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Examiners' Report/ Principal Examiner Feedback

January 2011

GCE

GCE Core Mathematics C1 (6663)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

January 2011

Publications Code US026231

Core Mathematics Unit C1
Specification 6663

Introduction

The paper seemed to be appropriate to the entry, differentiating between strong and poor candidates. There were some excellent solutions and most students were able to make reasonable attempts at the questions. Lack of time did not appear to be an issue. Poor basic arithmetic was a common deficiency and it was disappointing to see errors of the type:
5*d* = 8 so *d*=5/8 or even 3(1) = 4 and - 4*x*(-1^2) = +4 etc.

Some candidates had difficulty dealing with fractions in any form.
Algebraic errors indicated a failure to see the difference between an equation with 2 sides (where both sides may be multiplied by the same number to eliminate a fraction) and an expression, which one cannot simply 'double up' to conveniently lose the denominator.

Graphs were easier to see this session and few had used a light pencil making it difficult to read on ePEN. Candidates should be advised that black ink is best and pale blue or pencil can appear illegible on scanned scripts. Also if two graphs are drawn then it can be difficult to ascertain which is the correct one. Candidates should be encouraged to re-start if they have drawn incorrectly rather than try to resurrect their answer.

Report on individual questions

Question 1

Overall this question was done poorly, with very few candidates scoring full marks. There were, however, many correct answers to part (a). Candidates were usually able to deal with either the negative part of the power or the fractional part, but some had problems in dealing with both. There were also some who did not understand the significance of the negative sign in front of the 1/4 and the fact that it implied a reciprocal. Some assumed it implied a negative final answer. e.g. -2.

Part (b) was successfully completed by very few candidates, with the vast majority of errors being caused by the failure to raise 2 to the power 4. The power of the *x* inside the bracket was also often incorrectly calculated. It was common for candidates to multiply by *x* before raising to the power and so ending up with either $2x^3$ or $16x^3$. Others added the powers -1/4 and 4. Even when the bracket was correctly expanded, the extra *x* was often omitted or not combined with the other term.

Question 2

This question was attempted by all and was well answered by most candidates. The integration was generally recognised and usually carried out correctly with many candidates scoring full marks with two or three lines of working. Only very few tried to differentiate. Virtually all knew that they had to increase the power by 1 and then divide by the new power. Usually if mistakes occurred it was when simplifying. The 3rd term presented the most challenge, highlighting weaknesses in dealing with fractions and reciprocals: many had difficulty when trying to simplify terms involving fractions such as 4/(4/3). The third term was often left as $4\,x^{4/3}$. The constant of integration was missed in only a minority of cases resulting in the loss of the final mark.

Question 3

This was generally well done with most candidates correctly multiplying both numerator and denominator by the same correct expression. (√3 + 1) was the expected choice but a surprising number used (-√3 – 1) instead. They then usually obtained 2 (or –2) in the denominator and most candidates were able to expand the numerator to obtain 4 terms. Some expanded 5 - 2√3 (√3 + 1) instead of (5 - 2√3) (√3 + 1), simplifying the question and not earning the method mark. Some had difficulty dealing with the simplification of 2√3 x √3. A number of candidates lost the final mark by unwisely multiplying through by 2 or by failing to express their answer as two separate terms.

Question 4

On the whole, this was a high scoring question, with most candidates understanding the notation and 45% obtaining full marks. Almost all candidates earned the first mark for 6 - c or 3x2-c, given as their answer in part (a). A correct expression for the third term was seen regularly, occasionally followed by incorrect simplification to 18-2c or even 18-c. Candidates who attempted to use the formula for the sum of an Arithmetic Progression lost the final three marks. A few candidates simply equated the expression for the third term to zero and solved to find c, ignoring or not understanding the summation.

Question 5

In part (a) there were many well drawn correct graphs with the new asymptotes clearly labelled. Where asymptotes were correct the most common error lay in the position of the left hand branch of the curve, which was either drawn through the origin or crossed the negative axes. Most candidates recognised a translation and all manner of one unit translations, including movement in both x and y directions at once, were seen.

