



BOARD OF STUDIES
NEW SOUTH WALES

2003

**HIGHER SCHOOL CERTIFICATE
EXAMINATION**

Software Design and Development

General Instructions

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

Total marks – 100

Section I Pages 2–9

20 marks

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

Section II Pages 10–15

60 marks

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

Section III Pages 16–20

20 marks

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

Section I

20 marks

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 the correct answer by writing the word **correct** and drawing an arrow as follows.

A B C D
correct ↙

1 An interactive video game has a large number of screens.

Which of the following methods would be BEST to show the concept of the game?

- (A) Concept diagram
- (B) Content diagram
- (C) Storyboard
- (D) Systems analysis chart

2 At which stage in the software development cycle would the design of the user interface be first considered?

- (A) Defining and understanding
- (B) Implementation
- (C) Testing and evaluation
- (D) Maintenance

3 Applicants for a job vacancy were asked to show their ability to:

- define the scope of systems development projects;
- monitor and control the development and cost of systems;
- ensure that all project group activities are coordinated with other project groups, operations and other user areas;
- produce accurate and timely project status reports.

What is the most likely position that was being advertised?

- (A) Analyst/Programmer
- (B) Customer Support Analyst
- (C) IT Project Manager
- (D) Web Developer

- 4 Consider the following fragment of pseudocode.

```
PRINT "Have you ever been refused credit?"  
READ answer  
IF answer = "yes" THEN  
    provide_credit = FALSE  
ENDIF
```

Which of the following is the BEST data type for the variable `provide_credit`?

- (A) Boolean
 - (B) Date
 - (C) Hyperlink
 - (D) Integer
- 5 A school installed hardware and software in order to process students' attendance data. The attendance system was tested using the data from one class and it appeared to work as expected. On the first day of actual use the system ran too slowly to be acceptable.
- What type of testing would have foreseen this problem?
- (A) Black box
 - (B) Mixed transaction types
 - (C) White box
 - (D) Volume data
- 6 One approach to systems development uses well-defined phases with set tasks and deliverables from each phase. What is this approach called?
- (A) End-user development
 - (B) Phased approach
 - (C) Rapid application development
 - (D) Structured approach
- 7 Which are the two most important roles in determining the requirements for a new system?
- (A) Programmer and systems analyst
 - (B) Project manager and systems analyst
 - (C) User and programmer
 - (D) User and systems analyst

- 8** Napster was a peer-to-peer file sharing system that allowed computer users to download music (MP3) files. It was closed down after a court ruling in the USA.

Which of the following BEST summarises the reason for the closure of Napster?

- (A) It had engaged in illegal outsourcing.
 - (B) It had engaged in copyright infringement.
 - (C) Peer-to-peer networking breached Beta-testing laws.
 - (D) Peer-to-peer networking breached the Software Developers' Code of Conduct.
- 9** Consider the following fragment of pseudocode.

```
Index = 1
Highest = Array[Index]
WHILE Index <= ArraySize
    IF Array[Index] > Highest then
        Highest = Array[Index]
    ENDIF
    Increment Index
ENDWHILE
```

What is the purpose of this algorithm?

- (A) To find the largest number in an array
 - (B) To find the position of the largest number in an array
 - (C) To sort an array of integers in ascending order
 - (D) To sort an array of integers in descending order
- 10** An advantage of using an interpreter to translate source code is that
- (A) it uses less space in RAM.
 - (B) the source code is protected.
 - (C) syntax errors are located easily.
 - (D) the machine code can be used by any CPU.

11 Consider the following algorithm.

```
BEGIN
  READ first_number, second_number
  REPEAT
    total = first_number + second_number
    first_number = second_number
    second_number = total
  UNTIL total > 8
  PRINT second_number
END
```

If first_number = 1 and second_number = 2, what is the first value of second_number printed by the program?

- (A) 5
- (B) 8
- (C) 13
- (D) 21

12 Consider the following piece of code.

```
SUBROUTINE Calc_Comms (emp_id, emp_hrs)
  PRINT "sub calc_comms commenced"
END SUBROUTINE
```

What is this an example of?

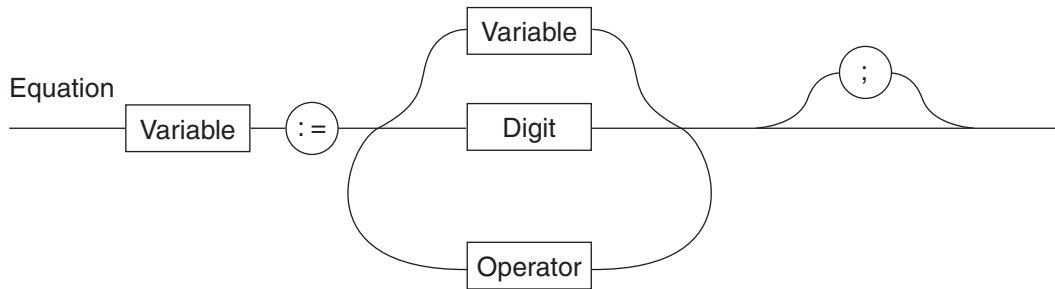
- (A) A flag
- (B) A stub
- (C) Run-time checking
- (D) Variable identification

13 Which of the following is a major problem with prototyping?

- (A) Provision of feedback from users is simple.
- (B) Development time is increased unnecessarily.
- (C) The users of the system have a direct involvement in the development of the prototype.
- (D) The project team may be committed to a solution before there is a thorough understanding of the problem.

- 14 In which activity of the software development cycle should the impact of a new software system on the working conditions of the employees of an organisation be addressed?
- (A) Preparing a feasibility study
 - (B) Testing for a mix of transactions
 - (C) Selecting the language paradigm
 - (D) Ensuring that coding matches benchmarks

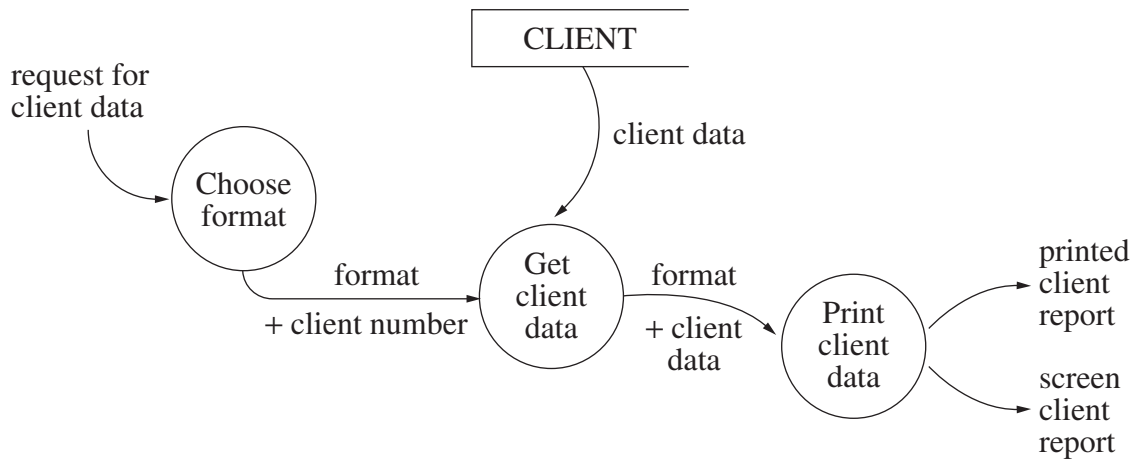
15



Which EBNF statement describes the same syntax as the railway diagram above?

