Examiners' Report/
Principal Examiner Feedback

Summer 2013

International GCSE Mathematics B
(4MB0) Paper 01R

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General comments

The questions were as accessible as those set in previous sessions, and candidates were able to demonstrate positive achievement. Some questions proved to be quite challenging to many students and centres would be well advised to focus some time on these areas when preparing students for a future examination.

In particular, to enhance performance, centres should focus their candidate's attention on the following topics, ensuring that they read examination questions carefully:

- Coordinate geometry
- Matrix multiplication of matrices other than 2 x 2 matrices
- Surds
- The meaning of the set notation n(S)
- Column vectors – back-substitution of answers to check working
- Applying ratios to similar figures
- Tangent secant theorem
- Pie Charts
- Reasons in geometry
- Linear kinematics

It should be noted that the methods identified within this report and on the mark scheme may not be the only legitimate methods for correctly solving the questions. Alternative methods, whilst not explicitly identified, earn the equivalent marks. Some students use methods which are beyond the scope of the syllabus (such as the product rule for differentiation) and, where used correctly, the corresponding marks were given.

Question 1

Many students were able to add the correct values and subtract from £ 20 (M1) and a large majority of these students wrote down the answer of £ 8.2 (A1). Strictly, this should have been £ 8.20 but the A mark was allowed for 8.2. The most common error was not to work out 5 x 0.15 for the 5 pencils and, as a consequence, £ 8.80 was a common, but incorrect answer earning no marks.

Question 2

A very well answered question with an over-whelming majority of students subtracting (216 + 96) from 360 (M1) to arrive at the required answer of 48° (A1).

Question 3

Again, a popular question with many students correctly evaluating $\frac{18}{450}\times 100$ (M1) to arrive at the required answer of 4% (A1). A significant number of students however evaluated $\frac{18\times 450}{100}$ (M0) and, as a consequence, 81% was a popular, but incorrect, answer.

Question 4

Much wrong working was evident in this question with only a small number of students arriving at the required answer of (3, 4) (B1, B1). Where students had drawn a diagram, often the wrong mirror line had been drawn with $x = 1$ proving to be popular.

Question 5

Recognising that a pentagon is a five sided figure proved to be problematic for some students as the answer of 5 (B1), for part (a), was not seen as often as expected. Whilst an answer of 4 (B1) for part (b) proved to be popular, some students thought that the order of rotational symmetry was 90°, 180°, 270° and 360° and, as a consequence, earned no marks for this part of the question.

Question 6

Not as many students as expected arrived at the required answers of $a = 6$ (B1) and $b = 0$ (B1). Responses to this question and to question 4 suggest that students found this aspect of coordinate geography difficult.

Question 7

Many students were able to show that $x > \frac{-25}{3}$ (or -8.33) (M1) but fewer than expected identified -8 (A1) as the required integer. Many students simply chose to ignore the word 'integer' and left their answer as -8.33. A few either wrote down -9 or the integer 8. All such students lost the last mark.

Question 8

Good work was seen here with -3 correctly substituted and equating to zero (M1) showing that students are well prepared in the process of using the factor theorem. Many correct answers of $k = -13$ (A1) were seen.

Question 9

Students found this question challenging because it involved a 3 x 3 matrix and a 3 x 1 matrix. Indeed many incorrect answers of $\begin{pmatrix} 9 & 4 & 1 \\ 6 & -2 & 8 \\ 9 & -4 & -3 \end{pmatrix}$ were seen as a result of multiplying each value in a row of the 3 x 3 matrix with one value in the column matrix. Only a small number of students had the correct answer of $\begin{pmatrix} 14 \\ 8 \\ 2 \end{pmatrix}$ (M1, A1) seen.

