Examiners' Report/
Principal Examiner Feedback

Summer 2013

GCE Core Mathematics C3 (6665)
Paper 01

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2013
Publications Code UA035669

Core Mathematics C3 (6665)

Introduction

The 6665 (C3) question paper this summer was found to be more challenging than previous C3 question papers. As a result, the final grade boundaries were set taking into account the relative difficulty of this paper. An analysis of the question paper's performance and of individual candidates' performance was then completed to review if any further action was necessary. The results from this analysis indicated that no further action was required.

General points that should be noted are:

- Graphs should be clearly labelled and all aspects of the shape should be considered (eg asymptotes)
- All formulae used should be quoted before being applied. This has been mentioned many times before.
- Bracketing / algebraic manipulation needs to be clear.
- When a proof is asked for, all stages need to be shown.

There was no evidence that candidates had insufficient time to finish this examination.

Report on individual questions

Question 1

For the vast majority of candidates, the requirements were clear and they usually had the necessary understanding to attempt a correct method. As a result, a large number of candidates were able to find correct values for a, b and c and earn 3 out of the 4 marks available.

Long division was the more popular method and usually resulted in at least 3 marks being gained. Some candidates failed to keep their working to the 'correct columns' or became confused by the gaps which appeared due to the missing terms in the polynomials. This led to several errors and in some cases new terms appearing from nowhere.

Occasionally a long division attempt was seen using $x - 2$ followed by $x + 2$ or vice versa and such attempts usually lost their way soon after the first division was completed.

Those candidates who made a full attempt by the method of comparing coefficients were very often successful although the value of d was sometimes overlooked after finding e and ended up as 0.

Overall, this question proved to be quite accessible and rewarded candidates who took the time and care to set out their work carefully.

Question 2

The large majority of candidates did part (i) well. It was evident however that some candidates had no knowledge of the shapes of standard functions, with some candidates drawing $y = e^x$ whilst others attempted versions of $y = \frac{1}{x}$ or $y = \frac{1}{x^2}$.

Those who drew the graph in part (i) correctly could usually gain some marks in part (ii). Most candidates marked where their curve met the x-axis and they knew that the graph should not be below the x-axis. Candidates could not be rewarded when the curve to the left of the cusp was drawn with the incorrect curvature. Many also failed to state the equation of an asymptote, even using an inequality sign to describe it.

In part (iii) most candidates drew the correct shape but its position was incorrect for some. It was common to see a translation to the left of the original curve instead of to the right. Some candidates reflected the original curve in a vertical line as well as in a horizontal line. Nevertheless, an asymptote was drawn on most of these graphs and an equation given.

Too many candidates took the notion of sketch too lightly and did not focus on the key features of their graphs. Overall it would be recommended that candidates learn the shapes of standard graphs and to be more careful when they draw them. They should include key details such as any x and y intercepts and any asymptotes with their equations.

Question 3

In part (a) most candidates were able to expand the expressions correctly, so achieving the first mark. It was disappointing to see a few candidates writing $\cos [x + 50] = \cos x + \cos 50$ and thus making no further progress. However, many went on to attempt to divide by $\cos x$ and achieve either an equation or an expression in $\tan x$. Cancelling techniques must be improved. Some tried to divide by cos 50 and failed with this approach as well. The most successful method was to collect $\sin x$ and $\cos x$ on opposite sides, factorise and finally divide.

The first three marks were as much as the majority of candidates could obtain as very few recognised the connection between cos 50° and sin 40°, cos 40° and sin 50°. Those who were aware of the connection were almost always able to achieve the given identity.

Part (b) proved to be much more accessible with most candidates making a really good attempt at it and often achieving all four solutions. Even those who could not cope with part (a) made a good attempt at part (b), with the link with part (a) being made.

Of those who were less successful, some candidates wrote $\tan x = \frac{1}{3} \tan 40$ and others wrote $\tan x = \frac{1}{3} \tan 80$. A small, but not insignificant, number of candidates simply wrote down four answers without any working due to the use of a calculator.

