



Aquinas College

2004

HIGHER SCHOOL CERTIFICATE

YEAR 12

MID-SEMESTER EXAMINATION

Software Design and Development

General Instructions

- Reading time – 5 minutes
- Working time – $2\frac{1}{2}$ hours
- Write using blue or black pen
- Diagrams may be done in pencil

Section I

Total marks (20)

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

Section II

Total marks (60)

- Attempt Questions 21 – 23
- Allow about 1 hour and 40 minutes for this section

Section III

Total marks (20)

- Attempt Question 25
- Allow about 30 minutes for this section

Section I

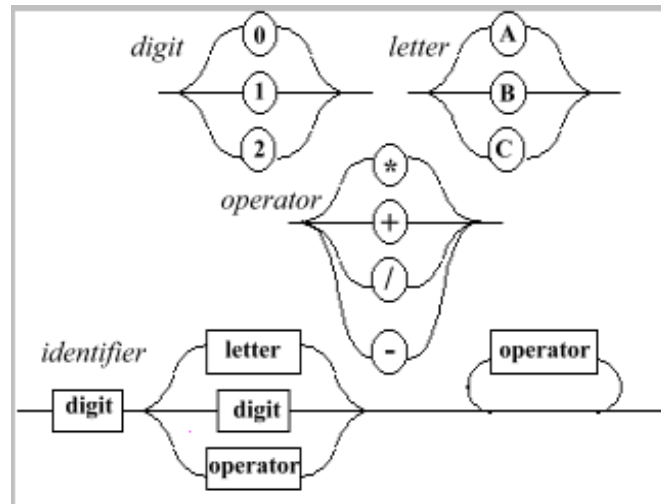
Total marks (20)

Attempt Questions 1 – 20

Select the alternative A, B, C or D that best answers the question.

- Q1. A piece of software that is freely distributed without the necessity of a license agreement is referred to as
- (A) hardware
 - (B) shareware
 - (C) freeware
 - (D) software
- Q2. To ensure that the software solution is implemented in an appropriate time frame, what project management technique could be utilised?
- (A) Data flow diagram
 - (B) Gantt chart
 - (C) IPO diagram
 - (D) Pseudocode
- Q3. The main difference between radio buttons and check boxes is that:
- (A) radio buttons usually produce an audible sound while check boxes do not.
 - (B) radio buttons must appear in separate dialogue boxes check boxes may appear anywhere on the screen.
 - (C) radio buttons only allow one option to be selected, check boxes may allow more options to be selected.
 - (D) radio buttons must be on order with the most selected items first, while check box items may appear in any order.
- Q4. The following algorithm
- ```
Number=0
WHILE Number >200
 Number =number + 5
ENDWHILE
```
- Contains all of the following
- (A) a post-test loop, a variable an assignment statement.
  - (B) a post-test loop, a variable and an output statement
  - (C) a pre-test loop, a decision and an input statement
  - (D) a pre-test loop, a variable and an assignment statement

Q5. Which of the following is a correct identifier according to the railroad diagram



- (A) 11+ /
- (B) AA++
- (C) 0B++1+
- (D) 2\*\*1

Q6. Given the following syntax definition.

$\langle \text{constant} \rangle = 5|7$   
 $\langle \text{variable} \rangle = A|B|C|D$   
 $\langle \text{expression} \rangle = \langle \text{variable} \rangle [\&|\% \langle \text{expression} \rangle] \% \langle \text{constant} \rangle$   
 $\langle \text{statement} \rangle = \langle \text{variable} \rangle ** \langle \text{expression} \rangle$

Which of the following is syntactically correct for a statement?

- (A) A\*\*7
- (B) B\*\*D&5
- (C) C\*\*C%7
- (D) D\*\*D&%4

Q7. To carry out a binary search on a list of names the list

- (A) should be sorted alphabetically A to Z.
- (B) should be sorted alphabetically Z to A.
- (C) should be sorted alphabetically (A to Z) or (Z to A).
- (D) does NOT need to be sorted.

