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Examiners' Report January 2009

GCE O Level

O Level Mathematics B (7361)

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Mathematics B

Specification 7361

Paper 1

Introduction

Once again it was pleasing to see that many candidates are well drilled in standard techniques, particularly in algebraic manipulation. Significantly though, where the wording or layout of questions deviates from the normal expected, candidates seem to have difficulty. Q11 was one such example where many candidates seemed to have difficulty in finding the required answer for *x*. Another example was Q18 where the length of the chord rather than the radius of the circle was given.

Further evidence of candidates' responses also suggests that other areas of the syllabus and techniques that centres should address are:

- The difference in the meaning of the phrases *equidistant from two lines* and *equidistant from two points* (Q2)
- Ratio of areas of similar figures (Q6)
- Combination of two transformations (Q9)
- Checking that answers make sense (Q12)
- Determining a median from non-ordered data (Q14)
- The number 2 is a prime number (Q17)
- Standard variation techniques (Q19)
- Methods of showing geometrical properties (Q20)
- Solving matrix equations (Q24)
- Determining heights of bars in histograms (Q28)

There was no evidence that candidates did not have enough time to complete the paper.

Report on Individual Questions

Question 1

Many correct answers of 0.0625 (B1) and 6.25% (B1) were seen. However, a significant number of candidates either truncated their answer to part (a) (0.06 or 0.063 proved to be popular incorrect answers) or divided by 100 in part (b) to arrive at an incorrect answer of 0.000625.

Question 2

Many candidates did not seem to understand the requirements of the demand '*the line which is equidistant from PQ and PR'* and many scripts showed perpendicular bisectors of a side or sides of the triangle rather than the angle bisector of $\angle$ RPQ. Of those candidates who did recognise the correct requirement, much good work was evident as many correct and accurate bisectors were seen (M1, A1).

Question 3

Candidates were generally good at reorganising the given inequality so that like terms could be collected (M1). However, removing the denominator of 3 proved to be quite problematic with many incorrect inequalities similar to $12x - x > 1 + 10$ seen. As a consequence, not as many candidates as expected arrived at the required answer of $x > 3$ (A1). Candidates using the equality sign throughout were penalised.

Question 4

Many incorrect answers of 120 mins were seen in part (a) rather than the required answer of 75 mins (B1). This common incorrect answer seemed to be as a result of interpreting '*the total time in minutes that the train was moving'* as the total time taken for the journey. Better attempts were made for part (b) with many correct answers of 45 mins (B1) seen.

Question 5

The required answers of (a) 0 (B1) and (b) 2 (B1) were seen on many scripts. However, a significant number of candidates see the diagonals of a parallelogram as lines of symmetry and many answers of 2 were observed in part (a).

Question 6

Using area ratios of similar shapes still proves to be problematic to candidates and much incorrect working was seen. Indeed, the most common incorrect working seen seemed to be: Required area = $\frac{4.5}{9}$ x 54 = 27 cm^2. Much incorrect working was also seen on many scripts by candidates who seemed to want to use the data given in the question and work out the area of the required trapezium independently of the fact that the two trapezia are similar. So many scripts simply showed the required area as ½ . (4.5 + 4.5) . 9 = 40.5 cm^2. A correct statement $(\frac{4.5}{9})^2$ x 54 = 13.5 cm^2 (M1, A1) was only seen on a minority of scripts.

Question 7

Except for some candidates who seemed to be confused into using 360° incorrectly, this was a well answered question with many correct initial equations of the form
$4x + x = 180°$ (M1) leading to the required answer of 36° (A1) seen.

Question 8

Many candidates were able to correctly identify the 6th and the 15th term (M1) but a significant number of these candidates simply left their answer as 11 and 29 thus losing the last mark which was for the sum of these two terms, 40 (A1).

Question 9

A surprisingly difficult question for many candidates as few correct answers were seen. It seems that a combination of two transformations and the introduction of algebraic notation prevented the appearance of the required answers of $w = 90°$ (B1) and $a = -1$ (B1).

