edexcel

# Examiners' Report/
# Principal Examiner Feedback

## June 2011

## GCE Core Mathematics C4 (6666) Paper 1

Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel's centres receive the support they need to help them deliver their education and training programmes to learners.

For further information, please call our GCE line on 0844 576 0025, or visit our website at www.edexcel.com.

If you have any subject specific questions about the content of this Examiners' Report that require the help of a subject specialist, you may find our **Ask The Expert** email service helpful.

Ask The Expert can be accessed online at the following link:
http://www.edexcel.com/Aboutus/contact-us/

June 2011
Publications Code UA027662

# Core Mathematics Unit C4
# Specification 6666

**Introduction**

This paper was accessible to nearly all candidates and the great majority were able to attempt all questions. The general standard of work seen was similar to that seen in recent years. The techniques of the calculus were well understood and, in general, the standard of presentation was satisfactory. The standard of algebra does give some cause for concern and, as is noted in the reports on individual questions, the solutions of questions 2 and question 7 were often spoilt by errors in elementary algebra and, throughout the paper, many marks were lost through the misuse or, more commonly, the omission of brackets.

Most candidates use calculators appropriately. Problems do arise, however, when candidates give exact answers to questions, presumably derived from calculators with functions giving such answers, without any supporting working. The rubric on the front of the paper advises candidates that they "should show sufficient working to make your methods clear to the examiner".

Sometimes candidates give solutions in a detail wholly inappropriate to the number of marks available for the question. For example, in question 4(a) candidates were asked to fill in two values in a table for just two marks. Nothing else is required. It was not unusual for candidates to provide over half a page of working for these two values and, from time to time, a whole page of working was seen.

**Report on individual questions**

**Question 1**

The majority of candidates gained full marks on this question. Most obtained the identity $9x^2 \equiv A(x-1)(2x+1)+B(2x+1)+C(x-1)^2$ and found $B$ and $C$ by substituting $x=1$ and $x=-\frac{1}{2}$. A significant number of candidates found an incorrect value of $C$ after making the error $\left(-\frac{3}{2}\right)^2=-\frac{9}{4}$. This can arise through the misuse of a calculator. The value of $A$ was usually found either by substituting $x=0$ or equating coefficients of $x^2$. Relatively few candidates attempted the question by equating all three coefficients to obtain three equations and solving these equations simultaneously. The working for this method is rather complicated and errors were often made.

**Question 2**

Many candidates got off to a very bad start to this question by writing $\sqrt{(9+4x^2)}=3+2x$ or $(9+4x^2)^{-\frac{1}{2}}=(3+2x)^{-1}$. Such errors in algebra are heavily penalised as the resulting binomial expansions are significantly simplified and, in this case, gave answers in incorrect powers of *x*. Those who obtained $\frac{1}{3}\left(1+\frac{4}{9}x^2\right)^{-\frac{1}{2}}$ showed that they understood the binomial theorem but there were many errors in signs, often due to the failure to use brackets correctly. Some candidates seemed to lose the thread of the question and, having expanded $\left(1+\frac{4}{9}x^2\right)^{-\frac{1}{2}}$ correctly, failed to multiply by $\frac{1}{3}$. It was not unusual to see an, often correct, term in $x^6$ provided. The examiners ignore this but such additional work does lose time.

## Question 3

This question was well done and full marks were common. Candidates were roughly equally divided between those who expanded and differentiated and those who differentiated using the product rule. The latter method was the more complicated and more subject to error but many correct solutions were seen using both methods. If the differentiation was correct, nearly all completed part (a) correctly. Rather oddly, a number of cases were seen where $\frac{1}{12}\pi h^2(3-4h)$ was misread as $\frac{1}{2}\pi h^2(3-4h)$. Part (b) was generally well done although there were a minority of students who made no attempt at it at all. The large majority correctly interpreted $\frac{\pi}{800}$ as $\frac{\mathrm{d}V}{\mathrm{d}t}$ and realised they had to divide $\frac{\pi}{800}$ by $\frac{\mathrm{d}V}{\mathrm{d}h}$. Inverting $\frac{\mathrm{d}V}{\mathrm{d}h}$ did cause difficulty for some candidates. For example, $\frac{1}{0.5\pi h-\pi h^2}=\frac{1}{0.5\pi h}-\frac{1}{\pi h^2}$ was seen from time to time and $\frac{1}{\frac{\pi}{25}}=25\pi$ leading to the answer $\frac{\pi^2}{32}$, instead of the correct $\frac{1}{32}$, was relatively common.

## Question 4

Part (a) was well done and the only error commonly seen in part (b) was using the incorrect width of the trapezium $\frac{\sqrt{2}}{5}$ instead of $\frac{\sqrt{2}}{4}$. A few candidates made errors, often due to a lack of clear bracketing, but great majority completed part (b) correctly and gave their answer to the degree of accuracy specified in the question. Part (c) was well done and the majority were able to find $\frac{\mathrm{d}u}{\mathrm{d}x}$ and make a complete substitution for the variables. The only common error in this part was simply to ignore the limits and to give no justification for the limits becoming 2 and 4. Most recognised that the integral in part (d) required integration by parts and those who used a method involving integrating $(u-2)$ to $\frac{u^2}{2}-2u$ and differentiating $\ln u$ usually reached the half way stage correctly. The second integration proved more difficult and there were many errors in simplifying the expression $\left(\frac{u^2}{2}-2u\right)\frac{1}{u}$ before the second integration. The errors often arose from a failure to use the necessary brackets. There were also many subsequent errors in signs and a few candidates omitted the $\frac{1}{2}$ from their integration.

