Examiners' Report

Principal Examiner Feedback

Summer 2023

Pearson Edexcel International GCSE

In Further Pure Mathematics (4PM1)

Paper 02

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Paper 02

Question 1:

Question 1 was intended to examine candidates' ability to manipulate surds and equate coefficients. However, a very large minority struggled to attain marks beyond the first.

The most common difficulty observed was an inability to equate coefficients correctly, many struggling with this fundamental concept. Beyond this, a number of candidates attempted to solve equations, making errors.

Those who rationalised the denominator as the initial approach were most successful. A minority of these were then able to equate coefficients and once this was completed, they were successful at finding the correct values for a and b.

Question 2:

Solutions were polarised here, often achieving full or no marks. Some students simply didn't recognise the format of the nth term given and that substitution of values of n were required to find the value of a and r.

A few candidates gave the first term as 8 and a few others thought that r was 8. Some candidates tried to use logs to present a solution but failed to make progress.

Question 3:

Many candidates were able to achieve the first 2 marks for setting up the correct equations related to arc length and the area of a sector. However, some candidates experienced difficulties when solving the resulting simultaneous equations, particularly if they were using $2\pi - \theta$ as their angle. Notably, many candidates who set up the equations using the obtuse angle (as intended) did not attain the final mark, as they failed to calculate the value of $2\pi - 3.8$.

Those using ALT2 and ALT3 often found solving their equations most difficult, with rearrangements and substitutions that failed to observe factors that could be cancelled, meaning the resulting algebra was difficult with errors usually made.

Some students used a combination of θ and the acute angle, which resulted in equations that led to an incorrect method to solve, as they were effectively in three variables, despite their appearance.

The most successful candidates were those that used the method in the main scheme.

Question 4:

In part a), many candidates attempted to establish the coordinates of point A by substituting $x = 0$ into the equation of the line or curve. Though most candidates did, some didn't appreciate the 'show that' demand of the question and failed to equate the equations for curve S and line l. Most of those who did were generally successful in making the required rearrangements to the given equations, setting up the equation for the points of intersection, continuing correctly to solve the resulting quadratic and then to find the required coordinates for A and B. Occasionally errors in algebraic manipulation were seen.

Fully correct solutions to part b) were rarely encountered. The majority of candidates tried to rotate about the x-axis. Of those rotating about the y-axis, the use of x limits (0 and 2) was common. Even though most candidates attempted to establish an expression, most of them failed to establish a correct statement for the required volume and marks were often only attained for integration and substitution of limits.

Question 5:

Parts a) and b) were generally answered well, with a substantial percentage of candidates successfully gaining full marks. However, one or two marks were lost by some candidates, often due to avoidable inaccuracies in drawing the straight lines.

Part c) posed more challenge for candidates, with a notable minority finding the values for x and y by solving the related simultaneous equations, rather than from the graph, as directed by the question.

Contrarily, some candidates did not use the intersection points at all and instead used integer or seemingly random values for x and y. Nonetheless, a considerable number of candidates were able to achieve full marks in this part by using their graphs to determine the values of x and y and subsequently using them to find the value of P. The most frequent wrong value given involved using x = - 4 and y = - 3.

A few candidates drew straight lines that didn't intersect, and centres could advise students on the importance of accuracy when drawing graphs.

Question 6:

Part a) was generally done well. Most candidates appreciated that the volume of the prism was obtained by multiplying the area of the triangle ABC by the depth of the solid. Candidates who didn't attain the mark here seemed not to appreciate that the solid was a prism or how to correct use the required formulas. A small minority of candidates made this question more difficult than intended by finding the perpendicular height and using the associated formula for the area of a triangle.

In part b), most candidates were able to state $\frac{\mathrm{d}r}{\mathrm{d}t} = 0.2$, successfully differentiate to find $\frac{\mathrm{d}V}{\mathrm{d}r}$ and form the appropriate chain rule to obtain $\frac{\mathrm{d}V}{\mathrm{d}t}$.

A minority of students failed to appreciate that the triangle was equilateral and the simplicity of finding the value of r to be used.

