

BOARD OF STUDIES
NEW SOUTH WALES

2001 HSC Specimen Paper

**Software Design
and Development**

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Software Design and Development

Introduction

This booklet contains the specimen examination paper for the 2001 Higher School Certificate examination in Software Design and Development. A mapping grid is also included, showing how each question in the examination relates to the syllabus outcomes and content, and to the performance bands.

The specimen paper shows the format of the New HSC examination. It has been printed on A4 paper and side-stapled to make it convenient for use in schools. Actual examination papers will be produced as A4 booklets. All New HSC papers will be printed on white paper.

The 2001 HSC specimen papers have been produced in accordance with the Board's *Principles for Setting HSC Examinations in a Standards-Referenced Framework*, published in Board Bulletin Volume 8 Number 9 (Nov/Dec 99). Questions are closely related to the outcomes of the course, and the paper as a whole is structured to allow for appropriate differentiation of student performance at all levels on the performance scale.

The papers have been designed so that students have a clear understanding of what they are required to do in each question and in working through the paper. Instructions have been standardised, and the demands of the questions have been made explicit. Key words in questions, such as 'discuss', 'analyse', and 'explain', have been used consistently in accordance with the glossary published in the Board's *Assessment Support Document*.

This specimen paper is an example of the type of examination that could be prepared within the examination specifications in the Software Design and Development syllabus. Examinations will be based on the syllabus, and will test a representative sample of syllabus outcomes. Therefore, the range and balance of outcomes tested in HSC examinations in 2001 and subsequent years may differ from those addressed in the specimen paper.

The mapping grid is an important feature of the development of the examination. It aids in ensuring that the examination as a whole samples a range of content and outcomes, and allows all students the opportunity to demonstrate their level of achievement. Where courses have components in the examination other than written papers, the grid indicates the wider range of outcomes that are assessed by including these other components.

There are a number of points to note in considering the Software Design and Development specimen paper:

- The glossary in the Software Design and Development syllabus (page 65) contains the statement that the terms *are in no way intended for examination purposes*. The intention of this statement is that these terms may be used in the Software Design and Development HSC examinations, but that the definitions given in the syllabus are not the only ones.

- The number of parts to the questions has been kept to a minimum. The questions now require more integrated answers, giving students the opportunity to show higher-order thinking skills.
- The number of question parts and sub-parts in the questions in Sections II and III may vary both from question to question and from year to year.

Software Design and Development

HSC Specimen Examination Mapping Grid

For each item in the examination, the grid shows the marks allocated, the syllabus content and syllabus outcomes it relates to, and the bands on the performance scale it is targeting. The range of bands shown indicates the performance candidates may be able to demonstrate in their responses. That is, if an item is shown as targeting Bands 3 – 5, it indicates that candidates who demonstrate performance equivalent to the Band 3 descriptions should be able to score some marks on the item, while those who perform at Band 5 or above could reasonably be expected to gain high marks. In the case of one-mark items, candidates who demonstrate performance at or above the bands shown generally could be expected to answer the item correctly.

Question	Marks	Content	Syllabus outcomes	Targeted performance bands
1	1	9.2.2 Planning and design of software solutions	H5.2	2 – 3
2	1	9.2.2 Planning and design	H1.3	3 – 4
3	1	9.1.2 Application of software development approaches	H6.2	2 – 3
4	1	9.2.4 Testing and evaluation of software solutions	H4.2	2 – 3
5	1	9.2.2 Planning and design of software solutions	H4.2	3 – 4
6	1	9.2.1 Defining and understanding the problem	H4.2	4 – 5
7	1	9.2.2 Planning and design of software solutions	H1.3	3 – 4
8	1	9.2.3 Implementation of software solution	H5.2	3 – 4
9	1	9.2.3 Implementation of software solution	H1.2, H4.2	5 – 6
10	1	9.2.3 Implementation of software solution	H4.2	3 – 4
11	1	9.2.3 Implementation of software solution	H4.2, H4.3	3 – 4
12	1	9.2.3 Implementation of software solution	H5.3	5 – 6
13	1	9.1.1 Social and ethical issues	H3.1	3 – 4
14	1	9.2.1 Defining and understanding the problem	H6.4	2 – 3
15	1	9.3 Developing a Solution Package	H5.2	4 – 5
16	1	9.1.1 Social and ethical issues	H3.1	2 – 3
17	1	9.2.2 Planning and design of software solutions	H4.3	5 – 6
18	1	9.2.3 Implementation of software solution	H4.2	4 – 5
19	1	9.2.1 Defining and understanding the problem	H5.2	3 – 4
20	1	9.2.3 Implementation of the software solution	H1.3	5 – 6
21(a)	4	9.2.3 Implementation of the software solution; and 9.2.4 Testing and evaluation of software solutions	H4.2, H5.2, H6.2	2 – 6
21(b)(i)	4	9.3 Developing a Solution Package	H5.1	3 – 6
21(b)(ii)	2	9.3 Developing a Solution Package	H5.2	2 – 4
21(b)(iii)	3	9.3 Developing a Solution Package	H5.1, H5.2	2 – 5
21(c)(i)	2	9.2.2 Planning and design of software solutions	H1.3, H5.2	3 – 4
21(c)(ii)	1	9.2.2 Planning and design of software solutions	H1.3, H4.2	5 – 6
21(c)(iii)	4	9.2.2 Planning and design of software solutions	H4.2	2 – 6
22(a)	2	9.1.2 Application of software development approaches	H1.2	2 – 3
22(b)(i)	2	9.2.3 Implementation of software solution	H1.3, H4.2	4 – 6
22(b)(ii)	2	9.2.3 Implementation of software solution	H1.3, H4.3	4 – 6
22(c)(i)	2	9.2.4 Testing and evaluation of software solutions	H4.3	3 – 5
22(c)(ii)	4	9.2.3 Implementation of software solution	H3.1	2 – 5
22(d)(i)	2	9.2.1 Defining and understanding the problem	H6.4	2 – 4
22(d)(ii)	2	9.2.3 Implementation of software solution	H6.4	2 – 4
22(d)(iii)	4	9.2.3 Implementation of software solution	H4.2, H6.4	2 – 6
23(a)(i)	2	9.2.1 Defining and understanding the problem	H4.2, H5.2	2 – 4
23(a)(ii)	1	9.2.5 Maintenance of software solutions	H4.2	4 – 5
23(a)(iii)	1	9.2.5 Maintenance of software solutions	H4.2, H6.2	5 – 6
23(a)(iv)	2	9.2.3 Implementation of software solution	H1.3, H4.2	3 – 5
23(a)(v)	2	9.2.2 Planning and design of software solutions	H1.3, H4.3	4 – 5

