



CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
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## 9618/32

October/November 2021

**1 hour 30 minutes**

You must answer on the question paper.

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Any blank pages are indicated.

1 (a) Numbers are stored in a computer using floating-point representation with:

- 12 bits for the mantissa
- 4 bits for the exponent
- two's complement form for both the mantissa and exponent.

(i) Write the normalised floating-point representation of the following unsigned binary number using this system.

1011100.011001

Working .....

.....

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.....

.....

**Mantissa**

**Exponent**

|  |  |  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |  |  |  |  |
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[2]

(ii) State the consequence of storing the binary number in **part (a)(i)** as a floating-point number in this system. Justify your answer.

Consequence .....

.....

Justification .....

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[2]

(b) Explain the reason why binary numbers are stored in normalised form.

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[3]

- 2 Draw **one** line from each programming paradigm to its **most appropriate** description.

| Programming paradigm | Description                                                                                                   |
|----------------------|---------------------------------------------------------------------------------------------------------------|
|                      | Programs using the instruction set of a processor                                                             |
| Declarative          | Programs based on events such as user actions or sensor outputs                                               |
| Imperative           | Programs using the concepts of class, inheritance, encapsulation and polymorphism                             |
| Low-level            | Programs with an explicit sequence of commands that update the program state, with or without procedure calls |
| Object-oriented      | Programs that specify the desired result rather than how to get to it                                         |

[4]

- 3 Enumerated and pointer are two non-composite data types.

- (a) Write **pseudocode** to create an enumerated type called `Parts` to include these parts sold in a computer shop:

Monitor, CPU, SSD, HDD, LaserPrinter, Keyboard, Mouse

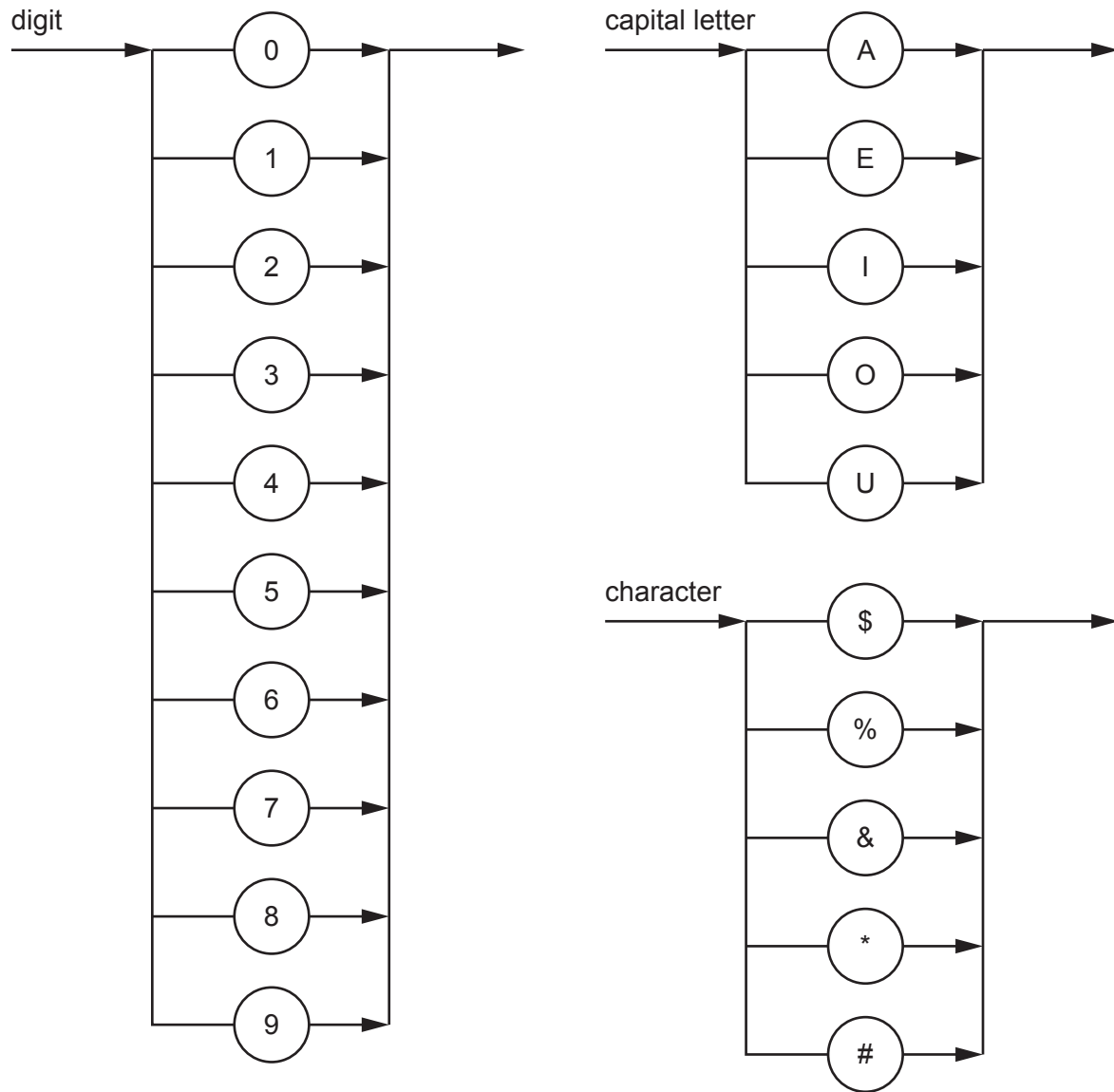
.....  
 .....  
 ..... [2]

