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Examiners' Report

Summer 2014

Pearson Edexcel GCE in Core Mathematics C4R (6666/01R)

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Mathematics Unit Core Mathematics 4

Specification 6666/01R

General Introduction

This paper proved to be a good test of students' knowledge and understanding of the specification.

Students' solutions were seen to be methodical and clearly set out.

The standard of algebra was usually good, although a number of students made basic sign or manipulation errors.

Report on Individual Questions

Question 1

Q01(a), most students started by manipulating $\frac{1}{\sqrt{(9-10x)}}$ to give $\frac{1}{3}\left(1-\frac{10x}{9}\right)^{-\frac{1}{2}}$ although a few incorrectly wrote $3\left(1-\frac{10x}{9}\right)^{-\frac{1}{2}}$. The majority were able to use a correct method for expanding a binomial expression of the form $(1+ax)^n$. A variety of incorrect values of a such as $\frac{10}{9}$, $-\frac{9}{10}$ or $\frac{9}{10}$ and n such as $\frac{1}{2}$, -1 or -2 were seen at this stage. The majority of students expanded $\left(1-\frac{10x}{9}\right)^{-\frac{1}{2}}$ to give $1+\frac{5}{9}x+\frac{25}{54}x^2+\ \ldots$, but some forgot to multiply this by $\frac{1}{3}$ to give the answer to Q01(a). Sign errors, bracketing errors and simplification errors were also seen here.

In Q01(b) most students multiplied $(3+x)$ by their binomial expansion from Q01(a). A small minority, however, attempted to divide $(3+x)$ by their binomial expansion. Some students attempted to expand $(3+x)$ by writing it in the form $k(1+ax)^n$. Other students omitted the brackets around $3+x$ although they progressed as if "invisible" brackets were there.

Question 2

In Q02(a) most students applied the trapezium rule correctly in order to find the approximate area for *R*. The most common errors were using an incorrect strip width of 0.4 or not rounding their final answer to 2 decimal places.

In Q02(b) a number of acceptable reasons were seen to explain how the trapezium rule can be used to give a more accurate approximation. These included; increase the number of strips, make *h* smaller or increase the number of *x* and/or *y* values used. Incorrect reasons included; use more decimal places, use smaller values of *x* and/or *y* or use definite integration.

In Q02(c) the majority of students employed a method of integration by parts with $u = 2 - x$ and $\frac{\mathrm{d}v}{\mathrm{d}x} = \mathrm{e}^{2x}$, although a minority multiplied out $(2 - x)\mathrm{e}^{2x}$ to give $2\mathrm{e}^{2x} - x\mathrm{e}^{2x}$ prior to integrating. Common mistakes included sign errors when integrating or evaluating their final answer; or integrating e^{2x} to give either $2\mathrm{e}^{2x}$, e^{2x} or $k\mathrm{e}^{4x}$.

Question 3

In Q03(a) many students were able to differentiate correctly, factorise out $\frac{dy}{dx}$, and rearrange their equation to arrive at a correct expression for the gradient function such as $\frac{dy}{dx} = \frac{4y - 2x - 10}{2y + 2 - 4x}$. A significant minority, however, did not simplify this expression as required by the question. A minority did not apply the product rule correctly when differentiating $-4xy$, whilst a small number left the constant term of 10 on the right hand side of their differentiated equation.

In Q03(b) most recognised that the numerator of their answer to Q03(a) had to be set to zero and obtained $x = 2y - 5$ or $y = \frac{x + 5}{2}$, but then a minority gave up at this point. Whilst most substituted their $x = 2y - 5$ (or equivalent) into $x^2 + y^2 + 10x + 2y - 4xy = 10$ a significant minority who had problems with the resulting algebra found difficulty in reaching a correct $3y^2 - 22y + 35 = 0$ or equivalent. Those who progressed this far were usually able to solve the quadratic equation to give both correct values of *y*. A minority of successful students applied an alternative method of finding both values of *x*, followed by using $y = \frac{x + 5}{2}$ to find both values of *y*.

Question 4

In Q04(a) the majority of students were able to split up $\frac{25}{x^2(2x+1)}$ in the correct form of $\frac{A}{x}+\frac{B}{x^2}+\frac{C}{(2x+1)}$, although a number of students missed the x factor to give the incorrect form of $\frac{B}{x^2}+\frac{C}{(2x+1)}$. Many students were successful in either substituting values and/or equating coefficients in order to find their constants.

In Q04(b) the majority of students were able to write down a correct expression for the volume formed, although a number of students omitted π and applied $\int y^2 \mathrm{d}x$.

The majority of students attempted to integrate their partial fraction, although a few tried to integrate either the square root or the square of their partial fraction. Most were able to integrate both $\frac{A}{x}$ and $\frac{B}{x^2}$ correctly with a few integrating $\frac{B}{x^2}$ to give $B\ln(x^2)$. The most common error was to integrate $\frac{C}{(2x+1)}$ to give $C\ln(2x+1)$. Most students applied the limits of 4 and 1 correctly, but a significant minority struggled to apply the laws of logarithms to manipulate their answer into the form $a+b\ln c$.

