Examiners' Report Summer 2009

GCE

GCE O Level Mathematics B (7361)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

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Summer 2009

Contents

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 to 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 would be 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 geometry and were able to apply them competently. Centres should emphasize to candidates that they should give their answers to the required degree of accuracy as often marks are lost on otherwise completely correct work – this was particularly the case with Q28 The question paper did however highlight the following problem areas, followed by their corresponding question numbers, which should receive special attention

- Venn diagrams - Q5
- Loci of points from a straight line - Q6
- Algebraic manipulation of signs - Q9
- Inequalities - Q12
- Manipulation of fractional indices - Q13(c)
- Vectors - Q15
- Inverse percentages - Q17(b)
- Translations - Q20
- Probability - Q22
- Conversion of units of distance and time - Q23(b)
- Differentiation - Q25(b)
- Circle geometry - Q27

Report on Individual Questions

Question 1

As expected, most candidates answered this question correctly. A number of candidates failed to give their decimal answer to 3 significant figures, giving 0.73 instead of 0.727 as their answer. An incorrect method seen often was $2\frac{6}{11} \div 3\frac{1}{2} \;=\; \frac{12}{11} \div \frac{3}{2} \;=\; \frac{8}{11}$, which, of course, gained no marks.

Question 2

There were many correct attempts at this question. A number of candidates, though, gave a factor of 2160 as their answer, gaining just the method mark.

Question 3

There were some excellent responses to the factorisation by grouping with almost all candidates scoring full marks. Only a few failed to reach the correct double brackets.

Question 4

There were many correct answers to this question. Some candidates mistakenly thought that the method was $\frac{22.5}{360}$.

Question 5

A minor discriminator question in which 24 and 19 were seen on the diagram, gaining B1, however, many candidates then failed to include the 10 outside the circles but within the box, thus losing the second B mark or writing 7 again losing the B mark. A common error was to put 27 and 22 in the relevant part of the diagram and then writing 4 outside the circles. These candidates scored B0 then B1 follow through on their 27 and 22.

Question 6

A major discriminator with many candidates not capable of the locus of points which are 2cm from a line of length 10cm. Only a small minority of candidates drew the correct parallel lines with the correct semi-circles at each end. There were some partially correct attempts seen in which candidates attempted to draw 2 parallel lines of length 10cm at a distance of 2cm from the line *AB* but many of these overshot the 10cm boundary. Other shots in the dark included the perpendicular bisector of *AB*, a circle of radius 2cm drawn at the centre of the line, a circle or circles of radius 2cm drawn at the ends of the line or no response at all.

Question 7

It was pleasing to observe that standard form is now well understood with most candidates obtaining full marks on this question.

Question 8

As in previous examinations, the good candidates collected both marks for this question with the weaker candidates guessing the answers and thus usually failing to score any marks for their guesses.

Question 9

The attempts at the algebraic manipulation were mixed, so this question was a minor discriminator. There were some excellent solutions seen but many lost a sign along the way and invariably ended up with $\frac{-x^2-11x}{4}$ instead of the correct $\frac{-x^2-3x}{4}$, usually gaining the two method marks. Weaker candidates often lost the denominator of 4 after the first line of working and some tried to make the question into an equation.

Question 10

Very well attempted. Most reached the sector angle of 128^0 and were able to proceed to the total number in the survey of 990. A few weaker candidates tried to add the angles and people together in a vain attempt to reach the total. Most of the remaining scripts not gaining full marks appreciated the need to link numbers of students to angles but there was some uncertainty over the placement of the 128, 352 and 360 (or similar for other colours) in the expression $\frac{a \times b}{c}$.

Question 11

Some candidates trivialised the problem by believing the requirement was 70/15 + 80/15 with many answers of £9.99 or £10 being seen. They had clearly not taken into account the number of pictures and/or number of ornaments that had been bought. Such candidates only collected the B mark. A high proportion of those who got as far as the correct 610/15 often spoilt the final answer by stating that the answer was £40.7 or £40.70 or even £41. From this it appears that although the question asked for the answer to 'the nearest penny', such candidates read this as 'to the nearest 10p' or 'the nearest £' or 'to 1 decimal place'. This, as in previous examinations, underlines the importance of candidates carefully reading the demand of a question.

