Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2020

Pearson Edexcel International GCSE
In Mathematics B (4MB1) Paper 2R

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Paper 02R

Introduction to Paper 02R

While examiners did report many excellent responses to questions, some candidates did seem under-prepared for this paper with examiners reporting many blank responses to the later questions on the paper.
To enhance performance in future series, centres should focus their candidates’ attention on the following topics:

- Enlargements with negative scale factors
- Questions that involve the demand to show all working (most notably questions 5) or working from a previous part (most notably question 3 part (b))
- Giving answers to the required degree of accuracy
- Application of bounds
- Vectors

In general, candidates should be encouraged to identify the number of marks available for each part of a question and allocate a proportionate amount of time to each part of the question. In addition, candidates should also be advised to read the demands of the question very carefully before attempting to answer. It should be pointed out 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 candidates use methods which are beyond the scope of the syllabus and, where used correctly, the corresponding marks are given.

Report on Individual Questions

Question 1

A significant proportion of candidates encountered difficulties in part (a) with reverse percentages and many incorrectly increased 20340 by 10% and then increased their result by 20%. It was interesting to note that many candidates seemed to favour a fraction approach rather than an arguably more direct decimal approach. Often the notation used by candidates did not allow the release of the corresponding method mark – for example, it was common to see: $(1 - 10\%)\,x = 20340$. However, in most cases, candidates were able to obtain full marks by recovering to obtain the correct answer. It would be beneficial to remind candidates to write equations using decimals or fractions rather than percentage signs.
Part (b) was usually more successfully attempted. Most candidates seemed to be well-prepared for finding a percentage change. There was roughly an equal split between those who used the formula: ‘(difference/original amount) $\times$ 100’ and those who, equivalently, divided 19323 by 20340 and then deduced that there was a 5% reduction. A common error that arose occurred when candidates misread the question and instead of finding the percentage change from March 2018 to March 2019, found the percentage change from March 2016 to March 2019. It was also reasonably common to see the value of -5%.

Question 2

This question highlighted misconceptions with ratio and therefore provided a good spread of marks. The less able candidates set the sum of the ratios: $1 + (2x + y) + (x + 2y)$ equal to the sum of the weights $105 + 252 + 273$ and were unable to make further progress. The more able candidates were able to link the ratio and the weight and set up two simultaneous equations such as $2x + y = 252$ and $x + 2y = 273$ giving rise to the common, but incorrect answers of $x = 77$ and $y = 98$. These candidates had failed to take account of the proportion aspect and, as a result, lost at least two marks overall. The most successful candidates were able to formulate equations which represented the proportions correctly. The most common of these involved comparing cement to sand and then cement to gravel and, indeed, this approach led to the simplest equations. Other more complicated equations were formed involving the total mass of the materials. Most candidates were able to earn the method marks for solving their simultaneous equations and the majority who obtained the correct solution, gave it as a simplified fraction as had been requested. Unfortunately, in some cases candidates wrote down very little working in this part and as result, were unable to earn marks for method when accuracy was lost. Candidates should be advised to demonstrate their method to avoid loss of marks in these cases.

Question 3

Most candidates were able to find the inverse of the given 2 by 2 matrix in part (a). Examiners commented that they saw very few errors in this first part. Where they did occur, errors included obtaining a determinant of +2 rather than -2 or failing to adjust the matrix entries correctly.
In part (b), candidates had been asked to use their answer to part (a) to find the solution of the simultaneous equations in matrix form. It was overwhelmingly the case that either candidates did not read the question carefully or that they chose to answer using an alternative method via multiplying out the matrix and obtaining two simultaneous equations in x^2 and y which could then be solved. This approach incurred a penalty of one mark. In some cases, candidates had been unable to answer part (a) but were able to attempt (b) via this alternative method. Unfortunately, this approach was sometimes unsuccessful where candidates were unable to multiply the 2 by 2 matrix by the column matrix correctly and in some cases did not manage to obtain two equations in x^2 and y. Candidates using part (a) and the inverse of the matrix were usually successful however in some cases, candidates incorrectly attempted to post-multiply the column matrix by the inverse rather than pre-multiply. This led to some creative matrix multiplication and did not earn any marks. Most candidates who obtained two correct equations either using part (a) or otherwise, managed to solve the equations correctly, although it was common for $y - =4$ to be omitted.

