Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

October 2020

Pearson Edexcel GCE Advanced Level
in Further Mathematics
Paper 2: Core Pure Mathematics 2 (9FM0/02)

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Question 1

Two different routes were chosen by candidates in solving this problem.
The more successful of these was to work with hyperbolic functions. Differentiation was usually correct and most spotted the necessary substitution in order to obtain a quadratic equation in cosh *x*. This was straightforward to solve but many candidates, probably after looking at the formula book, only found one solution for *x – that being* $\ln\left(4+\sqrt{15}\right)$

The alternative approach involving converting to exponential form was less successful. Quite a few candidates had hoped for an easier passage than to encounter a quartic equation and so became lost on the way. A large number did however arrive at the correct equation and were able to use their calculators to obtain the solutions. The main advantage of this approach was that if they completed it they would arrive at both of the possible values.

Question 2

Part (a) many candidates scored fully mark but there was a large proportion who found the length of the diameter and used this as the radius. A few candidates where unable to find the correct centre or did not give the answer in the form required.
Part (b) very few candidates scored full marks on this part. After writing down the Cartesian equations of each circle many stopped there. Those that did subtract to find the equation of the line of intersection many then did not know what to do next. Candidates who did precede to then eliminate either *x* and *y* from a circle equation went of to find the coordinates required.

Question 3

(a) Almost all of the candidates solved the auxiliary equation successfully and most of those wrote down the correct Complementary Function.
Only a minority forgot the need to find a Particular Integral. Of those who did find the PI most had a correct value of 2.
When writing down the general solution only a handful did not have the correct variables $x = \mathrm{f}(t)$

(b) Most candidates used $x = 0$ and $\frac{\mathrm{d}x}{\mathrm{d}t} = 10$ when $t = 0$ correctly having used the product rule when differentiating. A majority found the constants, correctly, to be – 2 and 47 however there were a few careless errors in the calculation of the second of these. A common error seen was to use $\frac{\mathrm{d}x}{\mathrm{d}t} = 0$ to find the value of the second constant.
Candidates who found constant most went on to find a value for *t* when $\frac{\mathrm{d}x}{\mathrm{d}t} = 0$ but many careless errors meant that the correct value was obtained by less than half of candidates. A correct value of *t* often lead to a correct maximum value although a few did fail to add in their PI when evaluating.
(c) Most were on solid ground here and were able to correctly substitute t =10 and draw the correct conclusion, however, as with the end of part b, a minority carelessly forgot to add in the PI when finding *x*

Question 4
Part (a) this part was done well by the majority of candidate with many scoring full marks. Some candidates did not score the final mark as they went from $7\left(1-\sin^2\theta\right)^3\sin\theta-35\left(1-\sin^2\theta\right)^2\sin^3\theta+21\left(1-\sin^2\theta\right)\sin^5\theta-\sin^7\theta$ to the printed answer, not showing the expansion of the brackets, which was required.
Part (b) the majority of candidate attempted to use the answer to Part (a) many successfully. They find at least one value for q with many progressing to find values for $x = \sin q$ but a few stopped at values for q. Candidates who reached values for x often achieved the correct 4 values.
A few incorrectly used $\sin 7q = 0$.

Question 5
(a) A small minority had absolutely no idea of what to do. Most did, however, know that the differential of tan x is $\sec^2 x$ and a majority knew the relationship between $\tan^2 x$ and $\sec^2 x$ – there were a few who had to divert via sine and cosine in order to establish the result.
(b) Fewer than half of the candidates were able to correctly differentiate $\tan^{-1} 4x$ which lead to a loss of accuracy throughout. The majority did make a reasonable attempt at integrating by parts. The resultant integral caused problems and only a small minority were able to adopt a sound strategy which, only occasionally, lead to the correct final expression.
A few candidates did replace $4x$ with tan u at the start of this process but, again, success was limited.
(c) Clearly most knew what they needed to do but were thwarted by failure to complete part b. There were a few fully correct solutions but not many sometimes due to careless slips in tidying up their expressions for the mean value.

Question 6
Part (a) Virtually all candidates knew how to find the inverse of a 3 by 3 matrix and scored full marks. Slips in signs was generally the only error seen.
Part (b) This part was answer well with many using their inverse matrix found in part (a) to find the point of intersection. A few candidates attempted to solve the three simultaneous equations where algebraic error often occurred.
Part (c) The part was only done successfully by a handful of candidates. Many candidates did not attempt this part.
(i) a few eliminated a variable to fid two equations and formed an equation for q. An alternative method was to find a point of intersection by letting for example $x = 1$ and then using this to find a value for q
(ii) Very few attempted this part. Correct answers were rarely seen using let $x = l$ and finding y an z in terms of l and went on to find a correct vector equation of the line.

Question 7
(a) Most candidates wrote down the correct equations and were able to successfully evaluate a and b
(b) Only a handful of candidates were able to complete this question successfully. There were quite a few who made no attempt, possibly because they ran out of time.

For C_1 most candidates obtained the correct integral and most, but not all, used the correct limits. The actual integration was ok for many but, disappointingly, quite a few did not recognise how simple the integration was.
For C_2 quite a few candidates tried to find some fraction of the volume of a sphere, which went nowhere. The other common errors were to find the wrong radius or even the wrong limits for their integration. There were quite a few correct integrals here but then, too often, careless errors were made in substituting the limits.
The volume of the base cylinder was often found correctly.
Many candidates did not attempt to add their values together at the end which could be due to running out of time.
A few candidates need to note that they will not gain the marks for evaluating an integral on their calculator – they must demonstrate the ability to integrate as required in the question by the phrase ‘use calculus’