Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2024

Pearson Edexcel International Advanced Level
In Pure Mathematics P2 (WMA12)
Paper 01R

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Introduction

This WMA12_01R paper was a very good test of the specification. Questions 1 to 4 proved to be very accessible with questions 5 to 10 providing differentiation at all grades. The paper was of appropriate length with little evidence of students rushing to complete the paper.

Points to note for future exams are:

- Candidates should take care when using a calculator to find the solutions of equations especially when the question demands that they ‘show using algebra’ or ‘show all steps of their working’. This was true in questions 5, 6, 7 and 10 where some candidates merely wrote down answers.
- Candidates should take care when presenting solutions to questions and should show all steps clearly when solving a multi- step problem. For example, in Questions 5(b) and 8(i) many candidates wrote down an answer following work that was hard to follow.

Question 1

This question was accessible to the majority of students with many gaining full marks.

Reasons for a loss of marks included

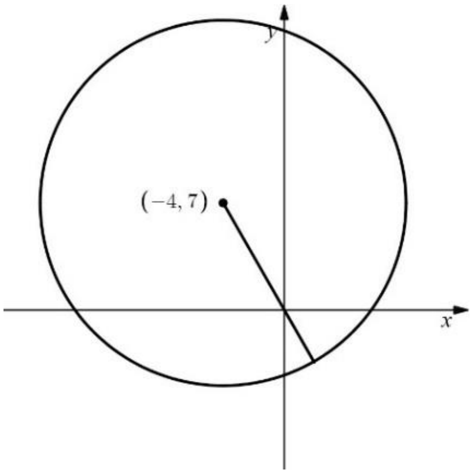
- failure to read the iteration formula correctly with the incorrect $u_3 = 3u_2 - u_1$ regularly used instead of $u_3 = 3u_2 - 2u_1$
- failure to fully understand $\sum_{r=1}^{4}(u_r + 2r)$ with various incorrect attempts including $\sum_{r=1}^{4}(u_r + r)$ and $u_4 + 8$ as well as versions using both arithmetic and geometric series

Question 2

In part (a), almost all candidates knew the form of the trapezium rule with most using the correct value of *h*. The question involved setting up an equation in *a* and using the fact that an approximation of the area was 19.3. Most were able to gain two of the three marks with many going on to score all 3

Part (b) was found to be more challenging. Many used their answer to (a) despite being told to use the answer of 19.3. The calculation of $2\times 19.3 - [3x]_{-4}^{5}$ was often done incorrectly with the double negative the main cause of incorrect answers

Question 3



Part (a) was a very straightforward question on the coordinates of the centre of a circle and the value of its radius. The majority of candidates achieved all three marks.

Part (b) involved some problem solving and was beyond many. It has been mentioned in previous P.E. reports that sketching a diagram would help. This was such a case, as can be seen here.

The point on the circle nearest the origin would be at a distance $\left(12-\sqrt{4^2+7^2}\right)=12-\sqrt{65}$ from the origin

Question 4

Questions on the binomial expansion are usually well done and this was no exception.

In part (a) most candidates could correctly form the first 4 terms in the expansion of $(3+2x)^6$ Reasons for the loss of marks here were:

- failure to put brackets around 2*x* terms meaning that terms appeared as ${}^6C_4\left(3\right)^4 2x^2$ rather than ${}^6C_4\left(3\right)^4\left(2x\right)^2$
- incorrect simplification of terms

Part (b) was a little more demanding but most candidates scored at least the mark for multiplying 729 by $2x^2$. The question demanded that candidates find the term in x^2 in the expansion of $\left(2x^2-\frac{1}{6x}\right)(3+2x)^6$. Common reasons for losing marks here were:

- writing $\frac{1}{6x}$ as $6x^{-1}$ and hence multiplying by 6 rather than dividing by it
- failing to combine the two terms $2x^2\times729-\frac{1}{6x}\times4320x^3$ into a single term

Question 5

The trigonometric model, set within the context of the height of the tide on one particular day, discriminated at all levels but especially at the higher grades.

Part (a) was often correct and involved the substitution of $t = 2$ into the equation of the model $D = 8 + 5\sin\left(\frac{\pi t}{6} + 3\right)$ to show that D was just over 4 (metres). Errors were rare but a significant number of candidates achieved an answer of 8.35 when calculators were set in degree mode.

Full marks were rare in part (b) with many only achieving the first two marks for reaching $\sin\left(\frac{\pi t}{6} + 3\right) = -\frac{2}{5}$. As the model was only valid on a particular day, it was important to find a value of t in the range $0 < t < 24$. Finding positive solutions was demanding for all but the most able, with many candidates proceeding to $t = -6.51$ via $t = \frac{(-0.4115 - 3) \times 6}{\pi}$. The correct method was via the solution of $\left(\frac{\pi t}{6} + 3\right) = 3\pi + 0.4115$. Solutions produced entirely from a calculator were prohibited in this question, so answers such as $6 = 8 + 5\sin\left(\frac{\pi t}{6} + 3\right) \Rightarrow t = 1.056$ scored no marks.

Question 6

This question was based around the cubic function $\mathrm{f}(x) = 4x^3 + px^2 + 8x + q$

In part (a) the two unknowns could be found using the two pieces of information provided.