Question 10

A very well answered question with much correct working seen. The majority of candidates were well able to use the total of 1000 cars and the total number of degrees of a circle to arrive at the expression $\frac{126 \text{ x } 1000}{360}$ (M1, M1 dep) to give the required answer of 350 cars (A1). For those candidates who did attempt the question and arrived at the wrong answer, (45.36 was a common incorrect answer seen), a non-integer value should have suggested something was not quite right.

Question 11

Much incorrect algebra led to many wrong answers here. Many candidates simply failed to equate two expressions for x correctly with $-3x + 4 = 3 - 2x$ proving to be the most popular incorrect equality. As a consequence, the incorrect answer of -1 was seen on many scripts. Candidates are normally well drilled in the standard technique of solving simultaneous equations. This question was a slight variant on the standard way of expressing two such equations and centres should ensure that their candidates are prepared for such examples. Successful candidates equated correctly (M1) and rearranged (M1 dep) to arrive at the required answer of 7/5 (A1).

Question 12

Many incorrect answers of 540 km were seen in part (a) as a significant number of candidates seemed to be confused by the units. An awareness of how far 540 km actually is might have helped some candidates to the realisation that this distance is impossible for a cyclist in 30 minutes. Those who correctly multiplied 18 by 0.5 arrived at the required answer of 9 km (B1). Irrespective of their answer to part (a), candidates could have picked up the method for part (b) by writing $\cos 50° = \frac{\text{their } 9}{\text{distance to mast}}$ (M1). However, a significant number of candidates did not seem able to interpret what was required in the question and used the wrong trigonometrical ratio or determined the wrong length. In many incorrect methods seen, a diagram drawn might have been helpful for these candidates. As a consequence of wrong answers in part (a) and incorrect methods in part (b) the required answer of 14.0 km (A1) was not seen as often as expected.

Question 13

Clearly representing a range (B1) with the acceptable notation for the endpoints (B1) on a number line is not well practiced in some centres as a variety of incorrect notations and dual lines were seen in part (a). Part (b) was generally better done than part (a) as it was independent of the this first part and simply required the candidate to write down -1 and 0 (B1).

Question 14

Even very able candidates seemed to be caught out with part (a) in this question as 426 proved to be a very popular, but incorrect, answer. Correctly ordering the data first invariably led to the required answer of 234 (B1). Part (b) was done very well with many correct answers of 266 (M1, A1) seen.

Question 15

Much correct working was seen in this question as candidates are well versed in algebraic techniques. Many candidates were able to recognise the common factor of x (M1), and were then able to correctly factorise the resultant quadratic (M1). Bringing the two components together into the required answer of $x(3x - 1)(x + 1)$ (A1) proved to be elusive to a significant number of candidates with many simply writing down an answer of $(3x - 1)(x + 1)$ and therefore losing the last mark.

Question 16

Despite many attempts at differentiating the given function (M1), correctly differentiating $\frac{1}{x}$ proved to be elusive to many. This did not prevent such candidates correctly substituting $x = 2$ into their differentiated function (M1 dep) but the required answer of 9.75 (A1) proved to be elusive to many. A popular incorrect answer was 10.25 which was arrived at by an incorrect differentiation of $\frac{1}{x}$.

Question 17

Identifying that the number 2 was not prime proved to be the downfall of many candidates in parts (a) and (b) with many incorrect answers of (a) 2, 4 10 and (b) $\varnothing$ seen rather than the required answers of (a) 4, 10 (B1) and (b) 2 (B1). Some candidates recovered in part (c) with many correct answers of 9, 15 (B1) seen.

Question 18

For candidates who used a radius value of 10, rather than the correct radius of $\sqrt{(10^2/2)}$ (B1), meant that only a maximum of two method marks were available for such candidates. Using their value of the radius, much correct method was seen as many candidates correctly identified at least one correct area (M1) and then found the difference between two correctly found areas (M1 dep). The required answer was 14.3 cm^2 (A1) but a significant number of candidates arrived at 14.4 cm^2 following a premature approximation to their value of the radius.

