Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination
Sample Paper

Computer Science

Sections A & B

Higher Level

Time: 1 hour, 30 minutes

130 marks

Examination number

Centre stamp

Instructions

There are **three** sections in this examination. Section A and B appear in this booklet. Section C is in a separate booklet that will be provided for the computer-based element.

Section A	Short Answer Questions	60 marks	12 questions
Section B	Long Questions	70 marks	3 questions
Section C	Programming	80 marks	1 question

Answer all questions.

Write your answers for Section A and Section B in the spaces provided in this booklet. There is space for extra work at the end of the booklet. Label any such extra work clearly with the question number and part.

This examination booklet will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Answer all twelve questions.

Question 1

For each of the JavaScript Boolean expressions listed below state whether they evaluate to **true** or **false**.

Boolean Expression	Result
`7 > 5`	
`(7 > 5) && false`	
`(7 == 5) || true`	
`(7 != 5) || false`	
`(!false) && (!true)`	

Question 2

(a) Add the following two binary numbers:

```
  01001010
  10011001
```

(b) Convert your answer to decimal (base 10).

Question 3

Complete the truth table below from the logic diagram shown. The first row has already been completed.
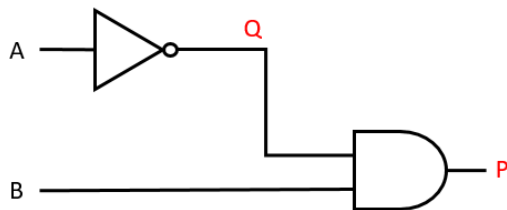
A	B	Q = NOT A	P = Q AND B
0	0	1	0
0	1		
1	0		
1	1		

Question 4

Abstraction is a key pillar of computational thinking and programming.

(a) Define what is meant by the term **abstraction** in the context of computational thinking.

(b) Explain how functions can be used by programmers to achieve abstraction.

Question 5

This JavaScript code shows the definition of a recursive function called **mystery**. The final line of code displays the output returned when **mystery** is called with an argument of 4.

```
1  function mystery(n) {
2
3      if (n == 0)
4          return 1;
5
6      return n * mystery(n-1);
7  }
8
9  alert(mystery(4));
```

(a) Which of the following values is displayed when the program is run? (Tick **one** option.)

4   ☐

1   ☐

24 ☐

12 ☐

(b) What makes the function **mystery** a recursive function?

Question 6

The JavaScript code below shows the definition of a function called **maxNum**. The function returns the largest of three integers **x**, **y** and **z**.

The final line of code displays the output returned when **maxNum** is called using the three arguments 2, 4 and 1. The call results in 4 being displayed in an alert pop-up box.

```
1    function maxNum(x, y, z) {
2      if ((x>y) && (x>z))
3          return x;
4      else if ((y>x) && (y>z))
5          return y;
6      else
7          return z;
8    }
9
10   alert(maxNum(2,4,1));
```

(a) The three arguments 2, 4 and 1 constitute a test case designed specifically to trigger the statement, **return y**. Suggest **two** further test cases that could be used to test **maxNum** as follows:

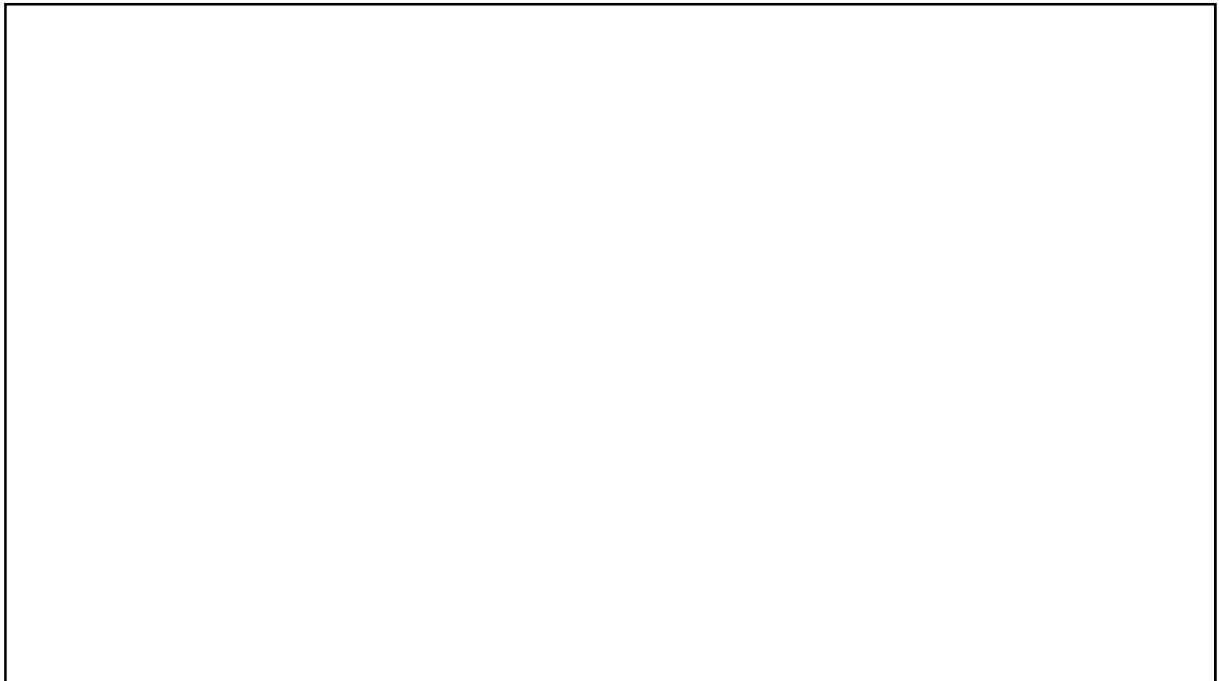| (i) A test case designed to trigger **return x** |
|---|
| |
| (ii) A test case designed to trigger **return z** |
| |

(b) Explain why this solution is not suitable if we wish to find the maximum of a larger number of arguments.

Question 7

The intention of the HTML shown below is to gather information from an end-user.

```
1   <!DOCTYPE html>
2   <html>
3       <body>
4           <h1>Survey</h1>
5           <form action="">
6               <label>Name:</label>
7               <input type="text" value="Enter name">
8               <fieldset>
9                   <legend>Do you wear glasses?</legend>
10                  <input type="radio">Yes
11                  <input type="radio" checked>No
12              </fieldset>
13              <input type="submit" value="Back">
14              <input type="submit" value="Next">
15          </form>
16          <p>Thank you for taking part.</p>
17      </body>
18  </html>
```

Sketch a picture of how the HTML form might look in a typical web browser.

Question 8

Fit Don't Quit is the name of a fitness club that uses a computer system to store information about its members.

(a) State the most suitable data type for each of the following **three** items:

(i) Member Identification (e.g. 1754):	
(ii) Member Name (e.g. Mary Murphy):	
(iii) Amount Paid (e.g. 45.50):	

(b) Suggest the name and purpose of another useful variable for the Fit Don't Quit computer system to capture information about its members. It should be a Boolean variable.

Name:
Purpose:

Question 9

(a) Define what is meant by the term **relational database**.

(b) Explain the purpose of a **primary key** in a relational database.

Question 10

On 15 May 2019, robotic engineers from Trinity College Dublin unveiled Stevie II, Ireland's first socially assistive robot.

(a)   Identify **two** ways in which robots such as Stevie II could have a positive impact on the lives of elderly people.

1.
2.

(b)   Outline **one** ethical concern that relates to socially assistive robots such as Stevie II.

Question 11

Algorithms, software and smart technologies have a growing presence in cities around the world. Artificial intelligence (AI), agent-based modelling, the internet of things and machine learning can be found practically everywhere now.
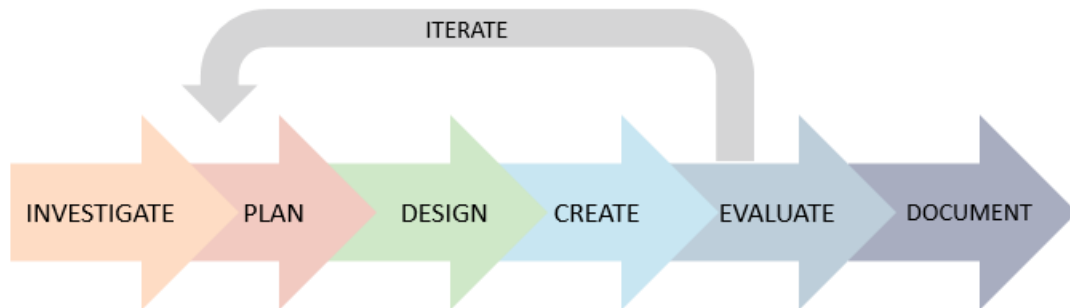
www.govtech.com, Silvio Carta, July 2019

(a) State **one** example of agent-based modelling.

