General Certificate of Education

Mathematics 6360

MFP3 Further Pure 3

Report on the Examination

2010 examination – June series

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General

The new form of Question Paper/Answer Booklet was used to good effect, with candidates' work being better organised than on some previous occasions. There were many excellent scripts seen and a very large proportion of candidates seemed to be thoroughly prepared for this examination. Almost all candidates appeared to have sufficient time to attempt all seven questions. Questions 1, 2, 4 and 5 were the best answered questions on the paper. Teachers may wish to emphasise the following points to their students in preparation for future examinations in this unit:

- Writing down a formula in a general form before substituting relevant values may lead to the award of method marks even if an error is made in the substitution.
- An integral, with ∞ as a limit, is improper because the interval of integration is infinite.
- To investigate an improper integral which has an infinite upper limit, the upper limit should first be replaced by 'a' for example, the resulting integral evaluated and then the limit as $a \to \infty$ investigated, ensuring that before the limit is taken all necessary manipulation is carried out. The limit as $a \to \infty$ of $a\mathrm{e}^{-ka}$ should be given special attention.

Question 1

This was the best answered question on the paper. Numerical solutions of first order differential equations continue to be a good source of marks for all candidates. The most common loss of marks was due to calculators being set in degree mode. It is worth recording that slightly more candidates than in recent series have slipped back into not showing the necessary working. Without such working, wrong answers cannot be awarded credit.

Question 2

This was another very good source of marks for candidates, with many fully correct solutions presented. In part (a) some candidates decided to ignore the given form of the particular integral and worked with $p\cos 2x + q\sin 2x$. Such an approach was not penalised by examiners provided the candidate showed that both $p = 0$ and $q = -\frac{1}{3}$. The vast majority of candidates showed that they knew the methods to solve the second order differential equation but errors in forming and solving the auxiliary equation were sources of loss of marks. Real solutions from the auxiliary equation were more heavily penalised than other errors.

Question 3

Improper integrals and limiting processes continue to cause problems for a significant minority of candidates. Part (a) was generally not answered well with too many candidates making a statement which they then contradicted in part (c). As highlighted in the MFP3 examiners' reports for January 2008 and January 2010, an integral, with ∞ as a limit, is improper because the interval of integration is infinite.

Most candidates correctly applied integration by parts to score the three marks available in part (b).

In part (c) examiners expected to see the infinite upper limit replaced by, for example, a, the integration carried out and then consideration of the limiting process as $a \to \infty$.

It was not uncommon to see in solutions the statement 'as $a \to \infty$, $e^{-4a} \to 0$ so $e^{-4a}(-a - 1/4) \to 0$' without seemingly any particular analysis of $\lim_{a \to \infty} a\,e^{-4a}$. This lack of analysis was penalised.

Question 4

Approximately half the candidates scored full marks for this question. Almost all candidates were able to show that they knew how to find and use an integrating factor to solve a first order differential equation. However, a significant minority did not recognise the form of the integral of $\int x^3 (x^4 + 3)^{\frac{3}{2}}\,dx$ as $k\left(x^4 + 3\right)^{\frac{5}{2}}$ or did not apply a suitable substitution, so made very little further progress.

Question 5

Candidates' differentiation skills have improved significantly over recent series. Almost all candidates could correctly quote the series expansion for $\cos 4x$ although some failed to give their answer in its simplest form. The methods required to obtain the three derivatives were well understood and, although some algebraic errors were seen, there were many correct expressions presented.

Most candidates displayed good knowledge of Maclaurin's theorem but only those who had made no errors in earlier differentiations could score both marks for showing the printed result in part (b)(ii). There was a pleasing improvement in explicitly reaching the stage of a constant term in both the numerator and denominator before taking the limit as $x \to 0$ in the final part of the question.

Question 6

This question on polar coordinates proved to be the most demanding question on the paper. In part (a), the better candidates had no problems in finding the cartesian equation for C_1 and rearranging it by completing the squares so as to be able to deduce that the curve was a circle. Many other candidates failed to eliminate θ even after a page or more of working and abandoned part (a) of the question.

Many candidates scored heavily on the more familiar part (b)(i), finding the area bounded by the second curve C_2.

Proving that the two curves did not intersect in part (b)(ii) was a challenge, even for the better candidates, and it was rare to award all four marks for this part of the question. However, some excellent solutions were seen which used a variety of methods including forming and solving quadratic equations in either $\sin x$, $\cos x$, $\tan x$, $\sec x$, use of calculus and use of the R, α form.

In the final part of the question, those who used part (a)(ii) to find the area enclosed by C_1 and used it with their answer to part (b)(i) had no problems scoring both marks. Those who tried to use integration to find the area enclosed by C_1 did not analyse the problem fully and failed to score. A common misinterpretation of the word 'intersect' is indicated by the not uncommon answer 'Since C_1 and C_2 do not intersect the required area is just 16.5π, the area bounded by C_2.'

Question 7

Candidates generally answered part (a)(i) correctly but showing the printed result involving the second derivatives in part (a)(ii) proved to be more difficult, although candidates' attempts displayed a significant improvement over candidates' performances on previous papers.

Although most candidates realised what was required to answer part (b), careless work resulted in many less than convincing solutions.

In the final part of the question, the majority of candidates started out correctly to solve the differential equation for y in terms of t with many obtaining the correct form of the complementary function (although some used x instead of t), but finding the correct particular integral proved to be more problematic. A very common careless error resulted in candidates solving the equation '$-4p + 3pt + q = 3t$' instead of the correct equation '$-4p + 3pt + 3q = 3t$'. However, correct answers were quite frequently seen and it was particularly pleasing to see a higher proportion of candidates correctly converting back from t to x.

Mark Ranges and Award of Grades

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