The first mark in part (b) was gained by many for marking the required point on the *x* axis. A number of candidates stopped at this point. Others tried substituting x=0 into the original equation. Better candidates obtained the *y*-intercept by evaluating *f*(-1) and usually scored full marks (with only a few leaving their answer as "1/3" without indicating anywhere that this was the *y* coordinate of the intercept). Those that attempted to find an algebraic expression for *f*(x-1) often scored the first M1, but a number of these did not make sensible use of it (i.e. did not substitute *x*=0) and so did not score the second M1. M0M1A0 was reasonably common, often by using *x*=0 in *f*(x) – 1. Some horrendous algebra was seen by those struggling to find the y intercept in this part and even attempts to solve (*x*-1)=*x*/(*x*-2) were tried in some cases.

Question 6

There were many excellent, well presented solutions with 55% gaining full marks. The majority gained full marks for (a) using the S_n formula. The formula was not always stated and candidates should take care to show sufficient method in 'show that' questions. A minority worked from first principles, writing out all of the terms and adding them but did not get the credit if they missed out terms.
Common incorrect equations seen in (b) were:
6a + 15 d = 17 (from finding the sum of 6 terms), a + 16d = 17 and

a + 6d = 17 In some cases, 17 and (a + 5d) were seen but not equated.

In (c), the elimination method was favoured, but some careless arithmetical errors were made. Sometimes 8/5 was changed to an incorrect decimal e.g. 1.4 which meant that their value for a was incorrect (if they found d first). There were several algebraic mistakes in part(c) such as 5d = 8 then d = 5/8.
A few candidates omitted/forgot to calculate a second variable.

Question 7

This question was done well by most candidates and the actual process of integration was well practised. There were a large number of completely correct responses. Some candidates however did not realise that the constant of integration had to be found and stopped after integrating. They lost the final two marks. For those who continued the majority of errors arose because they incorrectly evaluated their expression with *x* = -1. This was due to the minus sign, which had to be cubed and squared. Some who did substitute correctly failed to realise that their expression in c needed setting equal to zero and so they made a false conclusion leading to *c* = -9.

Question 8

In part (a) most candidates appreciated the need to use b^2 - $4ac$ and the majority of these stated that b^2 - $4ac$ >0 is necessary for two real roots. Some candidates however only included the inequality in the final line of the answer. They should be aware that a full method is needed in a question where the answer is given. The algebraic processing in solutions was usually correct but common errors were squaring the bracket to give k^2 + 9 and incorrect multiplication by -4.

(b) The critical values of -3 and 1 were generally found by factorisation but many candidates struggled to give the correct region; others used poor notation 1<*k*<-3. Candidates who gave their final answer in terms of x lost the final accuracy mark.

Question 9

Part (a) was done well by the majority of candidates. Most were able to obtain k = 5 after the substitution of the coordinates for A.

To find the gradient in part (b) most candidates realised that they needed to rearrange the equation of the line into the form $y = mx + c$, and the vast majority were able to do this accurately, with only a few getting mixed up with signs. Unsurprisingly, those candidates that attempted differentiation on the given equation without first rearranging to $y = mx + c$ were generally unsuccessful in determining the gradient. A significant number of candidates found a second point on the line and used the two points to find the gradient. Many candidates gave their answer as 1.5 which sometimes caused them problems when finding the negative reciprocal in (c). Common incorrect gradients were 3 and 3x/2.

Part (c) was done quite well. Most candidates were able to write down an expression for the negative reciprocal. It was pleasing to see so many of them writing down the correct form, i.e. -1/m before attempting to work it out. The most common error here was the 'half remembered' negative reciprocal leading to 2/3 or -3/2. Many of the candidates who failed to obtain the correct gradient in part (b) were able to score the majority of the marks here. Most candidates were able to use the negative reciprocal gradient to write down an expression for equation of L_2. Methods of approach were roughly equally divided between those using $y - y_1 = m(x - x_1)$ and $y = mx + c$. Those using the former method were generally more successful in scoring the first accuracy mark. Only the better candidates were able to simplify their equation into the correct form.
In part (d), many candidates were able to substitute $y = 0$ into their equation to find the coordinates of B. By far the most common mistake (from about 20% of the candidates) was to substitute $x = 0$ into their equation. The next most common error here was to substitute $y = 0$ correctly but then not being able to solve their equation for x.