Question 10

Students for this paper were well prepared in algebraic techniques and good working was seen in this question with a correct common denominator of either $(x^2-1)(x+1)$ or $(x-1)(x+1)$ (M1) seen, followed by a correct corresponding numerator of either $x(x+1)-(x^2-1)$ or $x-(x-1)$ (A1) seen. Where the candidate correctly used a denominator of $(x-1)(x+1)$, many arrived at the required solution of $\frac{1}{(x-1)(x+1)}$ (o.e.) (A1). However, many who used the common denominator of $(x^2-1)(x+1)$ either did not cancel down or cancelled down incorrectly and, as a consequence, lost the last mark. A number of these latter students expanded their denominator to x^3+x^2-x-1 and, despite a correctly evaluated numerator of $(x+1)$, were unable to see a further common factor.

Question 11

Answers such as $\frac{17.32-6.93}{3.46}$ did not gain marks, as this question required students to only work in surds. Seeing either $10\sqrt{3}$ or $2\times5\sqrt{3}$ or $2\sqrt{3}$ (M1) leading to $\frac{10\sqrt{3}-4\sqrt{3}}{2\sqrt{3}}$ (M1 dep) invariably led students to the required answer of 3 (A1).

Question 12

Part (a) was testing the understanding of prime numbers. As 1 is **not** a prime number the required answer was 3, 5, 7, 11 (B1). Many incorrect answers, which included 1, were seen. Part (b) was better answered with many correct answers of 1, 2, 3, 5, 7, 9, 11 (B1) seen. Part (c) proved to be a little more problematic for a significant number of students. Indeed, many correctly identified $(A\cup B)'=4,\ 6,\ 8,\ 10$ but then interpreted $\mathrm{n}((A\cup B)')$ as the sum of these elements. As a consequence, 28 was an often seen incorrect answer rather than the required answer of 4 (B1).

Question 13

Whilst many students correctly identified the two column vectors $\begin{pmatrix}28\\4\end{pmatrix}$ and $\begin{pmatrix}3\\-6\end{pmatrix}$ (B1), many of these students did not know what to do next. $\begin{pmatrix}28\\4\end{pmatrix}-\begin{pmatrix}3\\-6\end{pmatrix}$ (M1) followed by a division by 5 to arrive at $\begin{pmatrix}5\\2\end{pmatrix}$ (A1) proved elusive to a significant number of students. This type of question is an ideal question to test whether or not the candidate's answer is correct by substituting back into the original vector equation. Centres should encourage students to do this in order to avoid simple arithmetical mistakes in the candidate's working.

Question 14

Except for a few students who used the area of a circle instead of the circumference of a circle, there was correct working in this question with $\frac{12}{2\times 20\times \pi}=\frac{x}{360}$ (o.e.) (M1) followed by $x=\frac{12\times 360}{2\times 20\times \pi}$ (M1 dep) frequently seen leading to an answer of $34.4°$ (A1). As no degree of accuracy was required in the question, any answer which would round to $34.4°$ was accepted for the accuracy mark.

Question 15

Part (a) proved to be difficult to answer for many students as many did not link the condition to the length of the garden. For those students who identified that when $x = 1.5$ the length of the garden is zero or when $x < 1.5$ the length of the garden is negative the mark (B1) was awarded.

In part (b), some students confused the perimeter with the area of the garden or simply thought the perimeter was length + width. Such students earned no marks. Identifying the perimeter as $2(2x-3)+2(3x+7)$ (M1) enabled students to successfully arrive at $10x+8$ (o.e.) (A1).

Question 16

This question proved to be a good discriminator, many students simply multiplied 500 by 2/5 to arrive at the incorrect answer of 200. Some students recognised that cube values were to be used, and those who did invariably wrote down either $\left(\frac{2}{5}\right)^3$ or $\left(\frac{5}{2}\right)^3$ (B1) and evaluated $\left(\frac{2}{5}\right)^3\times 500$ (M1) to arrive at the required answer of 32 cm^3 (A1).

