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Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel GCE
In AS Mathematics (8MA0)
Paper 01 Pure Mathematics

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General Comments

Overall, this paper tested most aspects of the Pure content of the AS Level specification and gave prepared candidates the opportunity to demonstrate what they knew and understood. Candidates were presented with a variety of questions which required problem-solving and many of these had multiple routes that they could pursue to reach the answer. There were a few blank responses, and this was possibly a combination of those who were not prepared, whilst others had spent too long on less efficient methods on earlier questions. Candidates are still not clear how they should be using their calculator or using it appropriately. Indeed, when information is given in the stem to a question, it is expected that this is used, so candidates should be aware that in using their calculator instead to solve the problem may result in not scoring all of the available marks.

Candidates would benefit from considering the time required to answer questions and think about the amount of working required. Generally, earlier questions should be more accessible and require less time such that heavy algebraic methods should not be needed. Taking some time to consider the most suitable approach would really help to increase the overall number of marks for some candidates, particularly if they are prone to making errors in algebraic manipulation which can result in even more time wasted in return for few marks being gained. Making sure that solutions are clearly presented and labelled with the relevant part would also help with structuring responses.

Comments on individual questions

Question 1

This was a very accessible question on integration to start the paper and most candidates were able to score well. Most candidates attempted to separate the fraction into two terms and achieved at least one correct index. The first term caused problems for some with errors such as $x^{-\frac{5}{2}}$, $x^{\frac{3}{2}}$, $x^{\frac{1}{2}}$. A few ended up with three terms as they had added or subtracted x^{-2}. A few tried to integrate the numerator and denominator or wrote $(2\sqrt{x}-3)x^{-2}$ but did not expand the brackets and integrated both inside and outside separately. Those who had scored the first M1 usually were able to raise the power by one on at least one term with a correct index and score the next method mark. Several made errors when processing the indices and ended up subtracting by one on at least one of the terms. A few made errors with the coefficients. The most common mistake was to forget the + *c*.

Question 2

This question which required use of the factor theorem and solving simultaneous equations provided an opportunity to score a good number of marks. Some candidates found this question to be accessible and scored full marks or nearly full marks. Others however, encountered difficulties, particularly with part (b) and dropped marks accordingly. Some candidates lost marks because they did not pay heed to the instruction to show all stages of their working.

In part (a), most candidates made progress and attempted to employ the factor theorem, as the question had instructed, and used $\text{f}(4)=0$ to obtain the given answer. Some lost the second mark for not including '= 0' anywhere in their proof or for algebraic slips. A few candidates attempted algebraic division and scored nothing in part (a).

For part (b), many candidates continued with the theme of the question and applied the factor theorem a second time using $\text{f}(2)=0$, obtaining a second equation in *a* and *b*. This was the easiest way to proceed. Surprisingly however, a significant number of candidates chose more difficult routes and progressed instead with entirely different methods. Many candidates had some success by expanding $(2x+k)(x-4)(x-2)$ and then comparing coefficients with the original function, obtaining further equations. Others attempted to divide the original function by $(x-2)$ or sometimes by x^2-6x+8, using long division. This approach was less successful because of the algebra involved and few reached a second equation. There were also a few attempts using the sum and product of the roots of a cubic equation. Some candidates attempted to use $\text{f}(2)=0$ with $\text{f}(x)=(2x+k)(x-4)(x-2)$ and made no progress in part (b). Generally, when candidates obtained further correct equations in part (b), they were then able to successfully solve them simultaneously to obtain values of *a*, *b* or *k* which were usually correct. This was often followed by the correct factorised expression for f(*x*), although a number of candidates failed to write this down and lost the final mark. A few correct answers were presented with no working, which gained no credit in part (b).

Part (c) was answered quite well, even by those who had made little or no progress in part (a) or part (b). In part (i) many identified that there were three real roots, although stating that there were two real roots was a common incorrect answer. Some also lost the mark because they listed the roots without stating how many there were. In part (ii) many realised that the largest root was 12, although $\frac{4}{3}$ was a common incorrect answer.

Question 3

Overall, this question proved fairly tricky with lots of candidates losing marks throughout.

In part (a), most candidates knew they needed to subtract the vectors, there were a few signs slips when doing this and quite a few candidates subtracted the wrong way round so found $\overrightarrow{QP}$ instead. There were a small but significant number who added the vectors.