Question	Marks	Content	Syllabus outcomes	Targeted performance bands
23(a)(vi)	3	9.2.2 Planning and design of software solutions	H4.2, H6.2	3 – 6
23(a)(vii)	2	9.2.3 Implementation of software solution	H1.3, H4.2, H6.2	3 – 5
23(b)(i)	3	9.2.1 Defining and understanding the problem	H3.1, H4.1	2 – 5
23(b)(ii)	4	9.1.1 Social and ethical issues	H2.2, H3.1	3 – 6
24(a)(i)	2	9.4.1 Evolution of Programming Languages	H2.1	2 – 3
24(a)(ii)	2	9.4.1 Evolution of Programming Languages	H1.2, H2.1	2 – 4
24(b)(i)	2	9.4.1 Evolution of Programming Languages	H1.2, H4.2	3 – 4
24(b)(ii)	2	9.4.1 Evolution of Programming Languages	H1.2, H4.1	3 – 5
24(c)	5	9.4.1 Evolution of Programming Languages	H2.1, H2.2	3 – 6
24(d)	2	9.4.1 Evolution of Programming Languages	H2.1, H2.2	3 – 5
24(e)(i)	1	9.4.1 Evolution of Programming Languages	H2.2	4 – 5
24(e)(ii)	1	9.4.1 Evolution of Programming Languages	H4.2	4 – 5
24(e)(iii)	3	9.4.1 Evolution of Programming Languages	H1.2, H4.2	3 – 5
25(a)(i)	1	9.4.2 The Software Developer's View of the Hardware	H1.3	2 – 3
25(a)(ii)	1	9.4.2 The Software Developer's View of the Hardware	H1.3	3 – 4
25(a)(iii)	2	9.4.2 The Software Developer's View of the Hardware	H1.3	3 – 5
25(a)(iv)1	2	9.4.2 The Software Developer's View of the Hardware	H1.1, H1.3	3 – 5
25(a)(iv)2	1	9.4.2 The Software Developer's View of the Hardware	H1.1, H1.3	3 – 4
25(b)(i)	1	9.4.2 The Software Developer's View of the Hardware	H1.1, H1.3	2 – 3
25(b)(ii)	2	9.4.2 The Software Developer's View of the Hardware	H3.2	4 – 6
25(b)(iii)	1	9.4.2 The Software Developer's View of the Hardware	H4.1	3 – 4
25(c)(i)	1	9.4.2 The Software Developer's View of the Hardware	H1.3	3 – 4
25(c)(ii)	1	9.4.2 The Software Developer's View of the Hardware	H1.3	4 – 5
25(c)(iii)	2	9.4.2 The Software Developer's View of the Hardware	H1.3	4 – 5
25(c)(iv)	5	9.4.2 The Software Developer's View of the Hardware	H1.3, H4.1	2 – 6



Sample marking guidelines for Software Design and Development

The following marking guidelines have been developed for selected questions from the 2001 HSC Specimen Examination in Software Design and Development. These guidelines indicate the approach that would be taken to marking questions.

For each question, the following are typically included:

1. The syllabus outcomes that are targeted by the question.
2. The assessment rubric from the specimen paper, where there is one, listing the set of general criteria that are used to assess responses.
3. The marking guidelines, which show the criteria to be applied to responses along with the marks to be awarded in line with the quality of the responses. For extended-response questions, performance is described at a number of levels of performance, each covering a range of marks.
4. A sample answer or some points that answers might include. Sample answers indicate the scope and depth of treatment expected, and are not intended to be prescriptive. Similarly, the points that could be included in answers are not intended to be an exhaustive list, but rather an indication of the considerations that students could include in their responses.

Marking guidelines will generally require some refinement at the Marking Centre to take account of unanticipated responses that students present. For essay-type questions, the standard described at each mark range will be made clear during pilot-marking by the selection of sample scripts.

In a standards-referenced framework, examination questions are closely linked to syllabus content and outcomes. Expectations of the question are to be clear in the wording of the question. Marking guidelines will be developed at the same time as the examination questions, by examination committees. The development of marking guidelines will be guided by the Board's *Principles for Developing Marking Guidelines in a Standards-Referenced Framework*, published in Board Bulletin Volume 9 Number 3 (May 2000).

Sample Marking Guidelines – Software Design and Development

Question 21 (20 marks)

Marks

- (a) Process diaries and CASE tools are both used during the software development cycle. At which point in the software development cycle is each likely to be utilized, and for what purpose?

4

Outcomes assessed: H4.2, H5.2, H6.2

MARKING GUIDELINES

Criteria	Marks
Two marks for each of process diaries and CASE tools <ul style="list-style-type: none"> • Selects an appropriate point in the software development cycle where the respective tool could be utilized • Describes an appropriate purpose for that tool at that point in the software development cycle 	2
<ul style="list-style-type: none"> • Selects an appropriate point in the software development cycle where the respective tool could be utilized OR <ul style="list-style-type: none"> • Describes an appropriate purpose for that tool in the software development cycle 	1

Sample answer:

(Process diaries) The process diary may be used in the analysis stage of the software development cycle as a record of the activities of the software developer.

- (b) (i) Describe the importance of identifying tasks to be undertaken and allocating resources in a project management plan.