Question 12

There was a mixed response to this question on inequalities. Most candidates proceeded correctly with trying to gather x on one side of each inequality but many had trouble with the need to reverse the sign when dividing by -2 . Some had no idea whatsoever with many of these breaking up the $3 + 4x$ term and tried to solve the left hand side with < 3 and the right hand side with > $4x$. The better candidates who reached the correct $-4 < x < 3$ often stopped at that point preferring not to list the integers in the interval. Those that did list the integers often omitted 0 or included 3 in the values.

Question 13

There were many fully correct attempts at this question. A common but incorrect answer for part (b) was $\frac{1}{27}$. In part (c) there was a significant number of candidates who thought that $243^{\frac{3}{5}}$ was $\frac{243^3}{5}$ and thus giving an answer of 2869781.4 .

Question 14

There were some very good responses to the transformation of a formula. The most common error seen was to double square the right hand side of the given equation to obtain $t^2 = \frac{4s^2}{g^2}$ or even $\frac{2s^2}{g^2}$, gaining no marks for their efforts.

Question 15

As this question was one of the main discriminators of the paper, there were a few correct attempts at this question. Many candidates did not fully understand the demand of the question and gave their answer as $\begin{pmatrix}4\\5\end{pmatrix}$ or $\begin{pmatrix}2\\12\end{pmatrix}$ thus gaining only the method mark.

Question 16

Part (a) was usually correctly answered. Common and expected problems with part (b) were the exclusive use of the equals sign rather than the inequalities or having the inequalities the wrong way around. However, the failure to include the equality with the inequality sign was not penalized.

Question 17

Part (a) was well answered with most gaining full marks. Part (b) caused problems for many candidates and was thus a minor discriminator. Instead of the correct $\frac{£514.80}{0.78}$, it was not uncommon to see $£514.80 \times \frac{22}{100}$ or $£514.80 \times \frac{122}{100}$ or even $\frac{£514.80}{0.88}$. The latter case arising from the mistaken belief that 100 – 22 was 88 rather than 78.

Question 18

The calculation of the mean was generally accurate with many reaching 1.5 as the answer. Some decided this should then be rounded to 2 or even 1 perhaps feeling that one could not have 1.5 passengers, but showing a lack of understanding of the impact that this rounding will have on the information that the mean is designed to give. However, in many such cases, if 1.5 was seen as answer, the "Ignore Subsequent Working" ruling was invoked and so such candidates were not penalised for their misunderstanding. Some of the more erroneous responses included $\frac{135}{15} = 9$ or $\frac{90}{15} = 6$ or $\frac{90}{6} = 15$ or $\frac{161}{90} = 1.79$ (from the $0 \times 26 = 26$ error) or $\frac{15}{6} = 2.5$.

Question 19

In part (a), often 3 – (-4) became 1 instead of 7 or 3 – 2(-2) became 1(-2) = 2 otherwise the question was well answered. There were many successful and pleasing attempts in part (b) with many able to gain full marks. For a number of candidates applying * twice did cause some problems but this was more a case of sign errors when rearranging the equation rather than not understanding the nature of the operation.

Question 20

There was a surprising number of non attempts at this question. It was not uncommon for the line to be drawn correctly but not labelled. Whilst the majority of candidates could draw the line y = -x there was a substantial number who drew y = x or who thought that y = -x was the line x = -1. Where the line y = -x was not drawn, a surprising number knew where triangle C should be plotted (as if by intuition). The description of the translation was usually accurate either in vector form or in words. However, when image C was incorrectly placed there was much confusion in (c) over 'translation' with many responses describing transformations such as rotations, reflections and enlargements. Of those with a correct positioning of image C and an incorrect translation vector, the most common errors were either -2 instead of -3 for the movement in the x direction, the translation for B to C rather than C to B or interchanging the -3 and -2.

