Examiners' Report
Principal Examiner Feedback

Summer 2022

Pearson Edexcel International Advanced Level
In Pure Mathematics P1 (WMA11) Paper 01

The first four questions on this paper were found to be very straightforward and accessible to most candidates. Later questions did test the ability to think and problem solve, although there were plenty of available marks for the well prepared candidate. One thread that ran through this paper, that needs to be relayed back to centres and candidates, is an over reliance on calculators. It is vitally important that when warnings are given, they are heeded by candidates. In WMA11, candidates are expected to show skills in rationalising surds and solving quadratic equations. The following warning requires candidates to complete the question showing non-calculator methods.

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

It was evident in questions 3 and 6 that many just used their calculators to generate the answers and, as a result, lost a great many marks.

Question 1

This was a very familiar and straightforward question on integration. Generally it was well done with many candidates scoring 3 or 4 marks.

Amongst those scoring 3 marks, the most common error was a failure to deal with the $-3/x^2$ term. This was often integrated to $-3/x$ or $\pm k/x^2$. Other common errors amongst those who scored 3 or 4 marks was a failure to include the "+c" or else failing to cancel down one of the earlier terms.

It was disappointing to see the following errors in this question:

- differentiating instead of integrating
- raising to a new power but failing to divide by the new power
- raising to a new power but then multiplying by the new power
- retaining the integral or dx symbols or both

Question 2

This question was attempted by the majority of candidates with a very common score being 3 out of the 5 available marks. The more successful candidates were the ones who used a sketch to summarise the given information enabling them to see the link between the sides and the angles in triangle *ABC*. This is very good practice and should be encouraged amongst candidates.

Part (a)

Candidates were instructed to use the sine rule on triangle *ABC*. The majority of candidates correctly set up the sine rule and gave the value of sin(x) to be 0.827 to 4dp as required. Where students were not successful in part (a) the main reasons were:

- not having a correct sine rule formula
- not having the correct ratios (due to not having a sketch)

- directly taking inverse sine without stating the value for sin (x)
- failing to give sufficient decimal places for their answer
- having their calculator in the wrong setting, sometimes in radian mode and sometimes even in gradient mode.

Part (b)

Most students understood that 43.05° could not be the largest angle in the triangle and correctly subtracted this from 180° to give the value for x as 136.95°. Where students were not successful, it was in simply leaving the acute angle or else finding $180-90-43.05$.

Question 3

This question was generally done very well with most candidates scoring at least 3 marks and many scoring all 5 marks. Throughout the whole question, candidates lost marks as a result of using their calculators to generate the answers and not showing the required steps.

Part (i)

This part was well answered by most candidates. Many were able to score at least 1 mark for either simplifying $\sqrt{180}$ to $6\sqrt{5}$ or $\sqrt{80}$ to $4\sqrt{5}$. The accuracy mark, when lost, was mostly lost for not showing an intermediate step before reaching the answer 2.

Part(ii)

Most candidates were proficient in rationalising the denominator by multiplying the numerator and denomiator by $7+3\sqrt{5}$. This step needed to be clearly seen at it was easy to reach the answer directly by use of a calculator. Candidates were required to show all stages of their work, so it was necessary to show the expansion of $\left(4\sqrt{5}-5\right)\left(7+3\sqrt{5}\right)$ as well as the 4 in the denominator. Some candidates lost the final accuracy mark as they failed to give the answer in the required form.

Question 4

Question 4 tested transformation geometry. It is really important for candidates to read the instructions carefully and sketch **separate** graphs. It is also vitally important in a sketch to show clearly all key pieces of information. Too often sketches were not asymptotic at both ends, and coordinates did not match their positions on the coordinate plane.

Part (i)

There was a lot of confusion between the graph of $y = f(x) - 2$ and the graph of $y = f(x - 2)$. Most candidates recognised that a translation was required but shifted left, right or even upwards rather than down. Some candidates omitted the equation of the asymptote or did not draw their curve to be asymptotic at both ends.

Part (ii)

There were many correct attempts here but errors included:

- attempting a translation rather than a reflection in the y-axis
- reflecting their graph from part (i) instead of the original graph

- omitting the equation of the asymptote
- not drawing their curve to be asymptotic at both ends.

