Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International GCE
In Core Mathematics C12 (WMA01) Paper 01

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General

This was the penultimate C12 paper of this IAL series, with the final sitting being May 2020. Candidates for this January's paper were generally well-prepared showing both good knowledge and understanding of the specification. Questions that discriminated across all grade boundaries were 3, 7, 9, 11, 15 and 16. Centres need to be aware that some questions require students to show detailed reasoning and not to rely on calculator technology. Question 1 and 13 were such examples.

Report on Individual Questions

Question 1

In this question, most candidates realised they had to prove their results without calculators. However, a significant minority failed to read the bold writing above the question and thus didn't show enough steps in their working to gain full marks here.

For part (a) there were many excellent solutions with most candidates realising that they had to multiply by $\frac{\sqrt{5}+2}{\sqrt{5}+2}$. To gain both marks it was necessary to show an extra step before the printed answer.

For part (b) very few candidates realised that they could use part (a) to solve this question. They simply started again, rationalising the denominator, but gaining the correct answer anyway. Again, there were many instances where candidates did not show enough steps to gain more than 1 mark out of 3. These candidates usually jumped from $\frac{18\sqrt{5}}{\sqrt{5}-2}$ to $30+6\sqrt{10}$ without showing any relevant working. The realisation that it was $3\sqrt{5}\times(\text{a})$ escaped most and the most common correct approach was to once again multiply by $\frac{\sqrt{5}+2}{\sqrt{5}+2}$

Question 2

There were many fully correct solutions to this question. Most candidates could differentiate the powers of x correctly but the coefficient of ¼ did cause some difficulty with many converting $\frac{1}{4x}\to 4x^{-1}$ The majority of candidates understood how to use their derivative to proceed to the equation of the required tangent. Marks were lost in (b) when students attempted the equation of the normal rather than the tangent.

Question 3

Part (a) was answered correctly by almost all candidates with only a few getting the inequality in the wrong way around or by failing to expand $4(x-3)$ correctly.

Most students successfully solved $2x^2-5x=63$ in (b) in an attempt to find the critical values. Finding the required region was more demanding, with many selecting outside region or (incorrectly) writing down $x\leqslant -\frac{9}{2}\quad x\leqslant 7$

Part (c) proved to be the most challenging part of this question with many candidates not gaining any marks at all. Solutions were often a restatement of their previous inequalities and equations, with no attempt to combine them.

Question 4

The majority of candidates appreciated the need to split the given fraction into two separate terms before proceeding to integrate. The processing of the indices was often completed correctly but the fractional power did cause some difficulties. Candidates mostly understood how to integrate the powers. Although there was no requirement to do so, there were attempts to write the negative powers of x back into fractions; these attempts were usually correctly done. Unfortunately, the omission of the arbitrary constant of integration from the indefinite integral meant that the final mark of otherwise fully correct solutions had to be withheld

Question 5

Part (a) was relatively well attempted. Most candidates realised that applying the log laws to both sides of the equation to form $y\log 4 = 3000\log 10$ produced a straightforward solution to this problem. Unfortunately attempting $y = \log_4 10^{3000}$ caused "math error" messages as 10^{3000} was too big a number for the calculator

In part (b) most candidates knew how to form a quadratic equation not involving logs. The laws of logs were generally well understood and applied successfully. The quadratic equation was in most cases solved accurately but many candidates included the solution $x = 4$ as well as $x = 1/2$, not realising that $x = 4$ would have been an invalid value in the second term of the original log equation.

Question 6

Most candidates had a sound understanding of how to find both of the required coordinates and also to find the equation of the required normal. There were some errors in finding the required coordinates, although these were rare, but most candidates could then proceed with a correct method to find the equation of the normal.

Having found an equation for their normal, most candidates could find the coordinate of the point R.
Less successful were attempts at finding the area of the quadrilateral. There were many methods to find the required area including adding the area of a trapezium to a triangle, splitting the area into a triangle and two triangles as well as finding the difference between the areas of two triangles. It was surprising to see the difficulty some candidates had in one of the methods when finding the area of a right-angled triangle. Many felt that they had to do much work to find the lengths of the two sides at the right angle before finding the area, rather than using the hypotenuse as the base and finding its vertical height.

Question 7

Candidates usually made good progress in part (a) via use of the cosine rule. The answer was usually given to the required degree of accuracy.
Part (b) was less well attempted but the correct area of one of the triangles was usually seen. Common misconceptions in this part were that the given diagonal bisected the angle at the vertex of the quadrilateral or that opposite angles of the quadrilateral were supplementary, assuming that the quadrilateral was cyclic. Candidates who used either of these properties could not be awarded any further marks.
The use of the sine or cosine rule to find another angle and then adding the area of the two triangles was often seen, as was the correct answer. An alternative approach summing the area of two triangles and a trapezium was seen less often.

Question 8

The majority of candidates successfully tackled the proof in part (a). Those who made errors tended to do so in the expansion of $(2x + k)^2$ though others missed out the $+4x$ term or made errors expanding $-2(2x+k)$

Most students knew how to employ "$b^2 - 4ac$" in part (b) but not all were able to identify the expressions for a, b and c correctly from the given equation. Of those who set out with the correct idea, most reached the answer successfully, while those who did not, usually slipped up as a result of a failure to include brackets in the $(4k)^2$ term. Weaker students made a variety of strange attempts in (b). Probably the most common were based on wrongly deciding that they needed to solve $k^2 - 2k - 3 = 0$.