Question 17

An incorrect conversion between kilograms and grams led to a popular, but erroneous, answer of 4.4. Given the context of the question, a non-integer value should have alerted such students to errors in their working. The required answer of 44 (A1) was arrived at by students who wrote down 4.29×1000 or $\frac{4.29}{97.5}$ or 0.0975 (M1) and followed this by $\frac{4.29\times 1000}{97.5}$ (o.e.) (M1 dep). A few students simply evaluated $\frac{97.5}{4.29}$ to arrive at an answer of 22.7 oranges. Again, by the nature of their answers, such students are advised to check their working.

Question 18

Good work was seen here as many students showed their strong ability at algebraic manipulation. A significant majority were able to successfully remove denominators (M1), factorise out h (M1 dep) and arrive at the required answer of $h=\frac{fg}{g+f}$ (A1). Some students left their answer as either $h=\frac{1}{\frac{1}{f}+\frac{1}{g}}$ or $h=\frac{1}{\frac{g+f}{fg}}$ and only earned one mark as a result.

Question 19

Students did well on this question with many knowing how to express a numerical value in standard form. The figures 15 (in any form eg. 1.5, 150….) or 10^{13} earned the first mark (B1). Any correctly formatted standard form statement earned (M1). The required answer of 1.5×10^{12} (A1) was seen on a significant number of scripts.

Question 20

In part (a), many students correctly expressed 504 as $2^3 \times 3^2 \times 7$ (M1, A1). Very few students however were able to successfully tackle part (b) as, in many cases, the candidate did not recognise that their answer to part (a) was an aid to finding the next square number (7056). An answer of 14 (B1) was rarely seen on a script.

Question 21

Because the two parts of this question could be done independently of each other, there were a significant number of students who scored just two marks by only getting one part correct. Recognising a correct ratio was what was required so, in part (a), $\frac{12}{8} = \frac{AE}{6}$ or $\frac{12}{20} = \frac{AE}{AE+6}$ (M1) led successful students to an answer of 9 cm (A1). In part (b), a common mistake was to write $\frac{CB}{7} = \frac{8}{12}$ leading to CB 4.67 (M0, A0). Successful students, however, wrote down a correct ratio of $\frac{CB}{7} = \frac{20}{12}$ or $\frac{CB}{7} = \frac{"9"+6}{"9"}$ (M1) to arrive at an answer of $CB = 11.7$ cm $\quad (11\frac{2}{3})$ (A1).

Question 22

The majority of students were successful with part (a) with many answers of 24 (M1, A1) seen.
Part (b), however, proved more challenging to students as they did not write down a correct equation of the form $\frac{24+x}{60+x} = \frac{1}{2}$ (M1), which led students to the required answer of 12 (A1).

Question 23

In part (a) there were many correct answers of $x^3 - 3x^2 - 2x + 6$ (M1, A1). A notable mistake, (which still earned the M mark), was -6 instead of +6. Part (a) was an aid in helping to differentiate in part (b) and again, many correct answers of $3x^2 - 6x - 2$ (M1, M1dep, A1) were seen showing that, in general, this cohort of students were confident in their handling of algebra. Some students started part (b) afresh and tried, with mixed success, to use the product rule of differentiation.

Question 24

A few students were unsuccessful with their attempt at this question because they either determined that f(11) = 59 or simply solved $x^2 - 6x + 4 = 0$. In the case of f(11) = 59, no marks were earned. In the case of $x^2 - 6x + 4 = 0$, no more than one method mark could be earned. It was evident that the majority of students understood the topic and showed that f(x)=11 reduces to $x^2 - 6x - 7 = 0$ (M1,A1). Good algebraic technique involving either factorisation or a correct use of the formula (M1) led many to the required solution of $x = 7$, $x = -1$ (A1, A1). Generally, a well-answered question.