- (A) Equation = <Variable> := <Digit>{<Operator><Digit>|<Variable>} ;
- (B) Equation = <Variable> := <Digit>{<Operator><Digit>|<Variable>} [;]
- (C) Equation = <Variable> := <Digit>|<Variable>{<Operator><Digit>|<Variable>} [;]
- (D) Equation = <Variable> := <Digit>|<Variable>{<Operator><Digit>|<Variable>} {;}

Use this portion of a data flow diagram to answer Questions 16 and 17.



16 Which of the following shows all of the input to 'Get client data'?

- (A) client data
- (B) format + client data
- (C) format + client number + client data
- (D) format + client + client number + client data

17 From where does 'CLIENT' receive data?

- (A) Choose format
- (B) Get client data
- (C) Print client data
- (D) Another system

18 In a Victorian Supreme Court case an Australian citizen sought damages against an American company for publishing defamatory comments over the Internet. The court found that, while the publication of the defamatory comments was not made in Australia, a person may sue in the country where defamation occurs.

Of what is this an example?

- (A) Decompilation being used to identify the source of the defamation
- (B) Legal implications of the implementation of technology
- (C) Reverse engineering being used to identify the source of the defamation
- (D) Social implications of the implementation of technology

- 19 The following shows the arrangement of elements in an array after successive passes of a sorting algorithm.

Apple	Orange	Banana	Cherry	Grape
Apple	Orange	Banana	Grape	Cherry
Apple	Orange	Grape	Cherry	Banana
Apple	Orange	Grape	Cherry	Banana
Orange	Grape	Cherry	Banana	Apple

What type of sort algorithm has been used to arrange the elements of the array into ascending alphabetical order?

- (A) Binary
 - (B) Bubble
 - (C) Insertion
 - (D) Selection
- 20 In which of the following documentation would you MOST LIKELY find specifications of the minimum hardware requirements for a software application?
- (A) Installation guide
 - (B) Intrinsic documentation
 - (C) Reference manual
 - (D) Tutorial

Section II

60 marks

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) A financial program is being modified by a bank to allow for an increase in the number of transactions. The manager of the project has decided on the structured approach to solve the problem. Twelve weeks have been set aside for the project, with each stage taking the same amount of time as the other stages, except the planning and design stage. The planning and design stage will take twice as long as any of the other stages.

Using a Gantt chart, document the scheduling of this project. | 4 |
| (b) A company hires a group of programmers to modify an existing system. The tools they will use include the original data dictionaries and test data.

Explain the use of each of these tools in the modification of an existing program. | 4 |

Question 21 continues on page 11

Question 21 (continued)

- (c) The following pseudocode is used to calculate the total receipts for a business (including GST).

```

1  BEGIN
2      OPEN Transaction
3      total = 0
4      gst_total = 0
5      READ first record
6      WHILE record NOT sentinel
7          total = total + Transaction.amount
8          gst_total = gst_total + Transaction.gst
9          READ next record
10     ENDWHILE
11     OUTPUT total, gst_total
12  END

```

- (i) Desk check your algorithm using the following test data. 3

<i>Amount</i>	<i>GST</i>
22	2
33	3
11	1
ZZZ	0

- (ii) Using pseudocode or a flowchart, modify the above algorithm to calculate and display the output of the average Transaction.amount. 3

- (d) A software developer uses a CASE tool to keep track of the version and lines of code in each modification to their main software product. Each time a version of the product is created, the information is stored in a sequential file. Below is a small section of the file. The first version recorded is 3.1.

VERSION

3.1	10 233	3.2	11 777	3.21	10 022	3.3	12 030	3.4	10 666
-----	--------	-----	--------	------	--------	-----	--------	-----	--------

- (i) Justify the use of this particular CASE tool. 2
- (ii) Using pseudocode, create an algorithm that scans the sequential file and stores the numbers of all the versions that exceed 11 000 lines of code in a sequential file called 'Results'. 4

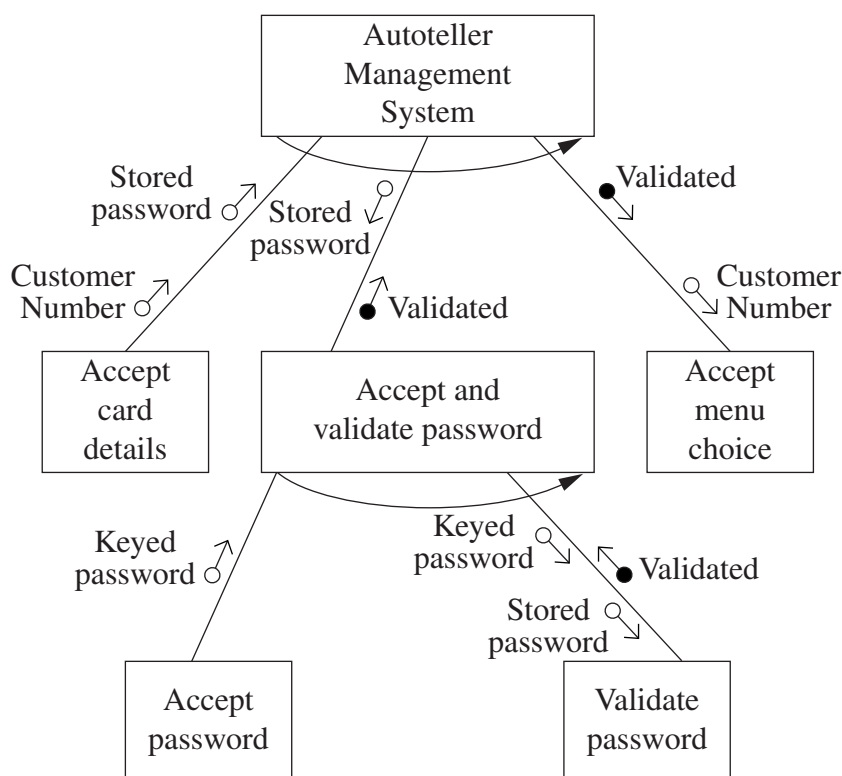
End of Question 21

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

(a) A large bank is building a secure internal network that will allow employees to interact directly with the company’s financial databases. The company decides to outsource the construction of software for the network.

- (i) Define the term *outsourcing*. 2
- (ii) Discuss the implications of outsourcing the construction of this software. 3
- (iii) Recommend steps to be taken during software development that ensure the reliability of the internal network systems operation. 4

(b)



A section of a Bank Autoteller Management System is described on the structure chart. There are other modules in the system, but they are not included as they are not relevant to the following questions.

- (i) Interpret the symbols $\circ \nearrow$ and $\bullet \nearrow$ used on a structure chart. 2

Question 22 continues on page 13

Question 22 (continued)

The following algorithm relates to parts (ii) and (iii) below.

```

1   BEGIN Autoteller Management System
2       System_on = TRUE
3       Validated = FALSE
4       WHILE Switched_on
5           Customer Number = 0
6           StoredPassword = " "
7           Validated = FALSE
8           CardInSlot = FALSE
9           WHILE NOT CardInSlot
10              READ cardslot
11              IF Card is located in cardslot THEN
12                  CardInSlot = TRUE
13              ENDIF
14          ENDWHILE
15          AcceptCardDetails (CustomerNumber, StoredPassword)
16          AcceptAndValidatePassword (StoredPassword, Validated)
17          IF Validated = TRUE THEN
18              AcceptMenuChoice(Validated, CustomerNumber)
19          ENDIF
20          READ System_on
21          Validated =TRUE
22      ENDWHILE
23  END

```

The above pseudocode represents the mainline of the Bank Autoteller Management System. The system has a logic error.