Those who, at the first stage of integration by parts integrated $(u-2)$ to $\frac{(u-2)^2}{2}$, which is, of course, correct, had markedly less success with the second integral than those who integrated to $\frac{u^2}{2}-2u$.

A few split the integral up into two separate integrals, $\int u\ln u\,\mathrm{d}u$ and $\int \ln u\,\mathrm{d}u$ but the second of these integrals was rarely completed correctly. Those who ignored the hint in the question and attempted to integrate with respect to $x$ were generally unable to deal with $\int \frac{x^5}{x^2+2}\mathrm{d}x$, which arises after integrating by parts once

**Question 5**

The majority of those who used implicit differentiation were successful on this question. The commonest error was to differentiate $2x\ln x$ incorrectly and, occasionally, integration by parts was seen. Those who differentiated correctly were usually able to find that $y=16$ when $x=2$ and complete the question. The commonest error at this stage was $\ln y = 4\ln 2$ leading to $y=8$.

Those who started by making $y$ the subject of the formula rarely made progress beyond the first step of writing $y=\mathrm{e}^{2x\ln x}$. This can be differentiated using the chain rule but the majority made some attempt to transform this expression before differentiating and this was often done incorrectly, $\mathrm{e}^{2x\ln x}=\mathrm{e}^{2x}\mathrm{e}^{\ln x}$ being a common error. Those who transformed, correctly, to $x^{2x}$ often differentiated this to $(2x)x^{2x-1}$.

**Question 6**

In part (a) the majority of candidates were able to set up equations in $\lambda$ and $\mu$ and, with a few exceptions were able to solve them correctly. Substitution into one of the given line equations to obtain the coordinates of *A* usually followed correctly, although a substantial number of candidates were unable, or forgot, to show that the lines did indeed intersect. In part (b), the great majority of candidates realised that a scalar product was involved although substantial numbers of candidates selected the position vectors of the fixed points on the line rather than the direction vectors. Among those who did select the correct vectors, the commonest error was to give an obtuse angle rather than the acute angle which the question asked for. Part (c) was well done although some did not show the consistency of $\lambda$ for all three components.

Part (d) proved very demanding. Those who were able to draw a simple diagram to represent the situation and who remembered that each part of a question frequently relies on previous parts were able to find the length of *AB*, using the results of parts (a) and (c), and the angle found in part (b) to complete the question using elementary trigonometry, although some used the tangent of the angle rather than the sine. These were however a small minority of candidates and the majority either just left the question blank or thought that *AB* was the length they were looking for. Some tried more complicated methods such as finding a general expression for $\overrightarrow{BX}$ and taking the scalar product of this vector with the direction of $l_2$ and equating to zero. The working for this method gets very complicated $\left(\mu = \frac{33}{7}\right)$ but a few correct solutions of this type were seen.

## Question 7

The majority of candidates were able to complete part (a), although some candidates gave the answer in degrees rather than radians. Most could start part (b) correctly and, apart from a few errors in sign, obtain $\frac{dy}{dx} = \frac{\cos\theta}{\sec^2\theta}$, although this was often simplified to $\cos\theta$ rather than the correct $\cos^3\theta$. The majority of candidates were able to demonstrate the correct method of finding the equation of the normal and to complete the part by substituting $y = 0$ and solving for *x*. A small number of candidates eliminated $\theta$, successfully differentiated the cartesian equation and completed the question.

Part (c) proved challenging for many candidates and a substantial number of candidates thought that the volume was given by $\int \sin^2\theta$, often ignoring $d\theta$ or $dx$. Among those who recognised that the appropriate integral was $\int \sin^2\theta \sec^2\theta \, d\theta$, many were unable to rewrite this in a form which could be integrated. $\ln\sec\theta$ and $\sin^3\theta$ were among the erroneous attempts seen. Those who realised that $\sin^2\theta\sec^2\theta = \tan^2\theta = \sec^2\theta - 1$ usually completed the question correctly, although a few used *x* limits rather than $\theta$ limits. There are a number of possible alternative approaches to this question and there were some successful attempts using integration by parts. A number of candidates attempted to use the cartesian form of the equation but few of these were able to establish a method of integrating $\frac{x^2}{1+x^2}$.

## Question 8

The majority of candidates realised that the answer to part (a) was of the form $k(4y+3)^{\frac{1}{2}}$ and although the value $k = 2$ was common, most did obtain $k = \frac{1}{2}$. In part (b), the majority of candidates knew that they needed to separate the variables, although this was not always done correctly. Those who separated correctly usually were able to integrate $\frac{1}{x^2}$ correctly, although $\ln x^2$ was seen from time to time. A significant number of candidates did not use a constant of integration and could gain no further marks in the question. It is disappointing to report than many otherwise correct solutions were spoilt by elementary algebraic errors. Many candidates obtained a correct expression, for example, $(4y+3)^{\frac{1}{2}} = 2 - \frac{2}{x}$ but were unable to make *y* the subject of the formula correctly. For examples, $4y + 3 = 4 + \frac{4}{x^2}$ and, even, $4y + 3 = \sqrt{2 - \frac{2}{x}}$ were often seen.

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467
Fax 01623 450481
Email publication.orders@edexcel.com
Order Code UA027662 June 2011

For more information on Edexcel qualifications, please visit
www.edexcel.com/quals

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

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Rewarding Learning