Using both the factor and remainder theorems, two equations could be produced, which when solved, provided values for both p and q. Many candidates scored full marks here, but marks, when lost, were lost due to:

- failure to show a full proven solution in this non calculator question
- errors in setting up the equations using $\mathrm{f}\left(-\frac{3}{2}\right) = 0$ and $\mathrm{f}(-2) = -5$

Part (b) involved finding the range of values of x where $\mathrm{f}(x)$ was decreasing. Many candidates failed to differentiate and divided $\mathrm{f}(x)$ by $(2x + 3)$ losing all 4 marks. Candidates who knew to differentiate usually scored at least 3 marks with errors mainly due to the inequalities used.

Question 7

This question on trigonometry was in two parts.

Part (i) was familiar to a well-prepared candidate and many went on to achieve at least 4 of the 5 marks using the identities $\tan x = \frac{\sin x}{\cos x}$ and $\sin^2 x = 1 - \cos^2 x$. For candidates who knew the method, marks were generally lost for

- failing to write down both solutions of $\cos x = \frac{1}{4}$ namely $\Rightarrow x = 1.318$ **and** 4.965
- errors/slips in algebra. E.g. $3\left(1-\cos^2 x\right) = 11\cos x + \cos^2 x \Rightarrow 4\cos^2 x - 11\cos x + 3 = 0$

Part (ii) was unfamiliar and required careful thought. Calculator use, although prohibited, was common with many resorting to write $\cos\theta = \frac{1}{3} \Rightarrow \theta = 70.5° \Rightarrow \tan\theta = 2.828$ with some of these recognising $2\sqrt{2}$. This scored no marks. Various methods were possible, but Pythagoras' theorem was required in some form or another. For example,

$$\cos\theta = \frac{1}{3} \Rightarrow \sin^2\theta = 1 - \frac{1}{3^2} \Rightarrow \sin\theta = \frac{2\sqrt{2}}{3}$$

This part of the question was highly discriminating, especially at the top grades.

Question 8

This question on series was accessible at all grades, although completely correct solutions were rare.

In part (i)(a) candidates were required to prove the sum to *n* terms of an arithmetic series is $S_n = \frac{n}{2}\left(2a + (n-1)d\right)$. Considering this is a standard proof, it wasn't well known and there were relatively few fully correct proofs.

Part (i) (b) required some problem solving and most candidates made some progress. Finding the number of terms of $900 + 892 + 884 + ... + 500$ proved demanding for some with 50 a common incorrect answer. There was also confusion about whether *d* was 8 or -8.

Once the link between the terms of the geometric series in (ii)(a) had been established, proofs were generally concise and well written. Very few marks were lost for sloppy algebra or missing = 0's.

Part (ii)(b) was more discriminating. Most candidates were able to solve the equation in *k* but knowing which value to use proved difficult for some. The fact that the series had a limit should have led to the fact that $r < 1$. Well prepared candidates who knew this then finished the question with ease.

Question 9

This question involved logs and the roots of a cubic equation.

Part (a) was not well done. To verify that a value is a solution of an equation involves substituting it into the equation and demonstrating that it satisfies the equation. So, for example, verifying that $t = 4$ is a solution of $3\log_2(t+4) - 2\log_2(t-2) = 7$ involved substituting $t = 4$ into the equation to get $3\log_2 8 - 2\log_2 2$, then calculating its value $3\times3 - 2\times1 = 7$ and giving a minimal conclusion.

Part (b) was more familiar, and candidates who knew the rules of logarithms generally went on to produce the given answer. For candidates who did make some progress marks were generally lost for

- either an inability to fully expand $(t+4)^3$
- or else producing an incorrect starting equation, usually $\frac{(t+4)^3}{(t-2)^2} = 7$

Part (c) produced few fully correct answers. As t = 4 was given as a solution, candidates should have divided the given cubic expression by $(t-4)$. The roots of the quadratic factor could then have been found via appropriate means. It is important to understand that the question required candidates to solve $3\log_2(t+4) - 2\log_2(t-2) = 7$ giving any solution in simplest form. Marks were dropped here as a result of

- including the solution $t = 56 - 12\sqrt{21}$ or omitting the solution t = 4
- using a calculator to solve $t^2 - 112t + 112 = 0$ and writing down a decimal solution

Question 10

This question involved the use of calculus to find a turning point as well as calculating an area under a curve.

Most candidates knew they needed to differentiate in part (a) but some struggled to accurately write the expression $\frac{9x - x^2}{2\sqrt{x}}$ in a suitable form. Mistakes were common including the 2 being moved to the numerator. For those who did differentiate correctly, only the best candidates could work with the fractional index equation $\frac{9}{4}x^{-\frac{1}{2}} - \frac{3}{4}x^{\frac{1}{2}} = 0$ to find the value of x.

If candidates could not write $\frac{9x - x^2}{2\sqrt{x}}$ in the form $\frac{9}{2}x^{\frac{1}{2}} - \frac{1}{2}x^{\frac{3}{2}}$ for part (a), they were unlikely to make much progress in (b). Finding the top limit of the integral also proved to be a challenge with many attempting to solve $\frac{9}{2}x^{\frac{1}{2}} - \frac{1}{2}x^{\frac{3}{2}} = 0$ rather than the easier $\frac{9x - x^2}{2\sqrt{x}} = 0$.

Good candidates however achieved all aspects with ease and gained many of the marks in this question.

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