Q8. A driving school wants a programmer to write a program to analyse the performance of its students. The information to be stored for each student is name, age, sex, multiple choice score, and driving test results.

Which of the following would be the most suitable data structure?

- (A) data list
- (B) file of records
- (C) array of characters
- (D) two separate arrays

Q9 IF the function RND generates a random number in the range 0 to 1 and the function INT returns a whole integer.  $INT(RND*6)+4$  would result in integers in the range:

- (A) 4 to 6
- (B) 6 to 10
- (C) 4 to 10
- (D) 3 to 9

Q10 The following shows the arrangement of elements in an array after successive passes of a sorting algorithm.  
What type of sort algorithm has been used to arrange the elements of the array into ascending alphabetical order?

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 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  |

- (A) Binary
- (B) Bubble
- (C) Insertion
- (D) Selection

Q11. Consider the following fragment of pseudocode.  
Which of the following is the BEST data type for the variable provide\_credit?

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

- (A) Boolean
- (B) Date
- (C) Hyperlink
- (D) Integer

Q12. A postal article is classed as a parcel if its weight is 500 grams or more. The following algorithm is designed to determine whether an article is a letter or a parcel, but there is a logical error.

```
begin parcelsort
 obtain articleweight from user
 if (articleweight < 500) or (articleweight = 500)
 then display "the article is a letter"
 else display "the article is a parcel"
 endif
end parcelsort
```

Which test data item will highlight the error?

- (A) - 100
- (B) 450
- (C) 500
- (D) 560

Q13. A software designer has decided to include a button on each of the screens of a program to allow the user to navigate back to the main menu screen. It was decided that this button should always be located at the bottom left corner and be the same colour and shape. How are these design decisions best described?

- (A) Bad, because the programmers cannot demonstrate their skill
- (B) Bad, because the user will become bored with the screens
- (C) Good, because they demonstrate consistency of approach by the programmer
- (D) Good, because they reduce the need for choices by the user

Q14. Joining two or more strings involves the process of

- (A) inserting
- (B) deleting
- (C) extracting
- (D) concatenation

Q15. What is the difference between a one-dimensional array and a record?

- (A) The fields of a record can be of the same type but the elements of an array must be of different types.
- (B) The fields of a record can be of different types but the elements of an array must be of the same type.
- (C) The fields of a record can be accessed directly but the elements of an array can only be accessed sequentially.
- (D) The elements of an array can be accessed directly but the fields of a record can only be accessed sequentially.

Q16. Read the following algorithm

```
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
```

Changing the name of the variable 'rate' to 'hourly\_rate' in the second line would improve the

- (A) online documentation.
- (B) external documentation.
- (C) intrinsic documentation.
- (D) listing documentation.

Q17. Read the following algorithm where name[n] is an array of type string.

```
Begin
n=3
X=name[n]
n=5
Y=name[n]
X=Y
Y=X
End
```

The two assignment statements X=Y and Y=X would result in:

- (A) the contents of X and Y being swapped.
- (B) both X and Y containing the original value of X.
- (C) both X and Y containing the original value of Y.
- (D) no change to the value of X and Y.

Q18. 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.

Q19. The elements of a one-dimensional array *stadium\_seat* are shown. The smallest index is 17.

What is the value of *stadium\_seat*[20] – *stadium\_seat*[18]?

|   |   |   |   |    |   |
|---|---|---|---|----|---|
| 6 | 3 | 9 | 7 | 11 | 8 |
|---|---|---|---|----|---|

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Q20. The elements of the integer ARRAY A are shown below.

|   | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1 | 2 | 2 | Y |
| 2 | 6 | 7 | 1 | 3 |
| 3 | 5 | 1 | X | 2 |
| 4 | Y | 3 | 2 | 8 |

