Examiners' Report

Summer 2015

Pearson Edexcel International Advanced Level in Core Mathematics C12 (WMA01/01)

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Mathematics Unit Core Mathematics 12

Specification WMA01

General Introduction

Immediately all marking has been completed, Examiners are asked to forward a report to the Principal Examiner on this form. Such reports need not be lengthy but they should provide the Principal Examiner with information that will be useful in compiling the report on the examination. Examiners are asked to follow the guidelines on this form as set out below.

(a) **The response of students to particular questions**

Although it may not be necessary to comment upon each question in the paper, this section will form the most important part of the Assistant Examiner's report. At the Standardisation meeting, the Principal Examiner will indicate any questions on which you will be particularly required to report. In the report, the numbers of the questions should be clearly shown. The comments should be as meaningful as possible, and the following should be avoided as examples of bad practice:

Question 1 *Satisfactory*

Question 2 *Not so well done*

Question 3 *Badly done*

Question 4 *Some good answers*

Or *Some good students attempted question 1*

These comments should be contrasted with the following report which is considered to be informative and helpful:

Many students' responses to questions relating to the impact of agriculture on the environment had been influenced by the 'green' movement. At one level a simplistic view of farmers as exploiters prevailed. At other levels, the realisation that science applied to agriculture had made a great contribution to the provision of cheap food was more apparent. At all levels great concern for the environment was shown and students were familiar with such terms as 'greenhouse effect', 'ozone layer, and 'organic farming'. However the knowledge and understanding of these terms was often incomplete.

(b) **Popularity**

Comments on the popularity of any questions should be given in a separate section unless Examiners are asked to complete a question popularity analysis.

(c) **Administration**

Any observations on administrative matters relating to the conduct of the examiners should be given in a separate paragraph which will be conveyed by the Principal Examiner to the Assessment Leader.

(d) **Mark/Grade Boundaries**

The Principal Examiner may ask Examiners to give their view on certain mark/grade boundaries for that part of the examination that they have marked. If such a request is made, the suggestion should be given in the appropriate table provided on page 4 of this form.

This was the fourth Core 12 paper since the introduction of the IAL qualification. Students found this paper, on the whole, accessible. Timing did not seen to be an issue with the vast majority finishing the paper. The quality of responses seen was high, showing that students had been well prepared by their teachers. Questions 3, 8, 9, 13 and 16 were found to be the most challenging on the paper . Overall the level of algebra was pleasing, although a lack of bracketing was apparent in some cases. Points that could be addressed in future exams is the lack of explanation given by some students in questions involving proof. (See 9a and 13(i)).

Report on Individual Questions:

Question 1

Most students understood what was need in this question and attempted both parts.

(a) The majority of students successfully found the gradient with only a few failing to state it and leaving their answer embedded in an equation. Although almost all solutions saw the equation rearranged to give 2y = 10x + 7, some then lost marks by failing to divide by 2 and thus gave an incorrect solution of 10, rather than 5 as required. A small number of solutions were given with an incorrect sign.

(b) A significant number of students either had misread the question or assumed wrongly that they should use the normal gradient instead of the answer found in part (a).

Solutions were fairly evenly divided between those who used $y – y_1 = m (x - x_1)$ and those who found the answer using y = mx + c. Both methods were well done with only a few students making errors in these steps. Just a few who were using the first method failed to multiply out the bracket correctly.

The majority of those who gave a correct answer in (a) and used that same value in (b) went on to achieve full marks for this question

Question 2

On the whole this question was very well done, with clear presentation of the solution.

The majority of students used Remainder Theorem correctly by writing f(1) = 4 and f(-2) = 22. Only occasionally did students use f(-1) or f(2). However, poor use of brackets often cost marks in working with f(-2) so that resulting sign errors led to an incorrect equation. Virtually all students then went on to attempt to solve their pair of simultaneous equations with the majority doing so successfully.

A very small proportion attempted to use long division but hardly any of those who did so were able to reach a remainder in terms of a and b to be equated to 4 and 22.

Question 3

This question was not well answered, with even good students often losing one or two of the three available marks. Very complex working was often seen, usually leading to wrong answers.

Although many students answered part (a) successfully, a common error was to give the cube root of 1/27 as 3.

Part (b) was often left out or poorly done, with many being unable to deal correctly with the negative index. A variety of incorrect answers was seen, but some students lost the mark for not giving their answer in the form requested.