4

Outcome assessed: H5.1

MARKING GUIDELINES

Criteria	Marks
<ul style="list-style-type: none"> • Explains why identifying tasks to be undertaken is important, using well chosen examples • Gives several reasons why allocating resources in a project management plan is important 	4
<ul style="list-style-type: none"> • Explains, through an example, why identifying tasks to be undertaken is important • Gives a reason why allocating resources in a project management plan is important 	3
<ul style="list-style-type: none"> • Indicates that identifying tasks to be undertaken is the first step • Shows an understanding of what allocating resources means or the different types of resources to be allocated are 	2

Criteria	Marks
<ul style="list-style-type: none"> Indicates that identifying tasks to be undertaken is the first step OR <ul style="list-style-type: none"> Shows an understanding of what allocating resources means or the different types of resources to be allocated are 	1

Sample answer:

Identification of tasks – an essential first step in organising the project. It allows other techniques to occur, eg constructing Gantt charts, allocating resources. You need to know what needs to be done before you can do it.

Allocating resources–includes assigning physical, financial and human resources to the different tasks. If performed properly, it can help prevent project teams being idle while others are overworked, and also ensures the efficient use of equipment.

- (ii) During the development of any system, software and documentation frequently require modification. Explain the importance of version control. 2

Outcome assessed: H5.2

MARKING GUIDELINES

Criteria	Marks
<ul style="list-style-type: none"> Gives a clear explanation of why version control is important in projects where modification of documentation of software leads to new versions 	2
<ul style="list-style-type: none"> Shows an understanding of what version control is or how to achieve it, but with no explanation of why it is important 	1

Sample answer:

If all project members are not working with the same (most recent) version, then changes may be lost and resources squandered. Version control involves the careful designation of version numbers and their distribution.

- (iii) Draw a Gantt chart that documents the major milestones of a project you have completed. Include details specific to your project. 3

Outcomes assessed: H5.1, H5.2

MARKING GUIDELINES

Criteria	Marks
<ul style="list-style-type: none"> Draws a recognisable Gantt chart Includes several stages that show details of plausible student project Sequences stages appropriately eg evaluation stage after planning stage 	3
<ul style="list-style-type: none"> Draws a recognisable Gantt chart Includes several stages that show details of plausible student project or sequences stages appropriately eg evaluation stage after planning stage 	2
<ul style="list-style-type: none"> Draws a recognisable Gantt chart 	1

Sample answer

Children’s Quiz game project timeline	March	April	May	June
Data Dictionary	██			
Load files	██████			
Create Questions	████			
Instructions		██		
Maingame algorithm		██		
Exit procedure algorithm		██		
Code welcome screens		██		
Code opening procedures		██████████		
Code maingame			██████	
Code exit procedures			██	
Test opening procedures			██	
Test maingame			████████	
Test exit procedures				██

- (c) A teacher requires a program that calculates the position, or rank, of each student based on their examination mark. Students who have achieved the same examination mark get the same rank.

The main program is shown below.

```
BEGIN MAINPROGRAM
  GetStudentData
  SortExaminationMarksDescending
  AssignRanks
  DisplayNamesAndRanks
END MAINPROGRAM
```

An array of records is used to store the Student Names, Examination Marks and Positions.

- (i) Describe the data structure, including data types, used to store the Student Names, Examination Marks and Positions.

Marks
2

Outcomes assessed: H1.3, H5.2

MARKING GUIDELINES

Criteria	Marks
<ul style="list-style-type: none"> Describes the one-dimensional array of data of the type ‘record’ Determines the data type of Student Names as alphanumeric string, and Examination Marks and Positions as either integer or floating point decimal representations. 	2
<ul style="list-style-type: none"> Describes the one-dimensional array of data of the type ‘record’ OR <ul style="list-style-type: none"> Determines the data type of Student Names as alphanumeric string, and Examination Marks and Positions as either integer or floating point decimal representations. 	1

- (ii) Show the contents of the array containing 5 records, after processing has taken place, where the same top mark was gained by two students. 1

Outcomes assessed: H1.3, H4.2

MARKING GUIDELINES

Criteria	Marks
<ul style="list-style-type: none"> The mark would be awarded for array contents organised in appropriate form – ie ranked in descending order by examination mark and with two equal top students ranked 1 and the next student ranked 3. 	1

Sample answer:

<i>Student names</i>	<i>Examination Marks</i>	<i>Positions</i>
<i>Student B</i>	79	1
<i>Student E</i>	79	1
<i>Student A</i>	70	3
<i>Student D</i>	68	4
<i>Student C</i>	59	5

- (iii) Design an algorithm for the AssignRanks subprogram using the array of records you have described in part (i) 4

Outcome assessed: H4.2

MARKING GUIDELINES

Criteria	Marks
<ul style="list-style-type: none"> Algorithm designed and correctly constructed and documented which is a successful solution to the <u>AssignRanks</u> subprogram problem. 	4
<ul style="list-style-type: none"> Algorithm successfully sequences the appropriate elements of a successful <u>AssignRanks</u> subprogram, but has one or more minor errors that would impact upon the success of the subprogram. 	3

Criteria	Marks
<ul style="list-style-type: none">Algorithm sequences some of the elements of a solution in a logical way but is incomplete (omits critical elements) or has major flaws in coding or structure.	2
<ul style="list-style-type: none">Algorithm contains some of the elements of coding or structure needed for a successful solution to the <u>AssignRanks</u> subprogram, such as counters, repetition (loops), use of variables.	1

Sample answer:

(Algorithm may be represented as flowchart or pseudocode)

INDEX = 1

RANK = 1

RECORD.RANK (INDEX) = RANK

WHILE NOT END OF ARRAY

 IF RECORD.MARK (INDEX) > RECORD.MARK (INDEX + 1) THEN

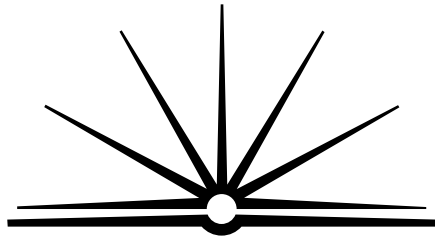
 RANK = INDEX + 1

 ENDIF

 RECORD.RANK (INDEX + 1) = RANK

 INDEX = INDEX + 1

ENDWHILE



B O A R D O F S T U D I E S
NEW SOUTH WALES

2001
HIGHER SCHOOL CERTIFICATE
SPECIMEN EXAMINATION

Software Design and Development

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen

Section I Pages 2 – 9

Total marks (20)