Question 21

Most candidates who attempted this question were able to score 3 out of the 4 marks. Many preferred to work with the angle of 28.1^0 rather than the more traditional way of using Pythagoras' theorem and adding fractions. The candidates who worked with fractions usually arrived at the correct answer of $\frac{27}{20}\frac{23}{17}$ whereas the others inevitably ended up with 1.35 or $\frac{27}{20}$. A number of candidates thought that the angle was obtuse thus potentially losing all the marks or 3 of them. It was not unusual for the first mark to be lost due to the value of 28° being used for x.

Question 22

This question acted as one of the main discriminators across the entry. The more able candidates took the time to draw a sample space and inevitably reached the correct answers. There were many non attempts or just pure nonsense written down. In part (a) it was frequently the case that one term was missing from the list – usually having 2 instead of 3 terms, these being (N, N) and (N, not N), and missing the need for (not N, N) as well. There was more success with part (b) but some thought part (b) was asking for the probability of (OO, NN) only and so many candidates went simply for NN + OO as $\frac{2}{6}\times\frac{2}{6} + \frac{2}{6}\times\frac{2}{6}$ (= $\frac{2}{9}$) but it was almost as common to see $\frac{1}{6}\times\frac{1}{6} + \frac{1}{6}\times\frac{1}{6}$. Both of these incorrect attempts collected the first method mark but not the second. A number of candidates thought that LL + OO + NN + DD + OO + NN was required and that this consisted of $6\left(\frac{1}{6}\times\frac{1}{6}\right)$, losing both of the method marks.

Question 23

Some excellent attempts at part (a) with a minority holding the belief that 1km =100metres. Part (b) produced some good responses however even when (a) was incorrect many candidates did go on to divide by 5100 in (b) and thus score 2 out of 5. Most understood the need for distance/time in (b) but a sizeable number divided by 85 and some just left the time in hours. Changing from hours to minutes caused problems with a lot thinking that 1 hour 25 minutes was equivalent to 1.25 hours.

Question 24

The question on simultaneous equations was well answered with many gaining valuable marks. The only notable error was the transcription of figures from one line to the next e.g. 7000 becoming 700 or 123200 becoming 123000. However, in part (b), quite often arithmetic slips meant the loss of the method mark.

Question 25

Part (a) was well answered and most reached the correct answer of 4. Some candidates over complicated the question and tried to set dx/dt = 0. In part (b) it was rare to see a completely correct differentiation. Either the 't' disappeared or $t - \frac{16}{t}$ became $-\frac{16}{t^2}$ instead of $+\frac{16}{t^2}$. 0.64ms^{-2} was a common incorrect answer. Some trivialised the question by evaluating $5 - \frac{16}{5} = 1.8$ or worse then went on to do $\frac{1.8}{5} = 0.36$.

Question 26

There were some very pleasing attempts at this question. Some did not explicitly set the expression equal to 0 and arrived at an answer of +31 rather than the correct -31. Weaker candidates tried to substitute (x - 3) into the expression but soon became unstuck. Many reached the trinomial quadratic $3x^2 + 17x + 20$ stage in part (b) and stopped. The better candidates went on to factorise the trinomial quadratic correctly. However, there were a number of candidates who successfully obtained the quadratic but then either did not factorise further or incorrectly factorised. (x + 5/3) was one error – usually because the quadratic had been 'solved' rather than factorised. Several candidates did not stop at factorising but went on to solve the equation $f(x) = 0$ which was not required.