Question 4

This question highlighted many misconceptions with bounds. It proved to be a very tricky question for most candidates with most obtaining very few marks. Even part (a)(i) which should have been quite accessible was found to be difficult for many. Candidates struggled to cope with different levels of accuracy for each weight and furthermore, a surprising number of candidates incorrectly deduced ranges of weights interpreting ‘7.5kg to the nearest 100g’ to be a weight within [7.4, 7.6) rather than [7.45, 7.55) for example.
Parts (a)(ii) and (iii) were more challenging and it was very common to see candidates using upper bounds for both weights in (ii) and then both lower bounds in (iii). Some candidates also missed that in part (iii) they had been asked for the lower bound to the nearest 50g although, given that it was generally the more able candidates that got to this point it was relatively few who gave too accurate an answer here. Weaker candidates were seen to calculate the difference between the two stated weights followed by an attempt to add or subtract amounts to erroneously determine the upper or lower bound.

Part (b) was more challenging and only a minority of candidates earned marks here. The less able candidates ignored the bounds altogether and simply calculated 45 times 220 and deducing that Bertie did not have enough sweets. Alternative responses included a partial attempt to consider bounds with an incorrect statement that the lower bound of the jar of sweets was 9.8 (rather than the correct 9.9); concluding therefore that Bertie *did* have enough sweets. It was clear that candidates were not confident in transforming a stated degree of accuracy into a range of possible values. Furthermore they did not realise that they needed to work out the lower bound of the weight of sweets in 45 bags and compare this to the lower bound for the weight of sweets in a full jar or, alternatively, calculate the largest number of bags required by using the upper bound for the weight in the jar and the minimum weight of sweets in a bag. Some candidates were unable to gain the final mark here because their conclusion was not explicit enough or because they referred to an upper bound of 46 bags.

Question 5

This question split candidates into two main groups. Those who were clearly well prepared for this style of question and who immediately wrote 45 as $3^2 \times 5$ (or, more rarely, $45 = 9 \times 5$ and 3^{4x} as 9^{2x}) and those who incorrectly attempted to combine terms with different bases to obtain, for example, $675^{4x+3x+1+1-2x}$ on the left hand side. Usually, candidates who replaced 45 with $3^2 \times 5$ were able to make good progress and either combined the powers of three so that they were reduced to 3^0 or, immediately wrote down an equation for the powers of five only to compare with the power of 4 on the right hand side. However, some candidates were less successful and were unsure how to proceed with an equation that included terms of different bases. Others tried to combine terms with base 5 and those with base 3 at this stage ultimately obtaining incorrect equations involving terms of base 15 or simply ignored the bases altogether and wrote down an equation with all the power terms. This method led to the correct answer of $x = 2$ due to the cancelling of the powers of 3 but since the method was incorrect, could not earn the corresponding accuracy marks. A small number of candidates managed to get the answer of $x = 2$ with very little working and then confirmed it via substitution. Given that the question had asked for clear algebraic working, such an approach was unable to earn full marks.

Question 6

Part (a) proved to be accessible to most candidates. In part (ii), most candidates worked out $\mathrm{h}\left(-\frac{1}{4}\right)$ to get -24 and then calculated $\mathrm{f}(-24)$ rather than finding the composite function $\mathrm{fh}(x)$ first.

