May 2017 subject reports

Mathematics SL - Time Zone 1

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 2017 examination session the IB has produced time zone variants of Mathematics SL papers.

Overall grade boundaries

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0–13	14–27	28–38	39–50	51–62	63–75	76–100

Standard level internal assessment

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0–2	3–5	6–8	9–11	12–14	15–17	18–20

The range and suitability of the work submitted

It is noted that the exploration has allowed candidates to make connections between mathematics and different subjects of the curriculum, be it the candidates other subjects or in a few cases TOK or CAS. The range of topics chosen continues to be interesting and demonstrates the wide use mathematics beyond the discipline itself. Candidates are collecting their own data, researching independently, conducting experiments, running simulations – all of which represents the true joy of learning.

There continue to be many explorations related to areas that personally interest the candidates and this is encouraging. Many of these were based on sports, computer and card games, music and arts. These real-life problems, using data generated by the candidate, help show personal engagement.

Regression continues to be a common area that frequently lacked understanding by using only technology generated models without even justifying the choice of model. Other explorations involved modelling the path of travel of an object that were usually not up to the level of good understanding or demonstrating mathematics of a suitable level. Some explorations were based on physics which did not allow much understanding to be demonstrated as they were often based on formulae that were just quoted and had values substituted in. As ever, common textbook problems or examples that are easy to find online, but were not generally extended or personalized in any way by the candidate, were evident.

A few explorations only used topics taken from previous knowledge and equally very few used mathematics at a level higher than the course although there were still some that did.

Some schools obviously coached their candidates to follow a particular format, sometimes producing near identical modelling style explorations. Schools are strongly discouraged from this approach. In some schools where modelling was encouraged strongly, candidates would choose a model without considering the nature of the data; either they started with one polynomial function in mind and never considered anything else, or they tried many regression models and chose one based on an R^2 value thus not scoring well in personal engagement, reflection, or use of mathematics.

Candidate performance against each criterion

Criterion A

Candidates generally do well in this criterion. The majority reached at least level 2 although level 4 has proved hard to achieve, often due to a lack of conciseness. Communication was well understood as many candidates started with a suitable introduction and a plan with an aim that was answered in a conclusion with clear mathematical flow in between. In order for this to be true it is imperative that the aim is clearly stated.

The higher attainment levels are distinguished by the quality of coherence. Coherence issues were occasionally a problem where some steps in mathematical calculations were left unclear to the reader. Repetitive calculations that affected the conciseness of the paper were also evident.

Criterion B

Candidates generally select appropriate mathematical presentations leading to at least level 2 in this criterion. A good standard of technology was demonstrated in producing graphs and equations. However, it is important that all symbols are clearly defined. Some other common issues are poor or missing labels on graphs and the lack of using an approximation sign. Inappropriate notations, like "*" for multiplication and "E" for power of ten are still used in many explorations. The same variable is written inconsistently both as capital and small letters.

Having said this, in general the majority of candidates are doing an adequate job typing mathematical expressions with correct notation.

Criterion C

This is the area in which there was most inconsistency due to the varied expectations of teachers. There are still many teachers who award levels 3 or 4 without much evidence in the paper itself of the personal engagement. Just being interested in the topic does not warrant a 3 or 4 although clearly it is a contributing factor. Common textbook topics still do not show the expected personal engagement and should be discouraged unless an interesting extension or perspective is added to it. In addition, candidates often chose topics that would self-limit the amount of personal engagement possible. For example, there were a number of statistics tasks correlating two sets of data (e.g. GDP and another variable). It is hard to demonstrate much personal engagement in topics like these unless candidates collect their own primary data.

More candidates seem to be making explicit connections with other DP courses (business management, environmental systems and societies, economics) which demonstrated some personal engagement.

Criterion D

Most candidates could not critically reflect on their work. There was a large number of fairly descriptive explorations that did not actually focus on what the mathematics itself was revealing or the problems behind the data collection itself.

There was also some success in providing reflection throughout the exploration although the conclusion itself in many cases tended to be fairly superficial. Simply stating results without considering validity, strengths, weaknesses, alternative mathematical approaches and limitations was still common across samples. In short, many did not consider the implications of their results.

Reflection over the appropriate degree of accuracy, given the context of the work, is often neglected by candidates

Criterion E

It was notable that in many explorations the mathematics explored was either part of the syllabus or in some cases beyond. Level 6 remains hard to attain, mostly due to a lack of demonstrating thorough understanding. There was still an issue with regression analysis being conducted using technology only without demonstrating understanding or justifying the chosen model; candidates did not explain why certain functions were chosen and they could not interpret the results adequately. Some candidates limited themselves to level 2 because they used only very simple mathematics.

Recommendations for the teaching of future candidates

Internal Assessments need to be discussed alongside the curriculum, and not be treated in isolation. It was good to observe that in many explorations, candidates explored their interest in different subjects and this should be encouraged rather than setting a template for what candidates should do.

When teaching topics whether functions, calculus or statistics etc. candidates should be exposed to possible explorations. Equally early interaction with the criteria is important. Thus mini-explorations and assignments before the exploration can show the candidates what is needed and how to earn the higher marks. This can then be combined with old explorations so that they get a better understanding of these criteria.

Candidates should be guided on how to select an exploration that provides opportunity to employ mathematics that is commensurate with the level of the course. It is helpful to be realistic about what topics, outside of the curriculum, different candidates might be able to cope with. Knowing the abilities of one's candidates is useful in guiding them to a suitable exploration that both interests them and will allow them to access the higher attainment levels on criterion E.

Candidates should be encouraged to use equation editors whenever possible to ensure correct mathematical notation. Ensure candidates check for notation mistakes.

Teachers should be more explicit in explaining the use of accuracy or approximation in their mathematical teaching so that this is not overlooked in the exploration. Similarly, the correct use of the approximate sign when given rounded values, consistent use of mathematical notation, labelling graphs and the defining of variables should be demonstrated by the teacher.

Further comments

A list of URLs is not an adequate bibliography, and yet some candidates persist in only including an unordered list of those. Also, URLs are required, according to p. 14 of the document "Effective citing and referencing" and not all candidates are including them on internet sources. Sources of images and information must be cited at the point in the paper where they appear. While a bibliography is also important, its presence does not remove the requirement for in-text citations.

The Teacher Support Material states two of the responsibilities of the teacher are

- To verify the accuracy of all calculations,
- To assess the work accurately, annotating it appropriately to indicate where achievement levels have been awarded.

It is essential that the teacher indicate where calculations have been found to be both incorrect and correct in the candidate work. It is also essential that the work be marked up to indicate where the teacher has seen features that led to the criteria levels they ultimately awarded.

Teachers should be encouraged to write comments within the exploration as it allows clarity in marking. It is essential that annotations are included on the candidate work that show why and where a level has been awarded. Teachers are advised to check all documents prior to upload to ensure all pages are present and oriented correctly, and any comment boxes added electronically are expanded and not blocking any text. Examiners will only see a static image of the work and cannot expand or move comment boxes.

Some schools have done an excellent job removing candidate details from the work. However, a few schools are still using the old 5/EXCS form, and many more have candidate names, school names, candidate numbers, and so on in the text. Teachers should take note that it is expected that candidate work be appropriately anonymized and this should be emphasized for the next examination session.

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0–11	12–23	24–31	32–42	43–53	54–64	65–90

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

- Interpretation of a regression line.
- Recognizing sigma means ‘sum’.
- Finding a unit vector and using this result to solve a distance problem.
- Interpreting the graphs of, and relationships between, f, f' and f''.
- Integration that involves setting up the integrand e.g substitution, or simplifying the expression.
- Working with a combination of topics e.g. geometric progressions and logarithms, probability and trigonometry.
- Working with an unknown value k, in context problems.

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

- Venn diagrams.
- Inverse and composite functions.
- Sine rule.
- Basic vectors – finding a vector and the vector equation of a line; perpendicular vectors means that the scalar product equals zero; point of intersection of two lines.
- Volumes of revolution.

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

Question 1: Venn diagram, probability

Most candidates were able to answer this entire question with no problems. The best solutions showed one step of working and clearly identified the number that took only economics. In part (c) the common error was mistaking the $n(U) = 18$, instead of 20.

Question 2: Inverse and composite functions

This question was very well done with just a small number of candidates confusing inverse with derivative notation. Virtually all candidates had an appropriate method for the composite function.

Question 3: Sine rule

Most candidates recognized that the sine rule was required and substituted correctly. Many knew the correct exact ratios and typically very good correct working with complex fractions was seen. It is expected that candidates will produce a final answer in an acceptable format and not present an answer which has decimals in the numerator/denominator of a fraction (for example).

Question 4: Regression

Most candidates were able to identify the independent variable and correctly interpret the boiling temperature of the liquid. Also, choosing either 0.992 or -0.992 as the correlation coefficient. In part (c), candidates commonly substituted $t = 2$ into the equation but then lost sight of the context of the question.

Question 5: Integration

A good proportion of candidates used substitution although not always to a successful result. Most included the constant of integration. Many candidates understood that they needed their answer from part (a) and substituted $(-1, 3)$ into their integrated expression and so earned follow through marks. Some found the value of the constant c but did not then use it to write $f(x)$.

Question 6: Interpreting f, f' and f'' from a graph

This syllabus area did not seem to be as well answered as it has been in previous examination sessions. Some did not understand that the y-coordinate of a point on f' is the slope of f. Furthermore, quite a few candidates did not take the negative reciprocal of their answer to part (a)(i) when determining the equation of the normal. In describing concavity some candidates commented about the slope but did not make it clear to which graph/slope they were referring. This was important to do as, although the graph of f' was given, the question referred to the graph of f.

Question 7: Logarithms and infinite sum

Most candidates correctly set up a ratio of terms, however, this did not necessarily demonstrate their understanding of logarithm laws leading to a convincing solution. Candidates either made the link to part (a) and tried to use the infinite sum or did not recognize that sigma notation meant 'sum' and tried to solve $16\ln x = 64$.

Question 8: Vectors

Almost all candidates correctly found $\overrightarrow{\mathrm{AB}}$ and formed a correct equation for L_1. Please note that writing "$L_1 =$" instead of "$\boldsymbol{r} =$" for the vector equation of a line does not earn full marks. In part (b) it was good to see that far fewer candidates worked backwards (i.e. substituting in the given value $p = 2$) than is typically seen. Part (c) was well answered even when less efficient approaches were used.

Most candidates did not appear to know what a unit vector is or how to find it, even when $\left|\begin{pmatrix}2\\0\\1\end{pmatrix}\right|$ was found. This prevented an efficient approach to part (d)(ii).

Question 9: Quadratics functions

Some simple ideas were overlooked in this question. Many candidates did not use the symmetry of the quadratic function and as such produced algebra far more complex than needed. Candidates took one of two approaches in part (c), either to find the derivative of $f(x)$ or to equate the line to the quadratic function. Sadly, not many progressed much further than this initial idea. Most chose to find the derivative of the curve but then incorrectly equated this to $kx - 5$. Few candidates who took the latter approach used the fact that the tangent intersects the curve once, hence $\Delta = 0$.

Question 10: Discrete probability, trigonometry and volume of revolution

Most candidates were able to recognize that they need to sum to 1. Unfortunately, many thought $\mathrm{E}(X) = 1$, instead of $\sum p = 1$. Given that $\cos\theta = \frac{3}{4}$, very few candidates justified why $\cos\theta = -1$ was not a solution. Many candidates found a correct value for $\tan\theta$ using the given answer in part (a). Many candidates also successfully set up the volume integral but most failed to correctly integrate. Greater care needs to be given to choosing correct limits.

Recommendations and guidance for the teaching of future candidates

Examiners commented on the increasing prevalence of muddled presentation of work. The working for a question is an integral part of the solution and should be presented as a part of the answer, not separately (either in a separate booklet or at the bottom of a page). Poor notation and setting out often reflected lack of understanding. A significant proportion of candidates were somewhat casual with their use of brackets, frequently omitting them in their working, which may lead to an incorrect answer. Work needs to be clearly and neatly presented – examiners cannot mark what they cannot read. Candidates should also be encouraged to draw diagrams that can help them to tackle and engage with challenging questions.

Familiarize the candidates with the command terms, which guide the candidates as to what is expected in their responses. Stress the importance of reading carefully and giving valid reasoning for answers when needed e.g. justifying positive concavity and rejecting invalid solutions to an equation. Do not work backwards in 'Show that' questions.

A number of comments from teachers mentioned surprise that topics were combined. This is common practice as evidenced in past papers. Encourage candidates to think of how maths in different topics could be combined.

Non-calculator papers do not require awkward or long calculations with big numbers or difficult decimals. If a solution develops into this, it may be best to look for an alternative approach and recheck the work.

Some basic exam practices are worth remembering: label all parts/subparts well and cross out any earlier attempts not used to find the answer, when replaced with other working. Be aware that in the long response questions proceeding parts can often be used to help find later answers. Some candidates cross out perfectly good, if incomplete work, without replacing it, leading to no marks being awarded for a question that may have had some credit otherwise.

Answers should be written in pen, with pencil reserved for diagrams. Candidates should not write all of their working/answers in pencil as the responses are scanned and information may be lost if the pencil lines are too light.

Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0–13	14–26	27–36	37–46	47–56	57–66	67–90

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

- Calculating variance from a frequency table
- Finding the value of a function
- Recognizing and applying the binomial distribution
- Recognizing problems involving sector areas
- Knowing when to use radian measure and when to use degree measure
- Finding a single term in a binomial expansion
- Interpreting velocity-time graphs and calculating the distance travelled
- Application of circular functions
- Finding z-scores and using that to set up a relation to find an unknown
- Conditional probability
- Geometric properties of a function and its inverse
- Problem-solving

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

- Statistical measures and their interpretation
- Using the scalar product to find the angle between two vectors
- Analysing key features of the graph of a function
- Calculating the expected value of a binomial distribution, and the probability of a single event in that distribution
- Using the binomial theorem
- Differentiation using the chain rule

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

Question 1: Statistical measures and their interpretations

Most candidates found part (a) straightforward and correctly found the mode and range of the data given in the frequency table. There were a few candidates who gave the value of the range as an interval, rather than the difference between the maximum and minimum values. A common error was for candidates to work with the frequencies, rather than the x-values.

In part (b), the majority of candidates were able to find the mean, but few were able to obtain the variance. A significant number attempted to compute both by hand. Many candidates did not know the relationship between the standard deviation and the variance, and attempted to apply the formula for the variance of a binomial distribution, $\mathrm{Var}(X) = np(1-p)$, which is seen in the formula booklet. Of those who attempted to square the standard deviation, common errors included: the use of an inaccurate value for the standard deviation, which resulted in an incorrect answer; and the use of their calculator's sample standard deviation, Sx, rather than the population standard deviation, σx.

Question 2: Angle between two vectors

The majority of candidates were able to find the scalar product and the magnitude of the given vectors, and demonstrated a good understanding of how to apply the formula. However, it was disappointing that many candidates lost marks as a result of arithmetic errors when multiplying by zero in the scalar product, or when squaring a negative value in the magnitude. A number of candidates failed to round their final answer to one decimal place as instructed in the question.

Question 3: Functions

The question asked candidates to "consider the graph". While a sketch of the graph was not required, most of the marks could have been easily obtained using the graphing functions of the GDC. Candidates who found this question challenging, generally attempted unnecessary arithmetic and analytical techniques.

The majority of candidates who were successful with this question used their GDC effectively. Parts (a) and (b) of this question were generally answered well with many candidates able to earn the majority of the marks. In part (a), few who substituted $x = 0$ into f obtained the correct answer. An incorrect y-intercept of 3 was seen often. Many lost marks in part (c), as they either gave the coordinate of the minimum point, rather than the minimum value, or the x value of the minimum rather than the y value.

Question 4: Binomial distribution

In part (a), almost all the candidates were able to find the correct number of left-handed candidates, k.

Part (b)(i) was done well by those candidates who recognized the binomial distribution. However, many candidates attempted to use simple probability, with the wrong answer $\mathrm{P}(X = k) = \frac{12}{150} = 0.08$ commonly seen.

In part (b)(ii), few candidates displayed an understanding that the distribution is discrete, and that "fewer than k candidates" should be translated as $X \le 11$. The majority of candidates who attempted this part included $X = 12$ in their cumulative probabilities, and obtained the answer 0.576.

Question 5: Area of segment

This question proved to be one of the most challenging questions in Section A, particularly for those candidates who did not recognize the need to consider sector OAB and the central angle $\mathrm{A\hat{O}B}$. Those who did mark on the diagram appropriate radii, and calculated the central angle, were generally successful. However, as a consequence of working with an inaccurate intermediate value, e.g. $\mathrm{A\hat{O}B} = 1.7$, many obtained an incorrect answer for the shaded area and were not awarded the final mark. Many candidates also chose to work in degrees and found themselves having to convert to radians to use the sector area formula. Of those who continued to use the degree measurement regardless, most did not seem to question the very large sector area obtained in relation to the triangle area.

It was disappointing, given how prevalent questions similar to this are in textbooks and past examinations, that the majority of candidates made no progress with this question. A wide variety of approaches were seen. These included: assuming the central angle was 90°; inscribing a square in the circle; using the formula for the length of an arc with $l = 12$ in an attempt to find the central angle.

Question 6: Binomial theorem

This question saw candidates using one of two approaches: either differentiating the function first and then finding the term in x^4, or finding the term in x^6 initially and then finding the derivative of this term. Of these, the former proved the more popular approach and consequently the success of the question was largely determined by the candidate's ability to differentiate using the Chain rule. Some were able to do this accurately but then poor algebra skills resulted in them simplifying their expression incorrectly. Those who found x^6 initially were in general more successful.

Many candidates did not identify the required individual term of the binomial expansion, but instead found the complete expansion. This was both unnecessary and time-consuming. The few candidates who attempted to expand the binomial algebraically were generally unsuccessful. Some candidates gave the coefficient instead of the term as the answer.

Question 7: Kinematics

This question was poorly answered by most candidates. However, a number of candidates had clearly been well-prepared for this type of question and demonstrated a good understanding of how to interpret a velocity-time graph. This was a calculator active question, where the majority of the marks available could be obtained by the GDC. It was disappointing that few candidates used their GDC effectively.

In part (a)(i), few were successful, with many giving $t = 1.17$, the first local maximum of the graph, at the time when P first changed direction. In (a)(ii), most did not attempt to use the total distance formula correctly, as they did not consider the absolute value of *v*. This was surprising, as the distance formula is in the formula booklet and it is not something that candidates usually perform poorly on. Those who applied the distance formula correctly, and evaluated the integral using their GDC were largely successful. Those who attempted to evaluate their integral analytically were unsuccessful, and those who split the domain to consider positive and negative displacements generally ended up making computational errors.

In part (b), candidates generally recognized the need to integrate the velocity function, although many were unclear how to set up the solution with the appropriate limits and it was not uncommon to see candidates solving the equation algebraically in many stages rather than making use of their GDC to do so. While many were awarded follow through marks from part (a), poor communication of working was an issue, and the mistakes made by those attempting to solve their equation analytically often showed a lack of understanding of integral calculus.

Question 8: Trigonometric graph and its application

Most candidates were successful in part (a) and many made good progress in part (b). However, a few did get their answer to (a)(i) and (a)(ii), and/or (b)(i) and (b)(iii) the wrong way around. Part (b)(ii) was not done well, with many candidates either working with a period of 6.25, or giving the unfinished answer, $q = \frac{2\pi}{12.5}$, which was not awarded the final mark. Some attempted to substitute a point into the given formula. Where the candidate had found p already, this approach was generally successful, but too often an attempt to set up a system of equations in p and q was seen, which did not lead to the final answer.

Part (c) proved challenging for the majority of candidates, even though it required very little technical knowledge. While there were a variety of approaches which could be used to find the required time, the candidates who worked systematically through the times of each high tide were the most successful. Very few candidates appear to have used their GDC, either to check that their values from previous parts were correct, or to use it to find the time of the second high tide.

Question 9: Normal distribution, independent events, conditional probability

Most candidates were able to answer part (a), but their understanding of this topic appeared to be superficial, as few were able to progress successfully through the subsequent parts.

In part (b), although many candidates recognized the need to work with a standardized value, a probability was often seen instead of the appropriate z-value. Of those that did calculate a z-value, many obtained $z = -0.524$ from using $\mathrm{P}(X < 9) = 0.3$, often despite having correctly answered part (a).

In part (c), although many recognized that they needed to multiply probabilities, few were able to make any significant progress. Many failed to recognize that $\mathrm{P}(X > 9) = 0.8$. Of those that obtained $\mathrm{P}(Y > 9) = 0.5$, it was surprising how many were then either unable to write down the value of λ, or attempted to use z-values to find λ.

In general, candidates struggled with part (d), with many giving their final answer as $\mathrm{P}(Y < 13) = 0.873$. Those that recognized conditional probability either did not find $\mathrm{P}(9 < Y < 13)$, or instead calculated $\mathrm{P}(-\infty < Y < 13)$. Many missed the conditional aspect of the question and stopped after calculating $\mathrm{P}(9 < Y < 13) = 0.373$, believing this to be the required final answer.

Question 10: Transformation of graphs, area between curves, optimization

On the whole, candidates appear to have found this question challenging, with many leaving large parts of it blank. In part (a), few recognized the stretch factor, with most giving the incorrect answer of $q = \frac{1}{2}$, rather than the correct answer of $q = 2$. Most were able to obtain the correct values for the translation, although a significant number of candidates transposed the values of h and k.

In part (b)(i), those candidates who used their GDC to evaluate the integral, generally worked in degrees to obtain the incorrect answer of 2.91. In part (b)(ii), very few candidates recognized the symmetry and the relationship between the answers in parts (b)(i) and (b)(ii). A significant number attempted, in one or both parts, an analytical approach.

Very few candidates attempted part (c). Of those that did, some were able to find an expression for d, but then struggled to make any further progress. Many appeared either unaware of their calculator's angle measure or purposely changed it, switching from using radians in (b) to degrees in (c). Many attempted to consider the perpendicular distance to $y = x$, rather than the vertical distance. Of those that managed to make any significant progress with this part, few were able to communicate their reasoning, with many simply writing down their point P.

Recommendations and guidance for the teaching of future candidates

It is essential that both teachers and candidates are familiar with the Mathematics SL guide, especially the syllabus content (including prior knowledge), command terms, notation list and formula booklet, so that candidates are adequately prepared for this examination.

This paper has revealed that many candidates have not been given enough exposure to a variety of questions on the major syllabus topics. Concepts should be taught using a variety of different approaches and contexts. Teachers are reminded that, in particular, the more challenging questions require candidates to effectively make connections between different topics in the syllabus. Too often it appears that they are being treated as discrete units, and how the concepts interrelate is not being emphasized.

Candidates must have access to a GDC at all times during the course and be given proper instruction on its correct use. There were a number of questions in this paper where candidates were poorly prepared in the use of their GDC. Candidates should be aware of when an analytical approach is necessary and when one using their GDC will suffice. In general, for Paper 2, once an equation has been set up, there is little reason why its solution should not come directly from the GDC. Failure to make use of the GDC when appropriate, could result in candidates having insufficient time to complete the paper.

Candidates do not have a clear understanding of how to round answers correctly to three significant figures and are losing marks as a result of inaccurate answers. They should also be advised to work with a minimum of four significant figures (and preferably more) in the case of non-exact values, and only round to three significant figures at the end of a question part. Candidates should also be taught how to retrieve unrounded values from previous calculations in their calculator.

Candidates should be reminded to consider the reasonableness of their final answer before progressing onto subsequent parts. For example, checking that values found are consistent with the information or context provided.

Teachers should emphasise that in general, for full marks to be awarded, steps indicating the method used must be given. Candidates should be given regular feedback on how they communicate their solutions, and encouraged to show their working.

All teachers should read the Subject Reports after each session, which continue to repeat recommendations regarding skills that are absolutely essential for Mathematics SL but are still not well understood or applied.

Answers should be written in pen, with pencil reserved for diagrams. Candidates should not write all of their working/answers in pencil as the responses are scanned and information may be lost if the pencil lines are too light.