Question 5

In Q05(a) many students wrote down $\frac{\mathrm{d}V}{\mathrm{d}r}=4\pi r^2$ and used the chain rule correctly to set up an equation for $\frac{\mathrm{d}r}{\mathrm{d}t}$. They applied 3 divided by their $\frac{\mathrm{d}V}{\mathrm{d}r}$ and substituted $r=4$ to find a value for $\frac{\mathrm{d}r}{\mathrm{d}t}$. Common errors in this part included applying $3\times$ their $\frac{\mathrm{d}V}{\mathrm{d}r}$, substituting $r=3$ into their $\frac{\mathrm{d}r}{\mathrm{d}t}$, giving their final answer as $\frac{\mathrm{d}r}{\mathrm{d}t}=\frac{3}{4\pi r^2}$, or incorrectly rounding their answer to give either 0.015 or 0.01

In Q05(b) the majority of students applied $8\pi r^2\times$ their $\frac{\mathrm{d}r}{\mathrm{d}t}$ and substituted $r=4$ to give the correct answer for $\frac{\mathrm{d}S}{\mathrm{d}t}$. Some applied $8\pi r^2$ divided by their $\frac{\mathrm{d}r}{\mathrm{d}t}$ whilst others made no attempt at this part.

Question 6

In Q06(a) the majority of students found the correct answer of $p = 5$, with a few incorrectly stating $p = -5$.

In Q06(b) the majority of students applied the simplest method of equating the **i** components of l_1 and l_2 leading to $\mu = -2$. They then substituted this value into the equation for l_2 to give the coordinates of *C*. There were a significant minority, however, who did not attempt to show that that l_1 and l_2 intersected.

In Q06(c) the majority of students applied the scalar product formula in order to find the angle *ACB*. The majority achieved the correct answer by applying the scalar product formula between $\overrightarrow{AC}$ and $\overrightarrow{BC}$ (or $\overrightarrow{CA}$ and $\overrightarrow{CB}$). Some students applied the scalar product formula between the direction vectors of l_1 and l_2 which gave an obtuse angle. Only a small number of students manipulated this angle to give the correct answer of $27.7°$.

In Q06(d) the majority of students used $\frac{1}{2}ab\sin C$, with $a = |\overrightarrow{AC}|$ and $b = |\overrightarrow{BC}|$ and achieved the correct answer of 14.7. Some unsuccessful students applied *a* and *b* as the length of their direction vectors.

Question 7

Those students who separated the variables correctly in Q07(a), were usually able to integrate at least one side of their equation correctly. Common errors at this stage included integrating $\dfrac{1}{5000 - N}$ to give $\ln(5000 - N)$ and omitting a constant of integration "$+ c$", whilst a number of students found it challenging to integrate $\dfrac{(kt - 1)}{t}$. Some students did not show sufficient steps in order to progress from $-\ln(5000 - N) = kt - \ln t + c$ to $N = 5000 - Ate^{-kt}$. Other students found it challenging to remove logarithms correctly and gave an equation such as $5000 - N = e^{-kt} + e^{\ln t} + e^{c}$ which was then sometimes manipulated to the answer given on the question paper.

In Q07(b) many students wrote down two equations each containing *A* and *k* and attempted to solve them simultaneously. Algebraic manipulation and dealing with exponentials caused problems for a significant minority of students.

Those who were successful in finding the exact values of *A* and *k*, usually achieved the correct answer of 4400 fish in Q07(c).

Question 8

In Q08(a) the majority of students were able to apply a full method of setting $y = 1$ in order to find *t* and substituting *t* into $x = t - 4\sin t$ in order to find *k*. Only a minority of students found and applied $t = -\frac{\pi}{2}$ to give the correct answer of $k = 4 - \frac{\pi}{2}$. The majority used values of *t* such as $\frac{\pi}{2}$ and $\frac{3\pi}{2}$ leading to incorrect answers of $k = \frac{\pi}{2} - 4$ and $k = \frac{3\pi}{2} + 4$ respectively.

In Q08(b) the majority of students were able to apply the process of parametric differentiation followed by substitution of their t into their $\frac{dy}{dx}$. Occasional sign errors were seen in the differentiation of both *x* and *y* and a number of students obtained $-4\cos t$ for $\frac{\mathrm{d}x}{\mathrm{d}t}$. Only a minority of students used $t = -\frac{\pi}{2}$ to obtain a correct answer of $\frac{dy}{dx} = -2$. Most used $t = \frac{\pi}{2}$ to give a final answer of $\frac{dy}{dx} = 2$, when it was clear from the diagram that the gradient of tangent to the curve at *A* must be negative.

In Q08(c) many students achieved $4\sin t - 4\cos t = -1$ (or equivalent) after setting their $\frac{dy}{dx} = -\frac{1}{2}$. The majority, however, were not able to find a correct strategy for solving their trigonometric equation. Some students squared $4\sin t - 4\cos t = -1$ (or equivalent) to give $16\sin^2 t + 16\cos^2 t = 1$. The most popular method was to square both sides of $\frac{2\sin t}{1 - 4\cos t} = -\frac{1}{2}$, and apply the identity $\sin^2 t + \cos^2 t \equiv 1$ to achieve a quadratic equation in either $\cos t$ or $\sin t$. Some students squared both sides of $4\sin t - 4\cos t = -1$, applied the identities $\sin^2 t + \cos^2 t \equiv 1$ and $\sin 2t = 2\sin t\cos t$ to achieve $\sin 2t = \frac{15}{16}$. Few students correctly rewrote $4\sin t - 4\cos t = -1$ as $4\sqrt{2}\sin\left(t - \frac{\pi}{4}\right) = -1$ (or equivalent). The majority of students who used a correct strategy usually achieved the correct answer of $t = 0.6077$.

Grade Boundaries

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

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