Part (b) was found to be quite accessible for most candidates and many were able to gain some marks here. Marks were sometimes lost when $(\mathrm{hf})^{-1}$ was given in terms of y rather than x or when the value of x to be excluded from the domain was given as $x = -3$ or sometimes $x = 2$ (which would give zero numerator rather than zero denominator). Weaker candidates sometimes thought that $(\mathrm{hf})^{-1}$ meant the reciprocal of $\mathrm{hf}(x)$ so wrote down $\dfrac{x+3}{6}$. Others made mistakes multiplying both sides of the equation $y = \dfrac{6}{x+3}$ by $(x+3)$ obtaining for example, $yx + 3 = 6$.

Part (c) was well done by many candidates. The majority understood how to combine functions h, g and f correctly with only a minority of candidates finding $\mathrm{fgh}(x)$ rather than $\mathrm{hgf}(x)$. Some candidates lost marks when they made errors expanding the quadratic $(x + 3)^2$ to obtain $x^2 + 9$ and others made arithmetical errors when rearranging $\mathrm{hgf}(x) = 2$. When errors occurred, it was sometimes not possible to award method marks as insufficient steps were shown in working.

Question 7

Part (a) was answered correctly by almost all candidates.
Part (b) was usually correct. Where errors occurred, it appeared to be due to miscounting the number of relevant multiples. Probabilities were almost always given in fraction form: sometimes simplified but often not simplified. Either form was acceptable.
Part (c) was very challenging for many candidates and it was very common to see incorrect answers such as P(Ahmed wins) = $\frac{4}{20}\times\frac{3}{20}$ or P(Ahmed wins) = $\frac{4}{20}+\frac{3}{20}$ etc. It was clear that many candidates were confused by the multiple branches and did not know how to tackle a complex probability tree diagram nor how to find the probability of several successive events taking place. Most candidates did not realise that the game could comprise between 1 and 4 rounds and that Ahmed could only win in 1 or 3 rounds and Hani only in 2 or 4 rounds. Almost all candidates who managed to obtain the correct probabilities gave conclusions which were enough for full marks.

Question 8

This question was successfully attempted by many candidates and was a good source of marks. Candidates had been asked to give answers to 3 significant figures and are therefore reminded that they should give answers to the degree specified in the question.
All parts were well attempted. Errors usually arose due to mixing up sine and cosine in the respective formulae in parts (a) and (b) or missing a factor of ½ in the calculation of the area of triangle *DCM* in part (d). Some candidates incorrectly treated the triangles as right angled triangles in one or more than one part of the question. In part (d), some candidates took a longer route to a solution and found the area of triangle *ABC* and then determined the proportion of *ABC* required for triangle *DCM*. Examiners noted that they saw several responses where candidates misinterpreted the ratio $AD : DC = 1 : 2$ as $AD = \frac{1}{2}AC$.

Question 9

This question proved to be a good differentiator. Almost all candidates were able to correctly draw triangle *A* in part (a) and many were able to pick up at least one mark in part (d) often for 'enlargement' or 'scale factor 2' and less commonly 'centre $(9,-8)$'. Examiners saw several responses where candidates had stated more than one transformation and so were unable to obtain marks in part (d) as the question had clearly specified that a single transformation be given.
Success in parts (b) and (c) was more varied. Some candidates attempted to write down matrices to assist in determining the new vertices of the triangles, but this did not take account of the centre not being at the origin. It was surprising to see that weaker candidates had not realised that the side lengths of triangle *B* should be half that of *A* nor that triangle *C* should have the same side lengths as *B*. It was quite common to see no construction lines used especially for part (d). Sometimes when they *were* present, construction lines did not go through the relevant centre of the transformation.

Question 10

This question also proved to be a good differentiator. It was clear that some candidates were very well prepared for a question on vectors whereas others seemed to have much more difficulty working with vectors effectively. A reasonable number of candidates fared well with part (a) but for others, errors cropped up repeatedly resulting sometimes in very few marks here. There were several opportunities for candidates to pick up method marks even if earlier work had been incorrect but often errors of the same manner occurred from one part of the question to the next which meant that an incorrect method had repeatedly been used. It seemed that, for some reason, many candidates were confused about the vector $\overrightarrow{OA} = \mathbf{a}$ being from left to right on the page and many used $\overrightarrow{AO}$ or $\overrightarrow{OD} = \mathbf{a}$ rather than $-\mathbf{a}$. Other issues arose when candidates made mistakes with vector addition, believing that, for example, $\overrightarrow{AC} = \overrightarrow{BA} + \overrightarrow{CB}$ or similar.