Question 27

There was a mixed response to the circle geometry question this, thus, being one of the discriminators of the paper. Many candidates produced some elegant solutions whilst others could not get started. It is worth mentioning that candidates should be encouraged to annotate their diagram with any angles found and many picked up valuable marks in doing so. A common error was to believe that triangles *CQD* and *BRC* were congruent, so whilst $\angle CDQ = \angle DCQ = 35^0$ was correct, it was not correct to assume that angles *RBC* and *RCB* were also 35^0. Of those who did identify that triangles *CDQ* and *BCR* as isosceles triangles maybe as many as half went on to get $\angle DBC = 29°$ and $\angle CDB = 35°$ but then failed to apply the angle in alternate segment rule correctly. It seems that many thought that *BD* was parallel to *RQ* thus getting 29° for (a) and 35° for (b). Having established angles *BDP* and *DBP* as 64° some candidates just halved this and gave $\angle DBC$ and $\angle CDB$ as both being 32°. Often part(c) was answered well, independent of the success or failure in parts (a) and (b).

Question 28

Attempts at this question on the trigonometry of right angled triangles were variable. It was not unusual to see completely correct solutions but then again it was not unusual to see a complete non attempt by some candidates. Most did give answers to 3 significant figures as required although there were a number who rounded the first answer to 12, usually causing a loss of all subsequent accuracy marks by using their 12 rather than the correct 11.9 and sometimes even the method marks in (c) if there was a lack of Pythagoras or trigonometry to support their 1decimal place values for other sides. The main error in part(c) was the wrong choice of sides in attempting to find the area, for example, $0.5 \times 7 \times 9.63 \times \sin 36^0$ (2 sides and the non included angle) or choosing non perpendicular sides when using 0.5 *bh*. Some weaker candidates thought the shape was a trapezium and tried to use the associated formula to find the total area. There were also a number of non attempts at this question.

Paper 2

Introduction

It was pleasing to see many good responses from the majority of candidates across the paper. Having said this, there was still too many candidates making the same type of errors which are repeated year on year and are continually mentioned in these reports. In particular, centres need to focus on the following areas:

Interpreting and drawing histograms. (Q2)

Reasons in geometrical problems. (Q4)

Correct use of mensuration formulae. (Q7)

Re-checking vector work when values of parameters prove to be ‘unusual’ fractions. (Q9)

Development of formulae from given data. (Q10)

Giving answers to the required degree of accuracy. (Q10 and Q11)

Report on Individual Questions

Question 1

Despite some attempts to multiply the matrices the wrong way round, there were many correct answers seen for part (a) (B2). Part (b), however, proved to be more problematic with many incorrect answers of the form (9, 7) or $\begin{pmatrix} 11 \\ 5.8 \end{pmatrix}$ seen. In the case of the former answer, the candidate had multiplied the matrices the wrong way round and in the latter case, the candidate seemed to confuse a column vector with coordinates. As a result, fewer than expected correct answers of (11, 5.8) (B1, B1) were seen.

Question 2

The answer of 19 (B1) proved to be a popular entry in the table. However, some candidates, despite this correct value, seemed to ignore the statement that the farmer has 100 cows and many incorrect answers were seen for the second table entry. The value of 24 seen and a correctly drawn bar was required for the second mark (B1). Despite comments in previous reports, many candidates are still under the misconception that the height of a bar in a histogram is proportional to the number represented and many incorrect heights of 9 and 18 were seen rather than the correct heights of 3 (B1) and 9 (B1).

Part (b), was well answered by the majority of candidates and the correct answer of 42/100 (B1) was often seen. However, a significant minority of candidates seemed to have misread the question and wrote down the probability that the cow will have a mass greater than or equal to 215 kg but less than 220 kg and gave an answer of 24/100.

Question 3

Part (a) was well answered with many candidates either showing $\frac{9}{2}\times 180$ or $\frac{11}{2}\times 180 - 180$ (M1) to arrive at the required answer of 810 gms (A1). Part (b) was not answered as well as some candidates either tried to link their answer to part (a) into their working for part (b) or used an incorrect conversion from kilograms to grams. Some weaker candidates reduced the question to simultaneous equations leading to incorrect answers. For those candidates who knew what to do, much correct working of the form $\frac{2}{11}\times 1320$ and $\frac{9}{11}\times 1320$ (M1) was seen leading to the required answers of 240 gm (A1) and 1080 gm (A1).

