Examiners' Report/ Principal Examiner Feedback

January 2012

International GCSE Further Pure Mathematics (4PM0)
Paper 02

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Publications Code UG030471

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Introduction

This paper was found to be very demanding with even good candidates struggling with several of the questions. However, there were enough straightforward questions to allow all candidates to show what they could do.

Candidates at this level are expected to know that obtaining an answer to a specified degree of accuracy requires working with more figures until the final rounding. In several questions many otherwise good candidates seemed unaware of this and so lost accuracy marks. Some candidates are still throwing away marks by failing to follow rounding instructions included in the questions.

Answers to some questions can be obtained from a calculator without showing any working. However, candidates need to be aware of the danger of not including evidence of their methods; a slight error will lead to an incorrect answer and without working this incorrect answer will score zero.

Report on individual questions

Question 1

Part (a) was a good start for the majority of candidates. Most candidates used the vector approach rather than the coordinate approach using the formulae for the point dividing a line in a given ratio. Drawing a diagram and using it is actually the easiest method; the answer can be written down straight away and the diagram counts as showing the working. Part (b) was, however, a totally different story. There were very few successful responses, of which most were by using the components of the vectors as coordinates and applying the "matrix" method for obtaining the area of a polygon. Most candidates either made no attempt or tried to use vectors in a variety of illegitimate ways.

Question 2

Again. part (a) provided a quick two marks for almost all candidates but most were unsuccessful in part (b). Some made no attempt at part (b) and the majority of the others calculated the size of the angle between a sloping edge (eg *VB*) and the base.

Question 3

This was one of the best questions on the paper in terms of candidate success. The majority scored 5/5 here although some lost marks through arithmetical slips or forgot to complete the question by finding the *y*-coordinates corresponding to their *x* values.

Question 4

Some candidates seemed to be unfamiliar with the formulae needed for this question; perhaps this is because this topic was not included in this specification's predecessor. Use of the corresponding formulae in their degree form was seen frequently, often using the size of the angle in radians. Changing the 1.2 radians to degrees before tackling the question is perfectly acceptable but candidates who adopt this approach are penalising themselves on time. In part (b) some found the length of the line *AB* instead of the length of the arc. Candidates should read questions carefully before rushing to a calculation.

Question 5

The binomial expansion was well known and applied in part (a) with only occasional errors when simplifying the terms. Part (b) differentiated between the best candidates and the rest. Only the most able could see the connection between $\frac{5}{8}, \frac{20}{32}$ and $\sqrt[5]{20}$ but the majority followed the instruction in the question and gained a mark by substituting $x = -\frac{1}{8}$ into their expansion. Some were then astute enough to double their answer and gained an extra mark but others simply wrote down the value given by their calculator and so did not gain that mark. Few candidates seemed to realise that a series of this type has limited values of x for which it is convergent and so part (c) was often not attempted. Answers such as "because it gives the wrong answer" were much more common than a comment about the range.

Question 6

This was by far the most difficult question of the paper and many candidates did not know where to start or tried to use connected rates of change in part (a). Some wrote down an incorrect formula for the volume of a cone, others managed to find the initial volume of the cone correctly but could not find the volume at t seconds in terms of h and link the two volumes by means of the rate of loss of the water from the container. In part (b) most who wrote anything managed to produce one of the several potentially useful chain rule statements but failed to make any significant progress. A very few candidates would have scored 12/12 had they not forgotten that $\frac{dV}{dt}$ was negative; fortunately this error only cost them the final A mark.

Question 7

Most candidates completed part (a) correctly using the gradients of the two lines, although some failed to obtain the product of these gradients and hence the required conclusion. In part (b) it was surprising how many candidates found the coordinates of the mid-point of *AC* in order to obtain the equation. Many overlooked the requirement for integer coefficients in their equation or made an arithmetic slip when moving from a correct equation with non-integer coefficients to the required form. In part (c) many appeared to not understand the term "produced" and placed the point *D* between *A* and *C* hence obtaining incorrect coordinates. The most common method seen in part (d) was the "matrix" method, for which 3 marks were available with follow through for those with incorrect coordinates for *D*.

Question 8

Part (a) should have been a piece of standard work, using the given identities but some candidates could not reproduce all the necessary steps. Most worked from left to right but some successfully worked from right to left. There was a tendency for candidates to not show the division by $\cos A \cos B$ clearly; when the required result is given in the question candidates must be extra careful about showing every step. Part (b) was an easy mark for most candidates to gain by writing $A = B = \theta$ in the result in part (a). Candidates who had not successfully completed part (a) were often more successful in part (c) although there were, as usual, cases where intermediate errors were compensated for later in the work in order reach the required result. In part (d) some candidates failed to show their derivation of the given equation. The hint that $(\tan\theta - 1)$ was a factor of this equation was overlooked by many in part (e) and this omission led to various erroneous methods for solving the equation. Candidates who earned the first M mark frequently then earned the second one but sometimes then lost the A marks through giving decimal answers or not simplifying their surd solution to the demanded form.

Question 9

A surprisingly large number of candidates did not know what to do in part (a). Even among those who knew that integration was required many forgot to include a constant. There are two stages to establishing a minimum point; the point has to be a turning point, so it must be shown that $\mathrm{f}'(x)$ or $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ and the sign of the second differential must be shown to be positive (or some other valid reason for the point being a minimum rather than a maximum must be used). Many candidates seemed to think that as they were given the *x*-coordinates of the minimum points in part (b) there was no need to check that $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ and simply looked at the sign of $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$. Candidates generally attempted part (c) well, using either evidence found in (b) or factorising $\mathrm{f}'(x)$ to establish that now they were interested in the point where $x = 1$ and checking the sign of $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$; many however obtained an incorrect *y*-coordinate as they had omitted the constant in part (a). In part (d), $x > 3$ was seen reasonably often but $-1 < x < 1$ was rare; candidates more frequently gave two separate, incorrect inequalities instead.

Question 10

Most candidates who attempted this question wrote down two correct equations in part (a) but some were then let down by poor algebra. A large minority ended up with $r = \frac{13}{3}$ or $\frac{3}{13}$ from incorrect division and cancelling. Those who could cope with the algebra usually obtained the correct quadratic and the correct solutions of this but many failed to extract the one value that fitted the convergence condition of the series. In part (b) many did use an appropriate value for r. However, some failed to use a value that gave a convergent series and gained no marks. Considerably less than half of the candidates progressed to part (c) and gave a different value of r for the new series (admittedly not a possible option for those whose algebra gave them only one possible value in part (a)). As part (d) was about comparing two different series, one convergent and the other not, this error had serious consequences. A small minority managed to obtain and solve the required inequality although only the most able realised that n had to be odd and so completed that work correctly.

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Order Code UG030471 January 2012

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