(b) Explain how agent-based modelling can be used to demonstrate emergent behaviours.

Question 12

The diagram below illustrates the typical stages of a software development design process.
Outline briefly the main purpose of the (i) **design** and (ii) **create** stages.

Design:
Create:

Answer all three questions.

Question 13

Not to be confused with the internet, which had been evolving since the 1960s, the World Wide Web celebrated its 30th anniversary on 12 March, 2019.

Since 1991 external web servers have been up and running and today it is estimated that there are over 2 billion websites online.

While recognising the power of the web to transform governments, businesses, and societies for the better, inventor of the web, Sir Tim Berners-Lee used the occasion to highlight the abuse of his creation. "All kinds of things have gone wrong. We have fake news, we have problems with privacy, we have people being profiled and manipulated." He called for a 'contract' to reclaim the web as a force for the common good.

(Adapted from Irish Independent Editorial, May 16th 2019)

(a) Distinguish between the World Wide Web and the Internet.

(b) Explain each of the following terms:
  (i) HTML
  (ii) Web browser
  (iii) URL
  (iv) HTTP

HTML:

Web browser:

URL:

HTTP:

(c) This image highlights one of the many challenges currently facing the World Wide Web.

(i) Discuss this or any other challenge currently facing the World Wide Web.

(ii) Suggest **one** way the challenge could be overcome.

"The web has evolved into an engine of inequity and division"

Sir Tim Berners-Lee

| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

Question 14

(a) This diagram depicts a high-level view of some of the main components of a computer system.

```
┌─────────────────────────────┐
│  ┌───────────────────────┐  │
│  │ Central Processing Unit│  │
│  └───────────────────────┘  │
│         ↓    ↑               │
│  ┌───────────────────────┐  │
│  │   Primary Storage      │  │
│  │   (Main Memory)        │  │
│  └───────────────────────┘  │
└─────────────────────────────┘
          ↓    ↑
   ┌───────────────────────┐
   │  Secondary (Auxillary) │
   │       Storage          │
   └───────────────────────┘
```
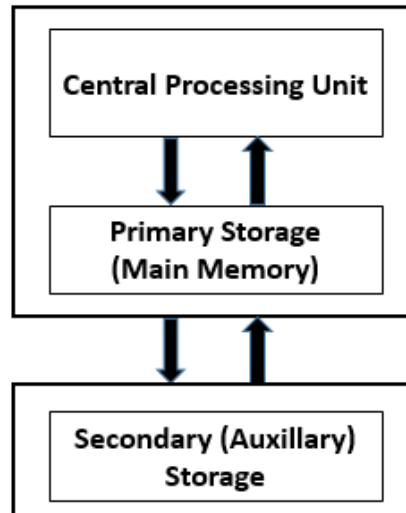
(i) What is the purpose of the Central Processing Unit?

(ii) List **two** types of primary storage.

1.
2.

(iii) List **two** types of secondary storage.

1.
2.

(iv) State **two** key differences between primary and secondary storage.

1.
2.

(b) Explain the cycle of operations that are carried out as instructions are fetched and executed from a computer's memory.
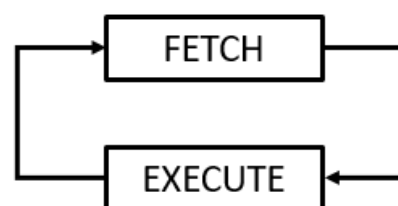
Your explanation should refer to the role of registers.

(c) The **SUM** and **CARRY** resulting from the addition of two binary variables, A and B, are described by the following two Boolean expressions:

$$SUM = (A\ AND\ NOT\ B)\ OR\ (NOT\ A\ AND\ B)$$

$$CARRY = A\ AND\ B$$

(i) Use the information provided to complete the drawing of the logic circuit shown.
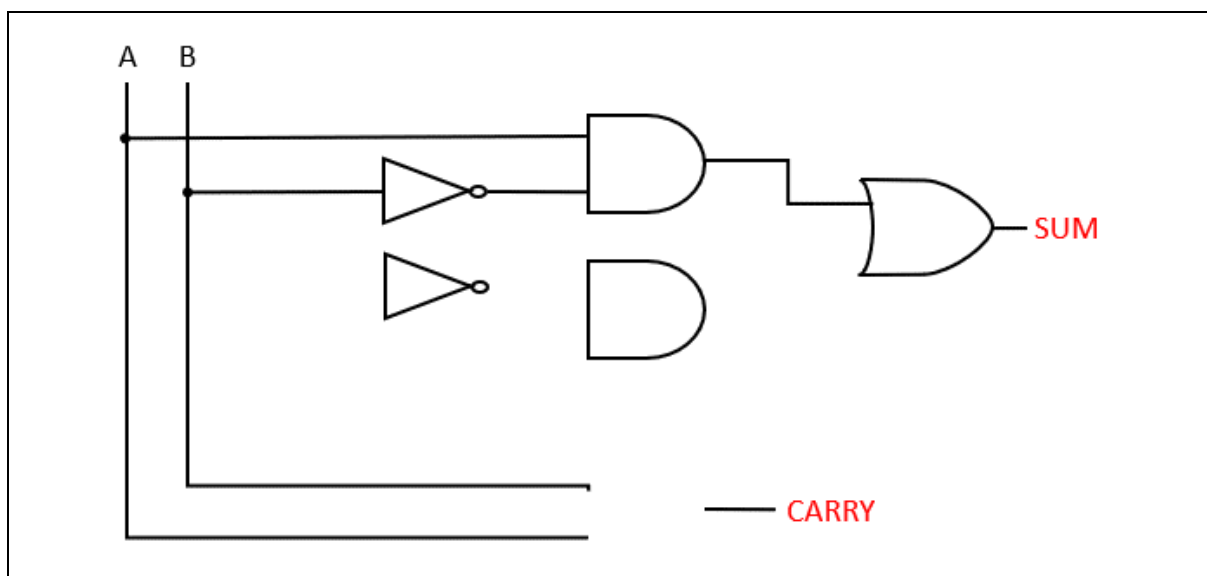
(ii) Explain how 0+1 is computed to have a SUM of 1 and a CARRY of 0.

SUM:
CARRY:

Question 15

Algorithms have given the world everything from social media feeds to search engines, satellite navigation to music recommendation systems, and are as much a part of our modern infrastructure as bridges, buildings and factories ever were.

Adapted from: *Hello World: Being Human in the Age of Algorithms* by Hannah Fry
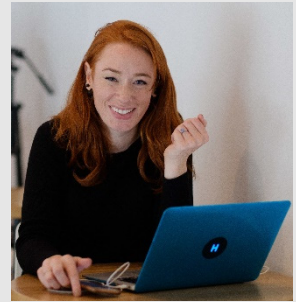
(a)   Define the term **algorithm**.

(b)   Outline briefly **one** example of how algorithms have played a role in the following areas:

(i)   Travel

(ii)   Retail

Travel:
Retail:

(c) The data below depicts the steps taken by a certain sorting algorithm to sort the list of integers: 88, 46, 25, 11, 18, 11 and 22.

Study the data and answer the questions that follow.

```
INPUT (initial list):  [88, 46, 25, 11, 18, 11, 22]
Pass 1: [46, 25, 11, 18, 11, 22, 88]
Pass 2: [25, 11, 18, 11, 22, 46, 88]
Pass 3: [11, 18, 11, 22, 25, 46, 88]
Pass 4: [11, 11, 18, 22, 25, 46, 88]
Pass 5: [11, 11, 18, 22, 25, 46, 88]
Pass 6: [11, 11, 18, 22, 25, 46, 88]
Pass 7: [11, 11, 18, 22, 25, 46, 88]
OUTPUT (sorted list):  [11, 11, 18, 22, 25, 46, 88]
```

(i) State the name of the algorithm.

(ii) Explain how the algorithm works.

(iii) Referring to passes 5, 6 and 7 identify **one** limitation of the algorithm.

(iv) Suggest how this limitation could be overcome.

(d) Quicksort is an efficient sorting algorithm, developed in 1959, which is still commonly used today.

(i) Using 50 as the initial pivot perform a quicksort on the following list of integers. In your answer you should show the state of the list after each pass.

85   24   63   45   17   31   96   50

(ii) Explain why the worst-case time complexity for the quicksort algorithm is $O(n^2)$.

Space for extra work.

Indicate clearly the number and part of the question(s) you are answering.

Space for extra work.

Indicate clearly the number and part of the question(s) you are answering.

There is no examination material on this page

There is no examination material on this page

There is no examination material on this page

Leaving Certificate – Higher Level

Computer Science – Sections A & B

Sample Paper
Time: 1 hours, 30 minutes