May 2016 subject reports

Computer Science

Overall grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 13	14 – 26	27 – 36	37 – 45	46 – 55	56 – 65	66 – 100

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 14	15 – 28	29 – 41	42 – 51	52 – 60	61 – 71	72 – 100

Higher and standard level internal assessment

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 5	6 – 10	11 – 15	16 – 19	20 – 23	24 – 27	28 – 34

Generally the work submitted followed the instructions as laid out in the Computer Science Guide and the Handbook of Procedures for the Diploma Programme, section B4.6.

Some recommendations from the Principal Moderator:

- An observed trend of candidates addressing the criteria in a superficial manner, has become more pronounced.

- The course is recommended to be taught over two years. There is a growing concern about schools administering a one-year program for this course. The time limitations are not conducive to fulfilling the IA criteria to the expected level of complexity and may very well be the cause of the observation in the previous point.

- A tendency has been identified for teachers to award marks for effort instead of content. A typical example would be a teacher awarding full marks in criteria A, when the candidate wrote a nice description of the intended solution, without identifying or consulting a client, without describing an actual, existing scenario, with only a trivial reason for the software (for example “Java is multi-platform” without any further explanation why this is a benefit) and a few non-specific Criteria for Success (“It will have an easy interface”).

- More candidates were able to demonstrate the proper working of their solution within the 7 minutes that are indicated for the video. Candidates who used their Criteria for Success (criterion A) and their test plan (criterion B) to script the screencast, tended to be more successful.

- Although not a requirement, teachers are requested to provide pertinent comments on how they awarded marks to the candidates in their sample. This facilitates the moderator's validation of the teacher's marks.

The range and suitability of the work submitted

The described scenarios typically allowed for worthwhile projects. The majority of solutions concerned programming projects and the majority of those had been coded in Java. However, an encouraging number of candidates tried their hand at web design, (Access) databases and Android app design. It is hoped that the range of solutions continues to expand.

The quality of the solutions showed a wide range and not all solutions had been developed to the level of complexity expected of IB DP candidates. Some examples of trivial products include: Java programs that mainly focus on GUI and not on actual functionality; Java programs that consist of one class only; Java programs consisting of a Greenfoot template with only two methods overwritten; rudimentary versions of freely available games (like Sudoku); Access databases that contain just one or two tables or non-relational tables; websites that are template-based (Wordpress, Wix or Weebly) or that have minimal content; basic Excel projects; Scratch projects that had not been properly designed.

Very strong solutions tended to incorporate features from more than one software. For example, website projects that incorporate JavaScript / PHP / SQL functionality, or programming projects that interact with an Access database or with on-line resources.

Candidate performance against each criterion

A Planning – Too many candidates still make a minimal effort to fulfil this criterion. A real-life problem should be addressed for a real client, including the following steps:

- investigate a situation,
- identify client/adviser,
- explicitly consult the client (and/or adviser),
- describe the scenario with explicit reference to key points from the client consultation,
- choose a solution,
- describe the rationale for the solution and also for the software to be used,
- outline comprehensive Criteria for Success for the chosen solution.

Contrived tasks and clients were routinely seen in the weaker samples submitted. Too many candidates had generic success criteria – these criteria must be specific and testable. The Criteria for Success are essential to the project and must be explicitly addressed in the test plan (B) and in the evaluation (E) and can help to structure the script of the video.

B Solution overview – Comparatively this was the poorest criterion, and candidates typically only provided an outline design or even screenshots from the final product (which is incorrect). The structured approach of prototyping together with client feedback allowed some candidates to achieve a higher level. Records of Tasks were generally only partially complete, typically because the final product had not been implemented / fully tested by the client. Some Records of Tasks were preoccupied with tasks related to the writing of the documentation, which is not the intention of this document. A wide variety of test plans were seen. The better ones aligned with the Criteria for Success.

Please note that the use of the proper template in forms.zip is mandatory, to ensure all columns are correct and all information is present – the use of a different version should be discouraged as marks may be lost. If no Record of Tasks is included or if there is no evidence of a design then 0 marks will be awarded for this criterion.