In part (b), quite a few candidates seemed unclear as to how to show $PQR = 90°$; some made no attempt whilst others used the given fact within their proof often finding two angles in a triangle and showing that they were complementary, but they had assumed a right angle in order to utilise trigonometry which achieved no marks. The candidates who tended to be most successful at this were the ones who attempted to show the required property using gradients. There were a small number of signs slips and incorrect attempts at gradients but overall, this approach was usually successful. Quite a lot attempted to use Pythagoras' theorem but there were a significant number who would only find $|\overrightarrow{PQ}|$ and $|\overrightarrow{QR}|$ and either did not attempt to find $|\overrightarrow{PR}|$ or had a poor attempt at finding it. It is of note that for those who successfully used Pythagoras' theorem to complete the proof, diagrams proved useful. There were a small number who attempted the dot product or cosine rule and usually these attempts were good enough to achieve the marks. It was disappointing that the most common reasons for the M1A0 score were due to incorrect/incomplete solutions or simply a lack of conclusion.

Part (c) proved quite tricky for a lot of candidates many of whom did not seem to have fully understood the shape with which they were working. Those who were successful usually had a good diagram identifying it as a trapezium and were able to find the area. There were a number of attempts at splitting the shape up into a rectangle and triangle or 2 triangles, but often there was a misunderstanding about which lengths were which and how they should be combined to find the area. The most common error in the rectangle and triangle approach was that the candidates failed to spot that the triangle was a right-angled triangle so could use $|\overrightarrow{QP}|$ as the 'height.' The two triangles approach would also often have the same issue. There were quite a few attempts that treated the shape either as just a rectangle or just a triangle.
It was pleasing however to see that whilst a large number of candidates were unsure of how to proceed to find the area many did at least acknowledge the need to attempt the lengths of various vectors, which generally resulted in two marks being awarded.

Question 4

This question using advanced trigonometry was generally answered well and as part (a) was a "show" question, this provided great accessibility for part (b), which candidates were typically more successful in completing.

In part (a), whilst the vast majority of candidates were able to correctly state, and substitute into, the sine rule, a large proportion of them demonstrated a poor understanding of algebra and were unable to rearrange the equation to make *x* the subject. Many candidates, whilst arriving at the correct answer via valid algebra, used inefficient or inelegant techniques. Only a few students misquoted the sine rule e.g. misplacing the angle/opposite side pairings, using 30° and 140° instead of sin 30° and sin 140°, and writing $\sin x$ and $\sin(x+3)$. It was disappointing that for a "show" question where the focus is on providing a rigorous argument, that some candidates failed to work to at least 3 significant figures, instead approximating values such as sin140° too much and/or too early, which led to the answer mark being lost. Candidates should also be discouraged from working with approximated values when answering these types of questions. There was evidence of candidates resorting to using the equation solver on the calculator to find the correct value for *x* after having got stuck, or having made an error, whilst attempting to solve their equation, too, hence the requirement for ideally rearranging to find an expression for *x* before achieving the given answer.

Candidates were more confident when using the cosine rule and so part (b) resulted in many achieving the correct answer. This may reflect the fact that they simply needed to substitute in the given correct value for *x* into the formula and then do the numeric processing i.e. no algebraic work was required. The vast majority of candidates realised that the most efficient solution used triangle *ABD* with an angle of 150°. Those that chose to use triangle *ABC* tended to arrive at the correct answer, although they probably took longer to do so, as there was an additional side length to calculate. A number of candidates did not substitute side lengths into the cosine rule, instead working with *x* and $x+3$. They then attempted to manipulate the resulting algebraic expressions. Some failed to realise that the value of *x* was given; others noticed this at the last minute, after considerable algebra. This was another example where, had candidates read the question carefully and realised the requirement was to give the answer to 3 significant figures, then the need to work algebraically was no longer necessary as an exact answer would not need be required.

Question 5

This question tested candidates' ability to sketch graphs and to be able to divide polynomials. Many candidates did not heed the warning in part (c) that "solutions relying on calculator technology are not acceptable" and this cost them marks. Overall, this question had a wide spread of marks.