- Attempt Questions 1 – 20
- Allow about 35 minutes for this section

Section II Pages 10 – 15

Total marks (60)

- Attempt Questions 21 – 23
- Allow about 1 hour and 50 minutes for this section

Section III Pages 16 – 22

Total marks (20)

- Attempt either Question 24 or Question 25
- Allow about 35 minutes for this section

Section I

Total marks (20)

Attempt Questions 1 – 20

Allow about 35 minutes for this section

Use the multiple-choice answer sheet.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9
 A B C D

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

A B ^{*correct*} ← C D

- 1** To keep track of data elements during the software development cycle, a systems analyst could develop a
- (A) database.
 - (B) data file.
 - (C) data dictionary.
 - (D) data flow diagram.
- 2** Which is the correct description of a binary search?
- (A) A binary search moves through ordered data sequentially.
 - (B) A binary search moves through ordered data non-sequentially.
 - (C) A binary search moves through unordered data sequentially.
 - (D) A binary search moves through unordered data non-sequentially.
- 3** A project team is to develop computer software for a client. The client insists on early and ongoing demonstrations of the software so that requirements may be revised and changed if necessary.
- Which of the following is the most appropriate method to meet the client's needs?
- (A) Involve the client in the project team.
 - (B) Extend the project development time.
 - (C) Show the client structure charts and data flow diagrams.
 - (D) Use a prototyping approach.
- 4** A system made up of individual programs should be tested with system test data in order to
- (A) check that the programs work together properly.
 - (B) check that the programs can handle realistic amounts of data.
 - (C) have the programs tested by a person other than the programmer who wrote them.
 - (D) produce the user documentation.

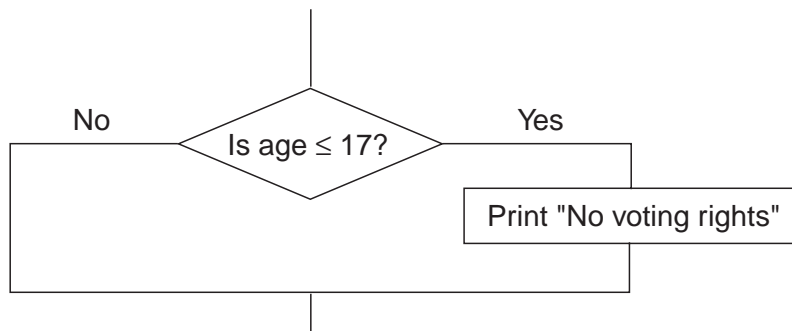
5 Refer to the following algorithm.

```
BEGIN
  set Count to 1
  get Mark
  WHILE there are more Marks
    set Result [Count] to Mark
    increment Count by 1
    get Mark
  ENDWHILE
END
```

What is the purpose of this algorithm?

- (A) To store marks in a data file
- (B) To count the number of marks
- (C) To fill an array with marks
- (D) To store marks as a simple variable

6 Refer to the following fragment of a flowchart.



This flowchart contains

- (A) a Boolean operator, an output statement, and a variable.
- (B) a relational operator, an output statement, and a variable.
- (C) an assignment statement, a Boolean operator, and a variable.
- (D) an arithmetic operator, a relational operator, and an assignment statement.

- 7 What is the most appropriate way of producing a module to search a file for specific data elements?
- (A) Analyse the details of the problem to custom-craft a solution.
 - (B) Use a standard routine from a library.
 - (C) Allow the compiler to provide the most efficient method.
 - (D) Use a bubble sort to solve the problem.

Questions 8 and 9 refer to the following fragment of a program.

```
get hours_worked
multiply hours_worked by rate giving total_pay
multiply total_pay by tax_rate giving tax_payable
subtract tax_payable from total_pay giving net_pay
```

- 8 Changing the name of the variable 'rate' to 'hourly_rate' in the second line would improve the
- (A) online documentation.
 - (B) internal documentation.
 - (C) intrinsic documentation.
 - (D) listing documentation.
- 9 The program fragment is most likely to have been written in which type of language?
- (A) Assembler
 - (B) Declarative
 - (C) High-level
 - (D) Pseudocode

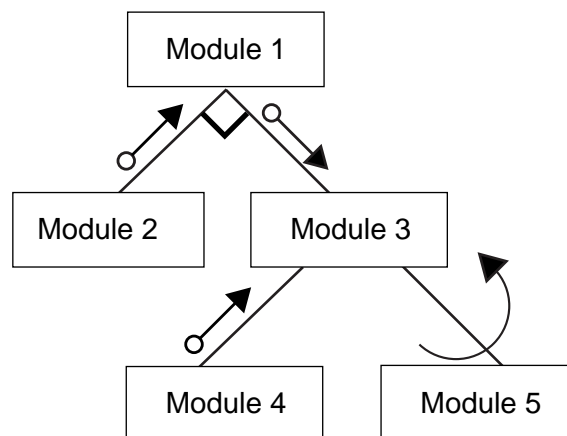
10 Refer to the following algorithm.

```
BEGIN
  set B to 100
  set A to 1
  WHILE A < 10
    B = B / A
    A = A - 1
    print A
  ENDWHILE
END
```

This algorithm will result in

- (A) 10 numbers being printed.
 - (B) a compile-time error.
 - (C) a divide-by-zero error.
 - (D) a syntax error.
- 11** A program consisting of several modules is not producing the results expected by a programmer. The programmer suspects that the problem occurs in one particular module.
- Which of the following methods would the programmer use to confirm these suspicions?
- (A) Temporarily replace the suspect module with a stub to check that the rest of the program works correctly.
 - (B) Include debugging output statements in all modules.
 - (C) Use flag variables to indicate which modules have been called.
 - (D) Use a program trace to check which lines of the code are being executed.
- 12** What happens when a program written in a high-level language is compiled?
- (A) Each line of the source code is executed before the next line is compiled.
 - (B) Variable names used in the source code are replaced by addresses in the object code.
 - (C) If there are syntax errors in the source code, the compiler produces the object code only for the error-free sections of source code.
 - (D) Comments in the source code are included with the object code.