Question 19

Except for the minority of candidates who misread the question as a direct proportion question and, as a consequence, lost all the marks, much good working was seen here as many candidates are well drilled in the necessary technique. Many correctly found the constant value as 1500 (M1, A1) and correctly substituted this value into $\frac{k}{x^2}$ (M1 dep) to arrive at the required answer of 60 (A1).

Question 20

Whilst many candidates showed one correct pair of angles equated with a valid reason (B1) followed by a second correct pair with a valid reason and a correct conclusion (B1), a significant number of candidates showed a circular argument with an assumption of similarity to prove similarity and thus earned no marks for part (a). Part (b) was generally better attempted with many candidates identifying a correct pair of ratios equated to each other (M1) leading to the required conclusion (A1).

Question 21

Despite a rather complex change of subject question, this was done well by those candidates who were able to handle the two denominators correctly. A variety of successful methods were seen all of which involved, (in some order), removing denominators correctly (M1), expanding bracketed terms (M1), and collecting the terms in x (M1). It was pleasing to see that many of the more able candidates were able to reach the required answer of $x = \frac{a}{1 - a - ay}$ (A1).

Question 22

The majority of successful candidates in part (a) determined that $n(B \cap (A \cup C)') = 5$ (M1) to arrive at the required answer of 16 (A1). The most common incorrect answer was 9 which was arrived at by simply calculating $n(B) = n(A \cup B) - n(A)$. To determine the required answer for part (b), a candidate was required to work out either the number in $(A \cap B')$ and add to $n(B \cup C)$ (M1) to arrive at 43 or was required to work out the number of elements in the three regions with missing numbers and adding on 11. Candidates who arrived at the required answer of 43 using correct methodology. but incorrect figures earned only (M1, A0) for this part of the question.

Question 23

Those candidates who did not determine the height (M1) of the cylinder earned no marks for this question. Numerical slips for the height were allowed for the method in the remainder of the question but using 12 cm or 20 cm was not allowed. It was pleasing to see that many candidates knew the correct volume formula for either or both the cylinder and the cone (M1) and most, who got this far, identified that the required volume was the difference (M1 dep) between these two values. Despite reminders over many years about giving answers to the required degree of accuracy, some candidates lost the last mark because they failed to round to the required three figure accuracy of 4830 cm^3 (A1). An alternative acceptable answer was 4820 cm^3. On some scripts, candidates seemed to feel that 3 significant figures meant giving only 3 figures and, as a consequence, 483 or 482 were answers not infrequently seen.

Question 24

For those candidates who recognised that the given matrix form led to one quadratic equation, this question was straightforward and led to many correct answers following the derivation of the correct equation, $10x^2 - 13x - 3 = 0$ (M1, A1). While some candidates seem to persist in using the formula to solve a quadratic equation, this quadratic factorised to $(2x - 3)(5x + 1) = 0$ (M1) to enable a significant number of candidates to write down the required answers of $\frac{3}{2}$ and $-\frac{1}{5}$ (A1, A1).

Question 25

Although a minority of candidates calculated the percentage of sand in the mixture rather than the percentage of cement, it was pleasing to see many correct answers of 12% (B1) for part (a). Part (b) proved to be quite difficult for many with a popular incorrect method and answer seen of $2x + 3x = 25$ so $x = 5$. Many candidates could not use the extra x kg of water and x kg of sand correctly and only on a few scripts was the expression $25 + 2x$ seen (B1). Even more elusive was the appearance of the original quantity of sand, 22 kg (B1) in order to form the required equation of $\frac{22}{25 + 2x} = \frac{2}{3}$ (M1). As a consequence, the answer of 4 kg (A1) was not seen as often as expected.

Question 26

After many correct uses of Pythagoras (M1), a significant number of candidates wrote down $k = 4.24$ rather than the required answer of 18 (A1) and consequently lost the last mark in part (a). Part (b) saw much further correct Pythagorean work (M1, M1 dep) leading to the required conclusion (A1). A significant number of candidates used successfully used the property that the product of the gradient of two lines which are at right angles to each other is -1. This, of course, earned full marks.

Question 27

This proved to be a very popular question as many candidates are well drilled in using defined binary operations and many correct first steps of $\frac{3 + x}{3 - x} = \frac{x + 4}{x - 4}$ (M1) were seen. Except for the occasional arithmetical slip, the denominators were removed correctly (M1 dep) and the terms expanded (M1 dep) enabling many

candidates to arrive at the correct quadratic equation of $2x^2 - 24 = 0$ (o.e.) (A1). While many candidates wrote down an answer of 3.46 (A1), most did not recognise that there are two answers to a quadratic equation and -3.46 (A1) was often missed.

Question 28

Histograms always prove to be difficult for candidates and this question proved to be no exception. Many candidates were able to draw four bars in the correct positions (B1) but the correct heights of 0.9, 1.4, 2.3 and 1.7 (B3) proved to be quite elusive to many. Using $\frac{\textit{number of goals scored (frequency)}}{\textit{time interval (class width)}}$ = *height of given bar* as a starting point in all questions of this nature would enable more candidates to be more successful with this type of question. In part (b), the majority of candidates did not seem to recognize that for the first twenty minutes meant that they were expected to arrive at an estimate by finding 2/3rds of the number of goals scored in the second interval and add to the number of goals scored in the first interval (M1). The answer of 23 goals (A1) was only seen on a small minority of scripts.

Question 29

A correct trigonometrical ratio (M1) was seen on many scripts leading to the required answer of 17.5° (A1) for part (a). Whilst many candidates correctly determined the length of *AD* (M1) in part (b), much good work was then spoilt by incorrect statements of the form tan 20° = *BE*/*AD* leading to a very popular, but incorrect, answer of *BD* = 6.47 cm. Using tan (20 + 17.5)° = *BD*/*AD* (M1 dep) led a minority of candidates to the required answer of 7.31 cm (A1). As usual, in this type of question a range of 3 significant answers were acceptable. This range was 7.30 → 7.32 cm. Much correct working was seen in part (c) as many candidates recognized the symmetry of the diagram and many correct statements of the form $\frac{1}{2}$ x(2 x *AD* x *BD*) (M1) were seen. Answers, to 3 significant figures in a given range (69.5 → 69.8 cm^2) (A1) were seen only on those scripts where candidates had previously shown correct working in part (b).

Mathematics B

Specification 7361

Paper 2

Introduction

There was no general indication that the examination paper was too long, with many candidates attempting most of the questions. Overall, the standard of presentation and clarity of work was high.

Once again, it was pleasing to observe that many of the candidates have a good understanding of the basic techniques of arithmetic, algebra and two dimensional trigonometry and were able to apply them correctly. The major discriminating questions were Q2 (ratios and converting between distance units), Q5(d) and Q5(e) (dependent events), Q7(d) (giving geometrical reasons), Q8(b) and Q8(c) (vectors) and Q11(d), whilst minor discriminating questions were Q1 (percentages), Q6(c) (composite functions), Q9(e) (vector translations) and Q10(e) (surface area). These will be discussed below.

Report on Individual Questions

Question 1

There were a number of correct attempts at this question but fewer than expected. Many candidates scored zero. When candidates did attempt the question, many incorrect solutions were seen here as the candidates had a poor understanding of the calculation of percentage increases. Thus, $\frac{3.6^3 - 3^3}{3.6^3} \times 100$ was often seen scoring just one mark in total (the B1 for 3.6).

Question 2

As mentioned above, this question was one of the discriminators of the paper. In both parts of the question, there was a lot of confusion over the conversion of units. Of those candidates who did understand how convert between units, many lost the answer mark in part (a) because they did not express their answer in the required form – many gave their answer as n = 40000, for example. In part (b), many candidates failed to square the scale factor.

Question 3

On the whole, this question was correctly answered by many candidates. However, there was a significant number of candidates who failed to recognize the need to differentiate. Of these, $21 = \frac{6t^2 - 3t + 1}{t}$ was often seen and this was followed by an attempt to solve a quadratic equation. Of those that did differentiate in part (a), many failed to differentiate again in part(b). Most, but not all, of those who obtained 12 for the acceleration did conclude that it was a constant.

Question 4

It was pleasing to see that even the weaker candidates managed to collect full marks for this question. Indeed, the majority of candidates knew how to deal with algebraic fractions, and a large number of the mistakes that did occur were sign errors in collecting terms. Quite of a lot of the candidates needed to use the formula to solve $x^2 + 7x + 6 = 0$.

Question 5

This was poorly attempted Judging by the number of candidates who failed to collect marks for the first three parts, it seem to be advisable for Centres to spend more effort on Venn diagrams. In parts (d) and (e), it was clear that many candidates had a poor understanding of probabilities without replacement. So, often seen, was $\frac{3}{25}\times\frac{3}{25}$ in part (d) and $\frac{2}{25}\times\frac{2}{25}$ in part (e), both collecting the B mark for $\frac{3}{25}$ in (d) and $\frac{2}{25}$ in (e). Also, in parts (d) and (e), many candidates tried to add probabilities rather than multiply.

Question 6

There were many correct answers to part (a), however, there were a number of candidates not being able to evaluate $\frac{1}{\left(\frac{1}{2}\right)}$. Most candidates knew how to do part (b) but there were frequent errors in signs and multiplying out brackets. Unfortunately, many did not give the answer in the required form. Most candidates made a reasonable attempt at obtaining an expression for hfg(x), but a large number made sign errors in forming the quadratic. Also, there were several occurrences of a cubic rather than a quadratic being obtained which resulted in the loss of at least 3 marks. Commonly seen were solutions using only one of the square roots which resulted in the loss of the last 3 marks.

Question 7

A surprising number of candidates in part (a) did not manage to use the given formula correctly and of those that did, some forgot to divide by 8. Some found the exterior angle and not all then used it to find the interior angle. Many candidates correctly answered parts (b) and (c). As in previous examinations, many candidates again failed to provide geometrical reasons as instructed in part (d). A lot of candidates found two angles to be 67.5°, but sometimes it was the wrong two (usually $\angle CBY$ and $\angle BCY$ which was in fact 45°). Candidates who correctly found that $\angle CBY$ and $\angle CYB$ were 67.5° but did not give any relevant reasons scored one mark for this part.

Question 8

The candidates who had some idea about vectors mostly got part (a) correct, although there were some sign errors. Part (b), on the other hand, proved to be too difficult for many candidates. Many candidates tried to find $\overrightarrow{MP}$, but did not use the given ratio correctly to find $\overrightarrow{AP}$. As in previous examinations, there was widespread division of vectors and it be would prudent of Centres to advise their students that the division of a vector by a vector is always penalized.

Question 9

On the whole, this question was well answered but many candidates struggled with part (e) with many of these having the given matrix **N** as their answer. There many completely correct diagrams. However, a lot of candidates lost the marks in part (d) caused by a mistake in part (c). Reflections in $x = 0$ or $y = 1$ were common.

Question 10

There were a number of clear and accurate solutions to this question, however, a lot of errors were seen and there were also many candidates who hardly attempted the question. The greatest difficultly was with part (e) where many candidates tried to produce a formula for the surface area usually confusing it with volume. Many more assumed that the four triangles all had the same area. A few calculated the correct areas of the triangles but then forgot to add the area of the base.

Question 11

Parts (a) and (b) were usually well done, however, there were a few common errors particularly plotting (3, -3) as (3, 0) as the final point. In part (c), although points for the $y = 1$ intersections were often given, few obtained correct inequalities. Only the more abler candidates were to make a good attempt at part (e). It was clear that most candidates had no idea how to tackle problems such as that in part (e) and Centres would be advised to devote more time to these types of problems which have also appeared in previous examinations.

Statistics

Overall Subject Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	U
Overall subject grade boundaries	100	72	55	39	34	24	0

Paper 1

Grade	Max. Mark	A	B	C	D	E	U
Paper 1 grade boundaries	100	72	57	42	32	23	0

Paper 2

Grade	Max. Mark	A	B	C	D	E	U
Paper 2 grade boundaries	100	72	55	38	31	25	0

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