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AS/A LEVEL GCE

Examiners' report

MATHEMATICS (MEI)

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4751/01 Summer 2018 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 4751/01 series overview

This legacy paper had a very different cohort to previous years, as year 12 prepare for the new specifications. This meant that many of the candidates were retake candidates.

In this non-calculator paper, weaknesses in arithmetic, especially with negative signs and values, and with fractions were exposed.

Overall, Section A gave candidates of all abilities the opportunity to show what they could do, whilst giving scope to differentiate the more able candidates. In Section B, the three questions were sufficiently demanding in parts to differentiate more able candidates whilst allowing lower ability candidates some access.

The majority of those who needed to use page 12 and/or an extra booklet used them for questions 12(ii) and 12(iii). There was evidence from some candidates of rushing into questions before considering the best approach.

The word 'hence' was used in questions 10 and 12(ii). A few candidates lost marks because they did not, as requested, use the results already obtained in their subsequent work.

Section A overview

The structure of shorter questions here enabled testing of a range of topics. It proved to give candidates of all abilities the opportunity to show what they could do, whilst giving scope to differentiate the more able candidates. Questions 6 and 8(ii) proved to be the most challenging.

Question 1

1 Simplify $(5a^2c)^3 \times 2a^4c^{-5}$. **[2]**

Candidates usually answered this correctly. Where errors were made, it was usually in applying the power of 3 to the number term or to *c*.

Question 2

2 Find the equation of the line joining the points $(-1, 9)$ and $(2, -3)$, giving your answer in the form $y = mx + c$. State the coordinates of the points where this line intersects the axes. **[5]**

Many candidates obtained five marks here, with the $y = mx + c$ and $y - y_1 = m(x - x_1)$ methods both commonly used to find the equation of the straight line. Once they had found the correct gradient, success tended to follow. Candidates who made errors either demonstrated that they had not fully understood negative number arithmetic, or forgot to calculate the intercepts. Very few did not gain any marks.

Question 3(i)

3 Find the value of

(i) $\left(2\frac{1}{4}\right)^{-2}$, **[2]**

Many candidates worked confidently and gained both marks. Some made errors in converting the mixed number to a fraction. A few interpreted the power as an inversion followed by a square root.

Question 3(ii)

(ii) $(8000)^{\frac{2}{3}}$. **[2]**

Candidates who dealt with the cube root first made fewer errors with the zeros than those who first squared 8000. In general, there were more errors in this part than in part (i).

Question 4

4 For the following equation, express x in terms of y.

$$\frac{x}{3y} = \frac{2x+1}{y+2}$$ **[4]**

A good majority of candidates were able to rearrange and factorise to isolate *x*, with a few minor sign and arithmetical slips when collecting like terms seen. Some did not simplify the denominator in their answer, leaving it as $x = \frac{3y}{y+2-6y}$. Some isolated *y* instead of *x* and the mark scheme covered this event. A few candidates made life difficult for themselves by working in fractions throughout – only rarely was this strategy fully successful.

Question 5

5 Find the coordinates of the point of intersection of the lines $y = 4x + 3$ and $3x + 2y = 9$. **[4]**

Candidates were usually confident in the method required to solve these simultaneous equations, and most reached the correct value for *x*. Coping with the fractions in substituting to find *y* was found more challenging by some.

Question 6

6 Find the term that is independent of x in the binomial expansion of $\left(\frac{1}{x} - 3x\right)^6$. **[3]**

There were some good confident answers, elegantly obtained. Some candidates wrote all the terms of the expansion before realising which one they needed, but then often chose correctly. A common error was to omit the negative sign in the final answer. A few candidates had no idea of what they needed to do, although some were able to gain a mark for writing the correct row of Pascal's triangle.

Question 7(i)

7 **(i)** Express $\sqrt{28} + 3\sqrt{175}$ in the form $a\sqrt{b}$, where a and b are integers and b is as small as possible. **[2]**

Many candidates answered this confidently but not all were sure of the technique needed. In general, candidates found it easier to find $\sqrt{28} = 2\sqrt{7}$ than they did to find $3\sqrt{175}$. Quite a common error was to find $\sqrt{175} = 5\sqrt{7}$ and then to omit the factor of 3 in obtaining their final answer.

Question 7(ii)

(ii) Simplify $\dfrac{6}{5-\sqrt{2}} - \dfrac{3\sqrt{2}}{5+\sqrt{2}}$, giving your answer in the form $\dfrac{a+b\sqrt{2}}{c}$, where a, b and c are integers. **[3]**

Most candidates knew what to do, but many lost marks due to making a sign error in the numerator. The other common error was in multiplying two irrational terms, so that $\sqrt{2} \times 3\sqrt{2}$ frequently became 12 instead of 6, or remained irrational.

Question 8(i)

8 For each of the following pairs of sentences A and B, give a reason why the statement A $\Leftrightarrow$ B is false and write either 'A $\Rightarrow$ B' or 'A $\Leftarrow$ B' to show the correct relationship.

(i) A: n is positive.
B: $n^2 + 6$ is positive. **[2]**

Most candidates realised that negative numbers were needed in their argument, but they were not always clear or accurate in what they said. The implication symbols in both parts in question 8 were sometimes poorly written, for instance as a single arrow, which was not accepted. A few candidates, many of whom had a correct argument, gave the wrong answer $A \Leftarrow B$, indicating that they were unsure of the meaning of the symbols. A few candidates tried to use arguments involving odd and even numbers.

Question 8(ii)

(ii) A: The diagonals of a quadrilateral bisect each other but not at right angles.
B: The quadrilateral is a rectangle but not a square. **[2]**

The reasoning in this part was much poorer than in part (i). Some candidates referred vaguely to 'other shapes', which was not sufficient. Others referred incorrectly to trapezium, rhombus or kite. A good minority spotted that the parallelogram was the shape needed which also fulfils the condition given.