If  $A[3,1]=5$  and

$A[1,1] + A[1,2] + A[1,3] + A[1,4] = X$  and

$A[1,1] + A[2,1] + A[3,1] + A[4,1] = 2 * X$

then the value of

$A[3,1] + A[3,2] + A[3,3] + A[3,4]$  is

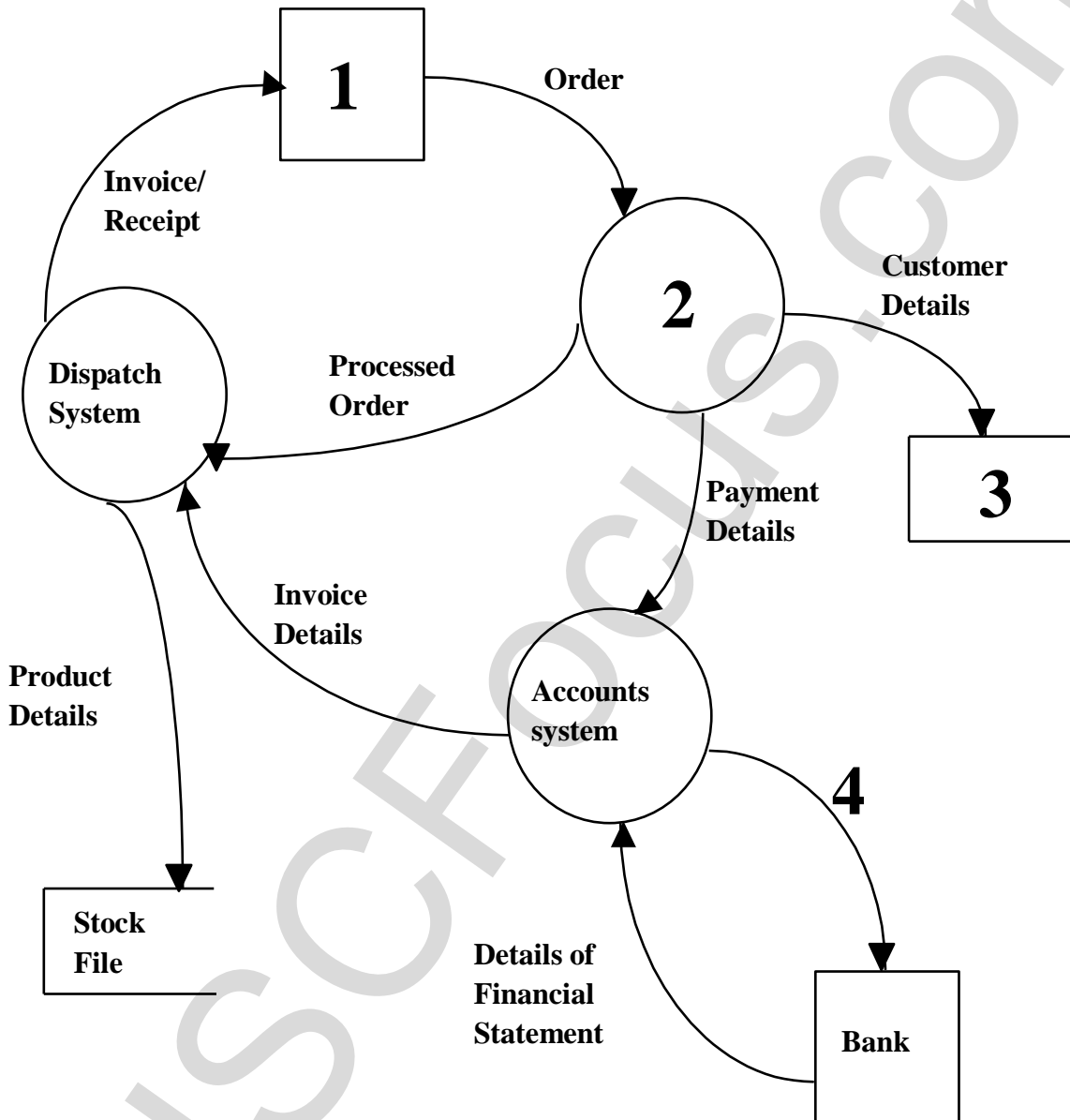
- (A) 2
- (B) 5
- (C) 15
- (D) 20

SECTION II

QUESTION 21. (20 marks)

Data flow diagrams may be used by analysts as system modelling tools. Consider the following data flow diagram for *Small Mail Order Company*.