- 13 What is the most likely consequence of a single software developer having a disproportionately large market share?
- (A) Reduction in software quality and quantity
 - (B) Innovative software solutions encouraged
 - (C) Software competitively priced
 - (D) Software packages with similar 'look and feel'
- 14 A data-entry operator is entering the results of a survey into a database. One of the survey questions asked people to choose several items from a list. The screen element that the data-entry operator would find most convenient for entering the data from this question would be a set of
- (A) icons.
 - (B) windows.
 - (C) check boxes.
 - (D) radio buttons.
- 15 Refer to the diagram.



Which of the following best describes the purpose of the documentation?

- (A) It shows how the user can navigate between different screens within the program.
- (B) It is used by the project team in developing a piece of software to indicate who is responsible for different tasks.
- (C) It is used to indicate the sequence in which different sections of a development task must be carried out.
- (D) It shows the relationship between the individual components of a piece of software.

- 16** A program is sold with a software licence that prohibits the work being copied or converted into another form, except for the purposes of backup.

Which of the following is allowed?

- (A) Sending the program to someone else in an e-mail message
- (B) Decompiling the program to see it in a high-level language
- (C) Saving the program on a disk, which is stored but not used
- (D) Changing the program so that it runs on a different platform

- 17** Refer to the following module, ‘age’, called from the mainline of an algorithm.

```
BEGIN SUBPROGRAM age (number, target, result)
  Count = 0
  result = false
  REPEAT
    OUTPUT "Guess my age"
    INPUT guess
    add 1 to Count
    IF guess = target THEN
      result = true
    END IF
  UNTIL Count > number OR result = true
  RETURN result
END SUBPROGRAM age (number, target, result)
```

Which one of the following statements is true?

- (A) ‘Count’ and ‘result’ are local variables; ‘number’ and ‘target’ are global variables.
 - (B) This module needs two values from the mainline. The mainline receives one value from the module.
 - (C) The terminating condition of the loop cannot be tested because ‘number’ has not been initialised.
 - (D) The repeat/until structure is not appropriate for this module.
- 18** You have just written a program in which a syntax error has been detected by the compiler. What would be the most appropriate step to take to fix the problem?
- (A) Examine EBNF descriptions for the language
 - (B) Run the acceptance tests
 - (C) Use a different compiler
 - (D) Consult the users about their needs

- 19** Which statement about a data flow diagram is correct?
- (A) A data flow diagram is drawn with the data inputs at the top, and the outputs at the bottom, so that data flows through it from top to bottom.
 - (B) A data flow diagram can represent the relationships between data items.
 - (C) A data flow diagram shows the sources and destinations of data.
 - (D) A data flow diagram shows the structure of data stores.
- 20** During the execution of a computer program, the following steps take place:
- Step 1. The number 8 is placed in the accumulator.
- Step 2. The number 5 is added to the accumulator.
- Step 3. The result of this addition is stored in memory location 5002.
- Which one of the following events occurs during Step 3?
- (A) 5002 is moved to the accumulator.
 - (B) 5002 is moved to the RAM.
 - (C) 13 is moved to the accumulator.
 - (D) 13 is moved to the RAM.

Section II

Total marks (60)

Attempt Questions 21 – 23

Allow about 1 hour and 50 minutes for this section

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available. If you include diagrams in your answer, ensure that they are clearly labelled.

	Marks
Question 21 (20 marks) Use a SEPARATE writing booklet.	
(a) Process diaries and CASE tools are both used during the software development cycle. At which point in the software development cycle is each likely to be utilized, and for what purpose?	4
(b) (i) Describe the importance of identifying tasks to be undertaken and allocating resources in a project management plan.	4
(ii) During the development of any system, software and documentation frequently require modification. Explain the importance of version control.	2
(iii) Draw a Gantt chart that documents the major milestones of a project you have completed. Include details specific to your project.	3

Question 21 continues on page 11

Question 21 (continued)

- (c) A teacher requires a program that calculates the position, or rank, of each student based on their examination mark. Students who have achieved the same examination mark get the same rank.

The main program is shown below.

```
BEGIN MAINPROGRAM
  GetStudentData
  SortExaminationMarksDescending
  AssignRanks
  DisplayNamesAndRanks
END MAINPROGRAM
```

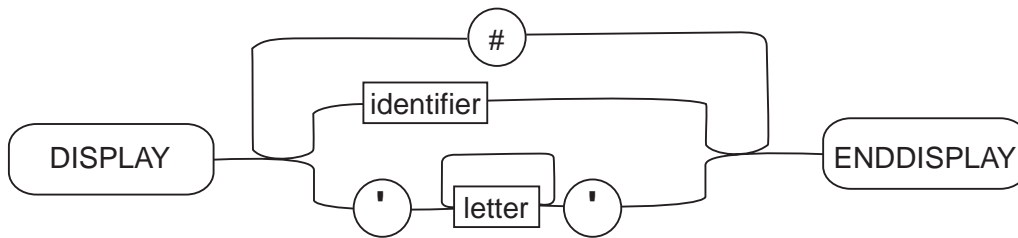
An array of records is used to store the Student Names, Examination Marks and Positions.

- | | |
|---|----------|
| (i) Describe the data structure, including data types, used to store the Student Names, Examination Marks and Positions. | 2 |
| (ii) Show the contents of the array containing 5 records, after processing has taken place, where the same top mark was gained by two students. | 1 |
| (iii) Design an algorithm for the <u>AssignRanks</u> subprogram using the array of records you have described in part (i). | 4 |

End of Question 21

Question 22 (20 marks) Use a SEPARATE writing booklet.