Question 4

The majority of candidates seemed to be able to determine the required angles in this question but many were unable to give correct and detailed enough reasons. In part (a), simply stating that $AB = BC$ was not sufficient as this was given in the demand of the question and in part (b), angles of a cyclic quadrilateral add up to 360° whilst true, was not sufficient. In part (a), candidates were expected to find $\angle BCA = 72°$ (M1) leading to $\angle FDC = 36°$ (M1). Two reasons were required for the complete solution: isosceles triangle, ΔABC (A1) and either alternate angles between parallel lines or corresponding angles (A1).

In part (b) many candidates identified an angle correctly (M1) but fewer than expected identified the correct reason of opposite angles of a cyclic quadrilateral are supplementary (A1).

Question 5

There were many correct answers of $\frac{x}{12}$ (B1) and $\frac{x+81}{15}$ (B1) seen in parts (a) and (b). However, not all candidates who obtained the correct answers to these two parts were able to state the correct equation in part (c). Many simply added the 2 to the wrong side of the formed equation or multiplied one of the two expressions found in part (a) or part (b) by 2.

The correct equation, $\frac{x+81}{15} - \frac{x}{12} = 2$ (B1) for part (c) invariably led to a correct linear equation in x (M1, A1) for part (d) but then many candidates simply stopped at $x = 204$ thus losing the last mark for the answer required which was the mean number of fish caught on Monday, 17 (A1).

Question 6

This question proved elusive to gain full marks as a significant number of candidates either made errors on the diagram or on the subsequent set listings.

In part (a), a completely correct diagram (B4) was often missed by candidates simply with the omission of b. In (b), many candidates showed the correct two elements of g and j for part (i) (B1). However, the remaining two parts were poorly attempted as candidates showed a weak understanding of the union of sets and often confused with the intersection. Other candidates seemed to simply miss out the element j. These final two marks, (B1, B1), proved to be quite rarely awarded.

Question 7

What on the surface seemed a straightforward question proved to be difficult to answer correctly by many candidates. This was as a consequence of four issues:

(i) an incorrect determination of the radius of the semicircle with diameter AC;
(ii) an introduction of an extra factor of 4 into answers and working in parts (b) and (c);
(iii) using circles rather than semi-circles in parts (b) and (c);
(iv) an incorrect interpretation of the area of a circle leading to each coefficient of r not being squared.

So, in part (a) the answer of $10r$ (B1) was not seen as often as one would have liked. Common incorrect answers seen were $9r$ and $12r$. In part (b), a common error by some candidates was to simply add together the perimeter of 4 circles rather than four semi-circles $\frac{1}{2}\pi$ x 2 x $8r$ + $\frac{1}{2}\pi$ x 2 x $4r$ + $\frac{1}{2}\pi$ *x 2* x 2 x r +
$\frac{1}{2}\pi$ x 2 x c's($10r$) (M1). For those candidate who did obtain this method mark, the required collection of these terms, $24\pi r$, (A1) proved to be difficult for some candidates as the answer $4\pi 24r$ was seen on many scripts.

Some good work was seen in part (c) by those candidates who determined the two areas of $40\pi r^2$ (M1, A1) and $52\pi r^2$ (M1, A1) correctly. The conclusion (with method) invariably followed (M1, A1). However, a combination of errors either here or in part (a) meant that a significant number of candidates lost marks here. Common errors were either to use the area of circles leading to the appearance of $80\pi r^2$ and $104\pi r^2$ or using an incorrect form of the area such as $\frac{1}{2}\pi 8r^2 + \frac{1}{2}\pi 4r^2$.

Question 8

This was a well answered question with candidates seemingly well drilled in the technique of handling functional representation. Indeed, except for the simplification in part (c), many candidates scored highly on this question. Many correct answers of 3, 18 and 11 (B1, B1, B1) were seen in part (a) followed by an answer of 12 (B1) for part (b). Some candidates, however, showed that they do not have a clear understanding of composite functions as hf(x) = $\frac{6}{x}.\frac{1}{3}x+2$ was seen on a significant number of scripts rather than the required $\frac{6}{\frac{1}{3}x + 2}$ (M1).

