Pearson Edexcel

# Examiners' Report

# Principal Examiner Feedback

January 2020

Pearson Edexcel International GCSE

In Mathematics Further Pure (4PM1)

Paper 2

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## January 2020 Pearson Edexcel International GCSE Further Pure (4PM1) Paper 02

### Introduction

These two papers were well balanced with candidates finding paper 1 only slightly more difficult than paper 2. In general, candidates would benefit from:

- Reading the question carefully for
- rounding instructions
- the instruction 'show that' - which tells the candidates they must be careful to include every step of their working
- the instruction to use algebraic methods - which rules out the use of a calculator
- looking carefully at angle ranges given in questions involving trigonometrical questions - questions set in radians are best solved using the calculator in radian mode
- Checking work carefully – impossible answers indicate there is an error.

Drawing sketches in questions involving coordinate geometry.

### Report on 4PM1 02

### Question 1

This was an easily accessible question for most candidates and many gained full marks. The differentiation required to find the velocity at time $t$ was well done and after equating their quadratic to 8 and rearranging, the resulting quadratic was usually correctly solved either by factorizing (most common) or by the formula, although marks were lost for rounding (to 1 dp) if the exact answer was not seen. A few candidates lost the final mark for failing to rule out the negative answer as $t \geqslant 0$ was required.

### Question 2

Most candidates gave a correct answer for part (a). The errors that were seen included the inequality the wrong way round and 1 in place of -1. In part (b) finding the critical values was generally successfully completed; converting these into a correct statement proved more problematic. $x < \frac{1}{4}$, $x < -\frac{3}{2}$ was not uncommon, as were two distinct statements about $x$ rather than a range of values. Part (c) was poorly answered, in a lot of cases as a result of errors in (a) and (b) but even those who achieved full marks up to this point couldn't select the correct critical values to use in the inequality or used an incorrect inequality sign.

### Question 3

Most candidates gained full marks for part (a) using Pythagoras correctly with a minus sign to get the length of $AM$. A few recognised the triangle as a multiple of the 3,4,5 triangle and full marks were allowed here with no working. In part (b) most candidates used the cosine rule (rather than the simpler method of using the right-angled triangle $MCD$ giving $\cos C = \frac{8}{26}$) and found the required angle C.

Unfortunately marks were lost by those who failed to round to the nearest degree.
Part (c) saw the usual problem of identifying the required angle when asked for the size of the angle between two planes. Many candidates found angle *ACD* rather than angle *DMA*. Finding angle *DMA* involved having to find the length of *AD* or *DM* which the majority of candidates did, even though some of them didn't use it, as they went on to find the wrong angle. Those who did find the correct angle mostly used the tangent of the angle with *AD/AM*.

Unfortunately a mark was lost by those who failed to round to the nearest degree in (b) and/or (c).

## Question 4

Most candidates gained 2 of the 3 marks in part (a) due to an incomplete conclusion. A common response was to find one of the required vectors and state 'therefore it is a parallelogram'. A lot of students felt it sufficient to show equality of the vectors and failed to extract information about side lengths / parallel lines.
In part (b) many achieved the B1 but did not recognise that they needed to find the modulus/magnitude of their answer. Commonly candidates set $-3-3p=3\sqrt{10}$ and attempted to solve for $p$. Because part (c) was a follow through, candidates who attempted $\overrightarrow{BD}$ often achieved this mark as long as they had found a value for $p$.

## Question 5

Many candidates gained full marks for part (a). The common mistakes were not giving the equation in the form required with integer coefficients or omitting the minus sign in front of the sum of the roots. It was also surprisingly common to see the answer without "= 0". It is not an equation without an equals sign!
In part (b) most candidates correctly found the product of the roots, but many had difficulty finding the sum of the roots, equating $\alpha^2+\beta^2$ to $(\alpha+\beta)^2$ in the numerator. Again, the minus sign in the required quadratic or the "= 0" for the equation were frequently omitted.