- (ii) Locate the error and describe its effect on the system. Using pseudocode similar to that of the original, alter the algorithm to remove the error. **4**
- (iii) Using pseudocode similar to the mainline, develop an algorithm to perform the task of the AcceptAndValidatePassword module. If the password is incorrect, the user is allowed two further attempts to enter a correct password. **5**

End of Question 22

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

- (a) A small company is designing a database to hold company data. Compare and contrast a custom-designed solution with a customised off-the-shelf package for this company. **4**
- (b) A new approach to software development is the production of open-source software. Open-source software development may be characterised by:
- software developers contributing their skills without receiving payment;
 - software developers contributing from anywhere around the world to a single project;
 - source code being available to anyone;
 - the product being available at no cost to any user.
- (i) Describe hardware and software developments that have made this development approach possible. **3**
- (ii) Discuss the project management issues that might arise from the use of this software development approach. **3**

Question 23 continues on page 15

Question 23 (continued)

(c) A given CPU is available to carry out the following instructions.

LOAD (Reg n , Mem x)	LOAD the register Reg n with the contents of memory address Mem x
STORE (Reg n , Mem x)	STORE the value in register Reg n in the memory address Mem x
ADD (Reg n , Reg m , Reg p)	ADD the values in registers Reg m and Reg p and store the result in register Reg n
STOP	STOP execution

The CPU has three registers — Reg 1, Reg 2, Reg 3.

Data is in hexadecimal format.

<u>Address</u>	<u>Contents</u>
Mem 5	30
Mem 6	A1
Mem 7	F8

The following lines of code are executed.

```
LOAD    (Reg 1, Mem 5)
LOAD    (Reg 2, Mem 6)
ADD     (Reg 3, Reg 1, Reg 2)
STORE   (Reg 3, Mem 6)
STOP
```

After execution:

- | | |
|--|----------|
| (i) What is being used as an accumulator? | 2 |
| (ii) What is the hexadecimal value of the contents of Mem 6, and why? | 2 |
| (iii) What is the decimal value in Reg 3? Demonstrate how you arrived at this answer. | 2 |
| (iv) Using the instructions defined above, write code to multiply the contents of Mem 5 by three, and place the result in Mem 7. | 4 |

End of Question 23

Section III

20 marks

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)	(i) The imperative and functional programming paradigms are characterised by their particular use of procedures and functions. Define <i>procedure</i> and <i>function</i> in terms of their uses in these paradigms. Where possible use small fragments of code in languages of your own choice to illustrate your definitions.	3
	(ii) Explain the reasons for the development of the functional paradigm.	4

Question 24 continues on page 17

Question 24 (continued)

```

(b)  1  main :- int_database, go.
      2  init_database :- assert(country(australia)),
      3                          assert(country(spain)),
      4                          assert(country(france)),
      5                          assert(city(canberra)),
      6                          assert(city(paris)),
      7                          assert(city(madrid)),
      8                          assert(capital(australia, canberra)),
      9                          assert(capital(france, paris)),
     10                          assert(capital(spain, madrid)).

     11  go :- nl,list_countries,
     12          write($ Enter a country name or quit to finish. $),
     13          read(X),
     14          X \=quit,
     15          show_capital(X),
     16          !, go.
     17  go :-

     18  list_countries :- write($ Countries in database: $),
     19                      can_use(Country),
     20                      tab(2), write(Country),
     21                      fail.
     22  list_countries :- nl.

     23  can_use(X) :- country(X).

     24  show_capital(X) :- country(X), capital(X,Y),
     25                      write(Y), write($ is the capital of $), write(X), nl.
     26  show_capital(X) :- city(X), write(X), write($ is a city, not a country. $), nl.
     27  show_capital(X) :- write (X), write($ is not in my database. $), nl.

```

- (i) Identify the paradigm supported by the programming language used to write the above program. Justify your answer by listing THREE features of the paradigm, giving examples from the code. **3**
- (ii) Currently, this program has limited use as a geography database. Using the code given as examples of syntax, extend the third `show_capital` module (line 27) so that it prompts for and accepts the capital of the country not already in the database. The module must also add the new data to the database. **4**

Question 24 continues on page 18

Question 24 (continued)

- (c) A major Australian bank has been using, and maintaining, the same software for many years to manage customer accounts. The software was written using the programming language COBOL (Common Business Oriented Language), which supports the imperative programming paradigm. The management of the bank has decided that it is time to completely rewrite their account management software. **6**

The new software should be able to add new customers, process deposits to and withdrawals from customers' accounts, prepare statements of customer accounts and delete customers who close all their accounts. Customers may have one or more savings, cheque and/or loan accounts. During the design stage of the project the systems analyst decided that the new software would be written using a programming language that supports the Object Oriented Programming (OOP) paradigm.