Question 4

Part (a) involved differentiation using the product rule, setting $\frac{dy}{dx} = 0$ and finding the coordinates of the turning points. On the whole this method is well known although it is still disappointing to note that only a minority of candidates actually stated the product rule. Errors seen frequently included seeing the differential of e^{2x} as $2xe^{2x}$ or just e^{2x}. Most candidates then equated $f'(x)$ to 0 and successfully gained one x value (by cancelling) but many failed to gain both x values (by factorisation). Weaker attempts involved attempts to solve the equation by applying logarithms. Some candidates lost the final mark by either not giving an exact solution, or forgetting to find the y-coordinates.

Part (b) was a good exercise in algebraic manipulation of the exponential function which many candidates completed correctly. For some, though, it did cause a few difficulties. The main fault came in dealing with the e^{2x} term. A minority of candidates used the difference of two squares and as a result automatically picked up the +/– signs in the given identity.

Part (c) was very well answered overall, with answers given correct to 3 decimal places being the norm. The key mistake here was a rounding error where candidates used a rounded answer for x_1 to calculate x_2 resulting in an answer of 0.493 instead of 0.492.
Part (d) was not answered as well. Fortunately there were only two marks in this part and the first could be gained for simply stating $\alpha = 0.49$ as their accurate estimate of α. This was usually given. For the justification mark, candidates had to do the necessary extra calculation and make a conclusion. Many confident candidates calculated the value of the function on either side of the root, commented on the change of sign and often remarked on the fact that the function is continuous to arrive at their conclusion. Other candidates often struggled and attempted to use the convergence of the function. Too many candidates stated that the values were 0.49 to 2 decimal places but did not show any evidence to this fact. Those who took the repeated iteration method often did not relate their answers back to 0.49 or just gave 0.49 without any explanation.

Question 5

Though part (a) would appear to be a straightforward use of the chain rule or even differentiation using the product rule, it proved challenging for the majority of candidates with many not seeming to understand that $\sec^2(3y)$ is an alternative way of writing $(\sec 3y)^2$. The derivative of $\sec x$ is also given in the formula booklet. Incorrect answers of the form $(6)\sec^2(3y)\tan^2 3y$ were common. Some candidates resorted to changing $\sec^2(3y)$ to $\dfrac{1}{\cos^2(3y)}$, using the quotient rule to gain an answer.

Most candidates gained the first mark in (b) for inverting their $\dfrac{dx}{dy}$ and it was pleasing to note that very few changed to x at this stage as has happened on past occasions. A good many were then able to achieve the answer, as it was given. Those who had part (a) correct were generally successful with (b) .

Part (c) was perhaps the most challenging aspect of the whole paper. Less able candidates found it difficult to tackle an expression of this complexity, so that some just differentiated both parts at the same time or assumed that the second derivative could be inverted as had been the case with the first derivative. The majority tried to use the product rule but those candidates who did realise they had to write the x to the power of -1 often did not deal with the 6 correctly and wrote $6(x)^{-1}(x-1)^{-0.5}$.

The other main approach was to use the quotient rule with embedded product rule. However, although they had $u' = 0$ many did not use brackets round the uv' term resulting in a sign error. Unfortunately, a significant number of candidates (again) did not quote the relevant rules thus decreasing their chances of scoring the first method mark. Only the more able candidates were able to simplify their result to the required expression as a single fraction with a linear numerator.

Question 6

Although many candidates scored full marks on this question, there were many whose lack of knowledge of the laws of logs let them down. It was also surprising the number of candidates who could do one part fully correctly but could not use any correct log laws for the other part.

In part (a) many candidates managed to use the addition law on the left hand side of the equation and/or use the power rule for logs on the right hand side. However, many did not reach the correct answer due to sign errors when collecting like terms resulting in an incorrect quadratic equation, e.g. getting $-28x$ or $+37$. Those candidates who arrived at the correct quadratic equation generally gained full marks in part (a). In some cases all the terms were taken to the left hand side before removing logs and some candidates who adopted this approach demonstrated their ability to work with logarithms and eventually arrived at the correct solution. However, getting $\ln \frac{(4-2x)(9-3x)}{(x+1)^2} = 0$ but failing to make the RHS = 1 when removing the ln was quite common.