In part (c) most students seemed to be able to cope with the square root but some lost this mark as they left their answer as $x\sqrt{x}$.

Question 4

This question was generally well answered, with many students gaining full marks.

In part (a), most students knew the general position and shape of the graph and there were some good sketches. Surprising, some students attempted to *plot* the graph, often losing the accuracy mark as the asymptotic nature of the curve was lost. A few had 'extra' asymptotes, and occasionally straight lines, parabolas or cubic curves were seen. Many students included the branch for $x < 0$ but were not penalised on this occasion.

While there were many correct responses for the trapezium rule in part (b), the usual common errors were regularly seen. Interpreting the n in the formula as the number of values in the table rather than the number of trapezia gave the commonly seen value of 2/5 for h. Bracketing mistakes and other slips were also seen and just a few students attempted to 'integrate' rather than to use the trapezium rule.

Question 5

This question was generally well answered and responses showed that students could work confidently with laws of logarithms.

Most students were able to answer part (i) correctly, though not always giving the answer to 3 significant figures. Some methods were long winded, but it was common to see little or no working.

Part (ii) was often fully correct, although a significant minority of students seemed to have a poor understanding of the laws of logarithms, making mistakes such as $\log(x + 3) = \log x + \log 3$. The correct strategy of using $4 = \log_2 16$ was sometimes confused. Some students recovered from incorrect methods to arrive at the correct answer. For example, $\log(x + 3) - \log(2x + 4)$ was sometimes expressed as $\log(x + 3) / \log(2x + 4)$ and the logs 'cancelled' to obtain the correct answer. It is important that students realise that achieving the correct answer may not guarantee full marks. Some students lost the final mark as they did not express their answer in exact form as required.

Question 6

Almost all students were familiar with the binomial distribution, so most were able to score some marks in this question.

The most successful method in part (a) was to apply the formula for expanding $(a + b)^n$. With this method the common mistake was forgetting to square the 'a' in the third term, producing $240ax^2$ instead of $240a^2x^2$. Of those who tried to use the expansion for $(1 + x)^n$, many did not realise that they needed to use $(ax/2)$ in the expansion. Most of these students tried taking out a factor of 2 from the bracket but a few forgot to raise this to the power of 6. Some students achieved the correct expansion but then divided through by the common factor 8.

In part (b), it was good to note that only a small number of students wrote $192ax = 240\, a^2x^2$ rather than $192a = 240a^2$. Most were able to equate the required coefficients and correct answers were common.

Question 7

Most students attempted this question and understood what was required.

(a) Most students reached the correct answer 12, although quite often this was not seen until part (b). The mark scheme did allow the mark to be awarded but students need to make sure that they provide the required answers and state them appropriately for each part a question.

(b) Most students used the formula $s = r\theta$ to find the angle and a good proportion gave the exact answer. Of those who gave answers in decimal form, answers rounded to only 2 significant figures lost the accuracy mark. The use of rounded decimal answers also resulted in the loss of accuracy marks in parts (c) and (d)
A few students did not read the question carefully and, although the correct formula was used, they substituted 30cm as the arc length. A number of students worked out the solution for part (a) but then mistakenly thought this to be the length of the line AB rather than the arc and then used the cosine rule to find θ. Most students did find θ in radians but a few opted for finding the angle in degrees and such attempts were not always successfully converted to radians.

(c) This part of the question was generally well done with students using the formula $A = \frac{1}{2}r^2\theta$ successfully. Accuracy marks were lost here when the student had rounded their value of θ and thus arrived at an answer with less than the permitted accuracy.

(d) Most students were aware of the formula for area of a triangle involving $\sin\theta$ and used it successfully. Again, those who had inappropriately rounded their value for θ lost the accuracy mark.
Only a few students used alternative methods such as working out the triangle base and height in order to use A = ½ bh or finding the area of the segment and subtracting this from their answer to part (c). Where this alternative method was used it was, on the whole, successful.

Question 8

This question proved to be testing for many students.

(a) Most students understood that this was about an arithmetic sequence and recognised that they needed to substitute values into the formula $U_n=a+(n-1)d$.

Unfortunately a significant number were confused by the year and were unable to translate the year to the numbers of years since 1986 and this resulted in n being thought to be 13 or sometimes 15.

Those students who were successful in acquiring correct simultaneous equations in a and d usually went on to solve correctly and reach the correct answer for the number of houses built in 1986.
A small number of students use the year 1900 for the first term and went on successfully to find the number of houses built in 1986.

Quite a large proportion of students used a method of differences and showed little working. This approach tended to result in either full marks or low marks for this part of the question.
A few students mistakenly took this to be a question about a geometric sequence question and used inappropriate formulae.

(b) Apart from those students who still thought that they were dealing with a geometric series, nearly all students quoted a correct version of the summation formula and applied it correctly for their values of a and d. However many used d = 13 rather than -13 and therefore lost the accuracy mark.

Question 9

(a) Most students recognised that this question concerned the discriminant $b^2 - 4ac$ and were able to substitute correctly for a, b and c from the original equation.
Most students went on to state that $b^2 - 4ac < 0$ and were able to proceed correctly to the required result. However a significant minority of students failed to show sufficient rigour given that this was a 'show' question. Such students often only inserted the $<$ sign in their final line of working.

(b) The quadratic formula was the most common method used with just a few students attempting the method of completing the square. Most students were able to find the correct critical values for k although a significant number failed to achieve critical values as fully simplified surds as required by the wording of the question. However very few were successful in stating the range of values for k, either failing to go further than identifying the critical values or stating the wrong region.

Question 10

Nearly all students gained the first two marks in part (a), but the rest of the question was not answered as successfully, particularly the final part.
Part (a) was correctly answered by nearly all students although a few persisted in converting to decimals, losing the accuracy mark.

In part (b), many students realised that they were dealing with a geometric series and used the correct *n*th term formula. The accuracy mark, however, was sometimes lost through failure to round to the required accuracy. A few students calculated all 20 terms (not using a formula), while others thought they were dealing with an arithmetic series.

Those who used a geometric series formula in part (b) usually went on successfully in part (c), though it was common for the final answer to be given to an insufficient level of accuracy. Again, there were some students who listed and added all 16 terms, often losing accuracy.
The mark in part (d) was rarely scored. Most students either ignored this part or gave an explanation involving the size of r with no reference to the fact that 12 was the sum to infinity.

Question 11

Most students realised that integration was required in part (a) of this question and the integration was usually completed successfully. A few, however, were uncertain whether to increase or decrease the power. Those who remembered to include a constant of integration most were usually able to calculate its value correctly, though occasional sign errors were seen.

In part (b) students tended either to do very well or to get only one or two marks out of the available five. Those who didn't do well often failed to understand that they had to substitute $x = 9$ into $f'(x)$ or to work out its negative reciprocal, perhaps finding the equation of the tangent rather than the normal. Some differentiated $f'(x)$ again before substituting $x = 9$. Of those whose method was correct, a few failed to give the equation in the required form

Question 12

Many students had a good understanding of transformations of graphs and were able to complete some parts of this question successfully. Students should be encouraged, however, to check their coordinates carefully. Several otherwise perfect graphs lost marks due to sign errors or missing coordinates.
In part (a) most students reflected the graph correctly although they sometimes stopped short at the origin, losing a mark. The few who chose to reflect in the *y* axis were given one 'consolation' mark if their sketch was 'fully correct'.

Part (b) proved more difficult with many students halving all their *x* co-ordinates instead of doubling them, gaining only one mark.

There were many fully correct solutions to part (c), with only a few students translating the curve in the wrong direction. A common slip was to fail to write down the coordinates of the point (-4, 0).

Question 13

This question proved to be accessible to most students.

(i) The majority of students chose to expand the brackets and most succeeded in achieving four correct terms. The next stage, either substituting for $\sin^2 x$ and $\cos^2 x$ or grouping and factorising, caused more problems. A number of students appeared to believe that sin x = 1 – cos x.

Those students who chose the alternative method of replacing the 1 in the RHS bracket with $\sin^2 x + \cos^2 x$ generally fared better as there were fewer algebraic steps needed to complete the proof.
As for all 'show' questions full rigour is expected and the accuracy mark was withheld for poor bracketing and for bad notation such as $\cos x^2$.

(ii) Most students achieved the first method mark by replacing tanθ with sinθ /cosθ. Many then went on to gain all of the marks for the solutions in the range for cos θ = 1/3.However, only a minority of students recognised the presence of the option sinθ = 0 so that most students scored at most 4 marks out of a possible 6 for this part of the question. Many of those students who did produce solutions for sinθ = 0 included 360° despite this being outside the range. However the mark scheme did not penalise the inclusion of solutions outside the range. A few students squared 3sinθ and tanθ and then solved utilising $\sin^2\theta = 1 - \cos^2\theta$ thus running the risk of stating extra values for θ.

