A-LEVEL
MATHEMATICS

MFP3 – Further Pure 3
Report on the Examination

6360
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General

Presentation of work was generally good and most candidates completed their solution to a question at the first attempt. Candidates appeared to be well prepared for the examination and they were able to tackle all that they could do without there being any apparent evidence of shortage of time.

Teachers may wish to emphasise the following point to their students in preparation for future examinations in this unit:

- To show an exact result, for example, $OB = \frac{1}{4}\left(\sqrt{13}+1\right)$, it is not acceptable to work with decimal approximations.

Question 1

This question on numerical methods for the solution of differential equations of the form $\frac{\mathrm{d}y}{\mathrm{d}x} = \mathrm{f}(x, y)$ proved to be a very good source of marks for most candidates. The vast majority of candidates obtained the correct answers for both parts. There were very few errors seen in part (a) but in part (b) some candidates used $x_r = 2.1$ instead of $x_r = 2.05$. Also more candidates than last year failed to give their final answer to the required degree of accuracy stated in the question and as a result lost the final accuracy mark.

Question 2

This question which tested the use of an integrating factor to find the solution of a first order differential equation subject to given boundary conditions was generally answered very well with most candidates scoring at least five of the nine marks with a high proportion scoring all nine. There was a significant improvement compared with last year on candidates' ability to integrate an expression of the form $\tan^n x \sec^2 x$, with a variety of correct methods seen and applied correctly. Those candidates who multiplied both sides by $\cos x$ before substituting in the boundary conditions were generally more prone to making errors in finding the value for the constant of integration.

Question 3

This question tested series expansions and limits. The vast majority of candidates scored the mark for the correct $\ln(1+2x)$ series and then took the 'Hence' route by applying a law of logarithms to obtain the first two non-zero terms in the relevant expansion. A significant number of candidates made no attempt to state the range of values of x for which the expansion is valid and those that did, frequently gave a range which included either 0.5 or -0.5. The majority of candidates understood what was required to find the value of the limit in part (b) but weaker candidates did not attempt to find and use the series expansion for $\sqrt{9+x}$.

Question 4

Explanations for why the integral was improper were better than in recent series.
In part (b) the majority of candidates applied integration by parts correctly although sign errors were not rare. For full credit, examiners wanted to see $\lim_{a \to \infty} \left(a\,\mathrm{e}^{-2a}\right) = 0$ or an equally explicit form although absence of this particular form did not rule out the award of the final accuracy mark. Surprisingly, a small minority of candidates changed the lower limit from 2 to 0 towards the end of their solutions.

Question 5

In part **(a)** a large majority of candidates obtained the correct answer. Method errors were rare but surprisingly some candidates started with $a\sin 3x + b\cos 3x$ as a correct general form of the particular integral, found $a = 0$ and $b = -2$ correctly but then stated and used $-2\sin 3x$ as the particular integral. In part (b)(i) many candidates produced much more work than is normally required for just one mark. The examiners expected candidates to recognise that since $y = \mathrm{f}(x)$ was the solution of the differential equation then $\mathrm{f}''(x) + 6\mathrm{f}'(x) + 9\mathrm{f}(x) = 36\sin 3x$ (*). Putting $x = 0$ and applying the given boundary conditions then led to the printed answer. Candidates who applied this approach and subsequently differentiated (*) twice to find $\mathrm{f}'''(0)$ and $\mathrm{f}^{(\mathrm{iv})}(0)$ were much more successful in part (b)(ii) than those who used their answer to part (a) but frequently failed to include sufficient terms in the series expansion for e^{-3x}.

Question 6

There continued to be a significant improvement in candidates' ability to use a given substitution to transform one differential equation into another. A higher proportion of candidates showed that they could apply a correct method to transform the second derivative although the usual errors were still present in reaching the printed answer, some of which were due to unclear writing of the letters x and t which led to miscopies. In part (b), most candidates showed that they understood the general method with most scoring at least six of the ten marks. The most common errors resulted from lack of brackets, incorrect signs and missing correctly found terms when comparing coefficients, particularly when collecting the constant terms. Surprisingly some candidates having scored the first nine marks did not attempt to find the solution in terms of x.

Question 7

Most candidates applied the correct method to find the area of the required region bounded by the curve whose polar equation was given. The most common error was a wrong sign in the expression for $\cos^2 2\theta$ in terms of $\cos 4\theta$. In part (b)(i) many candidates obtained and solved the correct quadratic equation in $\sin\theta$ and most of these then went on to state the correct polar coordinates of *A*. However, a significant number of candidates lost one of the four marks because they gave no justification as to why $\theta = \frac{\pi}{6}$ was chosen and not $\theta = -\frac{\pi}{2}$. Part (b)(ii) was the most demanding part question on the paper. A majority of candidates failed to make any progress. A significant minority though gained some credit, normally by finding the polar equation for the horizontal line *AB* and solving with the polar equation for the curve C_1, eliminating r to reach the cubic equation $8\sin^3\theta - 8\sin\theta + 3 = 0$. At this point a high proportion of these candidates resorted to the use of the calculator which resulted in no further credit as a non-exact value for $\sin\theta$ could not lead to an exact value for the length of *OB*. The most able candidates recognised that point *A* lies on both the line *AB* and the curve C_1, so $(2\sin\theta - 1)$ was a factor of the cubic and normally such candidates went on to obtain the printed answer. It was pleasing to see so many candidates at least attempting part (b)(iii) by using the printed answer from (b)(ii). The main errors in this final part normally were associated with wrong angles. Sensible diagrams were seen but far too many candidates indicated obtuse angles on their diagrams as having a size of less than 1 radian. This often came from not considering the ambiguous case in applying the sine rule.

Mark Ranges and Award of Grades

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

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator