Examiners' Report Summer 2007

GCE

GCE O Level Mathematics B (7361)

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Summer 2007

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Mathematics B

Specification 7361

Paper 1

Introduction

There was no general indication that the examination paper was too long, with most candidates making reasonable attempts at nearly all of the questions and with a significant number of these scoring high marks. Overall, the standard of presentation and clarity of work was high. However, it should be emphasized that candidates should be encouraged include their working on the paper to show how they obtained their answers since if an incorrect answer was given without any working shown, all of the associated marks were lost. It would also be prudent of centres to encourage their candidates to answer the questions within the examination paper booklet and not, if at all possible, on any extra sheets of paper. Also, centres should emphasize to candidates who do need to use extra sheets of paper, to clearly indicate this in the answer area of the relevant question in the examination booklet.

Once again, it was pleasing to observe that many candidates showed that they have a good understanding of the basic techniques of arithmetic, algebra and trigonometry and were able to apply them competently. The question paper did however highlight the following problem areas, followed by their corresponding question numbers, which should receive attention

- Manipulation of fractional indices (Q2)
- Inequalities (7)
- Basic theory of sets (Q9)
- Speed-time graphs (Q14)
- Applying the Intersecting Chords Theorem (Q16)
- Manipulating algebraic formulae (Q19)
- Constructions (Q22)
- Finding the distance traveled in a particular period of time (Q23)
- Calculating the area of a regular pentagon (Q24)
- Binary operations (Q25)
- Showing that a triangle is isosceles (27c)

Of these, the questions which proved most elusive to candidates, including the most able, were questions Q16, Q22c, Q23, Q24 and Q27c.

Report on Individual Questions

Question 1

As expected, most candidates answered this question correctly although some lost a mark because of not correcting to the nearest penny. A number of candidates worked in US currency and failed to convert their answer of 22c to pence.

Question 2

There were many correct attempts at this question. There were, however, many candidates who thought that $16^{-\frac{1}{2}} = 0.25$ or -8 or 4, losing both marks. Also, $9^{\frac{1}{2}} = 4.5$ was seen quite often.

Question 3

A common and expected error was the division of 9.465×10^{12} by 1.5×10^8. Other incorrect attempts were $9.465 \times 10^{12} - 1.5 \times 10^8$ and the multiplication of 9.465×10^{12} by 1.5×10^8. Many candidates who had the correct method failed to deal with the indices correctly in their calculation.

Question 4

Often seen was 156 = (2n - 4) 90 which usually resulted in an answer of n = 2.3 and gained no marks.

Question 5

There were a significant number of correct attempts at this question but there were also a number of candidates failing to factorise their answer as required by the question.

Question 6

There were many successfully attempts at this question. As expected, a common incorrect method seen often was $\frac{7.5 \times 60}{100}$.

Question 7

A significant number of candidates clearly did not understand the requirement of finding the *smallest integer* and gave 14 as their answer. Also, many gave their answer as 14.3 rather than as an integer.

Question 8

Many candidates did not give their answer to 3 significant figures as required. There were several attempts at calculating the perimeter or area of the sector. However, it was pleasing to observe that there were many fully correct attempts.

Question 9

There were many incorrect attempts at parts (i) and (ii) since it was evident that many of such candidates were unsure of the basic tenets of set theory. Some of these, however, were to collect the mark in part (iii) by correctly giving the union of their parts (i) and (ii).

Question 10

Usually well answered with $\angle BDC = 15^0$ correct. A common error seen was setting $\angle DAB = 57.5^0$ and invariably ending up with $\angle BDC$ as 7.5^0. Only the weaker candidates thought that $\angle DAB$ was 65^0, thinking it was an alternate angle to $\angle ABD$ (even though there were no parallel lines in the question).

Question 11

Many candidates were able to plot correctly the points *A*, *C* and *D* but then clearly did know what to do next and stopped. However, there were many correct attempts at the question.

Question 12

Many were able to clear the fractions but then mistakenly either expanded $-4(x+2)$ as $-4x+8$ or had $-8(x+2)$ appearing as $-8x+16$, usually ending up with an answer of $x = 4.5$, scoring only the method mark. Those who did proceed along the right lines with $8(x-8) = 100$, surprisingly wrote $8x - 64=100$ followed sadly by $8x = 36$.

Question 13

Many excellent responses were seen but equally many instances of $\pi(7)(24) + \pi 7^2 = 175\pi$ were seen and these unfortunately collected no marks.

Question 14

Many candidates drew a horizontal line to (5.5, 6) but then ended on the t-axis at 8.5 of 11.5 (presumably forgetting that the area of a triangle is $\frac{1}{2}$bh). Other diagrams made very little sense at all, being triangular in shape. A large number of candidates joined (5.5, 6) to 14 on the t-axis, showing very little logic to the problem.

Question 15

Many very good responses with 72 were seen quite often. Others simply did 56 -24 =32, showing little understanding. Another common error was to set $\frac{15}{10} = \frac{56}{x}$ leading to $x = 37.3$. A number of candidates forgot to divide 720 by 10 at the final stage.

Question 16

This question was very poorly attempted with all sorts of incorrect formulae being used thus many candidates fell at the first hurdle. Common sightings were: $(x + 10)^2 = (\frac{3}{4}x + 12)\,12$ or $x + 10 = \frac{3}{4}x + 12$ or $12^2 = 10(x+10)$ instead of the correct statement of $10(10 + x) = 12(12 + \frac{3}{4}x)$. Of those who did proceed with the right method often forgot to find $\frac{3}{4} \times 44 = 33$ at the end.

Question 17

Often the initial ratio of $\frac{48}{2058}$ was correct but many chose to go down the linear path. Thus, a sizeable majority did not realise the need to either cube $\frac{x}{21}$ or cube root $\frac{48}{2058}$. Some made matters worse by evaluating $\left(\frac{48}{2058}\right)^3$. Some reached the 216 stage but then took the square root instead of the cube root.

Question 18

Often well processed but loss of marks due to $\sqrt{81}$ being used rather than $\sqrt{161}$. Many candidates displayed a lack of care when dealing with the signs in the quadratic formula. Others were guilty of premature approximation after taking the root or not rounding their final answers to 2 decimal places as requested.

Question 19

Often the first process of multiplying across by $(x - y)$ was done correctly. The better candidates were able to make x the subject of the formula whilst a sizeable majority then made errors in the signs of the terms whilst manipulating their expressions.

Question 20

The angle of 195^0 was invariably found and many of the pie charts were correct. Occasionally 195^0 was drawn as 165^0. Some candidates failed to fully label their diagrams thus losing at least one mark in part (b).

Question 21

Generally some very good attempts at (a) and (b) were made but premature approximation or poor rounding were in evidence. A common error seen was to set $\angle CDB = \frac{106}{2} = 53^0$ which lost all of marks in part (a) but such candidates usually picked up the method mark in (b). Sadly, the knowledge displayed by some candidates of trigonometry was not as good as in previous examinations.

Question 22

Part (a) was usually well attempted but with only a few bisectors not passing through (0, 0) or touching it. Part (b) had many well drawn circles but some were incomplete or were slightly inaccurate. Part (c) defeated all but the most able candidates and was thus a discriminator mainly because many candidates had not drawn a sufficiently long bisector in (a). 19mm was an often wrong answer.

Question 23

Often correct but many only went as far as working out the distance travelled after 5 seconds rather than the distance travelled in the 5th second. Thus, a wrong attempt often seen was $s = 4.9 \times 5^2 = 122.5$, scoring M1 A1 (4.9) B1. Some tried to ignore the t^2 and dealt with the problem as $s = \frac{d}{t}$.

Question 24

This question was a discriminating question. There were too many candidates who used 60^0 as their working angle instead of 108^0 or 54^0 or 72^0. There were many protracted methods using the cosine rule to find the lengths of diagonals or the vertical height of the pentagon instead of concentrating on one particular triangle e.g. $\Delta\, ODC$, where O is the centre of the pentagon. There were many incorrect methods seen as well as many erroneous trigonometrical or geometrical arguments. In particular, it was disturbing to see many candidates believe that in $\Delta\, ODC$ that $OD = OC = 12$. Some started with $\frac{1}{2}(12)(12)\sin 108^0$ but did not know what to do next. A number of candidates did not even attempt this question.

Question 25

Part (a) was usually correct but there were many non-attempts. In part (b), $x * 4$ was often seen as $4x + 4$ instead of $4x – 4$ or as $4x - x$ and a surprising number of candidates who reached $20x – 15 = 75$ then wrote $20x = 60$ rather than $20x = 90$.

Question 26

Many good attempts but a common sighting during the expansion of the brackets was $5x^2 – 5$ rather than $5x^2 – 5x$. Factorisation and formula methods were often sound with only the occasional sign slip creeping into the work. Some strangely tried to reject the x = -1 root believing it to be inadmissible. A worrying feature seen was that a number candidates thought that the question required them to solve $5x + 3 = 4$ and $x - 1 = 4$.

Question 27

The coordinates of *Q* were often correct with *Q* correctly plotted but there were occasional errors in *R* e.g. (-4, -2) instead of (-2, -4). In part (c), many candidates simply stated that $QP = QR$ without any resort to Pythagoras or simply stated that by measurement, $PQ = QR = 5.5$, gaining no marks.

Question 28

Some excellent responses were seen to this calculus question. In part (b), some did not differentiate $3t^2 - 18t + 24$ and went on to try and solve $3t^2 - 18t + 24 = 0$. Those who did find $\frac{dv}{dt} = 6t - 18$ and so $t = 3$ sometimes stopped in their tracks when substituting $t = 3$ into the velocity equation – presumably because $v = -3$, which they thought was not right. A small minority substituted $t = 3$ into $s = t^3 - 9t^2 + 24t - 20$ and so lost the final 2 marks. Some failed to substitute $t = 3$ into the velocity equation believing they had had already found the answer. Many candidates confessed that "*v* could not be negative" and swiftly altered the sign.

PAPER 2

Introduction

As was stated in the June 2006 report, centres would be well advised to spend more time focussing on the application of their candidates' knowledge in extended literal questions. Evidence of candidates' responses on this paper shows that more work needs to be done on compound probabilities. To this end, candidates should be encouraged to construct tree diagrams to help in their interpretation and they should be drilled in techniques of interpreting the wording of the demands of a question.

On a very positive note, candidates have shown that many of them have sound algebraic understanding which, in some cases goes beyond the scope of the syllabus. Many correct solutions, well laid out, were seen. It should be noted however, that where an answer is given and the candidate does not arrive at this answer, then some form of checking should be carried out. This may require going back to a previous part of the question.

Whilst the probability question resulted in the poorest candidate responses, two other questions, Q5 and Q7, resulted in a mean of under half marks for the question. In the case of the responses to the geometry question, a lack of reasons given and/or incorrect assumptions were the primary cause. In the vector question, confusion with direction of vectors had a significant impact on the marks awarded.

Report on Individual Questions

Question 1

Many candidates correctly identified the identity as 7 (B1) for part (a). Part (B1) proved to be more elusive, however, as anything but the required answer of 5 (B1) was frequently seen. Many recovered to find the required answer of 9 (B1) for part (c).

Question 2

Many candidate's confidently answered part (a) and many correct methods of distance *x* time (M1) leading to the required answer of 135 km (A1) were seen. In part (b) however, many candidates started incorrectly by dividing 135 by 7.5. Many simply left 18 km/h as their answer or went on to use this value to arrive at an incorrect answer of 24 km/hr ([30 + 18]/2). Only a small minority seem to realise that in order to work out an average speed for two journeys, they needed to work out the total distance travelled (270 km) and divide this result by the total time taken (12 hrs) (M1). As a consequence, too few correct answers of 22.5 km/h (A1) were seen.

Question 3

Candidates sitting this paper are generally very good at algebraic techniques but the multiplication of three binomial terms in part (a) proved to be problematic for many. Many candidates were able to multiply out two bracketed terms correctly (M1), but fewer than expected were able to carry out the next process of multiplying by the third bracketed term and, as a consequence, the required answer of $x^3 - 7x + 6$ (A1) proved elusive to many. For those candidates who were successful in part (a), many were able to complete part (b) by correctly equating and gathering terms (M1) to arrive at the answer of 7 (A1).

Question 4

This was a well answered question. Candidates are well drilled in matrix multiplication and, in part (a), many correct matrices

(i) $\begin{pmatrix} 4p - 4 & -15 \\ 2p + 12 & 17 \end{pmatrix}$ (B2) and (ii) $\begin{pmatrix} 4p - 4 & -p - 6 \\ 30 & 17 \end{pmatrix}$ (B2) were seen.

In part (b), many correctly equated a pair of corresponding terms (M1) to arrive at the required answer of $p = 9$ (A1).

Question 5

Whilst many candidates seemed to know enough geometry to arrive at the three required answers, many spoiled their working by either incorrect arithmetic, incorrect geometrical assumptions or giving no textual reasons to support their working. In part (a), a significant number of candidates were simply content in showing that $\angle DAT = 64°$ (M1) without giving a textual reason such as base angles of an isosceles triangle (A1). In many cases, this method mark was the only mark that the candidate achieved as a significant number simply stopped there or went on to make incorrect assumptions such as $\angle ABD = 52°$. For those who recognised that $\angle CAT = 90°$(M1), many went on to arrive at the required answer of 26° (A1). In part (b), candidates were expected to use a combination of angles in a circle properties such as angles in the same segment or angles in the alternate segment, and the properties of angles in an isosceles triangle. To arrive at the answer, the candidate needed two steps and a suitable reason to find $\angle BAD$ (M1, M1). Correct method and accurate working led a minority of candidates to the answer of 32° (A1). In part (c), many candidates knew what to do but previously incorrect working prevented some of these candidates from achieving full marks. Sum of the angles of a triangle or vertically opposite angles (M1) were sufficient reasons which led the more able candidates to the required answer of 84° (A1).

Question 6

It is pleasing to see that candidates continue to be well drilled in the techniques of trigonometry and many correct answers were seen to this question. The only words of caution are that candidates should ensure that their calculators are set to degrees and not to gradians and that candidates should work to a greater degree of accuracy to that which is required. In part (a), many recognised that $BF/6 = \tan 36°$ (M1) which led directly to the required answer of 4.36 cm (A1). Part (b) required the correct use of sine (M1) for the answer of 10.52 cm (A1). In part (c), candidates who did get their trigonometrical ratio wrong in part (b) were still able to pick the two method marks up here provided that they showed a correct method for finding DC (M1) and subtracting 6 cm from this answer (M1 dep). Only those candidates with correct previous working however were able to arrive at the required answer of 1.64 cm (A1). A variety of different methods for finding the area of the required quadrilateral were seen and credit was given for correctly finding any initial area which could eventually lead to the required answer (M1). A second mark (M1 dep) was awarded for a completely correct method for the area of the quadrilateral $AEFD$. The acceptable answer(s) of either 60.41 cm^2 or 60.42 cm^2 (A1) proved a little more elusive as some candidates failed to work to enough decimal places and arrived at an answer just outside of the range.

Question 7

It is pleasing to see that candidates are well drilled in handling ratio statements in this type of question and on only a minority of scripts were incorrect fractions of $\frac{2}{7}$ or $\frac{1}{7}$ seen. Some candidates, however, still seem to be confused with direction when combining two vectors together to find a resultant and consequently this led to significant errors. Many correct answers of **a** + **b** – **c** (B1) were seen in part (a) (i). In part (ii), an incorrect sign or failure to gather terms prevented some candidates from getting both marks here. A common error was to write down – **a** + **c** - ½(**a** + **b** - **c**), or an equivalent incorrect statement. Candidates who got the two vectors and the sign between them correct (M1) invariably arrived at the required answer of ½(**b** + **c** – **a**) (A1). An incorrect answer in part (ii) did not disadvantage candidates in part (iii) as the mark was awarded as a follow through mark and candidates who wrote down, in a simplified form, 2/5ths of their answer to part (ii), were awarded the mark (B1). Many correct answers of $\frac{2}{5}$**b** - $\frac{3}{5}$**a** (M1, A1) were seen in part (b).

In part (c), equating their answer to part a(iii) to their answer to part (b) (M1) led to a correct conclusion (A1) provided the two previous parts were correct. Some candidates who had a wrong previous answer (particularly from part a(iii)), either fudged their working to arrive at the required conclusion or simply arrived at an incorrect conclusion. In the case of the latter, candidates should have recognised that some previous working had been incorrect and they should have gone back to rectify their previous answers. Centres should focus their students' attention on the process of reflection where an answer to a question is clearly wrong and then methods of rectifying the situation. Despite previous incorrect working, a significant number of candidates were able to recover in part (d).

Many showed a correct substitution of **b** into a correct $\overrightarrow{CB}$ (M1) leading to $\overrightarrow{CB} = 3\mathbf{a}$. Drawing a correct conclusion (A1) was seen on many scripts.

Question 8

Except for sign errors, many correct answers of -9 (B1), -2/3 (B1) and 61 (B1) were seen in part (a). Part (b) was also well done with many correct rearrangements (M1) of the function leading candidates to the required answer of $(1 + 2x)/x$ (A1). Of those who arrived at the correct answer to part (b), many were able to write down the value of 0 (B1) for part (c). Candidates seem to be well drilled in dealing with composite functions and very few incorrect methods of f(x) multiplied by g(x) were seen and many candidates were able to achieve all five marks for part (d). Simplifying fg(x) to $4x^2 - 12x + 5$ (M1, A1) led many candidates to a correct method of factorisation (M1) resulting in the required answers of 0.5, 2.5 (A1, A1).