Simplification proved to be elusive as the common incorrect answer proved to be $\frac{18}{x + 2}$ rather than the required answer of $\frac{18}{x + 6}$ (A1). Fortunately for these candidates the mark for part (d) is a follow through mark (B1 ft) and recovery was possible. Part (e) proved to be well done with the majority of candidates able to remove the denominator (M1) to arrive at the required quadratic of $3x^2 + 5x - 12 = 0$ (A1). An acceptable alternative, where the denominator was not removed, resulting in the quadratic equation of $x^2 + \frac{5}{3}x - 4 = 0$ earned the equivalent marks. The clue to factorisation of a quadratic is in the absence of the quadratic formula stated but many candidates seemed to ignore this clue. Whilst many factorised correctly (M1), just as many substituted into the quadratic formula, with varying success. The required answers of x = 4/3, x = -3 (A1, A1) were frequently seen.

Question 9

Part (a) proved to be well done with many correct answers of the form $3\mathbf{a} - \mathbf{b}$ (M1, A1). Part (b) tended to be started well with either $\overrightarrow{BC} = 6\mathbf{a} - 2\mathbf{b}$ or $\overrightarrow{AC} = 9a - 3b$ (M1) seen. However, centres should ensure that their candidates do not show vectors are parallel by dividing one vector by the other. Many instances of this were seen and, as a consequence, the last mark was lost. Successfully showing that one vector was a multiple of another and that one point was common to both vectors (A1) was what was required. It was pleasing to see that the majority of candidates handled the given ratio correctly and used fractions of 6 rather than fractions of 7. However, many incorrectly used $\overrightarrow{OX}$ rather than $\overrightarrow{XO}$ and this created problems for most of the remainder of the question. For those who used the correct initial expression for $\overrightarrow{XY}$ of $-\frac{1}{6}(8\mathbf{a} - \mathbf{b}) + 2\mathbf{b} - \mathbf{a} + \frac{1}{2}$ c's(AB) (M1), the majority went on to the required result of $-\frac{5}{6}\mathbf{a} + \frac{5}{3}\mathbf{b}$ (A1, A1) for part (c).The correct required answer of $\mu(2\mathbf{a} + \mathbf{b})$ (B1) was frequently seen in part (d) but the required answer of $\frac{1}{6}(8\mathbf{a} - \mathbf{b}) + \lambda$(c's($\overrightarrow{XY}$)) (B1) proved to be more elusive with a common wrong answer missing the term $\frac{1}{6}(8\mathbf{a} - \mathbf{b})$.

It was pleasing to see that candidates seem to be well drilled in the process of equating the coefficients of vector components to find the value of required parameters. Those candidates with correct answers to parts (d) and (e) invariably found $\mu = ½$ and $\lambda = 2/5$ (M1, M1, A1, A1). Many candidates, however, arrived at more 'unusual' fractions and this should have indicated to those candidates that perhaps they had gone wrong somewhere and that they should check their previous working. In part (g), many candidates guessed that Z is the midpoint of OB (B1). This, in itself, did not get the mark unless it could be justified from the candidate's working for part (f).

Question 10

In recent examinations the format of the longer graph questions has involved some algebra and calculus first. Whilst the majority of candidates seem to be quite comfortable with tackling graphs, many seem to have difficulty with the earlier parts of this type of question. As a consequence, the first eight marks of this question were harder to obtain than the second eight marks. Indeed, in part (a) many did not seem to know that h was required as the subject of the formula and answers were often left in the form $h + 2r = 20$ rather than the required answer of $h = 20 - 2r$ (B1). Part (b) was poorly done as candidates seemed to be unsure what to do and the required answer of $V = \pi r^2 h - \frac{2}{3}\pi r^3$ (B1) was not seen as often as was hoped. Only those with a correct answer to part (b) were able to successfully tackle part (c) by substituting their expression for h into their answer to (b) (M1) to reach the required conclusion (A1). Of those with incorrect prior working, many attempts were seen to fudge the answer.