Question 25

In part (a), a correct Pythagorean statement of the form $(r+4)^2 = r^2 + 72$ (B1) was sufficient for the mark. Many students however decided to use the tangent secant theorem but rather than writing down $4(4+2r) = 72$ (which would have earned the mark), a significant number of students wrote down $4(4+r) = 72$ and, as a consequence, lost this mark. If part (a) was correct, part (b) generally followed with an answer of $r = 7$ (M1, A1). An incorrectly quoted tangent secant theorem led many to an answer of $r = 14$ which earned the method mark only. There were many different approaches to part (b) with sine, cosine, tangent and even the cosine rule used. A correct trigonometrical method (M1) using their value of r, often led to a correct answer from their figures (A1 ft).

Question 26

This was one of the few questions on the paper where a significant number of students did not attempt it at all. Rather than drawing out a pie chart, students were only expected to complete the table and the key to the solution was in the entry for Michigan where the area of 58 was to be represented by an angle of 87° - a multiplying factor of 1.5 (M1).

For those students who were able to unlock the problem with this key, the majority picked up the marks for identifying Superior (123°) (A1), Huron (88.5°) (A1), Erie (24) (A1). Some students who had the wrong multiplying factor and therefore did not pick up any marks in the first 4 marks, did pick up the fifth mark (B1 ft) by a process of deduction – the sum of all the angles must be 360°. The final mark was available for the area of Ontario. The correct answer of 17 (B1 ft) was seen on scripts where the candidate had earned at least four of the previous five marks. Again, by deduction, this mark was available by subtracting the other four areas from 240.

Question 27

As well as answers, this question required correct geometrical reasons to support the answer.
In part (a), $\angle BPC = 90°$ (angles in a semicircle) (M1) was required followed by a correct use of the alternate segment theorem e.g. $\angle PBC = 58°$ (alt. segment) (M1). These two statements could be in either order. An answer of $\angle PCB = 32°$ (A1) on its own with no reasoning earned only one mark.

Part (b) proved to be a little more successful for students as only one mark was awarded for a reason. The first mark (M1) was for correctly using their answer to part (a), along with other angles found to subtract from 180. The reason to be given was ‘angle sum of triangle’ (M1). Note, ‘angles of a triangle’ did not earn this mark. A final answer of 26° (A1) was seen on many scripts. Centres are advised to encourage students to use correct and appropriate terminology in solving geometrical problems.

Question 28

Whilst $s(1)$ gave the required answer for part (a), no marks were earned for this incorrect method. Students were expected to differentiate (M1, A1), equate to zero (M1) to find $k = 3$. Those students with incorrect method, but a correct k in part (a) were able to recover in part (b). However, ‘the 3rd second’ had a different meaning for different students. Some simply evaluated s(3) = 12 (M1) which earned one mark and then they stopped. Some worked out $s(4)$ and subtracted $s(3)$ from this value. This earned no further marks.

Some students, who did not differentiate in part (a), did so in part (b) and evaluated $2kt - 6 = 2\times3\times3-6$, which gave an answer of 12 thus earning no marks. The third second is the difference between $s(3)$ and $s(2)$ = $s(3)-s(2)$ (M1, M1dep) which gave successful students the required answer of 9 m (A1).

Question 29

Good working was seen throughout this question with a correct Pythagorean statement often seen in part (a) followed by the required conclusion (B1). In part (b), some students were confused between the angles of 36.9° and 53.1° but a correct determination of one of these angles led to two of the three available marks (M1, A1). The final mark (A1) was for identifying the required angle as 53.1°. An answer of 53.13° lost this last mark as the answer was required to 3 significant figures. Further correct trigonometrical work was seen on many scripts in part (c) and $\frac{h}{25} = \cos 53.1$ (M1) was often seen with $h = 15$ (A1). This was subsequently added to 24 to arrive at the answer of 39 cm. (A1 ft). Some students thought that the height was simply $\sqrt{(30)^2 + (25)^2}$. This gave a length of 39.05 cm – which was close to the required value but earning no marks due to an incorrect method.

Grade Boundaries

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