Question 14

This question proved to be quite testing for the majority of students, not least in part (a).

(a) A large number of students were only able to score one or two marks on part (a). The majority were able to obtain the equation $6x = 2x^{3/2}$ (or equivalent) but could not deal with the indices correctly and hence could not obtain the value x = 9. Most students were able to obtain the correct coordinate of (0, 3).
Given the wording of the question marks were withheld from students who simply stated the coordinates of A and B without working.

(b) Most students realised the need to integrate one or both functions and there was a pleasing level of accuracy in the integration process. There was a more or less even split between those who integrated for the curve separately and those who first found the difference between line and curve algebraically and then integrated. Subsequent substitution of limits was usually well done although some students gave no working. A significant minority calculated the area of a triangle instead of a trapezium and hence lost the last three marks. Failure to obtain the correct x coordinate for B in part (a) meant that only a minority of students were able to score full marks. A number of able students lost the final accuracy mark as a result of subtracting either areas or functions the wrong way round.

Question 15

Most students were able to make good progress in this question, often gaining marks in all four parts.
For part (a), only a small minority were unable to find the radius using Pythagoras' theorem. There were just occasional numerical slips and a few students who did not give an exact answer for the radius.

Students were generally familiar with the equation of the circle in part (b), though a few forgot to square the radius. Some students went on to expand and collect terms, but this was not necessary for the marks. A surprising number of students attempted to use the equation of a line $y = mx + c$ instead of the equation of a circle, using the coordinates of *P* and *A* to determine *m* and *c* (and so finding the equation of the radius).
In finding the equation of the tangent in part (c), the gradient of *AP* was usually correctly calculated and most students realised that they had to find the negative reciprocal of this. Some students attempted to differentiate implicitly to find the gradient of the tangent, but these attempts were usually incorrect, usually leading to $\frac{dy}{dx} = 2x + 2y + 10 + 12$.

In part (d), most students found the correct lengths for the sides of the triangle and these were usually left in exact form. Those who worked with decimals sometimes finished with an inaccurate final answer. There were some errors in applying cosine rule, with sides being mixed up or the wrong angle being found.

Question 16

This proved to be a testing question for virtually all students. Some papers showed no attempt at this problem but, for the most part, students attempted some or all of the sections. However, few students achieved full marks as errors in lettering often caused even the best students to lose an accuracy mark.

(a) Most students attempted to formulate an equation for volume and then to rearrange to find a value for H. However, a significant number forgot to halve the volume for a sphere and thus started an incorrect equation. Most students showed clear working when trying to rearrange the equation but lettering proved a problem as many did not use H and R as opposed to lower case until the final line of their working. Occasionally a mix of lower case and upper case lettering was seen throughout. Since this was a 'show' question such inconsistency caused an accuracy mark to be withheld.

(b) Only a minority of students showed the three correct separate elements for surface area. Many students had the surface area for the curved face and the roof but failed to accounted for the floor of the building. Other students failed again to deal with the hemisphere as opposed to a sphere giving the surface area for the roof as $4\pi r^2$ rather than $2\pi r^2$.

Most students did achieve an expression $B\pi R^2 + C\pi RH$ and went on to substitute the given formula for H into their answer. Again, lettering proved to be a source of inaccuracy.

In both parts (a) and (b) many students who began with incorrect equations then tried to manipulate their equations in order to get the given solutions.

(c) Many students who struggled with the rest of the question, nonetheless were able to score well on part (c). Most attempted to differentiate A although a few students mistakenly tried to differentiate the equation for H instead. Those who differentiated A correctly then, for the most part, went on to put their answers equal to zero and tried to find a value for R. Errors at this point arose were mainly from losing one of the values of π in their working or showing errors in manipulation of $dA/dR = 0$ when calculating R.

(d) The majority of students attempted to use d^2A/dR^2 in order to prove that R gave a minimum value for A. One of the most common errors at this point was to lose π when differentiating the second term and thus ending up with $3200R^{-3}$ and not $3200\pi R^{-3}$. Other marks were lost on this part of the question when students stated the second derivative but then failed to input any value of R. In order to score the accuracy mark the student was required to have d^2A/dR^2 correct, to make a correct statement with regard to its sign and then to draw a correct conclusion.

(e) Virtually all students who had R correct in part (c) were able to achieve the correct value for H with just the occasional loss of this mark as a result of insufficient accuracy.

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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