General Certificate of Education

Mathematics 6360

MFP2 Further Pure 2

Report on the Examination

2009 examination - June series

Further copies of this Report are available to download from the AQA Website: www.aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX *Dr Michael Cresswell Director General.*

General
Once again this paper provided candidates with the opportunity to show what they had learnt of the specification, and it was pleasing to note that there were relatively few really poor scripts. There were many competent responses with good marks being earned on most questions. General presentation was good apart from the diagrams, which will be commented on later.

Question 1
This question proved to be slightly more demanding for candidates than had been anticipated.

The main difficulty in part (a) was that, having written down $2^4 e^{\frac{\pi i}{3}}$ (or frequently incorrectly $2e^{\frac{\pi i}{3}}$), candidates were unsure about how to proceed, and they either abandoned this part of the question at that point or then tried to manipulate $a\left(1+\sqrt{3}\,i\right)$ with little success.

In part (b), candidates were divided into two clear categories: those who had been clearly taught how to find roots of equations in the form $re^{i\theta}$ and those who were very muddled in their thinking. It generally hinged on candidates' ability to write θ as $\frac{\pi}{12}+\frac{k\pi}{2}$. Quite a number of otherwise correct solutions lost a mark through giving values of θ outside the specified range.

Question 2
Almost all candidates produced correct solutions to parts (a) and (b), apart from the odd arithmetical slip.

There was, however, less success with part (c). Few candidates worked with inequalities (although the use of the equals sign was condoned) and the lack of ability to solve an equation in n with decimals involved led to the solutions for n which common sense should have told candidates was impossible. It was not infrequent to see n as a decimal less than unity and, even when candidates, using equalities, arrived at 249.5, they left it as their final answer, not considering that n had to be integral.

Question 3
Responses to this question were good, and the vast majority of candidates produced a completely correct solution. If errors did occur they were usually arithmetic, although occasionally p and q were given as $\sum\alpha$ and $\alpha\beta\gamma$ respectively with no consideration being given to their sign.

Question 4
Sketches were poor in part (a). Sometimes asymptotes were not drawn and even when they were sketches crossed or mingled with their asymptotes. It was not uncommon to see $\frac{\pi}{2}$ or π on candidates' diagrams showing some confusion with the graph of $y=\tan x$.

In part (b), provided that candidates knew what to do when they reached $u=\frac{e^{2x}-1}{e^{2x}+1}$, they almost always went on to complete this part correctly, but a substantial number of solutions petered out at this point.

Part (c) was well done apart from the rejection of $\tanh x=2$ where lack of adequate reasoning for its rejection was often apparent.

Question 5

The general rules applicable to proof by induction in part (a) were usually understood, but because candidates realised that the product of $\cos\theta + \mathrm{i}\sin\theta$ with $\cos k\theta + \mathrm{i}\sin k\theta$ had to result in $\cos(k+1)\theta + \mathrm{i}\sin(k+1)\theta$, many lost marks through omitting some of the intermediate steps.

In part (b), many candidates lost a mark by assuming that $(\cos\theta + \mathrm{i}\sin\theta)^{-n}$ was equal to $\cos n\theta - \mathrm{i}\sin n\theta$ without any justification.

Part (c) was almost invariably correctly done.

Question 6

The coordinates of the centre of the circle in part (a) were usually obtained, but the notation was often poor and it was not uncommon to see the centre of the circle C_1 written as $(-1, -\mathrm{i})$ and, on the diagram, the scale on the y-axis written as i, 2i, 3i and so on. Also, radius and diameter were commonly confused.

Sketches in part (b) varied considerably, the best being those who used compasses for their circles. These were generally readable with centre and radius indicated. However, some candidates chose to draw their circles by plotting points and joining up by freehand. These sketches turned out to be very poor. The circle C_2 was sometimes mistakenly drawn in the incorrect quadrant through choice of centre as $(-5, 4)$ whilst others either failed to realise that the circle C_2 touched the x-axis or drew a circle touching both axes.

In part (c), although many candidates placed z_1 and z_2 on their diagram in the approximately correct positions, not all realised that these points were at the intersections of C_1 and C_2 and the line $O_1 O_2$, and even when they did, the finding of the length $O_1 O_2$ proved to be beyond many.

Question 7

Responses to part (a)(i) of this question were reasonable, although candidates starting with $s = \int \sqrt{1 + \left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)^2}\,\mathrm{d}x$ tended to flounder. Part (a)(ii) was very poorly attempted with the majority of candidates failing to realise that the way forward was to separate the variables in order to integrate. It was very common to see attempts at $\int \sqrt{4+s^2}\,\mathrm{d}x$ treated as if it were $\int \sqrt{4+s^2}\,\mathrm{d}s$. Of the few that did manage to separate the variables, virtually no one considered the boundary conditions but merely assumed that the constant of integration was zero. Candidates were more successful with part (a)(iii) and, although the constant of integration was omitted in many cases, more candidates considered the boundary conditions than in part (a)(ii).

Those candidates who managed part (a)(iii) usually went on to work part (b) correctly.

Mark Ranges and Award of Grades

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