## Question 6

Most candidates gained both marks on part (a) of this question. Very few chose the simplest verification technique and a few of the candidates who used this technique failed to verify using both equations, so didn't gain marks. Those who used the method of solving simultaneous equations, tended to gain full marks.
Part (b) proved a challenge for a significant number of candidates to gain full marks. Of the available methods, the majority chose to integrate and subtract the volume of the cone, calculated using the formula. A few candidates mixed up the use of coordinates for $r$ and $h$ within the formula. For the alternative method of integrating a difference, errors were frequent as a large number of candidates tried to apply the technique as for area, rather than 'square then subtract' which is required for volumes of revolution. Generally the algebraic integration step was done well, with only a few candidates mixing up indices and coefficients. Candidates who reached the stage where limits were applied mostly selected the correct limits.

## Question 7

A few candidates struggled with part (a) of this question, maybe not being familiar enough with geometric series, but most candidates managed to find $r$ by dividing the 8th term by the 7th term and then working back term by term or by dividing the 7th term by $r^3$. Some candidates found the first term and then used $ar^3$ to find the 4th term

Some candidates struggled with part (b) as they were unable to eliminate *a* from their equation, but those who managed to get an equation in *r* (having eliminated $t_n$ and *a*) usually went on to gain full marks.
Most of the candidates who attempted part (c) were aware that *r* had to be between -1 and 1 for the series to converge and selected the correct value from their solutions to the equation in (b). The formula (which was given on the formula page) was almost always quoted correctly but occasionally there were slips in calculating the numerator $(24/(-1/2)^2)$ or the denominator (1-(-1/2)) ie dividing 24 by 4 or losing a minus sign in the denominator and getting 1/2.

## Question 8

Candidates either scored very high or very low on this question. Aside from a few sign errors candidates who recognised to use the product rule would usually gain the M marks. There were many candidates who did not realise to use the product rule however and so were unable to score on this question.

## Question 9

Many candidates were successful in attaining the first two marks in part (a); those who didn't failed to recognise that the intercept of line l being given as the normal to the curve meant they could substitute $x = 0$ into the equation. For the remaining marks, a significant number of candidates failed to realise that the gradient of the line had been given and that they had to differentiate the equation of the curve to find $q$. Some errors in the use of the quotient rule could have been prevented if candidates first quoted the formula before using it.
Only the best candidates scored full marks in part (b), as $q = 3$ from part (a) was required for one of the marks. Of the remaining candidates, those who had clearly stated a value for $q$ were able to score highly on this part of the question, by drawing and labelling asymptotes and points of intersection with the axes.
In part (c), many candidates were happy with the approach required, and those who had found or stated a value of $q$ gained the majority of the marks. Candidates with an incorrect value of $q = 0$ could only gain one mark, due to not obtaining a 2 or 3 term quadratic.

## Question 10

Many candidates scored high marks on this question, with the best responses clearly showing the chain rule triple product and the substitutions into this formula. Other valid approaches were to combine two derivatives, and therefore use two applications of the chain rule to find $\frac{\mathrm{d}A}{\mathrm{d}t}$. Some candidates used inappropriate or inconsistent variables to state the relevant derivatives. In particular, a common error was to state $\frac{\mathrm{d}V}{\mathrm{d}r} = 40$ instead of $\frac{\mathrm{d}V}{\mathrm{d}t} = 40$ Candidates should be encouraged to state full formulae, before differentiating, including both sides of the equals sign, rather than attempting to differentiate expressions.

## Question 11

In part (a), generally candidates were able to expand both sides, simplify and find a value for $k$ with few errors. Most commonly the 3 was omitted from the 2nd term on the RHS.
Many candidates made very little progress in part (b). Lots of 'made up' identities were used to try to achieve the required result. Often one step was successful with a following stage missed out (before a

triumphant statement of the given answer).
In part (c) (i) most candidates used a correct expansion and the exact values were known and applied appropriately. However part (ii) was less successful as very few candidates to recognised that $\tan 255° = \tan 75°$ or produced some useful statement that allowed them to produce the given answer by using some of the exact values requested.

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