A customer places an order and sends the payment for a CD (Compact Disc). The *Small Mail Order Company* processes the order, banks the payment and sends a receipt and the CD to the customer.





|                                                                                                                                                                                                                                                                       | <b>Marks</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| (a) Discuss TWO symbols used in a data flow diagram and their representation.                                                                                                                                                                                         | <b>4</b>     |
| (b) Complete the dataflow diagram for this situation by suggesting appropriate labels for the missing sections <b>1, 2, 3</b> and <b>4</b> .                                                                                                                          | <b>4</b>     |
| (c) Complete an IPO (Input-Process-Output) chart for the <i>Small Mail Order Company</i> .                                                                                                                                                                            | <b>4</b>     |
| (d) The data administrator wishes to calculate the total number of CD's sold at the end of each week and determine which CD had minimum sales. Using either a flowchart or pseudocode, write an algorithm that will                                                   | <b>6</b>     |
| (e) <ul style="list-style-type: none"> <li>• Determine the total number of CD's sold and print the value</li> <li>• Determine the least popular CD for the week and print its stock number (The least popular is determined by the CD with minimum sales.)</li> </ul> |              |
| (e) Documentation is required throughout the development of this software solution. Identify ONE type of documentation used in a particular stage of the development cycle and justify the use of this type of documentation for its particular stage.                | <b>2</b>     |

**Question 22** (20 marks)

**Marks**

The national railway network has been privatised. In its reorganisation, the new owners decide to automate the operation of the ticket sales and timetable information. They will install a computer system to dispense tickets and timetable information at all stations. Existing staff will be reassigned to assist in the day-to-day running of this system. Touch screens will be installed so that customers will not need to use keyboards to purchase tickets or gain information. Tickets can be paid for by swiping a credit or debit card through a standard magnetic card reader, or by cash. The system will perform the following tasks:

- process the purchase of tickets;
- display train timetable information on the screen;
- display information regarding the early or late arrival of trains currently running;  
and
- plan journeys.

- (a) The development of the system involves the consideration of a number of interactive components. **6**
- (i) Construct a storyboard to describe the purchase of tickets.
- (ii) Design a screen that could be used as the main menu for the system.
- (b) The system has been implemented and it is found that the information on the touch screens is not accessible to all train travellers. **2**
- Identify ONE group of travellers who may have a major problem in using touch screens and explain how this problem could be resolved.
- (c) The following pseudocode is used to calculate the total receipts for a business (including GST). **5**

```
BEGIN
 OPEN Transaction
 total = 0
 gst_total = 0
 READ first record
 WHILE record NOT sentinel
 total = total + Transaction.amount
 gst_total = gst_total + Transaction.gst
 READ next record
 ENDWHILE
 OUTPUT total, gst_total
END
```

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

| Amount | GST |
|--------|-----|
| 33     | 2   |
| 22     | 3   |
| 10     | 1   |
| ZZZ    | 0   |

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

**Question 22 continued****Marks**

(d)

Read the following algorithms.

```
BEGIN MAINPROGRAM
Capitals=0
Vowels=0
read acharacter
WHILE (character is not "Z") AND (character is not "z")
 CASEWHERE character is "A", "E", "I","O","U", "a","e","i","o","u":
 Vowels =Vowels + 1
 OTHERWISE:
 IF (character >= "A") AND (character <= "Z") THEN
 Capitals=Capitals + 1
 ENDIF
 ENDCASE
read acharacter
ENDWHILE
write "The number of vowels is", Vowels
write "The number of capital letters is", Capitals
END MAINPROGRAM
```

- (i) Name the variables in the algorithm
- (ii) Name the variables being initialized
- (iii) The while loop is sometimes called the “guarded loop”. Explain this term in reference to the example above.
- (iv) Desk-check the algorithm, and clearly show what values will be written out if the following data are used.

**7**

Come\_ to\_ DUBBO\_ ZOO ®

where \_ represents a SPACE and ® represents a CARRIAGE RETURN.