Question 5

Question 4 tested transformation geometry. It is really important for candidates to read the instructions This was a question on equations of curves and lines and using these equations to define a region using inequalities. Only a minority of candidates achieved full marks for this question.

Part (a)

Most candidates knew the correct quadratic form but failed to achieve a correct answer due to ignoring the multiplier k in $y = 12 - k(x+2)^2$, $y = k(x-1)(x+5)$ or $y = kx^2 + bx + c$ As a result 1 out of 4 was a very common score. Generally there were 3 unknowns to be found and so three pieces of information were required to obtain them.

The most straightforward ways of finding the full equation were:

- substituting $\left(-5,0\right)$ in $y = 12 - k(x+2)^2$ to obtain $k = \frac{4}{3}$ and so $y = 12 - \frac{4}{3}(x+2)^2$
- substituting $\left(-2,12\right)$ in $y = k(x-1)(x+5)$ to obtain $k = -\frac{4}{3}$ and so $y = -\frac{4}{3}(x-1)(x+5)$

Candidates who used $y = ax^2 + bx + c$ were often unsuccessful in forming three correct equations. There were a surprising number of candidates who tried to find the gradient of a line between the maximum point and the x intercept at -5 and gave f(x) as a linear equation.

Part (b)

Almost all candidates answered this relatively simple part correctly. A handful did not use a changed gradient or changed it incorrectly but this was rare. Sign errors in rearranging or using $x = +5$ occasionally led to an incorrect c value.

Part(c)

This produced a variety of answers, several of which were not relevant. A large number of candidates were able to write correct inequalities for the two linear equations, but the negative values in the quadratic function seemed to confuse some into giving an incorrect inequality for the quadratic curve. A few candidates used R instead of y in their inequalities. A few candidates also wasted a great deal of time finding the x value where l_1 and the curve intersect producing an additional yet unnecessary inequality of the form $x < \ldots$

Question 6

This question involved the simultaneous solution of two curves. Part (b) caused a problem which required the solution a quadratic equation in x^2. This was a very accessible question but many lost marks by an over reliance on calculators.

Part (a)

Most candidates were able to successfully rearrange the second equation, substitute into the first and thus obtain the given solution. There were a handful who made it harder by rearranging the first equation which led to more complicated algebra and therefore more prone to errors.

Part (b)

A few repeated part (a) here to derive the equation in x again. Despite this being a non calculator question there were still many candidates who clearly used an equation solver to find values for x and, as a result, lost most marks. Some substituted eg $u = x^2$ yet still then used their equation solver to solve the equation in u. Those who did show working, either factorised or used the formula to find the answers for x^2. Some incorrectly achieved $x = 10$ rather than $x^2 = 10$. Unfortunately there were several candidates who tried to solve the equation by taking a factor of x^2 out and attempted to solve $x^2(x^2 - 15) = 50$. Quite a few candidates who achieved $x^2 = 10$ forgot the +/– for the root leading to only a single solution. A very large number did not then go on to get values for y costing them 3 marks. Again if y values were stated without any working marks were lost as this was a non-calculator question.

Question 7

This question on differentiation and integration was accessible to the majority of candidates with many gaining full marks. Marks were generally lost due to the inability to work with negative and fractional indices.

Part (a):

Most candidates understood the nature of the problem, that is differentiate $f'(x)$ to find $f''(x)$ and then solve $f''(x) = 0$ to find the value for A. Nearly all who found $f''(x)$ correctly, calculated $A = -4$ and thus gained all 4 marks.

The most common errors in finding $f''(x)$ were:

- writing $\frac{2}{\sqrt{x}}$ as $2x^{-2}$ or $2x^{\frac{1}{2}}$
- writing $\frac{2}{\sqrt{x}}$ as $\frac{2}{x^{\frac{1}{2}}}$ then differentiating to get $\frac{2}{\frac{1}{2}x^{-\frac{1}{2}}}$
- including the +3 in their $f''(x)$

Part (b)

Again, most candidates understood what to do and integrated $f'(x)$ to find $f(x)$ before setting $f(12) = 8\sqrt{3}$ to find their value for c. .