Question 9

9 You are given that $f(x) = ax^3 + cx$ and that $f(-1) = 3$. You are also given that when $f(x)$ is divided by $(x - 4)$, the remainder is 108. Find the values of a and c. **[5]**

Some candidates produced a well organised solution, leading directly to the expected values of *a* and *c*, with clear, concise working, and excellent solution of simultaneous equations (including the negative signs). The majority were able to find the correct initial expressions, with a few candidates neglecting to use the remainder theorem, and instead attempting to fully complete the division by $(x - 4)$, to find the second expression – a few managed this successfully. A few candidates interpreted $(-1)^3a$ as $-a^3$, and made little further progress. Some candidates who knew what to do did not subtract/add their equations accurately – some of these were able to spot their errors and recover.

Section B overview

In these long questions, the structure enabled access for all for some parts, whilst giving plenty of challenge in others. Question 12(iii) proved to be the most challenging question in the paper, as intended.

Question 10(i)

10 **(i)** Express $3x^2 - 9x + 5$ in the form $a(x+b)^2 + c$. Hence state the equation of the line of symmetry and the y-coordinate of the minimum point of the curve with equation $y = 3x^2 - 9x + 5$. **[6]**

Most candidates found *a* and *b* correctly. However, many made errors in finding *c*, where they often omitted a factor of 3 when subtracting from 5, or made errors in squaring *b*. Some did not follow the 'Hence' instruction, and some lost marks by giving the coordinates of the minimum point rather than just the *y*-coordinate.

Question 10(ii)

(ii) Find the coordinates of the points where the graph of $y = 3x^2 - 9x + 5$ intersects the axes. Give your answers in an exact form. Hence state the solution of the inequality $3x^2 - 9x + 5 < 0$. **[4]**

This was generally well done, but some candidates lost marks by omitting (0, 5). Expressing the inequality correctly was found the most difficult mark to earn.

Question 11(i)

11 You are given that $f(x) = (2x+5)(x^2 - 5x + 4)$.

(i) Sketch the graph of $y = f(x)$. **[4]**

Most candidates found the intercepts correctly and produced a good sketch of a cubic graph.

Question 11(ii)

(ii) You are given that $g(x) = 2x^3 - 5x^2 - 17x + 48$. Show that $x = -3$ is a root of $g(x) = 0$ and that it is the only real root. **[6]**

Candidates who found g(−3) were usually successful. Those who just divided by (*x* + 3) often did not say that (*x* + 3) is a factor implies that *x* = −3 is a root. Most candidates found the quadratic factor successfully and then used the discriminant. However, some did not relate their conclusion back to the demand in the question. Some others confused factors and roots, e.g. '(x + 3) is a root' and did not earn the final mark. A few candidates had no idea of how to proceed after finding g(−3), with some attempting to use the discriminant on the cubic.

Question 11(iii)

(iii) Show that $y = \mathrm{g}(x)$ is a translation of $y = \mathrm{f}(x)$ by $\begin{pmatrix} 0 \\ k \end{pmatrix}$, finding the value of k. **[3]**

This question was mostly well done. Some candidates did not multiply out f(x) and thought that they only had to compare the constant terms to show that g(x) is a translation of f(x). A few confused the direction, giving $k = -28$ instead of $+28$.

Question 12(i)

12

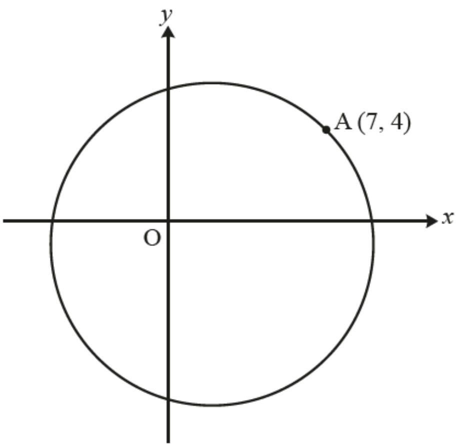

Fig. 12

Fig. 12 shows a sketch of the circle with equation $(x - 2)^2 + (y + 1)^2 = 50$. You are given that the point A (7, 4) lies on the circle.

(i) Write down the radius of this circle and the coordinates of its centre. **[2]**

Answers here were nearly always correct.

Question 12(ii)

(ii) The line L has equation $y = 2x - 10$ and passes through the point A (7, 4). Use algebra to find the coordinates of the point B where the line L meets the circle again. Hence show that the perpendicular distance from the centre of the circle to the line L is $\sqrt{5}$. **[6]**

Most candidates were able to form the correct equation for the intersection and to find the coordinates of B, although arithmetical or algebraic errors meant that some lost their way. Those who found the midpoint were usually able to complete the solution successfully. Some did not appreciate that 'Hence' meant that they should use their answer for B and so did not access the last two marks.

Question 12(iii)

(iii) Show that, when the line $y = 2x + k$ is a tangent to the circle, k satisfies the equation

$$k^2 + 10k - 225 = 0.$$ **[5]**

Candidates found this to be the most demanding question on the paper. Most started by substituting $y = 2x + k$ into the circle equation. A major source of error was in the expansion of $(2x + k + 1)^2$, which was more reliably done by those who expanded the circle equation before substituting $y = 2x + k$. Some did not rearrange the resulting equation to zero. It was always a pleasure to see candidates successfully completing the route to gaining full marks, but not many did. The mark scheme catered for three alternative methods, but candidates rarely completed these successfully. Some candidates had no idea where to begin, and some tried different approaches after making errors. For instance, substituting $k = y - 2x$ into the given result was a common tactic that was not fruitful.

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