C Development – Most candidates made a good attempt to document the development of their product and the techniques used. However, the quality of the explanations and the completeness of techniques often left something to be desired. The complexity of the product must be justified by the candidate in the write-up. A seemingly complex product without proper explanations of complex techniques used in the product, only achieves moderate complexity. Similarly, high ingenuity must be justified by algorithmic thinking (e.g. explanations of complex data structures, algorithms or macros). Design components have no place in this section and should be added to the criterion B section.

D Functionality and extensibility of product – The video should only show the proper working of the solution as outlined by the Criteria for Success. Many videos focused instead on the

development of the solution, which made them too lengthy. Others only showed the working of the interface, without showing actual functionality of the intended solution. There is no need to document extensibility in extended writing.

E Evaluation – The final product (after testing) is expected to be implemented and used / tested by the client before client feedback is given. For full marks evidence of feedback must be included (typically in the appendix) and it must be discussed and referred to in the candidate's evaluation against the Criteria for Success. Recommendations should be realistic in relation to the actual product – for example 'adding network capability' is not a realistic improvement for a low-level product.

Recommendations for the teaching of future candidates

The aim of the Internal Assessment for IB DP Computer Science is to create a working solution for a real client. The consultation (which must be included as an appendix) should be the basis for the description of the scenario, leading to Criteria for Success of a chosen solution. All high scoring projects showed ample evidence of client involvement.

Criterion B should provide evidence of a rigorous design stage with an overview of all five stages of the project (including the actual intended use of the product by the client) in the Record of Tasks, detailed layout design sketches that include annotations for complex techniques, evidence of algorithmic thinking (in the form of flowcharts, UML diagrams, pseudo-code, ER diagrams, structured database decomposition using NF, query and macro design), and a test plan that addresses all Criteria for Success. All high scoring projects included a thorough design stage.

Criterion C provides candidates with the opportunity to demonstrate their knowledge and understanding of the tools and techniques used in creating the product. The use of tools/techniques should be explained in relation to screenshots that show their use.

Criterion D does not require written documentation. The video should be around 5 minutes and should only show the proper working of the final solution. The structure of the video should be scripted by the candidate. For example, the video could show the testing of the implemented solution following the test plan from criterion B. Successful videos showed comprehensive evidence of the solution's functionality with lots of data, but were edited to avoid viewing tedious data entry. Candidates are advised to test their videos to ensure the playback is correct.

Extensibility can be evidenced by a detailed design in criterion B, by a detailed description of the creation process in criterion C.

Criterion E should provide evidence of a rigorous evaluation stage. The client feedback (which can be included, in full, in an appendix) should be cited and discussed by candidates as part of their own evaluation of the solution. A table showing the Criteria for Success with a tick for “met” and a cross for “not met” is not sufficient to achieve the highest level.

Recommendations for improvement should go beyond simply restating the success criteria that have not been met.

A word of caution: treating the project as a purely academic exercise typically means that there is no proper client and that the solution is not being implemented, which will likely impact upon the marks in criteria A, D and E.

The recommended word count **for each section**, as indicated in the Teacher Support Materials (TSM), is only for guidance. The **overall** word count of 2000 words however, is a fixed limit and a moderator is not required to read beyond this limit, which may lead to marks being lost in criterion E.

Further comments

For additional information regarding the Computer Science Internal Assessment, please consult:

- The Computer Science Guide (pages 56–72).
- The Teacher Support Material (Internal Assessment section).
- Forms.zip templates.
- Submission of the Computer Science IA in the Handbook for Procedures for the Diploma Programme (Section B4.6). Please note that the Handbook is updated yearly.
- IB Coordinator Notes.

For additional professional development regarding the Computer Science Internal Assessment, please consider:

- Getting involved in the Computer Science Online Curriculum Centre (OCC) discussion forum.
- Attending a Computer Science workshop (either face-to-face or online).

Higher level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 12	13 – 24	25 – 32	33 – 41	42 – 49	50 – 58	59 – 100

General comments

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

Most candidates had enough knowledge to attempt all of the questions. However, often their knowledge and understanding of a topic was evident but the discussion was insufficient to earn full marks.

Although many candidates constructed excellent algorithms (questions 13(f), 14(c), 15(c) and 15(d)), a few candidates were not able to construct an algorithm in pseudocode or as a set of steps (these questions were sometimes left blank and not even attempted).

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

Across the cohort there were some excellent responses to every question in this paper.

Question 11 was the most well answered question.

Constructing a truth table (4) and tracing an algorithm (15b) were both well done by many candidates.