Part (a) required the sketching of a reciprocal graph. A significant proportion of candidates did not even attempt to sketch the graph; those that did often produced a good positive reciprocal graph with both branches, scoring the first mark. The second mark proved harder with many graphs being in the wrong place, with an extra asymptote and the *x* intercept not labelled. The *y*-axis with a dashed line next to it also resulted in losing the second mark as candidates were not aware that this was implying that their asymptote was not the *y*-axis. Part (a)(ii) required both the equations of both asymptotes: $y = 3$ was common but $x = 0$ was not seen as often.

In part (b), candidates were required to equate both curves and rearrange to obtain a given answer. This was very well answered with the most common error being slips on the indices and not equating the final answer to zero. Those who were unsure what was being asked just proceeded to solve the cubic on their calculator.

Part (c) proved more difficult, and this is where the calculator warning was ignored. Many candidates simply stated the three roots with no working which scored no marks. Others tried to work backwards and failed to appreciate the requirement to use the given information. It is not acceptable to just use the calculator to solve to find the three roots, then above write the factorised version and then multiply out above this to achieve the cubic equation as there is not sufficient evidence that the given information had been used. If it was not factorised into $(3x+2)$(quadratic) or evidence that another factor had been found, demonstrated by an algebraic technique such as algebraic division, or using the factor theorem then full marks could not be awarded. Just factorising by inspection using one of the other factors which have mysteriously appeared was not accepted and these approaches should be discouraged. Those that realised that algebraic division was required scored well, a significant number of candidates choose to divide by $x+\frac{2}{3}$ rather than the expected $3x+2$. The resultant quadratic was then factorised to give the additional points of intersection.

Question 6

This was a very accessible question and candidates clearly felt comfortable with this topic. In particular, parts (a) and (b) were well answered, although part (c) did provide much more challenge and discriminated candidates well.

Part (a) was generally done well with most candidates able to form a correct equation and proceed to find *a*. Those who used $a=-\frac{5}{8}$ usually forgot to write a conclusion. There were a few who expanded and achieved $1+12ax+66a^2x^2$ but then did not equate the terms or substitute in *a* and did not score any marks.

In part (b), many candidates achieved the correct value for *k*. The most common mistake was to not square the *a* and ended up with $k=-\frac{164}{4}$. A few who just gave the answer as a decimal had rounded and lost the A mark.

In part (c), a minority of candidates achieved both marks. A common mistake was to solve $1-\frac{5}{8}x=\frac{17}{16}$ to find an appropriate value of *x* but to stop there and not substitute it into their expansion. A few substituted it back into $\left(1-\frac{5}{8}x\right)^{12}$ and ended up just evaluating $\left(\frac{17}{16}\right)^{12}$. For those who did substitute their *x* into the expansion, several had made errors when solving the equation and had an incorrect value of *x*. Again a few made rounding errors and lost the accuracy mark. Some candidates also found the next term in x^3 which was not required and took up additional time, however, successful responses were credited with both marks.

Question 7

This question tested the understanding of logarithmic graphs and exponential growth. This was successful in differentiating between candidates, although surprisingly candidates still struggle with this relationship. In addition, part (b) provided challenging for most who were unable to interpret in context.

Many candidates lacked confidence in relating the exponential form of the model $P = ab^x$ to the straight-line graph of $\log_{10} P$ against *x*. Whilst some very poor log work was seen, some candidates also made fundamental errors whilst forming the equation of a straight line, for example, an incorrect method for calculating the gradient, e.g. $\frac{6-0}{2.1-3.3} = -5$

Many candidates used *y* instead of $\log_{10} P$ when writing down the equation of the straight line.

Some candidates appeared confused as to whether they should use 3.3 or $\log_{10} 3.3$ within their equation, whilst others also showed a lack of robust understanding in manipulating indices after achieving a correct equation for *P*. A significant minority of candidates who achieved the correct values for both *a* and *b* failed to then write down the complete equation required.

In part (b), the vast majority of candidates were unable to correctly explain the meaning of "*ab*". Some thought that they simply had to calculate its value i.e $ab = 1005 \times 0.6310 = 1259$. Many others assumed they needed to give the meanings of each of *a* and *b* separately, as on previous papers.

Question 8

Marks awarded in this question were generally quite varied. Often candidates made progress in (c) only, by attempting some integration with little correct work seen in (a) or (b). Each part of this question presented a given answer, and candidates who failed to observe the warning in the question about showing all stages of their working, or relying entirely on calculator technology, often lost marks.

In part (a) candidates who identified how to proceed attempted two approaches. Some differentiated the equation of the given curve and set the answer equal to -2 to obtain $3x^2 - 14 = -2$. Others subtracted the equations of the curve and the line to obtain $x^3 - 12x + 16$ and used the derivative of this to obtain $3x^2 - 12 = 0$. A common error was attempting to solve $3x^2 - 14 = 0$ instead. Candidates then proceeded either to solve their equation to obtain $x = 2$, or substituted $x = 2$ into their equation to verify the solution. Some candidates lost the final mark in part (a) for reaching $x = \pm 2$ and failing to select $x = 2$. Other candidates often failed to make any progress in part (a) at all. These often attempted to substitute $x = 2$ into both the equations for the curve and the line or tried to solve $x^3 - 12x + 16 = 0$. Neither of these approaches gained credit because of the requirement of the question for use of calculus.

Those who attempted part (b) employed many varied methods. The easiest approach was to simply to verify that both the line and the curve passed through the point $(-4, 15)$ showing sufficient working. Many though, subtracted the equations of the line and the curve again to obtain $y = x^3 - 12x + 16$. Candidates then either verified that $x = -4$ was a solution of $x^3 - 12x + 16 = 0$, or attempted to solve this equation. Those who reached

$x = -4$ by factorising via $(x+4)(x-2)^2 = 0$ were in a position to score both marks, but a number relied on their calculator equation solver, and could only be awarded the first mark in part (b). Candidates often lost the final mark for not writing a full conclusion. To score full marks, candidates needed to reach $x = -4$ showing sufficient working using a valid method, and also indicate that they had completed the proof.

In part (c) candidates generally knew that they needed to proceed with integration, and often the first two marks were scored for correctly integrating even if they made no further progress. Successful candidates usually attempted to evaluate $\int_{-4}^{2} x^3 - 14x + 23 \, dx$ and then subtracted $\int_{-4}^{2} -2x + 7 \, dx$. Some used the area of a trapezium to give $\frac{1}{2}(3+15)\times 6$ instead of integrating the equation of the line. Alternatively, some attempted to evaluate $\int_{-4}^{2} x^3 - 12x + 16 \, dx$ reaching the required area of 108 in one step. Candidates were required to make their method clear, including showing the use of the limits -4 and 2. Some failed to do so, clearly relying on calculator technology to evaluate the integrals. Others failed to show the complete correct strategy for finding the area and often incorrectly identified the trapezium as a triangle. Also, correct notation was required and appropriate use of the integral sign and the 'd*x*' on either side.

Question 9

This question, testing the topic of logarithms, was poorly answered with the majority of candidates simply unable to engage with parts (b) and (c).

Some candidates did not appear to understand what was being asked of them. This portrayed both a lack of understanding of logarithms, and also a lack of practice on similar past paper questions. Part (a) however, was answered relatively well, with many candidates reaching the correct answer of 2*p*. Errors included, for example, candidates writing $\log_a 256 = 2\log_a 16$ without going onto write this in terms of *p*. Many appeared to think they had fully answered the question because it is given that $p = \log_a 16$.

Similarly, in part (b), many candidates wrote $\log_a 100 = \log_a 25 + \log_a 4$ but never proceeded further than this. These candidates lost the A mark, seemingly thinking they had given a complete correct answer.

It was rare in part (c) for candidates to make any progress, having already struggled on part (b). The lack of the use of brackets often caused issues, too. It was rare for candidates to progress to the impressive, simplified solution of $p^2 - \frac{1}{4}q^2$.

The general understanding of the laws of logarithms was very poor. Examples of conceptual misunderstandings were numerous. E.g. $\log_a 256 = \left(\log_a 16\right)^2 = p^2$, $p = \log_a 16$ so $\log_a 256 = 16p$, $\log_a 25\times 4 = q\times 4 = 4q$, $\log_a(80\times 3.2) = \log_a 256 = 2p$. There were, of course, some excellent solutions, too.

Question 10

This question required problem solving skills and focused on coordinate geometry and circles.

Part (a) required candidates to obtain a given equation. The most common route for this was to work out the gradient between *P* and *Q* and to set this equal to the negative reciprocal of the gradient of the tangent. Candidates attempting this route scored well. The other common route was to find two equations for radius using the coordinates of *P* and *Q* and the gradient of $\frac{1}{2}$. In general, candidates who had a strategy for the question did well on this part with just bracketing and sign errors being the major problem. Unfortunately, many did not appreciate the relevance of the gradient of the tangent of *l* would enable them to find the gradient of the normal to the curve at Q (hence the equation of the line between *P* and *Q*) and only typically scored one mark for being able to form an equation using the coordinates for *Q* with the given gradient of -2 and not knowing where to go from there.

Part (b) required candidates to find the equation of the circle. Most candidates found both values of *k* but ignored the information in the question that *k* was a positive constant. Those who did appreciate this and used $k = 5$ went on with good success to find the coordinates of *P*, giving them the centre of the circle and *Q* which allowed them to calculate the radius and complete the question. This part was more often successfully answered than the "show" part (a), which showed good accessibility, as well as good exam technique by many candidates to still attempt a later part, even if they were unable to successfully answer the earlier part.

Question 11

This question was a modelling one relating to the price per gram of two different metals. It enabled candidates to demonstrate understanding of working with exponential functions and differentiating them.

In part (a), a significant proportion of candidates scored both marks, achieving the correct answer of 240. A few candidates halved instead of doubled and got 60 and a few left *p* as 120. A few made errors when evaluating $20e^0$ or $40e^0$ thinking this was equal to 1 (or making a careless slip).

Part (b) was generally poorly answered, and a number of candidates made no attempt to answer this part. A common error was to set $V_A = V_B$. For those that found $\frac{dV_A}{dt}$ and $\frac{dV_B}{dt}$ some did not put them equal to each other, or they set one or both equal to 0 instead, but the most common mistake was to keep the negative and write $0.8e^{0.04t} = -4.8e^{-0.02t}$ thus forfeiting the last three marks. The minority who did set $\frac{dV_A}{dt} = -\frac{dV_B}{dt}$ were usually able to use a correct method to solve the equation. Some candidates did appreciate the issue of trying to take logs of a negative was not possible, but rather than go back to the original equation, they opted to either ignore it or scribble out the negative at some point of the solution which was not acceptable to score these final marks.

Question 12

This question provided a number of valuable entry points to provide candidates with the opportunity to progress in later parts of the question even if earlier parts proved challenging. As a result, the question provided a good spread of marks amongst the cohort. A significant minority of candidates abandoned the question, however, after coming unstuck on part (a) without an attempt at later parts. This was a shame particularly as later parts of the question provided a good source of marks for many candidates.

In part (a) attempts to find expressions for the surface area and perimeter of the given shape were often successful, although errors and slips were not uncommon. A correct expression for the perimeter was perhaps more often successfully achieved than a correct expression for the area. A relatively common error was in setting *x* as the diameter of the sector rather than the radius. A significant number of candidates found expressions in terms of *r* and could earn no marks until *r* was replaced by x. A minority of candidates equated the perimeter, rather than the area, to 100, but the vast majority made an attempt at the key step of rearranging their equation to find an expression for *y* in terms of *x*. Some candidates were more unusual in their choice of substitution: rather than finding an expression for *y* or 2*y*, they used effective and efficient substitutions for functions such as $\frac{100}{x}$. Once the critical substitution was achieved, most candidates went on to successfully obtain the required result, although occasionally marks were lost due to arithmetical and/or sign errors, or for the omission of '*P* =.'

Part (b) required differentiation to determine the position of a stationary point and the vast majority of candidates were well versed in this process; the majority earning full marks in this part. There were a few errors arising from errors in differentiation for example in the sign or the coefficient of the $\frac{200}{x}$ term. Other errors arose from poor rearrangement of the equation $\frac{dP}{dx}$, resulting in $x = -0.1$, or in the inclusion of the $x = -10$ root or stating a spurious $x = 0$.

In part (c), differentiation to obtain the second derivative was commonly successfully achieved. However, it was surprising that a significant minority of candidates felt that determining the second derivative was sufficient, neither evaluating it for their value of *x*, nor reasoning why it was positive for all positive *x*. Others lost the final mark in this part for a lack of conclusion.

A number of approaches to part (d) were observed. Most commonly, candidates evaluated *y* using their value of x and the relationship derived in part (a), to determine whether *y* was greater than the required lower limit of 1. This approach was usually the most successful. Slightly more circuitous routes were also seen which involved employing the given expression for *P* to determine the minimum perimeter and then an additional expression for *P* in terms of *x* and *y*, used with $y = 1$ and either $x = 10$ (to find *P*) or $P = 40$ (to find *x*). Often this approach fell slightly short of being complete as a final comparison of *x* with the value 10, or a comparison of *P* with the value 40 was required to justify whether the swimming pool dimensions were suitable. Some candidates tried to draw conclusions but gave insufficient supporting statements such as '10.8 is close to 10, so suitable', or '10.8 > 0, so suitable' rather than the relevant '10.8 > 10, so suitable'. Other candidates were unable to gain marks here for irrelevant statements unsupported by calculation such as ‘suitable, although the pool might be a bit small.’ Others were confused about what value of x they should use and erroneously substituted $x = 0.4$ (the result value of the second derivative at $x = 10$) into either their expression for y or their expression for P.

Question 13

The trigonometric equation, again, demonstrated how candidates are usually successful in solving these types of equations, however, they often struggle with the manipulation to show a given result.

Part (a) held one of the highest demands in the paper and showed a clear differentiation between the most capable mathematicians and those who were familiar with trigonometric identities but struggled to apply and manipulate them. Overall, this proved to be difficult for most candidates with quite a few gaining one or two marks but very few were able to gain all four marks. Multiple attempts were seen which showed good resilience but further evidenced the complexity of the question. Most candidates were able to gain the first M mark which usually was for using $\tan\theta = \frac{\sin\theta}{\cos\theta}$, (even if this followed from incorrect work which was quite often) quite a few candidates attempted to divide by $\cos\theta$ as they seemed to spot it would give them a $\tan\theta$ in their working, however not many recognised the need to divide by $\cos^2\theta$ and those that did would often forget to divide the 4 on the right hand side by it as well; they also tended to replace $\frac{7\sin^2\theta}{\cos^2\theta}$ with $3\tan^2\theta$. Of the candidates who did manage to pick up the first two marks, many could not reach a 3TQ in $\tan\theta$ and thus the required answer. The successful approaches would often start with using $\sin^2\theta + \cos^2\theta = 1$ on the right-hand side and proceed from there or work backwards from the given answer.

Part (b) was much more accessible due to the given answer in (a) not being a “show” which required constants to be found. Candidates achieved much more success with this part with most able to find the required roots and use these to find at least two of the required angles. There were occasional sign errors and a very small number attempted to solve the original equation from (a) without success. There were quite a few candidates who did not find all the required angles. This would often be because they would reject one of the solutions, $-\frac{2}{3}$ or the angle it gave being negative seemed to be a reason that candidates ruled it out. The other root, 2, would often be ruled out presumably because of a misconception that the range of all trigonometric graphs was $|y| \leqslant 1$. There were a small number who used an incorrect method to find other values, such as adding 90, or subtracting from 180 from their angles. Quite a lot of candidates did manage to find all the required angles, however.

Part (c) was usually poorly attempted with the vast majority not evidencing an understanding of graph transformations and just adding 63.4 to 720 or multiplying 243.4 by 4 as this would give an angle in the required range.

Question 14

This question proved to be a challenge for the majority of candidates and full marks were not common. The instruction to 'use algebra' was lost on a number of candidates who employed logical approaches or attempted to test an array of integer values for *n*. Perhaps a casualty of being the last question on the paper, there were also a number of blank responses seen.

For those employing a logical approach, some credit was given when algebra was used to factorise the quadratic followed by a consideration of the parity of the factors. This was often left incomplete however, and so rarely scored the two marks out of four for a complete attempt via this approach.

The majority of candidates who attempted the question did grasp the need to consider the general form for odd and even integers and made a reasonable attempt. Although some candidates incorrectly used '$k+1$' or considered even integers twice e.g. '$2k$' and '$2k+2$'. Unfortunately, marks were very commonly, yet surprisingly, lost due to basic mistakes in simple algebraic manipulation. These errors occurred in both the expansion and the factorisation of brackets and included errors such as $5(2k+1)=10k+1$ or $4k^2+10k=2(k^2+5k)$. It was surprisingly common for candidates to use *n* in their general form i.e. '$n=2n$' which led to the loss of the final mark, especially since this has been in previous mark schemes that this would not garner full marks. A large proportion of candidates failed to give an overall conclusion to their proof which was also penalised with the final mark.

A small minority of candidates employed proof by induction and, when seen, this was usually confidently executed.

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