In part (e), it was pleasing to see so many candidates able to make a good attempt at finding the distance between the points A and B. Many drew diagrams and many quoted the formula. Relatively few candidates this session got mixed up when determining the differences in the x values and the differences in the y values. However, candidates should still be advised to draw a diagram or to quote the formula before attempting to work out the differences The correct answer of $\sqrt{52}$ was frequently seen with 38% of candidates scoring full marks on this question.

Question 10

For part (a)(i) the majority of candidates drew a curve which was recognisably of a cubic form, although the occasional straight line and other non-cubic curves were seen. Very few candidates did not label the points where the curves crossed the axes, but it was quite common to see the curve passing through (-**3**, 0), (-2, 0) and the origin. The most common error was to draw a "positive" cubic curve, not appreciating that the equation of the curve was of the form $y = - x^3 + ...$; even having made this error, however, many candidates were still able to gain three marks for this curve.

Most candidates seem to know that the equation in part (a)(ii) represents a rectangular hyperbola, and the majority placed the branches in the correct quadrants, although it was not uncommon to see them placed in the first and third quadrants, and occasionally in the first and second. Although the curves were sympathetically marked, it should be said that some of the sketches of the hyperbola were quite poor, some looking as though they had asymptotes at $x = -2$ and $x = +2$, and some needing examiners to have quite an imagination to see the axes as asymptotes.

In part (b), only candidates who had correctly positioned graphs were able to gain both marks in this part; some, but by no means all of this group, clearly had a good understanding of what was being tested here and gained both marks. Candidates with an incorrect sketch were still able to gain the first mark, if their answer was compatible with their sketch, and supported with an acceptable reason. A disappointingly large number of candidates, however, did not seem to appreciate how their graphs could be used to provide the number of real roots, often giving the number of intersections with the x- axis. Some candidates did not refer to their sketch at all and often did quite a bit of work trying to find the actual roots.

Question 11

As a last question this enabled good candidates to demonstrate an understanding of the techniques of gradients, applying problem solving and logical skills to achieve the final equation. 26% achieved full marks in this question. There were very few blank scripts or evidence of candidates who did not have time to complete the question. Usually if candidates did have difficulty, it was because they had made a mistake in answering the early part of the question. In part(a) most candidates were able to differentiate the equation correctly, although there were some problems with coefficients. Most mistakes occurred when differentiating $\frac{8}{x}$ with candidates being unable to rewrite it as $8x^{-1}$ prior to differentiation, or losing the term completely on differentiation. This term also caused candidates problems in the subsequent substitution of numbers which resulted in many strange results. Again, as in Q2, an inability to deal with fractions was seen.

In part (b) the usual approach was to substitute (4, -8) into the equation and show that –8 = –8. Cases where candidates substituted *x* = 4 mistakenly into their gradient instead of the equation of the curve C were frequent, although sometimes corrected. Substituting into fractional items proved to be too much for some candidates and consequently elementary mistakes were made. Simplification of the third term to -72 caused the most problems (many getting 54).

In part (c) there was again the occasional mistake of substitution into the wrong expression. Those candidates who correctly found the gradient of the curve, at the point P, usually went on and found the equation of the normal without any trouble. Arithmetic was often poor and it was common to see $24-27-\frac{1}{2}=-\frac{5}{2}$ and other numerical slips. However even those candidates who had made an error initially then attempted to find a perpendicular gradient and went on to use it successfully in finding the equation of their normal. Very few used the gradient of the tangent in error. Where candidates used *y=mx+c* the calculations for *c* were often numerically incorrect and followed long, complex (often messy) workings.
Presentation in this question varied from some excellent easily followed solutions to some with little coherence.

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Order Code US026231 January 2011

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