It seems that the syllabus coverage in most schools is very good.

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

Question 1

This question was mostly well answered. Many candidates understood the term legacy system, and could outline an associated problem.

Question 2

This questions was mostly well answered. A few candidates confused a failover system with an off-site back up secondary storage. Other confused a failover system with an exception handler.

Question 3

Most candidates were able to describe the function of the control unit well.

Question 4

Most candidates were able to correctly construct the truth table. A few candidates did not attempt this question at all.

Question 5

This question was mostly well done. Candidates seem to be comfortably converting between binary and hexadecimal.

Question 6

Most candidates were able to correctly list the results after two iterations of a bubble sort.

Question 7

Surprisingly there was a significant number of candidates who did not answer this question well.

Question 8

This question received the most feedback from teachers, via the teacher feedback form. Many felt that the question was off syllabus, as VoIP is not explicitly mentioned in the subject guide. The focus of question 8 is on the system resources for a technology to operate in a given context, which is assessment statement 6.1.2 in the syllabus.

The syllabus includes example technologies, for 6.1.2, such as devices that transmit voice (cell phones), text (PDAs), images (digital cameras); however this list is not exhaustive. Voice-over-IP technology is widely used with services offered by many different providers (e.g. Skype). The question included the full term, rather than the abbreviation (VoIP) to help candidates understand what the technology does: it transmits “voice” (analogical signal), using the Internet Protocol, where IP is a transmission/communication protocol proper of computing devices. In question 8, factual knowledge of the technology was not being assessed, rather the knowledge and understanding of the resource requirements to transmit a specific signal (of analogical nature), using a certain protocol (IP), for a specific purpose (collaborative work on global scale).

Question 9

This question was generally well done across the cohort.

Question 10

Most candidates only stated that using CCTV in workplace will invade privacy rights. There was generally very weak further discussion.

Question 11

All parts of this question were well answered by majority of candidates, showing strong understanding of system design and organisation in a given context.

Question 12

In part (a), many candidates compared Ethernet with wireless in terms of security and not reliability as directed in the question.

In part (b) the features of a VPN were well described.

In part (d), advantages and disadvantages of the use of external services were outlined in most responses, however there was often very little further discussion.

Question 13

In part (a), most responses were able to describe the features of a linked list but could not relate them to a given scenario.

Responses to parts (b), (c), and (d) included a lot of general knowledge but with little Computer Science details given. Concurrent processing is not familiar to some candidates.

In part (f) some candidates demonstrated excellent problem solving skills with answers to this question and also answered other algorithm related questions very well. A few candidates did not attempt this question.

Question 14

In this question parts (a) and (e) were well answered by the majority of candidates.

From responses to part (b), most candidates knew that a GPS works by communication with satellites. Some candidates failed to achieve full marks as result of incomplete and vague descriptions. A few candidates wrote that the satellite calculates the user's position and draws the map.

Responses to parts (c) and (d) varied from poor to excellent.

Question 15

Part (a) was generally well answered.

In part (b) some candidates lost marks because they did not show the trace despite being asked to in the question.

Parts (b) and (c) were often either well answered or not attempted at all.

In part (e), most candidates were able to state the features of a stack but then did not describe how the stack is employed in the running of a recursive algorithm.

Recommendations and guidance for the teaching of future candidates

Candidates should be exposed to programming concepts. Computational thinking skills should be developed through the mediums of flowcharts, pseudocode and practical coding.

Teachers and candidates should use past examination papers to enhance examination skills. Candidates should analyse questions in order to determine what is being asked and they should pay attention to the number of marks allocated, ensuring that their response is appropriately brief or that points or elaborating upon.

Teacher must make sure that the whole of the course is covered. Candidates should be familiar with computer science terms and write answers that contain computer science, not general observations.

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 9	10 – 19	20 – 27	28 – 34	35 – 40	41 – 47	48 – 70

General comments

There was a high proportion of very poor responses, scoring less than one third of the total marks available. As usual, there were those who had knowledge but little application and algorithmic skills and vice versa.

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

Some basic terms were not understood and evidently not covered by some schools. Consequently many candidates did not answer specific questions in section A. Similarly, use of unfamiliar terms and expressions in section B questions resulted in vague responses which could have applied to different expressions and situations. Some candidates were unable to construct a truth table correctly and the same candidates generally had difficulty tracing the algorithm.

Question 13 caused some problems for candidates. The context required time and careful reading before attempting the algorithm and many candidates rushed into attempting to construct the algorithms and made basic mistakes such as using the TEAM array rather than the PARTICIPANT array to search for CURRENT.

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

The requirements for the application question (question 11) were understood despite the lack of correct terminology from the candidates. The stronger candidates were particularly good at answering questions 8, 9 and 10 showing a good grasp of computer science techniques.

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

Question 1

This question was well answered, provided the term "legacy system" was known by the candidate.

Question 2

In response to this question, user acceptance testing was often confused with client evaluation.

Question 3

This question was generally well answered, with most responses scoring 3 or 4 marks.

Question 4

From responses to this question it seems that failover system was an unfamiliar term to many candidates.

Question 5

The function of the control unit and its place in the CPU was mostly known but some answers were not precise enough.

Question 6

This question was reasonably well answered except where candidates referred to cache as “fast memory”.

Question 7

Features of the operating system were confused with hardware features by many and those who identified features correctly did not always apply the feature to the situation of a game application.

Question 8

This question seems to have split the cohort; strong candidates often responded with full and correct answers, however there were many responses that were completely wrong.

Question 9

This was question was generally well attempted with the majority of candidates able to convert 3B into 8 bit binary format.

Question 10

The expression “139 div 3” caused problems, both in terms of the arithmetic and the understanding of “div”. Hence, marks were lost by giving a decimal value for D. There were only a handful of completely correct answers. Many did not attempt this question

Question 11

The context of the question caused no problems and seems to have been understood by the majority of candidates.

In part (a), the phrase 'Aspects of data' was interpreted in various ways and many candidates described the data as written in the stem, which gained zero marks.

Vague answers to part (b), which could have referred to any data collection method, were common.

In part (c), a physical prototype was described by some candidates as the first creation of a product rather than a part of the development. Such responses were still able to gain some marks for client feedback.

In part (d), the context of the question was ignored here and full scale internet migration with hacking problems was described. Discussions rarely concentrated on the problems, which for the most part were identified as data loss and format incompatibility. Different foreign languages were not considered likely in the context.

Reasonably well answered with many gaining at least 2 of the marking points.

Question 12

As with question 11 the context was easily related by candidates to a familiar school situation.

Reliability was often confused with security, in part (a); the features of Ethernet was often restricted to “a cable” in many cases.

Part (b) was reasonably answered except by weaker candidates.

In part (c), almost no-one understood what technology was necessary for a VPN.

In responses to part (d), discussions were generally weak and meandered into advantages and disadvantages that were not restricted to external services.

Question 13

There were problems with understanding the requirements of this question and many were confused by the number of arrays. Time was needed to fully understand the question and at this stage in the exam it was evident that it was done in a hurry.

Part (a) caused a few problems but apart from those who divided by 5 instead of 3 it was ok.

Part (b) was generally correct.

Part (c)(i) was often correct for those who understood that they simply had to go through PARTICIPANTS and find the first one in a specific team. Responses to part (c)(ii) were rarely completed correctly showing limited understanding; there were many confused answers.

There were some good answers to part (d), which mentioned and used data structures.

Recommendations and guidance for the teaching of future candidates

Teachers should ensure that all basic terms, given in the syllabus, are familiar to the candidates.

Classes should spend time on problem solving, giving candidates the experience of breaking down unfamiliar problems into algorithmic steps and pseudocode.

Candidates should be taught to use the command terms (which are linked to a specific level of assessment object) and a question's mark total in order to gauge the appropriate length of a response, and better manage their time during the examination. Candidates should be discouraged from writing long repetitive paragraphs for questions which are worth only a few marks.

When an application or context is given, it is important to keep this in mind and answer appropriately.

Higher and standard level paper two

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 10	11 – 20	21 – 26	27 – 32	33 – 37	38 – 43	44 – 65

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 6	7 – 13	14 – 18	19 – 22	23 – 26	27 – 30	31 – 45

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

Many candidates had difficulty structuring written answers. “Discuss” questions require candidates to consider relevant factors and draw a conclusion; responses that only list the key points do not facilitate the development of an answer.

However (and paradoxically) many candidates did not adopt point form answer structures to questions asking for an outline of a set of steps. Lengthy paragraphs in response to these types of questions may mean wasted time in the examination.

Candidates often struggled to use higher order thinking to answer more complex abstract questions.

Specific issues of difficulty related to each option are listed below and teachers need to increase attention to these aspects of content.

Option A

ERD diagrams; relating ACID properties to realistic situations; normalisation and related table structure; data warehouse terminology and OOP related to databases.

Option B

Design of models and data type e.g. spreadsheets; general difference between a model and a simulation; using a simulation by changing inputs; 3D visualisation technologies; genetic algorithms and applications; supervised and unsupervised learning.

Option C

Semantic web and ontologies; theory and applications of page rank methodologies.

Option D

Advantages of encapsulation and the use of Library classes; broad level programming responsibilities; familiarity with the LinkedList class as outlined in Jets.

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

Across all four options candidates were well prepared for the fundamental theory. Questions which asked for basic recall or manipulation were often well answered, indicating that many candidates possessed a sound grounding in the basics of the option in question.

This contrasts with the commentary above and would indicate that candidates are possibly not being given sufficient time to reflect on what they have learnt and given time to apply it.

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

Option A

Question 1 in HL / Question 1 in SL

Part (a) was poorly answered. Candidates often could state the entities but were unable to show the relationship. This is a fundamental analysis and design tool and it was surprising that the question was so poorly answered.

Part (b) was well answered with candidates recognizing that primary keys must be unique.

Both subparts in part (c) were well answered by candidates.

In part (d), many candidates showed an understanding of the need to select data fields from tables and to use a condition.

In responses to part (e), candidates mostly listed backups but often failed to state another plausible approach, such as, writing logs before processing.

Question 2 in HL / Question 2 in SL

In answer part (a), most candidates understood the term scheme, and were able to distinguish between data and information using an appropriate example.

In part (b), candidates understood how problems could occur and used examples to support their answers. The concept of Isolation was also well understood.

In part (c), most candidates showed a good understanding of the process of rollback, occurring when a transaction is not completed.

Part (d) was reasonably well answered with many candidates showing understanding of the concept of durability.

Question 3 in HL / Question 3 in SL

In part (a), many candidates made good suggestions centring on granting privileged access.

Part (b) was not well answered; very few candidates mentioned the risk of a breach in terms of leaking of secrets to competitors.

Part (c) was also not well answered, with many restating answers to part (a); very few outlined blanking data fields in output.

Part (d) was on the whole well answered with candidates providing sound definitions supported by examples.

Most responses to part (e) showed understanding by stating reduced data redundancy; other factors such as minimizing a delete operation where not mentioned.

In part (f), a number of candidates answered this question well by splitting into two or more relations and providing a reasonable set of tables. However, it was clear that many candidates had not learnt this aspect of the course.

Question 4 in HL

In part (a), candidates were able to provide good examples. Some candidates only answered with theoretical points without examples and hence did not answer the question as directed.

Part (b) was not well answered, and seemed to not be a well understood concept.

A number of responses to part (c) indicated that the candidate had not learnt the concept of a clean-up procedure.

Part (d) was very poorly answered, with only a few able to explain the difference between a view and a data warehouse.

Part (e) was very poorly answered.

Part (f)(i) was not well answered; candidates did not show understanding of the benefits of OOP in databases.

Part (f)(ii) was not well answered.

Option B

Question 5 in HL / Question 4 in SL

Part (a) was poorly answered. Candidates did not take a design approach to each piece of data and its data type, nor did they use a simple “list” form of setting out their answers, often writing long unstructured description.

Candidates set out the spreadsheet well in part (b), but many found stating the formula difficult or listed incomplete answers.

Part (c) was done well; most candidates were aware of the way data inputs or relationships could be altered and studied.

Part (d) was also done well; candidates showed a good understanding of the use of a model to study groups of characteristics.

Question 6 in HL / Question 5 in SL

In part (a), many candidate understood the difference and provided well written answers. However, a number of candidates could not provide definitions and did not seem to be aware that a simulation uses a model under different conditions.

Responses to part (b) generally showed the data that was needed and provided a method of collection.

Part (c) was addressed well by the majority of candidates, showing an understanding of the base idea behind a simulation and changing conditions.

Part (d) was done well in general; candidates showed an understanding of the term criteria as a way of assessing and comparing.

Part (e) was not done well; although the higher scoring candidates understood the likelihood of reuse and argued well to support this.

Question 7 in HL / Question 6 in SL

Part (a) was answered very well, candidates demonstrated a clear understanding and expressed their points well.

Part (b) was addressed well, although often the hardware and software mentioned could have been outlined more specifically.

Part (c) was answered well; most candidates understood the need for realism.

Part (d) was answered well; most candidates understood the need for rendering, or described an appropriate algorithmic approach

Question 8 in HL

In part (a), many candidates were able to provide a definition or list of related points, but very few were able to meaningfully relate their answers to the given scenario. There was a reasonably sized group of candidates who did not seem to have learnt about this aspect of the course.

In part (b), many candidates seemed not to have learnt these concepts. Higher scoring candidates did however make well-argued recommendations.

For those candidates who have learnt the material, the responses to part (c) showed a good understanding, but far too many seemed to lack relevant knowledge.

In part (d), it seemed that many candidates had very little idea how to address this question and did not discuss differences; again, higher scoring candidates provided well-structured answers.

Option C

Question 9 in HL / Question 7 in SL

In part (a), most candidates were able to answer both subparts of the question well, although a number mentioned HTML, which is not a valid answer

Part (b) was well answered although some candidates did not understand the relationship between the DNS and the IP address.

Part (c)(i) was generally well answered. Part (c)(ii) was answered well on the whole, although many candidates relied on one point (e.g. prevent access), but did not suggest further options (such as hiding scripts).

Question 10 in HL / Question 8 in SL

Part (a) was well answered, with candidates showing good knowledge of improving a search ranking and that it is illegal/unethical.

In part (b), many did not state keyboard stuffing and often got off track. In general though, candidates showed an understanding of user avoidance and browser detection.

In part (c), candidates were able to demonstrate a good understanding of page ranking.

Question 11 in HL / Question 9 in SL

In part (a)(i), candidates seemed to be well aware of the term and most scored the mark. Part (a)(ii) was not well answered in terms of reasoning. Candidates did not seem aware of the restriction on bit length and the number of different combinations of 1s and 0s as 2^n. In part (a)(iii), most candidates were able to give a reasonable suggestion but many outlined online database applications which were not appropriate.

In response to part (b), candidates gave a range of interesting answers and on the whole well answered.

In part (c), candidates were able to indicate an understanding of net neutrality and suggest relevant pros and cons. A major issue in responses to this question was the inability to structure a coherent and structured answer.

Question 12 in HL

The diagram in part (a) was known by many candidates, however for a few it appeared not to have been learnt.

In part (b), candidates typically covered notes and lines but did not indicate the use of an arrow to indicate a direction.

In part (c), candidates answered well and recognized that the changing nature of webpages (new added and old deleted) would impact on page rank.

Question 13 in HL

In part (a), many candidates did not understand the terms ‘semantic’ and ‘ontology’ nor the importance of the standardisation of ontologies.

In part (b), candidates on the whole understood the idea of passive data collection and the notion of collecting inputs to monitor patients. Again a weakness was in the structure of answers and the lack of specific reference to the question.

Option D

Question 14 in HL / Question 10 in SL

In part (a), many candidates had little idea of the notion of an aggregation (“has a”) relationship.

In part (b), many candidates did not provide data types or arguments for the methods; otherwise candidates had a good understanding of the structure of UML.

Part (c) was not well answered; a large number of candidates failed to mention encapsulation, reuse etc.

In part (d), it was pleasing to see a majority of candidates were able to address this algorithm; answers typically contained all required constructs.

In part (e), candidates who were able to use dot notation and reference the `staydays` method typically constructed sound algorithms. Many candidates seemed to lack facility with dot notation.

Question 15 in HL / Question 11 in SL

Part (a) was answered well. Many candidates used extended and private, and included the two methods. However, some candidates seemed to not read the question carefully and did not include the get and set methods.

Responses to part (b) were often poorly set out; some candidates used descriptive paragraph style instead of simply listing the steps in algorithmic form. This resulted in answers that lacked the necessary detail and granularity.

Part (c) was done well.

Question 16 in HL / Question 12 in SL

Part (a) was not well done. Most candidates considered all manner of issues such as security and ignored the more general testing, documentation updated and citing of sources for code.

Part (b) seemed to be quite well answered, but many candidates had little or no idea about character sets or the idea of portable code.

Question 17 in HL

Part (a) seems to have been a difficult question; most candidates failed to test the date correctly and were not able to terminate the loop.

Part (b) was another difficult question, with candidates mostly failing to terminate the loop correctly or did not test the date correctly. It was clear that some did not know the bubble sort.

Part (c) was poorly answered; many did not seem to appreciate the ability to reuse code already able to provide abstract functions on lists.

In part (d), candidates showed general understanding of a tree structure but failed to order the date nodes correctly or adequately be able to explain the process with reference to the specific data.

Recommendations and guidance for the teaching of future candidates

Whilst candidates have shown a sound understanding of many aspects of the theory it was obvious that a number of candidates were not able to apply this knowledge. It is strongly recommended that teachers explore ways to enable candidates to put into practice and explore the theory that they have learnt.

It cannot be more strongly stated that teachers should cover all aspects of their chosen Option.

Some candidates were found to have answered questions from two or more Options. This should be actively discouraged by teachers; only the marks from one Option will count towards the candidate's final grade; their examination time is best spent getting as many marks as they can on the Option studied, rather than wasting time picking up inconsequential marks on a second Option.

Higher level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 3	4 – 7	8 – 9	10 – 12	13 – 16	17 – 19	20 – 30

General comments

An alarming trend, present amongst a significant number of candidates, is the copying of sections directly from the case study, in their responses to question 4, and presenting them as their own answer. This is likely to having carried out insufficient research of the case study prior to the examination. This practice of copying the case study not only fails to gain any credit whatsoever but is clearly plagiarism, which has serious consequences, both now and later on in their educational and professional life. Teachers must establish clear policies which prevent this from happening. If candidates wish to quote from the text and then expand upon it with further explanation quotations marks must be used.

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

Many candidates struggled whenever specific detail was required or where their own understanding was being tested (specifically questions 3 and 4).

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

Where they were able to directly relate the question to films that they had watched, presumably as either preparation for this course or in their free time.

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

Question 1

Although part (a) was only a definition question, an understanding of the processes involved in establishing the colour properties of each point in a scene was required in order to define the phrase correctly. There were many general answers that were along the lines of "… accurately determines the colour in a scene…" which did not gain any credit.

Part (b) was better answered particularly by those who focused on the use of cels with respect to their transparent properties and did not describe the use of frames.

Question 2

In responses to part (a) a reasonable description of the general transition processes, but the candidates found it difficult to put into words the precise differences between the techniques of morphing and tweening.

Almost all of the responses to part (b) had a good grasp of the "uncanny valley" scenario and referenced films that demonstrated it. Not all made it clear enough that it happens at a point close to, but not quite at, realism.

Question 3

The question clearly indicated that algorithms were being tested here, so specific steps were required in order to answer the question well. Candidates who had studied this area to a suitable level were able to gain 5 or 6 marks here.

Question 4

As always this is the most demanding of the case study questions and serves to differentiate between those who enter the exam with no more than a superficial or general knowledge of the case study and those who have had the opportunity to study and research it in depth.

The question came directly from one of the "Challenges Faced" and required the candidates to demonstrate their understanding of both modelling and rendering techniques *in relation to* the scenario presented in the question. This scenario involved a small company (who may have limited funds and resources) and a computer game (which needed to be rendered in real time).

The better answers then combined detailed explanations of both modelling and rendering techniques with *an analysis* of their likelihood of being used in the given scenario. The weaker answers either did not make this link with the actual scenario or simply provided a general summary of the material in the actual case study.

Recommendations and guidance for the teaching of future candidates

This can be a difficult component, but if teachers are teaching a HL class then they must make appropriate time studying the case study and preparing for this examination. Leaving this component until late on in the course or passing the responsibility entirely onto the candidates' shoulders will almost always lead to disappointing results.

Although each case study is different, the structure that can be applied should be the same each time. The 30 hours assigned to this component is more than enough for the teacher to manage the course with class time being combined with individual / group research carried out by the candidates themselves. Although the depth that each concept is taken to is not specified, it should be assumed that this will parallel the depth shown in other HL topics. All concepts in the case study must be taken to an explanatory level so that in all questions (particularly question 4) the candidates are able to demonstrate their understanding and not just factual recall.