Compare and contrast the appropriateness of the choice of the OOP paradigm for this software solution with three paradigms you have studied. Your response should relate the concepts and basic building blocks of the paradigms to the software solution.

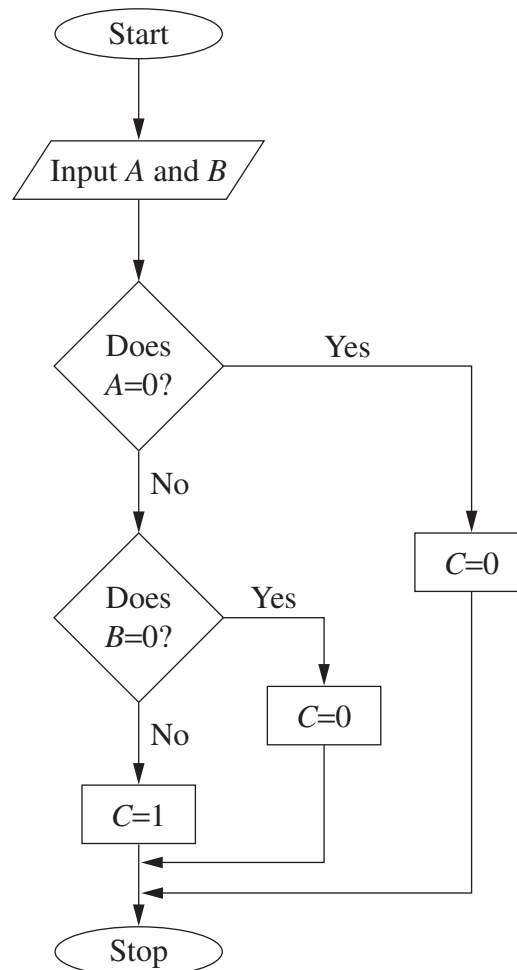
End of Question 24

OR

Question 25 — The Software Developer’s View of the Hardware (20 marks)

- (a) (i) Explain how a fraction is represented in single precision floating point binary representation. 3
- (ii) Convert the decimal number 45 (ie 45_{10}) to a hexadecimal number. 2
- (iii) Using four-bit binary representation and two’s complement, perform the following subtraction: $1110-0111$. 2

- (b) (i) Describe the function of a flip-flop, and briefly explain how it achieves its purpose. You may use a diagram to illustrate your answer. 3
- (ii) 4



The flowchart above describes the logic of an AND gate where the values of A and B are binary digits.

Use the flowchart to draw a truth table for an AND gate. Also draw a flowchart that describes the logic of an OR gate.

Question 25 continues on page 20

Question 25 (continued)

- (c) A fingerprint scanner is used by a software development company to maintain a high level of security at its premises. The fingerprint scanner operates in black and white mode only. 6

Ridges in the fingerprint are recorded and processed as black.



Valleys (indentations) in the fingerprint are recorded and processed as white.

When employees arrive at the workplace they must:

- place their index finger on an imaging pad located at the door; and
- wait for a scan of their fingerprint to be taken.

The image produced by the scan of the fingerprint is then sent to a central computer as a data stream. It is compared to the stored set of fingerprint data records for all employees. If a match is found, the door is opened.

In each of the data packets sent from the fingerprint scanner to the central computer there is header information, data characters and trailer information.

Compare and contrast the data stream that would be sent from the scanner to the central computer with the data stream that would be sent from the central computer to the door. Make specific reference to header information, data characters and trailer information for both data streams.

End of paper