- (a) Give TWO reasons why computer software (such as an accounting package) is normally bought ‘off the shelf’ rather than being outsourced or developed in-house. 2
- (b) A computer language has a DISPLAY statement that produces output consisting of values of identifiers, strings of letters, or a combination of these two. In a DISPLAY statement, strings of letters must be surrounded by apostrophes ('). The syntax of a DISPLAY statement in the language is given by the following railroad diagram.



identifier represents one of the symbols **A, B** or **C**

letter represents one of the lower case letters **a** to **z** or a **space**

- (i) Given that the identifier **A** has the value 5 and the identifier **B** has the value 3, write a syntactically correct DISPLAY statement that will produce the following output: 2

5 is greater than 3

- (ii) You need to extend the syntax of the DISPLAY statement to allow it to print an apostrophe ('), in order to be able to display, for example, **time's up**. A friend suggests that the easiest way is to add an apostrophe to the definition of **letter**. 2

Explain why this will not work.

- (c) A school is considering buying a science software package developed by a small local company. The software will be maintained by teachers in the school. The package will be used by all the students in a classroom at the same time, and must be suitable for Year 7 students.

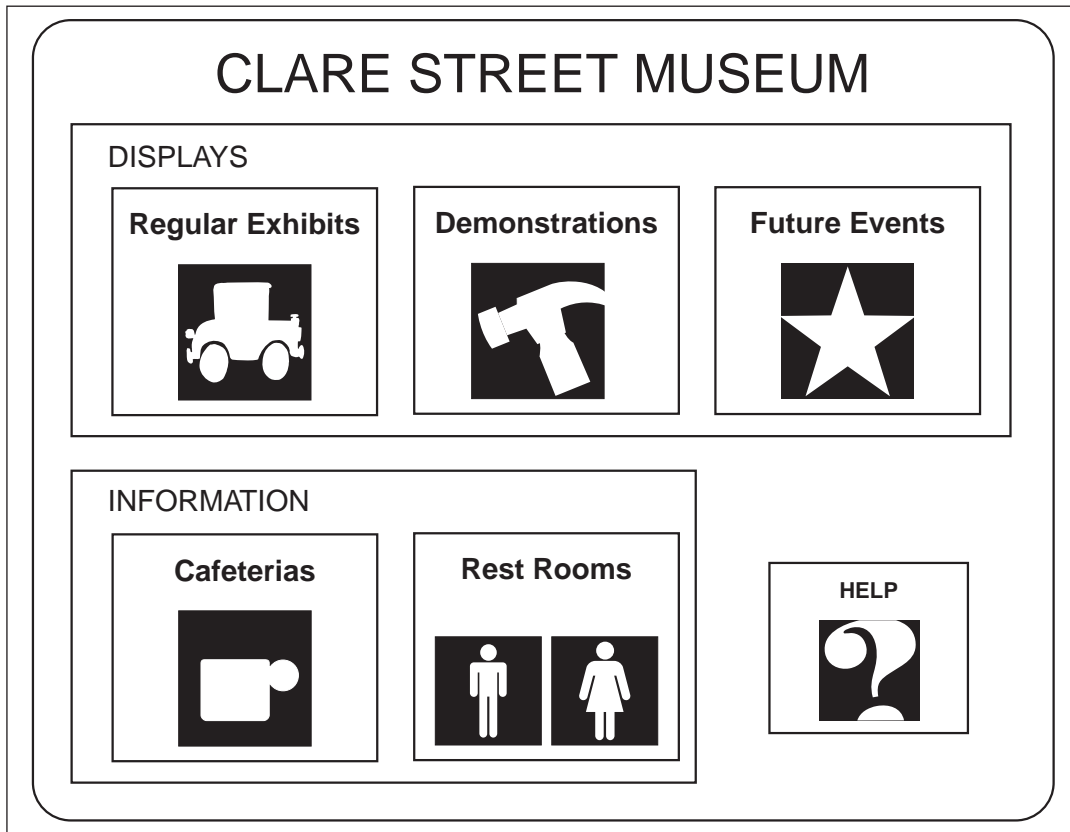
You have been given the task of evaluating this software package.

- (i) Describe TWO important aspects of functionality to be considered when evaluating this package. 2
- (ii) One of the advertised features of this software package is its ability to use a new technology to track an organism via satellite using its DNA structure. Discuss the possible effects upon society of this new technology. 4

Question 22 continues on page 13

Question 22 (continued)

- (d) The Clare Street Museum has touch screens that are used by visitors to help them find particular exhibits and museum facilities, such as cafeterias and rest rooms. The Main Menu is shown.



- (i) Name TWO groups that should have been consulted in the design and development of the touch screens, and explain the need for the involvement of these groups. 2
- (ii) Outline the elements of both good and poor design that have been used in this screen. 2
- (iii) Create a storyboard showing the Main Menu and the Regular Exhibits branch of the storyboard. 4

End of Question 22

Question 23 (20 marks) Use a SEPARATE writing booklet.

- (a) A program is needed that will ask a user to enter a login and password, then match them against entries in a table named 'CODES'. A section of 'CODES' is shown below. If the entries match, then 'TaskX' is to be run. If the user has had three unsuccessful attempts, an error message is to be produced.

The pseudocode below is an attempt to design an algorithm to work in a testing environment when the table 'CODES' has only the following 3 entries:

CODES

Login	Password
jblogg	blue19
cbabbage	cogs
aturing	enigma

```
1  BEGIN MAINPROGRAM
2  Count = 0
3  REPEAT
4      add 1 to Count
5      CheckIdentity (ValidUser)
6  UNTIL Count ≥ 3 or ValidUser = True
7  IF ValidUser = True THEN
8      RunTaskX
9  ELSE
10     display "Incorrect login or password"
11  ENDIF
12  END MAINPROGRAM

13  BEGIN SUBPROGRAM CheckIdentity (ValidUser)
14  get Login from CODES
15  ValidUser = False
16  Count = 0
17  REPEAT
18     add 1 to Count
19  UNTIL Count ≥ 3 or CODES(Count,1) = Login
20  IF CODES(Count,1) = Login THEN
21     get Password from CODES
22     IF CODES(Count,2) = Password THEN
23         ValidUser = True
24     ENDIF
25  ENDIF
26  END SUBPROGRAM CheckIdentity (ValidUser)
```