Candidates who wrote successfully wrote $\frac{2}{\sqrt{x}}$ as $2x^{-\frac{1}{2}}$ and $\frac{A}{x^2}$ as Ax^{-2} were able to do the integration correctly and reach a correct form for f(x). Reasons for a loss of marks in part (b) were:

- not integrating correctly
- not including a constant of integration
- loss of sign on the + c

Part (b) was rarely laid out clearly. Most candidates were able to apply the reduction formula at least once. A number of students applied the formula twice but were unable to find I_1, not noticing this required them to integrate. A surprising number involved I_2 and/or I_4 in error.

The majority of candidates did not progress to the correct numerical answer – with numerical and sign errors in the repeated application of the reduction formula causing most problems.

Question 8

This question on radian measure, arc length and area of a sector proved to be very discriminating. It was another question where clarity of method was important and failure to write down what was being found cost many candidates marks.

Part (a)

This was a proof and generally well attempted.

The main error amongst candidates who understood the method was to truncate or round their value of the angle 0.4277. Both 0.427 and 0.428 were seen as well as 0.43 and even 0.4

Most candidates appeared to know the relationship between arc length and radius but some candidates tried to work backwards – eg 35.9 ÷ 84.

Part (b)

Most candidates got the correct answer with the main error being the use of 6 lots of 84 instead of 6 lots of (84 –9) in their calculation.

Part (c)

This was a really discriminating part. Candidates generally got either 1, 4 or 5 marks with very little in between. The mark scheme made it easy for candidates to get the first mark for finding **any** relevant area. Many candidates then struggled to write down a corresponding area which could have been combined with their first area to get the final answer. Stronger candidates however went on to get all 5 marks although some lost the last mark for omitting units even when they had the correct answer of “4730”.

Some common errors were:

- using the same angle for two different sized sectors
- using formulae for triangles rather than sectors
- failing to multiply a correct combination of areas by 3

The most successful method was that on the main mark scheme. Methods which began by finding the entire area of the larger circle were generally unsuccessful.

Question 9

This question on trigonometric graphs and their periodicity and symmetries also proved to be very discriminating. Only the very best and most able candidates were able to access all three parts.

Part (a)

Fully correct solutions to this part were rare. A common set of incorrect answers were $-2p$, p, and $3+p$. A significant proportion of candidates were successful with the first answer but failed to progress any further. Many candidates gave answers in terms of sine functions and few seemed to appreciate that $\sin(x) = \sin(180 - x)$.

Part (b)

This was the most attempted and successfully answered part to the question. Candidates should have drawn the same shaped curve with the same amplitude but double the frequency.
Marks were lost when candidates drew a curve:

- with double the amplitude
- with incorrect intersections of the given curve with the drawn curve
- only in the +ve x direction

Part (c)

The majority of candidates scored no marks in this part. Good candidates were able to use transformation geometry to find one solution but only the very best were able to progress further to find both solutions.

Question 10

This was another testing question requiring knowledge of gradients. Those who differentiated the equation of the curve often began part (b), but if unsuccessful in reaching the given equation in part (b), just abandoned the rest of the question, despite part (c) being relatively simple.

Part (a)

Most candidates were able to differentiate the expression for y successfully.
Where students were not successful, it was for failing to deal with the constant k; where, in many cases, this was still included in the derivative.

Part (b)

Students generally began part (b) well, by substituting the value of x at A into their derivative. Many then applied the negative reciprocal rule to find the perpendicular gradient, which would be the gradient of the line. Only a few students then appreciated that they had an expression for the gradient of the curve and using $\frac{6}{7}x^2 + \frac{2}{7}x - \frac{5}{2} = -\frac{1}{7}$ would lead them directly to the given result. Where candidates were unsuccessful, they attempted to use the value of the gradient of the line as the y coordinate and substituted this into the equation of the curve.

Part (c)

Candidates mostly used their calculators to solve the quadratic, and correctly found both solutions $\frac{3}{2}$ and $-\frac{11}{6}$. Candidates then needed to justify why the answer was $\frac{3}{2}$, a point missed by many. Stating that "as *B* was in the fourth quadrant" or "as *x* has to be positive", was acceptable.

Part (d)

The approach given as the main scheme was by far the most popular but there were many successful and varied approaches. In the main method, candidates used the intercept of –1 to immediately write down the equation of the line. They could then use this equation to find the *y* coordinate of either *A* or *B* which then could be substituted into the equation of the curve to find *k*.Where candidates were not successful it was in confusing properties of the line and the curve. Many thought, for example, that (0,-1) was a point on the curve.