2017

HIGHER SCHOOL CERTIFICATE
PRELIMINARY EXAMINATION

Software Design and Development

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using blue or black pen
- Write your student number and/or name at the top of every page

Section I
Total marks (20)

- Attempt questions 1-20
- Allow about 25 minutes for this section
- Mark your answers on the answer sheet provided

Section II
Total marks (80)

- Attempt ALL questions
- Allow about 1 hour and 35 minutes for this section
- Answer in the spaces provided on this paper

STUDENT NUMBER/NAME: _____

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Section I

Total marks (20)
Attempt Questions 1 – 20
Allow about 25 minutes for this section

Use the multiple choice answer sheet

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

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1. Which of the following is the LEAST important characteristic to consider when developing inclusive software?
   (A) Privacy
   (B) Gender
   (C) Culture
   (D) Disabilities

Consider the following algorithm when answering questions 2 and 3.

```
BEGIN
    a = 2
    b = 3
    c = 4
    WHILE c <= 10
        b = b + a
        b = b - 1
        c = c + 2
    END WHILE
    IF b >= 6 THEN
        PRINT a, b, c
    END IF
END
```

2. What control structures are used in the algorithm?
   (A) Sequence, counted loop and binary selection
   (B) Sequence, pre-test repetition and binary selection
   (C) Sequence, post-test repetition and binary selection
   (D) Sequence, post-test repetition and multiway selection

3. The algorithm is executed. What is the output?
   (A) 2, 6, 10
   (B) 2, 7, 12
   (C) 8, -1, 12
   (D) There is no output

4. Which of the following best describes a record?
   (A) group of related data of the same data type.
   (B) group of unrelated data of the same data type.
   (C) group of related data of potentially different data types.
   (D) group of unrelated data of potentially different data types.

5. Which of the following algorithms, when implemented, will NOT result in a run-time error?

(A)
```
BEGIN
    a = 0
    b = 1
    c = b/a
END
```

(B)
```
BEGIN
    a = 0
    b = 1
    c = a/a
END
```

(C)
```
BEGIN
    a = 1
    WHILE a > 0
        a = a + 1
    END WHILE
END
```

(D)
```
BEGIN
    a = 1
    WHILE a > 0
        a = a - 1
    END WHILE
END
```

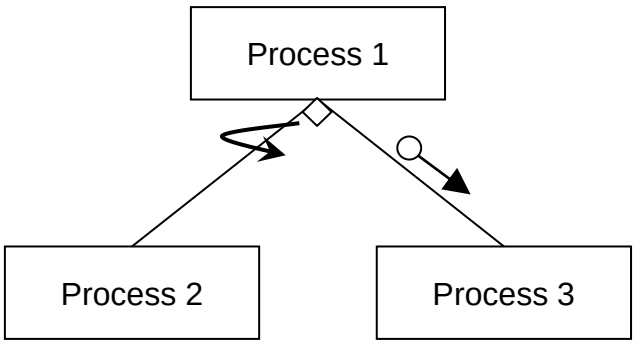
6. What is the most appropriate data type to represent a fraction?
   (A) String
   (B) Integer
   (C) Boolean
   (D) Floating point

7. Which of the following is the decimal value of 111101_2?
   (A) 2F
   (B) 3D
   (C) 47
   (D) 61

8. Which of the following is the binary value of $2A_{16}$?
   (A) 42
   (B) 162
   (C) 101010
   (D) 1010010

9. An ASCII table is often used to convert characters to integers. What ASCII character is represented by the value 65_{16}?
   (A) e
   (B) E
   (C) a
   (D) A

10. Consider the following structure chart.



Which of the following best matches the structure chart?

(A)
```
BEGIN Process1
    IF condition = True THEN
        WHILE boolean = TRUE
            Process2
        END WHILE
    ELSE
        Process3
    END IF
END Process1
```

(B)
```
BEGIN Process1
    WHILE boolean = True
        IF condition = True
            Process2
        ELSE
            Process3(parameter)
        END IF
    END WHILE
END Process1
```

(C)
```
BEGIN Process1
    WHILE boolean = True
        IF condition = True
            Process3(parameter)
        ELSE
            Process2
        END IF
    END WHILE
END Process1
```

(D)
```
BEGIN Process1
    IF condition = True THEN
        WHILE boolean = TRUE
            Process2
        END WHILE
    ELSE
        Process3(parameter)
    END IF
END Process1
```

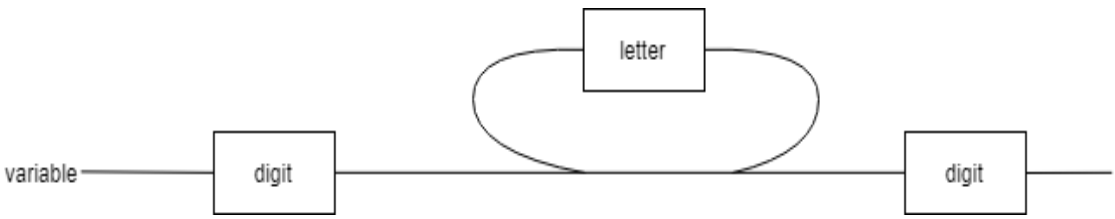
11. Which of the following best describes a module?
    (A) all the programs in a suite
    (B) a set of statements that performs a single logical task
    (C) a group of subroutines that together achieve a subtask
    (D) all the components required to perform the required task

12. Rectangles are used in a range of prescribed SDD modelling tools. What could a rectangle represent?
    (A) Subroutine or process
    (B) System, subroutine or process
    (C) External entity or manual operation
    (D) External entity, subroutine or process

13. Which of the following best describes online help?
    (A) printed reference manuals.
    (B) help which is available via the internet.
    (C) help provided electronically within an application.
    (D) phone support available from the software developer.

14. Which of the following is an example of secondary storage?
    (A) CPU registers
    (B) CD-ROM drive
    (C) cache
    (D) Random access memory

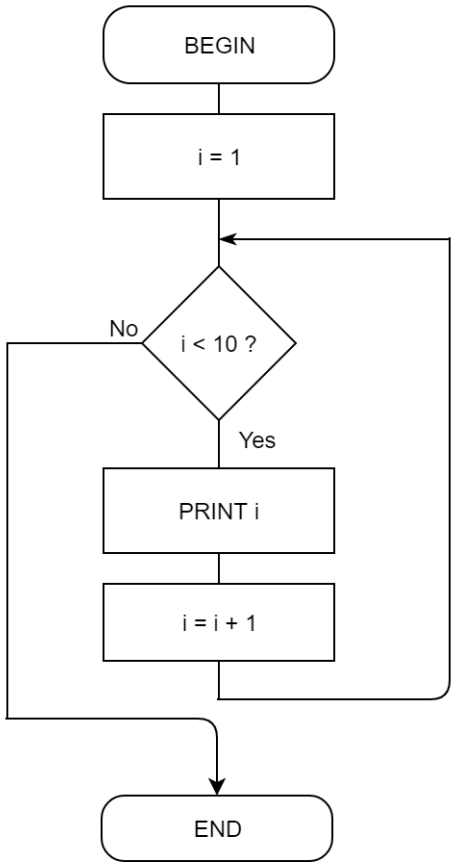
15. Consider the following railroad diagram.



    Which of the following is not a valid variable?
    (A) `22`
    (B) `1a3`
    (C) `3abcd`
    (D) `4abcdef6`

16. Which of the following is NOT a benefit of structured algorithms?
    (A) Ease of distribution
    (B) Ease of modification
    (C) Ease of development
    (D) Ease of understanding

17. Consider the following algorithm.



Which of the following best represents the above algorithm?

(A)
```
BEGIN
    i = 1
    WHILE i < 10
        Print i
        Increment i
    END WHILE
END
```

(B)
```
BEGIN
    i = 1
    REPEAT
        Print i
        i = i + 1
    UNTIL i = 9
END
```

(C)
```
BEGIN
    i = 1
    REPEAT
        Print i
        Increment i
    UNTIL i = 10
END
```

(D)
```
BEGIN
    FOR i = 1 TO 10
        Print i
    NEXT i
END
```

Consider the following algorithm when answering questions 18, 19 and 20.

```
BEGIN mySearch (needle, haystack)
    found = –1
    FOR i = 1 to length of haystack
        IF haystack(i) = needle THEN
            found = i
        END IF
    NEXT i
    RETURN found
END mySearch
```

18. Which of the following best describes this algorithm?
    (A) Framework
    (B) Custom logic
    (C) Global function
    (D) Standard subroutine

19. What is haystack?
    (A) Array index
    (B) Global variable
    (C) Array and parameter
    (D) Record and parameter

20. Which of the following best describes the purpose of the algorithm?
    (A) To return the first position of needle in haystack
    (B) To return the last position of needle in haystack
    (C) To return the first matching element of needle in haystack
    (D) To return the last matching element of needle in haystack

Section II

Total marks (80)
Attempt ALL Questions
Allow about 1 hour and 35 minutes for this section

Answer in the spaces provided on this paper.

If you include diagrams in your answer, ensure they are clearly labelled.

Question 21. (3 marks) **Marks**

Describe a situation where a command line interface would be appropriate, and describe a different situation where a graphical user interface would be appropriate. 3

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Question 22. (3 marks)

Compare and contrast freeware and shareware software licence types. 3

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_____

Question 23. (3 marks) **Marks**

Is open source software covered under copyright? Justify your response. 3

Question 24. (3 marks)

All computer-based systems are composed of fundamental elements. Identify TWO of these elements and provide an example of how those elements interact during the system's operation. 3

Question 25. (4 marks) **Marks**

A programmer types the following code.

```
PRINT "Hello World"
```

When they press the RETURN key the line of code is immediately evaluated and executed.

(a) What method of translation is being used? 1

(b) From when the programmer types their code, through to the translation and execution of the code, a variety of processes occur. Identify the processes that take place. 3

Question 26. (2 marks)

What is the fetch-execute cycle?. 2

Question 27. (3 marks) **Marks**

Describe ONE function of an operating system. 3

Question 28. (4 marks)

The government department responsible for Air Traffic Control (ATC) wishes to replace their ATC software. The new software needs to interface in real time with radar and other data received at 200 monitoring sites across the country. The main screen of the software shows a map with the location of aircraft and necessary data such as altitude, direction and aircraft type. The software must also alert Air Traffic Controllers if aircraft are on a path that could lead to a collision.

It is planned that they will switch to the new software in three years' time.

Recommend and justify a software development approach for this scenario. In your response, briefly explain why other approaches are not suitable. 4

Question 29. (3 marks) **Marks**

Explain how stubs can be used to help develop software using a top-down approach. 3

Question 30. (4 marks)

A team of developers is working on a large software project. The project manager is concerned that the project is not meeting key deadlines and is running over time. Describe strategies that the project manager could use to get the project back on track. 4

Question 31. (4 marks) **Marks**

Consider the following fragment of code.

```
1     BEGIN MysteryAlgorithm
2     READ INPUT a
3     abc = 0
4     qrs = [ ]
5     IF a ≠ " "
6     b = b + a
7     qrs[abc] = a
8     abc = abc + 1
9     READ INPUT a
10    GOTO Line 5
11    END IF
12    q = 0
13    FOR z = 0 TO abc - 1 STEP 1
14          IF qrs[z] > q THEN
15             q = qrs[z]
16          END IF
17         NEXT z
18         END MysteryAlgorithm
```

Outline changes to the above code which would help improve its maintainability. 4

Question 32. (4 marks) **Marks**

A program is being developed. The developer finds code online which they attempt to incorporate into their program. Describe TWO compatibility issues which may arise when including code from other sources. 4

Question 33. (3 marks)

Describe techniques a programmer could use to determine whether a section of code has executed. 3

Question 34. (6 marks) **Marks**

Consider the following algorithm for a function.

```
BEGIN calculateGrade (mark)
    IF mark >= 50 THEN
        RETURN "Pass"
    ELSE
        IF mark >= 45 THEN
            RETURN "Near pass"
        ELSE
            RETURN "Fail"
        END IF
    END IF
END calculateGrade
```

(a) Write an algorithm which prints the grade for each mark from 0 to 100 inclusive. For example, the first two lines of output should be 3

```
0 Fail
1 Fail
```

Your algorithm should call the calculateGrade function.

(b) List test data that should be used to test the calculateGrade function. Include the expected output and the reason for the inclusion of each test data item. 3

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Question 35. (7 marks) **Marks**

Consider the following algorithms which both calculate the average of five numbers using different methods.

```
BEGIN AverageFive1(array)
    sum = 0
    length = number of items in array
    FOR i = 0 TO length - 1 STEP 1
        sum = sum + array[i]
    NEXT i
    AverageFive1 = sum / length
END AverageFive1

BEGIN AverageFive2
    sum = 0
    FOR i = 1 TO 5 STEP 1
        READ INPUT a
        sum = sum + a
    NEXT i
    AverageFive2 = sum / 5
END AverageFive1
```

(a) Complete a desk check of AverageFive1 assuming the following values are in the array. 3

15, 10, 8, 4, 3

Question 35 continues on the next page.

Question 35. (continued) **Marks**

(b) Critically evaluate these two different approaches to solving the problem. 4

End of question 35.

Question 36. (7 marks) **Marks**

(a) EBNF is a metalanguage. What is the purpose of such metalanguages and how are they used by developers? 3

(b) Consider the following examples of syntactically correct pre-test loop control structures in a particular programming language: 4

```
WHILE condition
END WHILE

WHILE condition
    statement
    ...
END WHILE
```

Any number of statements

```
WHILE condition AND condition
    statement
END WHILE

WHILE condition OR condition
    statement
END WHILE
```

```
WHILE condition AND condition OR condition AND condition OR…
    statement
    ...
END WHILE
```

Any number and combination of ANDs and/or ORs

Produce an EBNF definition for the pre-test loop control structure in this language. Note, there is no need for you to define condition or statement.

Question 37. (2 marks) **Marks**

Outline strategies a developer could use to detect logic errors. 2

Question 38. (2 marks)

Describe a situation where the use of a global variable would be appropriate. 2

Question 39. (3 marks)

Distinguish between serif and sans serif fonts and justify which is better to use within a user interface. 3

Question 40. (10 marks) **Marks**

Run Length Encoding (RLE) is a simple way of compressing data without loss. It replaces consecutively repetitive data (or runs of data) with a single data value along with the repetition count. For example, if a piece of data is:

```
AAAAABBCCAADDDDBCCCC
```

Then once it has been subject to RLE algorithm it would be compressed to:

```
5A2B2C2A4D1B4C
```

In other words, there are five occurrences of A followed by two occurrences of B, then two occurrences of C, etc. This has compressed the original string, which was 20 characters in length, to a smaller string of 14 characters in length.

However, there are some situations where the compressed string may be longer than the original string. For example:

```
ABCD
```

Would be compressed to:

```
1A1B1C1D
```

In this situation an RLE algorithm should return the original string, as it's smaller than the compressed string.

(a) Construct an IPO chart for an algorithm which takes a string as input and then performs Run Length Encoding and returns a compressed string (or the original string, where appropriate). 4

Input	*Process*	*Output*

Question 40 continues on the next page

Question 40. (continued) **Marks**

(b) Write an algorithm to perform Run Length Encoding on a string, and return either the compressed string or the original string (if the compressed string is longer than the original string). 6

END OF EXAMINATION

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