Question 23 continues on page 15

	Marks
Question 23 (continued)	
(i) Two variables in the main program are 'ValidUser' and 'Count'. Suggest an appropriate data type for each of these variables.	2
(ii) The algorithm is to be changed to allow for 100 users. Write the number(s) of the line(s) that need to be changed, and indicate how the line(s) should be changed.	1
(iii) Describe how the algorithm could be changed to allow the number of users to be varied on a daily basis without needing to change the program each time the number of users changes.	1
(iv) Assume that the algorithm is implemented in a language where all variables are treated as local in scope. Perform a desk check using a login of 'cbabbage' and a password of 'blue19'.	2
(v) If the algorithm is implemented in a language where variables may be defined as local or global, what is the consequence of defining the variable 'Count' as global?	2
(vi) Using a flowchart, restructure lines 2 to 6 as a pre-test loop.	3
(vii) The number of users has increased to over 10 000. As a result it is no longer possible to store the Login and Password values in an array in the program, and they need to be stored in a file which will be accessed each time a user logs in. Choose an appropriate file type to use, and justify your choice.	2
(b) Use the following hypothetical situation to answer parts (i) – (ii).	
<p>A commercial airline has designed a radical new aeroplane that can transport more passengers in less time than current aeroplanes. Secret simulation tests need to be done on the design to check that the aeroplane will perform as expected. This will require the processing and storage of large amounts of data in real time. A new computer system is needed to assist in this task. You are the person contracted to develop this system.</p>	
(i) Discuss the factors that may influence whether the development of such a system is feasible.	3
(ii) Discuss the rights and responsibilities of the software developer as they relate to the hypothetical situation.	4

End of Question 23

Section III

Total marks (20)

Attempt either Question 24 or Question 25

Allow about 35 minutes for this section

Answer the question in a SEPARATE writing booklet. Extra writing booklets are available. If you include diagrams in your answer, ensure that they are clearly labelled.

Marks

Question 24 — Evolution of Programming Languages (20 marks)

- (a) The program segments A and B are written using two different programming languages.

<i>Segment A</i>	<i>Segment B</i>
SUM (GET (X, Y))	GET X GET Y SUM = X + Y

- (i) Identify the type of programming paradigm illustrated by each program segment. Give ONE reason for each choice. **2**
- (ii) Each programming paradigm has a DISPLAY procedure for displaying results on screen. For each of the program segments above, modify the code to display the SUM of X and Y. **2**
- (b) A school administration system is being developed to manage teacher and student details.

In the analysis of the system, two objects were identified: a STUDENT object and a TEACHER object. Data associated with both teachers and students were: NAME, ADDRESS, SEX and DATE-OF-BIRTH. In addition, student data included SUBJECTS-STUDIED and YEAR-ENROLLED.

The sorts of methods associated with both teachers and students included: DISPLAY-ADDRESS and CALCULATE-AGE. For students, the number of years enrolled also has to be calculated.

- (i) Describe the CLASSES you would need to set up for such a system. **2**
- (ii) YEAR-ENROLLED has to change from two digits to four digits. What effect would this have on the TEACHER object, and what feature of the language accounts for this effect? **2**

Question 24 continues on page 17

Question 24 (continued)

- (c) A new programming language has been developed, named Object Neural Interface Construct Algorithm, or ONICA. It has the following features: **5**
- program data are deposited in specially defined modular containers. The modular containers are also used to secure procedures of the program code;
 - the containers have a level of intelligence by maintaining the knowledge that is required to manipulate the data facts that they store;
 - the procedures of program code are written to observe and use the three structured programming constructs of sequence, selection and repetition;
 - parameters are passed between the module containers such that the procedures are implemented in accordance with the knowledge of the container, and the deposited data facts are modified as required;
 - modular containers can be subtracted from, and added to, the program, for ease of maintenance.

Using the three programming paradigms you have studied, how would you classify ONICA? Justify your choice of classification.

- (d) A programmer could write a program to solve a logic problem using a traditional third generation language. In most cases productivity will be increased by using a special purpose language such as Prolog. **2**

Describe TWO characteristics of logic programming languages that lead to increased programmer productivity.

Question 24 continues on page 18

Question 24 (continued)

- (e) The following is part of a Prolog program designed to answer questions about the layout of houses in a street.

```

1 immediately_west(house1, house3).
2 immediately_west(house3, house5).
3 immediately_west(house5, house7).
4 immediately_west(house7, house9).
5 immediately_west(house2, house4).
6 immediately_west(house4, house6).
7 immediately_west(house6, house8).
8 somewhere_to_the_west(A, B) :- immediately_west(A, B).
9 somewhere_to_the_west(A, B) :- immediately_west(A, M),
                                somewhere_to_the_west(M, B).

```

- (i) Why are there 2 rules, each called ‘somewhere_to_the_west’? 1
- (ii) List, in order, the numbers of the lines that would be executed in response to the query: 1

? somewhere_to_the_west(house1, house7)

- (iii) You need to extend the program to be able to answer questions about houses being to the east of other houses. A friend suggests that one way to do this is to add an extra fact corresponding to each fact already there — for instance, corresponding to the first fact, add 3

immediately_east(house3, house1)

and so on.

Describe one other way of extending the program to cope with questions about houses to the east.

End of Question 24

		Marks
Question 25 — Software Developer’s View of the Hardware (20 marks)		
(a)	(i) What is the largest positive integer that can be represented as a 4-bit two’s complement number?	1
	(ii) Explain the difference between the representation of 0 as a 4-bit one’s complement number and as a 4-bit two’s complement number.	1
	(iii) Divide 11110_2 by 101_2 performing all calculations in binary. Show all necessary working.	2
	(iv) The following sequence of hexadecimal digits is found in a computer’s memory: 43 6A 85 1C	
	1 If this sequence is interpreted as a floating point number in standard IEEE FPS format, is the number positive or negative? Write the bit pattern corresponding to the exponent.	2
	2 If this sequence is interpreted as a set of four 8-bit integers in a two’s complement representation, what decimal number is represented by the first 8 bits?	1

Question 25 continues on page 20

Question 25 (continued)

- (b) Data sent to a plotter comprise both commands to the plotter, and data to be plotted.