Some candidates correctly reached $\ln (36 - 30x + 6x^2) = \ln (x^2 + 2x + 1)$ but the failed to 'undo' the ln terms. Disappointing errors for some C3 candidates included writing expressions such as $\ln(4 - 2x) = \ln\left(\frac{4}{2x}\right)$ or writing the LHS = $\ln 4 - \ln 2x + \ln 9 - \ln 3x$.

Part (b) was not answered as well as part (a) but there were many eloquent and concise solutions. Errors often resulted from either not using the addition law correctly and writing $\ln 2^x (3x + 1) = \ln 10$ or moving the 2^x to the RHS and combined it incorrectly with the 10 to get, e.g. 5^x or 20^{-x}.

Question 7

There was a wide variation in the quality of answers to this question and in the techniques employed by the candidates. The question required a good understanding of functions. Many candidates struggled with the fact that the question did not provide equations – just a graph.

Many candidates answered part (a) correctly. Common incorrect answers were $f(x) > 0$ or $f(x) \geq 0$, omitting equality at one or both ends, using x instead of $f(x)$, f or y, and having 2 as the lower limit.

Many candidates answered part (b) by working out the equations of the lines. Those who did were then able to score well on part (d). Other successful methods seen involved using similar triangles. Many achieved $f(0) = 5$ from the graph but then struggled with finding $f(5)$. Common errors seen were $f(5) = 7.5$, $ff(0) = 5$ and using $f(x) = 2$.

Part (c) was the best answered part of the question with the majority of the candidates achieving full marks. Swapping x and y at the start or end of the rearrangement were both equally common. Sign errors and erroneous algebra were occasionally encouraged. A few candidates, as in previous sessions, either differentiated or found the reciprocal.

Part (d) was the least successfully attempted part of the question. Some candidates did not realise that $f(x)$ was $g^{-1}(gf(x))$ and hence scored no credit in this part. Frequently $x = 4$ was seen instead of $f(x) = 4$. Of those candidates who used the method where they found $f(x) = 4$ and then found x many just achieved x = 6 and missed $x = 0.4$, although some even achieved $x = 0.4$ and missed $x = 6$.

Those candidates who chose to substitute a linear expression for the lines into the equation for $g(x)$ were more common and more successful.

Question 8

Most candidates attempted at least some parts of this question. Overall parts (a) and (d) were answered well. There was little evidence that the model confused candidates, although part (c) was rarely attempted. It was extremely rare to see no attempt at this question, indicating that time was adequate for the paper to be completed.

The majority of candidates gained the full 3 marks in part (a). Some candidates used tan $\alpha = \frac{7}{24}$ and achieved $\alpha = 16.26$ while a few only gave α to one decimal place, thus not gaining the accuracy mark. Nearly all candidates found the correct value of R, although a few omitted it at this stage and found it later on in the question.

In part (b), most candidates found an answer for V using $\dfrac{21}{R\cos(\theta-\alpha)}$; however it was often $-\frac{21}{25}$. Many then realised that they should have a positive answer and just dropped the minus sign "because speed cannot be negative". Some candidates thought the answer was 25 or –25, the value of R found in part (a). Very few candidates attempted a calculus method and they were usually unsuccessful. Given that this part of the question was only worth 2 marks it should have indicated that very little working was necessary here.

A high proportion of candidates left part (c) blank or produced working that gained no marks at all. Many did not use the right angled triangle needed to find AB easily using $\sin\theta = \dfrac{7}{AB}$ or that $\theta = \alpha$ for the minimum value of V. A rare method used involved equating the time for both John and Kate. This involved Pythagoras and some equations which proved too difficult for most candidates to solve.

Part (d) was generally well answered with most candidates gaining 3 or more marks. Once the substitutions had been made, most candidates saw the link with part (a) and recognised it as solving a standard $R\cos(\theta - \alpha)$ equation, getting ... = 0.5, then obtaining at least one of the correct values of θ, from ... = 60°. A common error was to fail to identify –60 as the second value for $(\theta - \alpha)$ which meant that they were unable to find a second value for θ in the correct range.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwant to/Pages/grade-boundaries.aspx

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Rewarding Learning

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE