MATHS HL TZ2

(IB Africa, Europe & Middle East & IB Asia-Pacific)

Discrete mathematics

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 12	13 - 25	26 - 37	38 - 49	50 - 61	62 - 73	74 - 100

Series and differential equations

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 12	13 - 25	26 - 38	39 - 50	51 - 62	63 - 74	75 - 100

Sets, relations and groups

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 12	13 - 25	26 - 38	39 - 50	51 - 62	63 - 74	75 - 100

Statistics and probability

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 12	13 - 25	26 - 37	38 - 49	50 - 60	61 - 72	73 - 100

Time zone variants of examination papers

To protect the integrity of the examinations, increasing use is being made of time zone variants of examination papers. By using variants of the same examination paper candidates in one part of the world will not always be taking the same examination paper as candidates in other parts of the world. A rigorous process is applied to ensure that the papers are comparable in terms of difficulty and syllabus coverage, and measures are taken to guarantee that the same grading standards are applied to candidates' scripts for the different versions of the examination papers. For the May 2009 examination session the IB has produced time zone variants of the Mathematics HL papers.

Internal assessment

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 6	7 - 13	14 - 18	19 - 23	24 - 29	30 - 34	35 - 40

The portfolios in this session were generally well presented. Teachers and students appear to have understood the assessment expectations. Generally, the work was clearly marked, and the requisite forms have been completed correctly. Observations made by the moderating team are summarised below:

The tasks:

Most portfolio tasks were taken from the current publication, “Mathematics HL – The portfolio – Tasks for use in 2009 and 2010”. There were also a few good tasks submitted by a number of schools. Teachers are encouraged to design their own tasks, keeping in mind the need to satisfy all criteria fully.

There were three issues of concern this session:

1. Some teachers continued to use old tasks taken from a previous TSM. As explained in past Subject Reports and through the Coordinator’s Notes, those tasks are no longer eligible for use; hence, a number of candidates lost a significant number of marks through no fault of their own! This is completely inexcusable and must be rectified.

2. Tasks taken from the document for Mathematics SL are not at a suitable level for Mathematics HL and should not have been used.

3. Gauging from the similarity of some student work, it would appear that some teachers are providing too much guidance or direction to students. To avoid the danger of malpractice, such guidance should not prescribe how students should proceed with any task assigned.

Candidates’ performance

Most candidates performed well against criterion A. The use of computer notation seemed to be very limited; however, the inappropriate use of “^”, “E09”, and the like, continue to mar some student work. The careless misuse of some terminology (e.g. “equation” instead of “expression”) must also be avoided.

Good communication skills were evident in some samples. Where a student’s work began with an introduction to the task, and comments, annotations, and conclusions accompanied the steps and results, the work was easy to read and follow, and earned high marks in criterion B. However, there were many students whose work did not stand on its own, particularly when there was no introduction to a task or when a question-and-answer format to a task was adopted. Unlabelled graphs and the relegation of tables to the appendix rate poorly in terms of an effective presentation and should have been penalised.

Criteria C and D are meant to assess the mathematical content and jointly comprise half of the total marks awarded to each piece of work. Generally, students have produced good work, and the assessments by their teachers have been appropriate. However, in some type I tasks, insufficient exploration and patterning rendered the quick formulation of a conjecture questionable. In some instances, results were quoted from internet sources and there was little individual work in exploration and investigation, the key to the type I task.

In type II tasks, variables should be explicitly defined. Some realisation of the significance of the results obtained in terms of the model when compared to the actual situation should have been provided, and students should have reflected on their findings. The analyses of data must be quantified, and if a regression analysis were appropriate, the student must have provided reasons for a particular choice. The use of software that automatically determines the “best” regression model leaves little for the candidate to interpret by himself and should be avoided.

The use of technology varied considerably. Full marks were given much too generously for an appropriate but not necessarily a resourceful use of technology, for example, in the mere inclusion of a graph of data. For full marks, the use of technology should contribute significantly to the development of each task. Students should be discouraged from including GDC key sequences – they are quite unnecessary.

There were many good pieces of work; however, the awarding of full marks in criterion F requires more than completion and correctness, but the evidence of mathematical sophistication.

Suggestions to teachers

Tasks from the TSM must not be used as of this examination session - they carry a 10-mark penalty for their use. Please refer to the document, “Mathematics HL – The portfolio – Tasks for use in 2009 and 2010” for suggested tasks. Teachers are encouraged to design their own.

Teachers should select tasks that provide students with a variety of mathematical activities suitable at higher level. Tasks taken from the Mathematics SL publication do not meet HL requirements. Please ensure that candidates do not lose marks due to inappropriate choices made by the teacher.

The teacher who is uninformed of the changes to the portfolio assessment criteria is generally the reason for a significant loss of marks in moderation. This is not only disastrous to the student, but also completely unfair, and should not happen.

Teachers are expected to write directly on their students’ work, not only to provide feedback to students, but information to moderators as well. Some samples contained very few teacher comments. Moderation was extremely difficult when it was not possible to determine the basis upon which the teacher awarded marks.

Moderators find the background to each portfolio task very useful in determining the context in which the task was given when confirming the achievement levels awarded. This information must accompany each sample, either on Form A or through anecdotal comments.

A solution key for tasks from the current publication, as well as for those designed by teachers, must accompany the portfolios in order that moderators can justify the accuracy of the work, and appreciate the level of sophistication demonstrated in the work.

The tasks contained in the current document have now been in use with students completing their diplomas in 2009. They can only be reused with students finishing their diploma program in 2010. Students starting their first year this fall should not be assigned these tasks.

Paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 17	18 - 35	36 - 49	50 - 63	64 - 76	77 - 90	91 - 120

The areas of the programme and examination that appeared difficult for the candidates

On this paper candidates found difficulty with questions that required a proof, an explanation or in which they were required to show a result. Questions which required a structured, logical response were problematic for many. The areas of the programme that gave rise to difficulty were logarithms (manipulation and simplification), complex numbers, induction, sigma notation, functions (knowledge of definitions and sketching), continuous probability distribution functions and matrices.

The need to balance the time between Section A and Section B was problematic for some. Errors in basic arithmetic calculations and algebraic manipulations were common. The general presentation and formulation of responses was overall quite poor.

It seemed that a number were not aware of the Command Terms and their significance. Also the connections between parts in the question in section B seemed to be not understood as many students did not make the connections that made the questions easier or more accessible.

The areas of the programme and examination in which candidates appeared well prepared

In general the routine questions were well done. The particular areas that were done well were vectors, integration (straightforward), inverse functions, binomial theorem and implicit differentiation. Many students were able to access later parts of the extended response questions even following an inability to get a result earlier in the question.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Most candidates were able to access this question although the number who used either synthetic division or long division was surprising as this often lead to difficulty and errors. The most common error was in applying the factor of 7 to the wrong side of the equation. It was also disappointing the number of students who made simple algebraic errors late in the question.

Question 2

This question was done well by most. The most common error was in establishing the top 20% for the award of a B grade rather than the next 20%

Question 3

The integration was particularly well done in this question. A number of students treated the distribution as discrete. On the whole a) was done well once the distribution was recognized although there was a certain amount of fudging to achieve the result. A significant number of students did not initially set the integral equal to 1. Very few noted the symmetry of the distribution in b).

Question 4

Many students did not 'Show' enough in a) in order to be convincing. The need for the steps of the simplification to be shown was not clear. Too many did not link a) to b) and seemed to not be aware of the Command Term 'hence' and its implication for marking (no marks will be awarded to alternative methods). The simplifications of the log expressions were done poorly by many and the fact that $3^3 = 9$ was noted by too many. There were very few elegant solutions to this question.

Question 5

The first part of this question was done well by many, the only concern being the number that did not simplify the result from $-\frac{8x}{2y}$. There were many variations on the formula for the volume in part c), the most common error being a multiple of 2π rather than π. On the whole this question was done well by many.

Question 6

This question was poorly done. Many students were not precise enough in a). The most common response was to note that they simply stated that $a^2 - b^2$ was positive with no explanation. There was confusion between the determinant and the inverse. In c) the explanations were again not sufficient (for example $(a^2 - b^2)^2$ is greater than zero rather than non-negative). The need for precision was not understood by a significant number. Very few used the fact that the determinant of a product is the product of the determinants.

Question 7

Parts a) and c) were done quite well by many but the method used in b) often lead to tedious and long algebraic manipulations in which students got lost and so did not get to the correct solution. Many did not give the principal argument in c).

Question 8

This question was done poorly on a number of levels. Many students knew the structure of induction but did not show that they understood what they were doing. The general notation was poor for both the induction itself and the sigma notation.

In noting the case for $n = 1$ too many stated the equation rather than using the LHS and RHS separately and concluding with a statement. There were also too many who did not state the conclusion for this case.

Many did not state the assumption for $n = k$ as an assumption.

Most stated the equation for $n = k + 1$ and worked with the equation. Also common was the lack of sigma and inappropriate use of n and k in the statement. There were some very nice solutions however.

The final conclusion was often not complete or not considered which would lead to the conclusion that the student did not really understand what induction is about.

Question 9

There were very few complete and accurate answers to part a). The most common incorrect response was to state the triangle inequality and feel that this was sufficient.

Many substituted a particular value for n and illustrated the result. Most students recognised the need for the Cosine rule and applied it correctly. Many then expanded and simplified to the correct answer. There was significant fudging in the middle on some papers. There were many good responses to this question.

Question 10

This question was done very well by many students. The common errors were using the same variable for line 2 and in stating the vectors in b) were not parallel and therefore the lines did intersect. Many students did not check the solution in order to establish this.

When required to give the equation of the line in e) many did not state it as an equation, let alone a vector equation.

The difference between position vectors and coordinates was not clear on many papers.

In f) many used inefficient techniques that were time consuming to find the point of reflection.

Question 11

Many students could not sketch the function. There was confusion between the vertical and horizontal line test for one-too-one functions. A significant number of students gave long and inaccurate explanations for a one-to-one function. Finding the inverse was done very well by most students although the notation used was generally poor. The domain of the inverse was ignored by many or done incorrectly even if the sketch was correct. Many did not make the connections between the parts of the question. An example of this was the number of students who spent time finding the point of intersection in part e) even though it was given in d).

Question 12

Many students in b) substituted for the second term (again not making the connection to part a)) on the LHS and multiplied by the conjugate, which some managed well but it is inefficient. The binomial expansion was done well even if students did not do the earlier part. The connection between d) and f) was missed by many which lead to some creative attempts at the integral. Very few attempted the last part and of those many attempted another integral, ignoring the hence, while others related to the graph of sin and cos but not to the particular graphs here.

Recommendations and guidance for the teaching of future candidates

- Candidates need more practice in questions that involve formal, structured mathematical reasoning

- Students need to be aware of the distinctions between the commands Prove, Show, Illustrate and Verify. They should be given illustration of these and use them in completing questions.

- Students should complete questions involving ‘hence’ and understand the implications when presenting a solution.

- Students need guidance in questions that require an explanation and what is sufficient and necessary.
- The importance of structuring responses rather than writing answers needs to be emphasized.
- Students need to be exposed to a variety of question that require analysis and thought rather than simply routine questions.

Paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 9	10 - 19	20 - 34	35 - 48	49 - 62	63 - 76	77 - 120

General Comments

A Paper 2 provides scope for candidates to demonstrate their breadth of knowledge of the Core, mathematical competence and ability to link topics, reasoning powers and to make appropriate use of a GDC. In particular, candidates should be prepared to plot and interpret graphs, to perform standard GDC calculations and to understand the distinction between an exact result and an approximate numerical answer. Whilst agreeing with the perception of those teachers who provided feedback on G2 forms, that the paper had some challenging aspects, examiners were disappointed at the inability of some candidates to tackle straightforward questions on significant parts of the syllabus.

The areas of the programme and examination that appeared difficult for the candidates

The interplay between vectors and coordinate geometry; how kinematics can lead to a differential equation; permutations and combinations; integration by substitution; related rates of change.

The levels of knowledge, understanding and skill demonstrated

A wide range of these elements was shown by candidates. Of course candidates were much more comfortable with the relatively routine parts of questions. At the top end, wide knowledge and manipulative skills were usually seen, but it was often not well expressed. Most candidates showed good algebraic and GDC skills, and an understanding of basic probability and probability distributions. Although most candidates were competent in differential calculus, particularly the chain rule, that did not extend to related rates of change.

Questions expressed verbally rather than as direct mathematical commands were the most problematic for quite a number of candidates.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Although this was the best done question on the paper, it was disappointing that a significant number of candidates produced Venn diagrams with key information missing.

Question 2

A variety of approaches were seen, either using a scalar product of vectors, or based on the rule for perpendicular gradients of lines. The main problem encountered in the first approach was in the choice of the correct vector direction for the line.

Question 3

Most candidates scored well on this question, showing competence at non-trivial differentiation. The follow through rules allowed candidates to recover from minor errors in part (a). Some candidates demonstrated their resourcefulness in using their GDC to answer part (b) even when they had been unable to gain full marks on part (a).

Question 4

This question was well done by many candidates. It would appear, however, that few candidates were aware of the standard terminology – *Stretch* and *Translation* - used to describe the relevant graph transformations. Most made good use of a GDC to find the critical points and to help in deciding on the correct intervals. A significant minority failed to note $x = 10$ as an endpoint.

Question 5

Most candidates who successfully answered this question had first drawn a tree diagram, using a symbol to denote the probability that a randomly chosen person had received the influenza virus. For those who did not draw a tree diagram, there was poor understanding of how to apply the conditional probability formula.

Question 6

This was a poorly answered question which linked the topic of kinematics with that of first order differential equations. Many candidates seemed unaware that the acceleration is the time derivative of the velocity. This was often followed by a failure to recognize a separable differential equation and/or integration with respect to the wrong variable.

Question 7

Many candidates throughout almost the whole mark range were able to score well on this question. It was pleasing that most candidates were aware of the discriminant condition for distinct real roots of a quadratic. Some who dropped marks on part (b) either didn't write down a sufficient number of linear equations to determine the three unknowns or made arithmetic errors in their manual solution – few GDC solutions were seen.

Question 8

Very few candidates provided evidence of a clear strategy for solving such a question. The problem which was set in a circular scenario was no more difficult than an analogous linear one.

Question 9

For many candidates this was an all or nothing question. Examiners were surprised at the number of candidates who were unable to change the variable in the integral using the given substitution. Another stumbling block, for some candidates, was a lack of care with the application of the trigonometric version of Pythagoras' Theorem to reduce the integrand to a multiple of $\cos^2\theta$. However, candidates who obtained the latter were generally successful in completing the question.

Question 10

For those candidates who realized this was an applied calculus problem involving related rates of change, the main source of error was in differentiating inverse tan in part (a). Some found part (b) easier than part (a), involving a changing length rather than an angle. A number of alternative approaches were reported by examiners.

Question 11

This was the best done of the section B questions, with the majority of candidates making the correct choice of probability distribution for each part. The main sources of errors: (b) missing out the binomial coefficient in the calculation; (c) failure to rearrange 'at least one bottle' in terms of the probability of obtaining no bottles; (d) using 1.2 rather than -1.2 in the inverse Normal or not performing an inverse Normal at all; (e)(ii) misinterpreting ' more than two'.

Question 12

This is not an inherently difficult question, but candidates either made heavy weather of it or avoided it almost entirely. The key to answering the question is in obtaining the displayed answer to part (b), for which a construction line parallel to MN through Q is required. Diagrams seen by examiners on some scripts tend to suggest that the perpendicularity property of a tangent to a circle and the associated radius is not as firmly known as they had expected. Some candidates mixed radians and degrees in their expressions.

Question 13

Although the final question on the paper it had parts accessible even to the weakest candidates. The vast majority of candidates earned marks on part (a), although some graphs were rather scruffy. Many candidates also tackled parts (b), (c) and (d). In part (b), however, as the answer was given, it should have been clear that some working was required rather than reference to a graph, which often had no scale indicated. In part d(i), although the functions were usually differentiated correctly, it was often the case that only one point was checked for the equality of the gradients. In part e(i) many candidates who got this far were able to determine the y-coordinates of the local maxima numerically using a GDC, and that was given credit. Only the exact values, however, could be used in part e(ii).

Recommendations and guidance for the teaching of future candidates

The examiners share a concern that too few students seem able to demonstrate that they have explored the topics in the program to the breadth and depth expected. Many students are able to perform routine operations successfully but then flounder once slightly more difficult and applied situations are encountered. Students should be reminded that tackling mathematical questions often involves the interplay of several topics from the course, and, where appropriate, the intelligent use of a GDC. Teachers should insist that students explain their working out and their reasoning, and of course ensure that they follow the instructions given in the questions.

Paper three – Discrete mathematics

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 15	16 - 23	24 - 30	31 - 36	37 - 43	44 - 60

The areas of the programme and examination that appeared difficult for candidates

On this paper candidates found difficulty with using adjacency matrices, Chinese remainder theorem and using aspects of Fermat’s little theorem.

The areas of the programme and examination in which candidates appeared well prepared

On the whole candidates appeared to have been reasonably well prepared for questions on some aspects of graph theory and using the Euclidean algorithm.

The strengths and weaknesses of candidates in the treatment of individual questions

Question 1

Most candidates were able to name an algorithm to find the lowest cost road system and then were able apply the algorithm. All but the weakest candidates were able to make a meaningful start to this question. In 1(b) some candidates lost marks by failing to indicate the order in which edges were added.

Question 2

Part (a) of this question was the most accessible on the paper and was completed correctly by the majority of candidates. Most candidates were able to start part (b), but a number made errors on the way and quite a number failed to give the general solution.

Question 3

Stronger candidates had little problem with this question, but a significant number of weaker candidates started by making errors in drawing the graph G, where the most common error was the omission of the loops and double edges. They also had problems working with the concepts of Eulerian circuits and Hamiltonian cycles. A majority of candidates were unable to complete part (d), with a significant number showing no indication that they understood what was required.

Question 4

There were a number of totally correct solutions to this question, but many students were unable to fully justify the result. Some candidates had learnt a formula to apply to the Chinese remainder theorem, but could not apply it well in this situation. Many worked with the conditions for divisibility but did not make much progress with the justification.

Question 5

There were very few fully correct answers. If Fermat's little theorem was known, it was not well applied.

Recommendation and guidance for the teaching of future candidates

- Students need to cover the entire syllabus.
- Students need to know the correct terminology.
- Students need to be aware that contextual questions can be asked.

Paper three – Series and differential equations

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 16	17 - 25	26 - 32	33 - 40	41 - 47	48 - 60

The areas of the programme and examination that appeared difficult for candidates

On this paper candidates found difficulty in deciding which an appropriate series convergence test was and in solving differential equations correctly.

The areas of the programme and examination in which candidates appeared well prepared

On the whole candidates appeared to have been well prepared for questions on L'Hopital's rule and using Euler's method to solve a differential equation.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

This question was accessible to the vast majority of candidates, who recognised that L'Hopital's rule was required. A few of the weaker candidates did not realise that it needed to be applied twice in part (b). Many fully correct solutions were seen.

Question 2

Part (a) of the question was set up in an unusual way, which caused a problem for a number of candidates as they tried to do part (b) first and then find the Maclaurin series by a standard method. Few were successful as they were usually weaker candidates and made errors in finding the solution $y = f \quad x$. The majority of candidates knew how to start part (b) and recognised the need to use an integrating factor, but a number failed because they missed out the negative sign on the integrating factor, did not realise that $e^{\ln\cos x} = \cos x$ or were unable to integrate $\cos^2 x$. Having said this, a number of candidates succeeded in gaining full marks on this question.

Question 3

This question was found to be the hardest on the paper, with only the best candidates gaining full marks on it. Part (a) was very poorly done with a significant number of candidates unable to start the question. More students recognised part (b) as an integral test, but often could not progress beyond this. In many cases, students appeared to be guessing at what might constitute a valid test.

Question 4

Part (a) was well done by many candidates, but a number were penalised for not using a sufficient number of significant figures. Part (b) was started by the majority of candidates, but only the better candidates were able to reach the end. Many were unable to complete the question correctly because they did not know what to do with the substitution $y = vx$ and because of arithmetic errors and algebraic errors.

Recommendation and guidance for the teaching of future candidates

- Students need to cover the entire syllabus.
- Students need to understand the conditions for the application of series convergence tests.
- Students need to have a solid background with skills and understanding in the core calculus portion of the HL programme to be successful with this option.

Paper three – Sets, relations and groups

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 16	17 - 24	25 - 31	32 - 39	40 - 46	47 - 60

The areas of the programme and examination that appeared difficult for candidates

On this paper candidates found difficulty with finding equivalence classes, showing that a function is a bijection, and finding that set difference is associative.

The areas of the programme and examination in which candidates appeared well prepared

On the whole candidates appeared to have been reasonably well prepared for questions on most aspects of group theory.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Most candidates were aware of the group axioms and the properties of a group, but they were not always explained clearly. A number of candidates did not understand the term “Abelian”. Many candidates understood the conditions for a group to be cyclic. Many candidates did not realise that the answer to part (e) was actually found in part (d), hence the reason for this part only being worth 1 mark. Overall, a number of fully correct solutions to this question were seen.

Question 2

Part (a) of this question was the most accessible on the paper and was completed correctly by the majority of candidates. Part (b) was completed by many candidates, but a significant number either did not understand what was meant by associative, confused associative with commutative, or were unable to complete the algebra.

Question 3

Stronger candidates had little problem with part (a) of this question, but proving an equivalence relation is still difficult for many. Equivalence classes still cause major problems and few fully correct answers were seen to this question.

Question 4

Many students were able to show that the expression was injective, but found more difficulty in showing it was subjective. As with question 1 part (e), a number of candidates did not realise that the answer to part (b) came directly from part (a), hence the reason for it being worth only one mark.

Question 5

This question was found difficult by a large number of candidates, but a number of correct solutions were seen. A number of candidates who understood what was required failed to gain the final reasoning mark. Many candidates seemed to be ill-prepared to deal with this style of question.

Recommendation and guidance for the teaching of future candidates

- Students need to cover the entire syllabus.
- Students need to know the correct terminology.
- Students need to understand that they will be penalised for poor explanation or layout of work.

- In this option questions involving proof will be asked and it is essential that students understand that a degree of rigour is needed in these proofs.

Paper three – Statistics and probability

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 15	16 - 21	22 - 28	29 - 34	35 - 41	42 - 60

The areas of the programme and examination that appeared difficult for candidates

On this paper candidates found difficulty with working with the exponential distribution and the geometric distribution.

The areas of the programme and examination in which candidates appeared well prepared

On the whole candidates appeared to have been reasonably well prepared for questions on expectation algebra, t-distributions, Normal distributions and confidence intervals.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Most candidates were able to access this question, but weaker candidates did not always realise that parts (b) and (c) were testing different things. Part (b) proved the hardest with a number of candidates not understanding how to find the variance of the sum of variables.

Question 2

This question also proved accessible to a majority of candidates with many wholly correct or nearly wholly correct answers seen. A few candidates did not recognise that part (a) was a t-distribution and part (b) was a Normal distribution, but most recognised the difference. Many candidates received an accuracy penalty on this question for not giving the final answer to part (b) to 3 significant figures.

Question 3

Stronger candidates had little problem with this question, but a significant number of weaker candidates encountered a number of problems. Many did not realise that part (b) could be done using the answer to part (a) and the manipulation of logarithms in part (iii) was weak. Weaker candidates knew how to start part (c), but encountered problems by rounding the expected values and forgetting to combine equivalence classes. Some candidates seemed to think that the criterion for combining classes is that the observed frequency rather than the expected frequency is less than 5.

Question 4

This question was found difficult by the majority of candidates and few fully correct answers were seen. Few candidates were able to find $P(X = x)$ in terms of n and x and many did not realise that the last part of the question required them to find the sum of a series. However, better candidates received over 75% of the marks because the answers could be followed through.

Recommendation and guidance for the teaching of future candidates

- Candidates need to be aware of the potential of the GDC in this paper. The majority of candidates were not using it to the full potential.
- Students need to cover the entire syllabus and be prepared for questions on any of the distributions given in the syllabus.
- In the statistics and probability option many students lose the accuracy penalty mark and other marks due to accuracy. Full accuracy should be used, except in the final answer, which should be given to 3 significant figures.
- Students need to have a solid background with skills and understanding in the core statistics and probability section of the HL programme to be successful with this option.