Plotter commands are as follows:

PU Pen up

PD Pen down

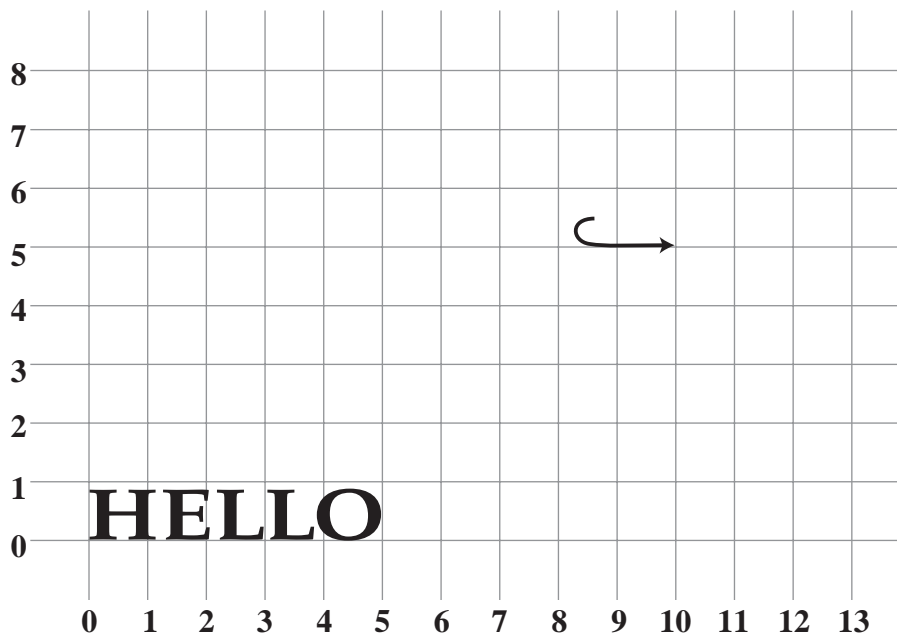
Mxx,yy Move to location xx (horizontally) and yy (vertically), with the pen in its current state (either up or down).

Pnddd...dd Put the pen down, then plot n characters of data 'ddd...dd' starting from the current location. After plotting the data, lift the pen up, move it to the position it was in just before it started plotting the text, and reset the pen to its original state (either up or down).

If the following command string is sent to the plotter while the pen is located at position 00,00:

PUP5HELLOM10,05

the following result is plotted (the numbers and dotted lines are not displayed, but are there only to help you determine location), and the pen is then moved to the location shown by the arrow.

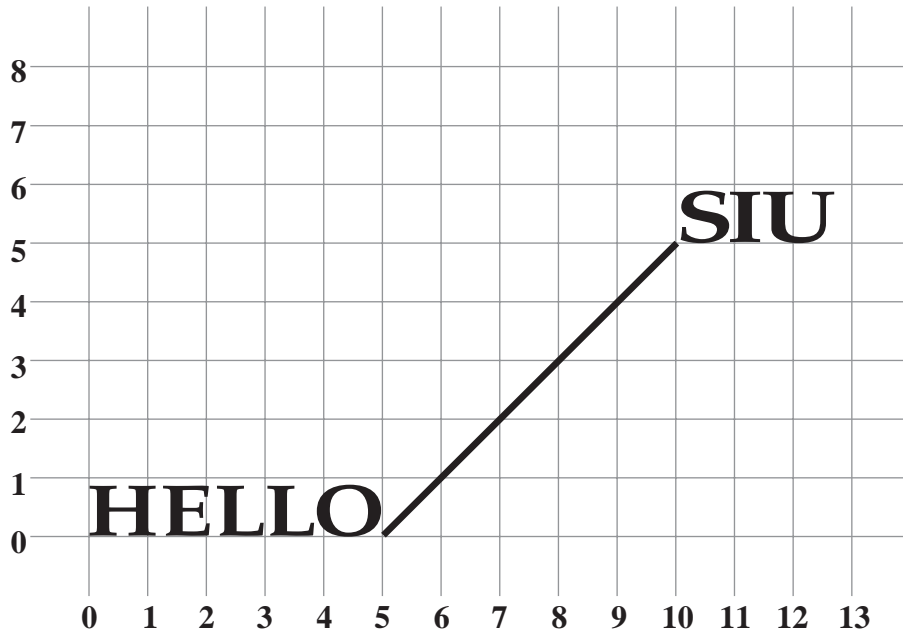


Question 25 continues on page 21

Question 25 (continued)

- (i) What would the result have been if the command string had started with PD instead of PU? 1

- (ii) After executing the original command string **PUP5HELLOM10,05** the pen is now up at 10,05. Write the extra command string that will produce the following result: 2

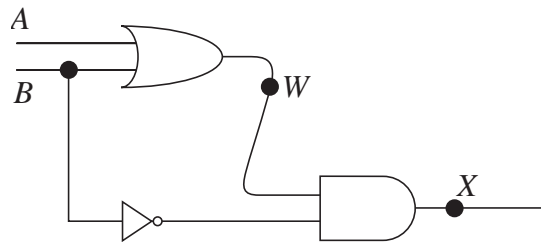


- (iii) A friend has said to you that it seems unnecessary for the plot command to specify the number of characters to be plotted. The plotter could just keep displaying characters until it found the next command. Give ONE reason why this suggestion would not work. 1

Question 25 continues on page 22

Question 25 (continued)

- (c) (i) With the aid of a diagram, explain how a half-adder could be used to make a full-adder. **1**
- (ii) Draw a truth table for this circuit, showing the signals at points *W* and *X*. **1**



- (iii) Draw a circuit, using only NOT and AND gates, that behaves as an OR gate. **2**
- (iv) A room is locked with a security device that has 3 buttons. The door will open only if the first and the second buttons or the second and the third buttons are pushed simultaneously. For any other combination, the door will remain locked. **5**

Construct the truth table for a circuit that satisfies the above requirement. Draw a circuit for the security device.

End of paper