Question 9

The candidates' responses to this question suggest that the majority are not able to cope with more than the most straightforward questions on probability. Indeed, the modal mark for this question seemed to be 3 with part (a) answered correctly 9/10 x 2/3 = 3/5 (M1, A1) and the method mark in part (d) being the only marks obtained by many. Correct answers to part (b) proved to be very elusive with a popular incorrect method and answer being 9/10 x 2/3 = 47/30. Whilst there is some sympathy for the candidate who deemed that the required probability was for either a dolphin or a whale **but** not both and who therefore wrote down 9/10 x 1/3 + 1/10 x 2/3 = 11/30, only one method mark was earned by these candidates as the method was incomplete and the answer wrong. There are alternative methods for tackling this part of the question but the most popular correct method seemed to be 9/10 x 1/3 + 1/10 x 2/3 + 9/10 x 2/3 (M1) = 29/30 (A1). Centres are well advised to focus their candidates' attention to the exact wording of this type of question. *Either a dolphin or a whale* implies that the candidate needs to take into account that **both** a whale and a dolphin can be seen. Despite many incorrect answers, it was impressive to see on some scripts the use of the formula: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. Where this formula was quoted, it was invariably used correctly and led to the required answer. Despite poor answers to part (b), some candidates recovered in part (c) and wrote down 1/5 x 1/10 x 1/3 = 1/150 (M1, A1). A similar proportion of candidates were also able to tackle part (d) and correctly identified the answer as 1/10 x 1/3 x 4/5 = 2/75 (M1, A1). In part (e), some candidates simply took 300 (number of days sailing) away from 365 (number of days in a year) – a novel, but incorrect method leading to an incorrect solution. Multiplying their answer to part (d) by 300 earned method (M1). The required answer of 8 days (A1) could only be arrived at from a correct answer to part (d).

Question 10

Some fairly complex algebra was very well handled by the abler candidates in this question with many achieving full marks on parts (a) to (e). In part (a), a correct interpretation of the information given invariably led the candidate to the required answer of $70 - 2x$ (M1, A1). It was pleasing to see some very good algebraic manipulation in part (b) as candidates wrote down correct algebraic expressions for a number of useful areas (M1, M1) and combined all the required areas correctly (M1 dep) to arrive at the conclusion (A1). In part (d), where the candidate recognised that calculus was involved, there were many correct attempts at differentiation (M1) and the resultant algebraic expression was equated to zero (M1 dep). The required answer of 17 m (A1) invariably followed for these candidates. However, a significant number of candidates equated the quadratic given in part (c) to zero and, as a consequence, earned no marks for this part of the question. Whatever method was used in part (d), a correct substitution of the candidate's answer into the given quadratic earned method (M1) in part (e). An answer of 870 m^2 earned accuracy (A1) which was only earned from a correct answer to part (d). Part (f) proved to be a discriminator as many candidates were unable to understand what was required. Indeed, many scored the first twelve marks on this question but went no further. Of those that did have some understanding, errors were still made and all marks were lost unless the candidate had attempted to evaluate (their answer to (d) + 4) and (76 – 2 x their answer to (d) - 3) (M1) and then correctly using these values in a Pythagorean expression (M1 dep). Fewer than expected answers of 44 m (A1) were seen. The usual penalty was invoked for an answer of 44.29 and the final mark was lost.

Question 11

There were a lot of good responses to parts (a) and (b) and many tables were completed correctly with the required values of 8.5, 27 , -5 and -8 (B3) seen, and graphs correctly drawn (B3). The most common lost marks in part (a) seemed to be where values of 59 and 48 were given when $x = -1.5$ and $x = -1$. In general, graphs are drawn well, but candidates should be reminded that straight lines, drawn with a ruler, where the graph is patently not a straight line, will be penalised. Part (c) proved to be problematic on three counts: (i) poor tangent, (ii) using calculus only and (iii) positive gradient. In the first two cases, no marks were earned as the demand of the question required the construction of a tangent (M1). An answer in the range -16 $\rightarrow$ -22 (A1) was required for the answer. In part (d), a significant number of candidates were able to identify points of intersection of their graph with the x – axis (M1) however, range statements proved to be more elusive (M1 dep) and correct range statements of the form $x < -1.7$ and $2.6 < x < 4.5$ were not seen as often as one would have liked. Part (e) required the candidate to draw the line $y = 20 - 4x$ (B1). Provided their straight line intersected their cubic three times and the x values of their intersections were written down then a mark (B1) was awarded. A significant number of candidates arrived at the required answers of 2 (A1) and -1.1 and 4.6 (A1). Some candidates, again, lost a mark here as they failed to give their answers to the required degree of accuracy.

Statistics

Overall Subject Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	U
Overall subject grade boundaries	100	81	66	51	46	32	0

Paper 1

Grade	Max. Mark	A	B	C	D	E	U
Paper 1 grade boundaries	100	82	66	50	40	31	0

Paper 2

Grade	Max. Mark	A	B	C	D	E	U
Paper 2 grade boundaries	100	81	66	52	42	33	0

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