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Mathematics 6360

MFP2 Further Pure 2

Report on the Examination

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General

The paper proved to be accessible to the vast majority of candidates and there were some excellent responses. However, it appeared that a minority of candidates had not covered the specification as their solutions were patchy and incomplete. Presentation was largely good even if some methods were not always the most efficient.

Question 1

Apart from a few candidates who factorised the quadratic in $\sinh x$ incorrectly, most candidates worked part (a) correctly. However, many candidates spent more time on part (b) than was necessary. They expressed $\sinh x$ in exponential form and solved the ensuing quadratic equations rather than quote the formula for $\sinh^{-1} x$ given in the formulae booklet which they were entitled to do. This method also led to superfluous incorrect solutions which candidates needed to reject.

Question 2

A few candidates misplotted the centre of the circle, usually at (–4, 2). Apart from this most drew the circle correctly. Not all recognised the line as the perpendicular bisector of the line joining the origin to the point (3, 2) in part (b), but rather thought that this equation represented another circle. This in turn had an effect on the shading in part (c) although the interior of the circle was usually shaded. It should be said that the diagrams were neat and in the main well labelled and in proportion; a great improvement on sketches submitted in previous years.

Question 3

Although this question was attempted by almost every candidate, there were few whose solutions presented the rigour required. Most substituted $k\mathrm{i}$ for z in the cubic equation, equated real parts and subsequently wrote $z^2 = 16$ so $z = 4$, not realising that $z = -4$ was also a root of $z^2 = 16$ and that imaginary parts had to be equated in order to reject the solution $z = -4$. Part (b) was not particularly well answered either. The most common errors were errors of sign in the use of $\alpha + \beta + \gamma$ or $\alpha\beta\gamma$, and those candidates using the product of the roots made extra work for themselves as they obtained a rational expression for γ which needed to be simplified. Some candidates thought that γ equalled $-4\mathrm{i}$, the complex conjugate of α.

Question 4

Generally, candidates scored quite well on this question. Some candidates struggled with part (a)(i) by not realising that $\operatorname{sech} t$ was $\left(\cosh t\right)^{-1}$, instead expressing $\operatorname{sech} t$ in exponential form. This latter method rarely led to a correct solution. However, apart from some sign fudging in part (a)(ii), most candidates were able to recover to answer parts (a)(ii) and (b)(i) correctly. Very few candidates were able to score the three available marks in part (b)(ii), by either ignoring the limits of integration completely or by writing $s = \ln\cosh t + c$ with no effort to show that the value of c was zero. In spite of some inelegant methods, part (b)(iii) was usually answered correctly. Part(c) caused problems, often by candidates attempting to integrate $\mathrm{e}^{-s} \tanh t$ with respect to t by regarding e^{-s} either as a constant or else as e^{-t}. Of those who correctly integrated to arrive at $-\operatorname{sech} t$, again very few candidates recognised the need for limits and so were unable to arrive at the printed result.

Question 5

It was clear that a good number of candidates had not met the proof of de Moivre's Theorem by induction before and there were not many solutions gaining full marks. It was also not uncommon to see expressions such as

$$\cos k\theta + \mathrm{i}\sin k\theta + \cos\theta + \mathrm{i}\sin\theta = \cos\left(k+1\right)\theta + \mathrm{i}\sin\left(k+1\right)\theta.$$

Parts (b) and (c) were generally well done, although in part (c) a number of candidates, when multiplying $\mathrm{i}\sin\theta$ by $-\mathrm{i}\sin\theta$, wrote $-\mathrm{i}\sin^2\theta$ and thus were unable to complete this part satisfactorily. Those candidates who spotted the connection between parts (c) and (d) usually went on to write out a correct solution to part (d), but it was disappointing to see $\left(1+\cos\frac{\pi}{6}+\mathrm{i}\sin\frac{\pi}{6}\right)^6$ written as $1^6+\cos\frac{6\pi}{6}+\mathrm{i}\sin\frac{6\pi}{6}$ with alarming regularity.

Question 6

It was disappointing to find many candidates unsure of the cube roots of unity and even more unsure of how to obtain them. It was also disappointing to note that few candidates were able to establish the result $1+\omega+\omega^2=0$ in part (b), in spite of the variety of ways in which this result could be established. On the whole, parts (c)(i) and (c)(ii) were correctly done in spite of using roundabout methods to obtain the printed results. In part (c)(iii), however, most solutions ended at $\left(-\frac{1}{\omega}\right)^k+\left(-\omega\right)^k$, but of those candidates who attempted this part further, sign errors hindered completely correct solutions.

Question 7

This question was surprisingly well done and attracted many completely correct solutions. When errors occurred, it was usually in the summation of terms in part (b). Candidates summed 20 terms instead of 19 which in turn led to some faking in arriving at the printed answer, especially the –20. For instance it was not uncommon to see the summation written as $\dfrac{\tan\frac{21\pi}{50}-\tan\frac{\pi}{50}}{\tan\frac{\pi}{50}}-20$ followed by the correct answer.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the **Results statistics** page of the AQA Website.