**Question 23** (20 marks)**Marks**

- (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) Explain why a project may be divided into smaller tasks and allocated to different team members 2

- (c) Perform the selection sort on the following set of numbers 2

**6      8      2      7      1      4**

- (d) An array of records called “Details” is created to contain the fields: Fname, Sname, Suburb, DOBmonth, DOByear, DOBday, Postcode. The following table shows sample data.

| <b>Fname</b> | <b>Sname</b> | <b>DOBday</b> | <b>DOBmonth</b> | <b>DOByear</b> | <b>Suburb</b> | <b>Postcode</b> |
|--------------|--------------|---------------|-----------------|----------------|---------------|-----------------|
| Sue          | Abbot        | 25            | 12              | 1972           | Menai         | 2234            |
| Craig        | Lee          | 4             | 4               | 1981           | Fairfield     | 2175            |
| Larry        | Smyth        | 18            | 5               | 1971           | Newtown       | 2000            |

- (i) The following example shows the task of the function Extract 2

Extract(2,3,Details.Fname[2])=rai

Write a statement that will extract the second character of the first element in the field Suburb.

- (ii) The function Concat performs the following task 2

Concat(Details.Sname[1]+Details.DOBday[1]+6)=Abbot256

Write a statement that will produce the following output:

Larry1971suburb

- (iii) Another field called ID is to be created using the first characters of Fname, Sname and DOBday. 4

Examples: Details.ID[1]=SA25, Details.ID[2]=CL4, Details.ID[3]=LS18

Write an algorithm that will perform this task for all elements in the array of records. (you may assume there are exactly one hundred elements in the file)

- (iv) The ID (identification) field is not unique. Explain. 2

- (v) Using the Concat and Extract functions can you design an unique identification code for each element in the array. 2

### Section III

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

**Marks**

(a) Perform the following conversions:

(i)  $11000100101_2$  to Hexadecimal

**3**

(ii)  $3B_{16}$  to binary then to a decimal

(iii)  $76_{10}$  to Binary

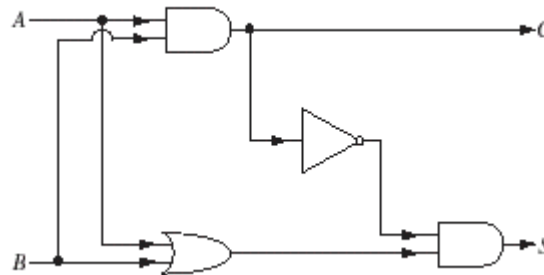
(b) Draw the logic circuit gate that will give the output described in the following truth table:

| Input |   | Output |
|-------|---|--------|
| A     | B |        |
| 0     | 0 | 0      |
| 0     | 1 | 1      |
| 1     | 0 | 1      |
| 1     | 1 | 0      |

**1**

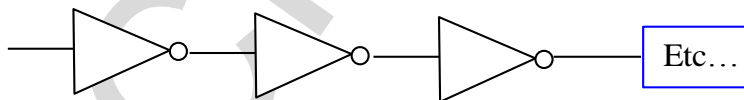
(c) Construct a truth table for the following circuit

**4**



(d) 243 **NOT** gates are connected in series with the output of the first becoming the input of the second and so on.

**2**



What would be the output of the 245<sup>th</sup> **NOT** gate, if the input of the first is 1? Explain how you arrived at this output.

(e) Using a flowchart or psuedocode write an algorithm which

**3**

- allows the user to enter a 4 bit binary
- converts the 4 bits entered to a decimal number
- prints the 4 bits and the equivalent decimal number.

(f) Using four-bit binary representation and two’s complement, perform the following subtraction:  $1011-0101$ .

**2**

(g) Convert the decimal number 463 to a binary coded decimal (BCD) using 4 bit numbers

**1**

**Question 25 continued**

- (h) Explain how a decimal is represented in single precision floating point binary representation. In your explanation use the terms mantissa, exponent and sign bit. **2**
- (i) Convert the following single precision floating point binary to our decimal number system. **2**

1 10000011 100000000000000000000000

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