Question 9

In part (a), scores of 2 marks were very common with many candidates missing out one of the two necessary steps. For example, most candidates who found S_9 to be 882 thought that all that was required was to subtract their answer from 1000. It was important to show that the distance covered on day ten would have been more than the 118 km if they had kept on cycling. Therefore finding S_{10} or u_{10} was necessary to show the result.

Part (b) was answered more successfully using the formula for the sum of n terms of a geometric progression. There were some unfortunate common errors in the common ratio with 1.2, 0.2 and 0.02 often seen instead of the correct value of 1.02.

Question 10

In part (a), a very common mark was M1 A0. The accuracy mark was seldom awarded as candidates either failed to follow $f(-2)=0$ by the required statement or a minimal conclusion. Many candidates had either statement or conclusion, but not both. Some candidates incorrectly used long division rather than the factor theorem in part (a), so did not score marks in this part.

The majority attempted part (b) using long division or inspection with most obtaining the correct quadratic expression $-2x^2 + 11x - 12$. Many then incorrectly factorised this quadratic, most often factorising as if the first term was positive $2x^2$. Common errors of $(x - 1.5)(x - 4)(x + 2)$ often resulted from candidates using their calculators to find the solutions then attempting to work backwards.

Part (c) (i) was the most correctly answered part of the question. The only common error was to set the cubic = 0 and divide by the x, thereby losing that factor.

Part (c) (ii) depended upon the previous factorisations, so many candidates were not able to achieve both marks. Where candidates had factorised correctly in part (b) as $(x+2)(2x-3)(4-x)$ they frequently did not obtain any marks in (c) as they did not know how to cancel $(4 - x) / (x - 4)$

Question 11

Most candidates gained the first three marks for finding the coordinates of the centre and for the exact value for the radius. However, many candidates did not know how to start part (b) and attempted to set $x = 0$ or $y = 0$ in the equation of the circle. This resulted in no marks for part (b) as they were not answering the question. Those who used a clear diagram and identified a right-angle triangle which they could solve using Pythagoras Theorem usually achieved a successful outcome. There were also a number of successful methods using circle theorems. This was highly discriminating question.

Question 12

Most candidates attempted part (a) of this question and achieved at least some marks, using either the expansion for $(2 - (x/8))^7$ or the power series expansion on $(1 - (x/16))^7$. This is a well-known theorem and, as a result, full marks were common. Errors resulted from incorrect squaring and/or the loss of the negative sign in the second term.

Parts (b) and (c) were considered as one for marking purposes. In part b) a good number of candidates correctly set $128a = 16$. A few continued by dividing incorrectly and stating $a = 8$, but many achieved the correct answer of $a = 1/8$ or 0.125. Part c) proved more challenging, and the common error here was setting only $128b = 249$, forgetting to include the $-56a$ term.

Question 13

Part (i) saw the majority of candidates begin by correctly taking arcsin (1/2) although there were a small minority who chose to work in degrees. These candidates rarely recovered to achieve the required answers in radians. The correct order of operations was generally appreciated and both correct solutions often seen but the larger of the two solutions was sometimes missed.
In part (ii) candidates usually scored four out the five available marks. Many started by rewriting $\tan x$ as $\sin x/\cos x$ and then rearranging. However, this usually yielded in an equation in just $\cos x$, as $\sin x$ was cancelled out from both sides, and no consideration was given to $\sin x = 0$ also having solutions. Extra solutions of the cosine equation within the range were also seen.

Question 14

Parts (a) and (b) were generally well done by the majority of candidates. For part (a) those that lost the mark tended to do so because they gave multiple crossing points and did not specify which corresponded to Q. Many candidates also achieved full marks in part (b) which was pleasing to see. Those that lost marks tended to struggle with expanding the cubic but were able to pick up marks for correct integration later in the question.
Part (c) saw very few successful solutions via transformation geometry. Many started from first principles and repeated work already done to find the area of the new region and then find the scale factor for generating the new area.

Question 15

Part (a) was very discriminating. For those who attempted it, it was clear that they knew the strategy, but many struggled with the fact that the radius of the sector was $2r$ thus resulting in incorrect expressions for P and or A. Hence only really careful students scored full marks here.
Part (b) saw nearly all candidates being able to find $\frac{\mathrm{d}P}{\mathrm{d}r}$.However, a significant number lost the second two marks due to finding the value of r at $\frac{\mathrm{d}P}{\mathrm{d}r} = 0$ and not finding the value of P.
Part (c) was well attempted with most considering the sign of the second derivative. Some solutions were not exact enough, for example, just stating $\frac{\mathrm{d}^2P}{\mathrm{d}r^2} = \frac{60}{r^3} > 0$, hence minimum, without referring to the positive nature of r.

Question 16

This question proved to be very discriminating. Many did not know how to proceed in part (a) and missed it out. For those who did set the common ratio of $\frac{u_2}{u_1} = \frac{u_3}{u_2}$ usually were able to prove the given result.

In part (b) the majority of students solved the equation correctly, but not all chose the acute angled solution, that is cos θ =7/9 (where θ = 38·9°).

Of those who did succeed in the second part, many resorted to using their calculators to produce decimal, and therefore only approximate answers to the two parts of (c). Some of those candidates who set out to find exact values started with the correct equation $\sin^2\theta = \sqrt{(1 - \cos^2\theta)}$ only for it to degenerate into $\sin\theta = 1 - \cos\theta$. Part (c) also saw similarly false statements. Note that it was possible to answer (c)(ii) from the three given terms at the start of the question as the third divided by the first is r^2 and so $r = \sqrt{2}$.

Full marks in this question was very rare and a sign of a very good candidate.

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