + 1) - f(k) (with other appropriate combinations of the two functions seen and used). There were many slips seen in dealing with the powers, and $3^{2k+6} – 2^{2k+2} = f(k)(3^2-2^2)$ was seen on more than one occasion. Some, having obtained a correct expression involving f(k + 1) and f(k), did not state f(k+1) explicitly was an expression divisible by 5. Of those who completed the algebra, most (but not all) stated a clear and logical conclusion drawing the elements of the proof together. Many candidates dropped the final mark for not stating if true for k **then** true for k + 1.

Question 7

Part (a) Candidates generally either chose to try to show that the lines intersected at a point or tried to find a vector which was perpendicular to both lines. Those candidates who tried to show that the lines intersected generally set up three equations and tried to solve one pair of them. Some candidates then failed to use their solution in the third equation and a significant number then failed to make a full conclusion. Those candidates who tried to find a perpendicular vector generally managed to do so, typically using the cross product, but then failed to use this with the coordinate points to find the equation of the plane show that both lines lay on the plane. Many candidates failed to achieve the final mark as they did not give a reason why the lines lie in the same plane i.e. point of intersection

(b) Most candidates gave a correct form for the equation of the plane, but a significant number lost this mark because they failed to write as an equation **r** = ... (many incorrectly wrote π =…)

(c) Most candidates successfully used the dot product to obtain the correct value for cosθ but some failed to give their answer to the nearest degree or used arcsin instead of arccos.

Question 8

(a) The majority of candidates answered this part well and the most common errors were sign slips or numerical copying mistakes. Some candidates used dot notation despite the question been written with $\frac{dw}{dt}$ and failed to give the answer as required.

(b) Most answered this section well with most finding the Auxiliary Equation correctly. The most common error occurred with the Particular Integral with an incorrect format, such as λte^{-t}, or poor differentiation. A small minority mistakenly used x instead of t.

(c) A significant number of candidates did not attempt this part of the question. Many successfully gained the method mark, but there were frequent sign errors in applying "$-\frac{2}{5}\ \frac{dw}{dt}$ ". A significant minority replaced their *w* in the second equation and integrated to find *s*. Only one solution that I saw attempted to find a constant for their solution.

(d) The majority of candidates gained the first two marks in this section but failed to proceed beyond setting w = 0. A significant number failed to create a 3TQ in $e^{1.5t}$ because they didn't multiply the whole equation by e^{-t} and had little chance of gaining the last 4 marks. There was mixed success in solving the 3TQ – some made a substitution using $x = e^{1.5t}$, but others attempted more complicated substitutions, or tried to square their equation with little progress. Those who solved their 3TQ were able to correctly undo the logs, but failed to round correctly.

(e) This part was very poorly answered with most candidates talking about other factors instead of the potential for negative values, they did not take the hint from part (d) finding the time when w = 0. Comments were rarely in context and too many failed to mention the validity of the model.

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