Part (d) allowed some recovery and many candidates showed a level of calculus beyond the scope of the course. Whilst creditable and allocated the appropriate marks, the product rule (and quotient rule) are **not** required for this syllabus. Neither do we need, in this type of question, confirmation, by using the second derivative, that a value is a maximum or a minimum. Indeed, most errors caused in this part of the question were either as a consequence of misusing the product rule of differentiation or eliminating the fraction of $\frac{1}{3}$ too early and state an incorrect differentiated expression of $120\pi r - 24\pi r^2$ rather than the required expression of $40\pi r - 8\pi r^2$ (M1, A1). Many, however, were able to equate to zero (M1) for the required value of $r = 5$ (A1). Some less able candidates scored no marks for this part of the question as they simply equated V to zero.

Candidates, in general, fared better with the remainder of the question. In part (e), table entries of 184, 524 and 452 (B1, B1, B1) were frequently seen although some candidates failed to follow the instruction to give table values *to the nearest integer*. As a consequence, a one mark penalty was invoked. The graph (B3) was generally well done with few penalties invoked. Occasionally a mis-plotted point or tramlines would appear on a script but there was much correct work to be seen here.

Part (g) was also well done with many scripts showing an appropriate straight line drawn (M1). Both required answers of 3.4 and 6.3 (A1) proved to be popular answers however again some candidates lost this mark because they failed to follow the instruction *estimate to one decimal place*.

Question 11

This question was a good discriminator with many candidates scoring well on the first four parts and the more confident candidates were able to develop effective solutions to the final two parts of the question. Part (a) saw many correct solutions, using Pythagoras (M1) of 15 cm (A1). In a similar way, a correct use of Pythagoras on Δ *PAT* followed by subtracting this value from their answer to part (a) (M1) invariably led to the required answer of 9 cm (A1) in part (b). In part (c), many candidates could see that they required trigonometry to work out two angles (M1, M1) and then subtract found the required angle of 25.0° (A1). As in the previous question, dropping the '0' here meant a mark dropped. Simple trigonometry on Δ *PAD* and using the angle just found (M1) led many candidates to the required answer of 4.23 cm (A1).

A variety of methods now seemed to be used for the remainder of the question: some more successful than others. Indeed, despite the fact that only trigonometry of a right angled triangle is on the syllabus, many successful methods involved the correct use of the sine rule or the cosine rule. Such methods were not penalised. The way part (e) was expected to be answered was to first of all find *BD* or *BC* by Pythagoras (M1, A1) and then double the answer to arrive at a value in the range 8.49 cm $\rightarrow$ 8.52 cm (A1). Some candidates, however, determined the length of *AB* using Δ *ABP* and the length of *AC* using Δ *ACP*. Both lengths required the use of non-right angled triangle trigonometry and, if applied correctly, earned the first two marks. Where some candidates went wrong was where *OB* was determined and then an assumption made that *C* was the midpoint of *OB*.

In part (f), candidates could (and some did) use the tangent-secant theorem. Many chose not to do it this way and a scheme was devised for a multitude of different methods. One popular method was to use the sine rule (M1, A1) followed by the cosine rule (M1) on Δ *ABP* to arrive at an answer in the range 4.79 $\rightarrow$ 4.83 cm (A1). Those who used only techniques identified on the syllabus, determined the length of *AD* using right angled trigonometry on Δ *ADP* (M1, A1) and then subtracted their value of *BD* from *AD* (M1, A1).

Statistics

Overall Subject Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	U
Overall subject grade boundaries	100	80	64	48	43	30	0

Paper 1

Grade	Max. Mark	A	B	C	D	E	U
Paper 1 grade boundaries	100	82	66	51	42	33	0

Paper 2

Grade	Max. Mark	A	B	C	D	E	U
Paper 2 grade boundaries	100	79	63	47	38	29	0

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