In part (b), candidates were asked to express $\overrightarrow{ON}$ in terms of **a**, **b** and λ and so it was surprising that some chose to write simply $\overrightarrow{ON} = \mu\mathbf{b}$ which had been given in the question. Of those that did write down an expression for $\overrightarrow{ON}$ in terms of **a** and **b**, different routes were used: for example, the direct route of $\overrightarrow{ON} = \overrightarrow{OA} + \overrightarrow{AN}$ or the less direct route of $\overrightarrow{ON} = \overrightarrow{OD} + \overrightarrow{DC} + \overrightarrow{CB} + \overrightarrow{BA} + \overrightarrow{AN}$. Some candidates did not simplify their expression by collecting terms in **a** but this was condoned provided there were two terms in **a** and one in **b**. Once an expression for $\overrightarrow{ON}$ had been found, some candidates did not manage to equate their expression to $\mu\mathbf{b}$. Of those that did equate the two expressions for $\overrightarrow{ON}$, a significant number of candidates were unsure how to proceed to solve an equation in terms of two non-parallel vectors **a** and **b**. However, some candidates who did not make progress in part (b)(i) managed to access (ii) by expressing $\overrightarrow{AN} = \overrightarrow{AO} + \overrightarrow{ON}$ and then by equating this to $\lambda\overrightarrow{AM}$ and comparing coefficients of **a** and of **b**. It seemed that the relationship $\frac{1}{2}\lambda = \mu$ was more easily identified than the result from the coefficients of **a**.

For those candidates who managed to progress to the end of part (c), part (d) was often completed successfully.

Question 11

Most candidates were able to correctly calculate the missing values of y although some lost a mark for rounding incorrectly (either to one decimal place or to more than two decimal places). Plotting the curve was sometimes more problematic. Some candidates failed to plot the point at $x = 0$. Others did not realise that curve should dip between $x = 0.5$ and $x = 1$ and so drew a straight line between these two points. For other candidates, errors arose with either plotting points inaccurately (the point (4, 2.53) sometimes caused issues) or struggling to draw a smooth curve passing through all the relevant points. Overall though, curves were well drawn.

Part (c) was a differentiator and several candidates did not make much progress here. Some candidates rearranged the equation to $-\frac{1}{6}x^3 + \frac{6}{5}x^2 - \frac{3}{2}x = x^2 - 5x + 3$ but then were surprisingly unable to write down the intersection points correctly. Sometimes giving no solution and sometimes giving intersection points with the axis rather than intersection points between the two curves. Some candidates wrote no working out, perhaps making use of a calculator to find solutions which were then checked on the graph (usually evidenced by $x = -4.4$ being considered). Sometimes candidates lost a mark here for failing to give values to 2 decimal places – usually 4.8 instead of 4.80.

The x coordinates for P and Q often appeared in part (d) even if they were absent in (c) and this part of the question was often more successful. However, there were several sources of error. For example, examiners saw calculations for the gradient that included: 'change in x / change in y' or $(y_2 - x_2)/(y_1 - x_1)$ or even '$(y_2 + y_1)/(x_2 - x_1)$ where candidates had perhaps become confused by the minus sign for the x-coordinate at P. Other incorrect responses included those that differentiated the cubic and then either tried to find stationary points on the curve or tried to find the gradient at P and/or Q.

Part (e) was accessible to candidates in a variety of ways. Some simply read off the intercept of their line between P and Q. Others used the coordinates for P and Q to set up a pair of simultaneous equations independent of part (d) and others used the gradient from (d) and the coordinates of either P or Q or some other point on the line PQ to find b. Earlier inaccuracies often meant that only one mark was available here even if the method was sound.

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