Question 7:

In part a), the overwhelming majority of students successfully achieved full marks. Where full marks were not gained, students usually didn't use $\frac{x}{3}$ in the expansion or made errors in simplification.

Very few candidates attained the mark available in part b) – centres could focus on referring students to the relevant part of the formula page and the validity of any binomial expansion.

For part c), the overwhelming majority of candidates realised they needed to take out a factor of 3 inside the brackets, but often only gained one mark as many then failed to process the index power of – 3 correctly.

Part d) – most candidates realised they needed to take their expansion from part a) and multiply by "P" and $(1+4x)$ gaining at least the first mark. The second mark was dependent upon having gained both marks in part c).

Part e) saw most students successfully gaining the first mark for integration and many gaining the second mark for substitution of limits. Centres could advise candidates to show substitution of limits in full.

Question 8:

Most candidates correctly established the gradient in part a) and went on to correctly establish the equation of the line. A notable minority failed to rearrange the equation into the required form.

In part b), most candidates found the length of the line correctly. Those who did not mainly made sign errors.

In part c), though often convoluted methods were seen, many candidates attained full marks here. Candidates could be encouraged more, with a lengthy coordinate geometry question such as this, to start building a sketch from early in their solution, which would have helped identify incorrect answers here.

Part d) proved a challenge to most candidates, with few gaining all available marks. The most successful strategy seen was finding the equation of line CX then solving this equation simultaneously with that of the circle, after having identified the centre and radius from previous work. Candidates who drew a simple sketch made better progress.

Though not listed as knowledge required on the specification, many candidates attempted part e) by evaluation of a determinant. Though many had incorrect values for p and q from part (d), two marks were available for demonstrating the correct method to find the area.

A smaller number of candidates attempted to find the formula for the area of a triangle, but difficulties finding the required lengths correctly led to very mixed results.

Question 9:

Candidates found this question challenging. Mainly, struggling to identify the required angle.

Despite this, a significant percentage of students were able to score the first mark for finding one of the angles and the second mark by correctly applying Pythagoras' theorem to find the height of the pyramid.

Diagrams were often not labelled and methods were often difficult to follow. To aid their own completion of such a question, centres could encourage candidates to mark and label key points on the given diagram and draw subsidiary diagrams in their working.

It is evident that students struggled with spatial visualisation and accurately interpreting angles in three dimensions. Common misconceptions included incorrectly assuming bisection of angles and symmetry not present and the incorrect assumption that triangles were isosceles and/or right angled.

Question 10:

Most candidates gained all the marks available in parts a) and b). Where marks were lost, this was either by mis or not labelling their answers correctly or in part b), not understanding parallel to the y or x axes.

Part c) was generally well attempted. Many good sketches were seen, though curves obviously bending back on themselves, and unlabelled asymptotes or intercepts were a source of lost marks. Some candidates drew a positive reciprocal curve, which resulted in losing all three marks. A few candidates sketched only one branch of a negative reciprocal curve.

Some candidates failed to realise differentiation was necessary in part d), but of those who did, a full and correct solution to this part of the question was often seen. Sign errors were sometimes seen, and unrecovered bracketing often led to incorrect simplifications beings used to calculate the required gradient. Most candidates differentiated using quotient rule, though a few chose to use product rule.

Although algebraic manipulation errors were sometimes seen, most candidates were able to pick up two method marks in part e) by equating their equation from part d to the given equation of the curve and solving to find a value of x.

Question 11:

A significant percentage of students were able to attain full marks in part a). Solutions were frequently concise and well presented with the distribution of methods used being evenly spread across the two available. Of those candidates who weren’t fully successful, most gained the first two marks in part a)i) for successfully setting up one equation. Many of these candidates didn’t think to use the given answer in a)i) to make progress in a)ii).

Many candidates also enjoyed a degree of success with part b), including students who hadn’t attained full marks in part a). Candidates tended to either know the relevant algebraic identities or not and solutions tended to attain full or no marks.

A significant minority of students made good progress in part c), though it was surprising how many who had made good progress in parts a) and b) didn’t realise the link with part c) and conversely, how many students who’d not picked up marks in part b) realised the link and picked up one further mark.

It was pleasing to note the number of candidates who were able to attain full marks on this question.

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