- (b) Write **pseudocode** to create a pointer type called `SelectParts` that will reference the memory location in which the current part name is stored.

.....  
 .....  
 ..... [2]

4 The following syntax diagrams for a particular programming language show the syntax of:

- a digit
- a capital letter
- a character.



(a) Write the Backus-Naur Form (BNF) notation of the syntax diagram for character.

.....

.....

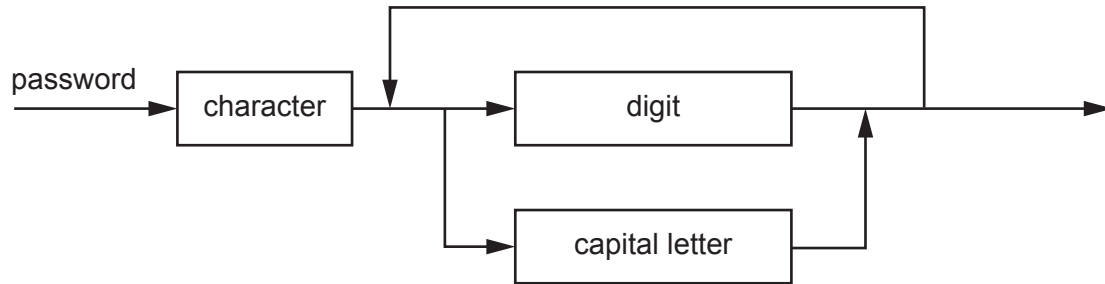
..... [2]

(b) A password must begin with a character and be followed by one or more digits or capital letters.

(i) State an example of a valid password.

..... [1]

(ii) A valid password is represented by the syntax diagram:



Write the BNF notation of the syntax diagram for password.

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..... [4]

- 5 (a) Compare sequential and serial methods of file organisation.

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..... [4]

- (b) State the most suitable method of file access when a record is referenced by a unique address on a disk-type storage medium.

..... [1]

- (c) State the most suitable method of file access when a bank stores its data records in ascending order of account number.

..... [1]

- 6 (a) Explain how packet switching is used to transfer messages across the internet.

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..... [5]

- (b) Outline the function of a router in packet switching.

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..... [3]

- 7 (a) Write the Boolean expression that corresponds to the given truth table as a sum-of-products.

| INPUT |   |   |   | OUTPUT |
|-------|---|---|---|--------|
| A     | B | C | D | Z      |
| 0     | 0 | 0 | 0 | 0      |
| 0     | 0 | 0 | 1 | 0      |
| 0     | 0 | 1 | 0 | 0      |
| 0     | 0 | 1 | 1 | 0      |
| 0     | 1 | 0 | 0 | 0      |
| 0     | 1 | 0 | 1 | 0      |
| 0     | 1 | 1 | 0 | 0      |
| 0     | 1 | 1 | 1 | 0      |
| 1     | 0 | 0 | 0 | 0      |
| 1     | 0 | 0 | 1 | 1      |
| 1     | 0 | 1 | 0 | 0      |
| 1     | 0 | 1 | 1 | 1      |
| 1     | 1 | 0 | 0 | 1      |
| 1     | 1 | 0 | 1 | 1      |
| 1     | 1 | 1 | 0 | 1      |
| 1     | 1 | 1 | 1 | 1      |

**Z** = .....

..... [3]

- (b) (i) Complete the Karnaugh map (K-map) for the given truth table.

|    |    | AB |    |    |    |
|----|----|----|----|----|----|
|    |    | 00 | 01 | 11 | 10 |
| CD | 00 |    |    |    |    |
|    | 01 |    |    |    |    |
|    | 11 |    |    |    |    |
|    | 10 |    |    |    |    |

[2]

- (ii) Draw loop(s) around appropriate group(s) of 1s in the K-map to produce an optimal sum-of-products. [2]
- (iii) Write the Boolean expression from your answer to **part b(ii)** as a simplified sum-of-products.

**Z** = ..... [2]

- (iv) Write the simplified Boolean expression for your answer to **part b(iii)**.

**Z** = ..... [1]

- 8 (a) Describe the purpose of the Secure Sockets Layer (SSL) and Transport Layer Security (TLS) protocols.

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..... [2]

- (b) Explain how SSL/TLS protocols are used when a client-server communication is initiated.

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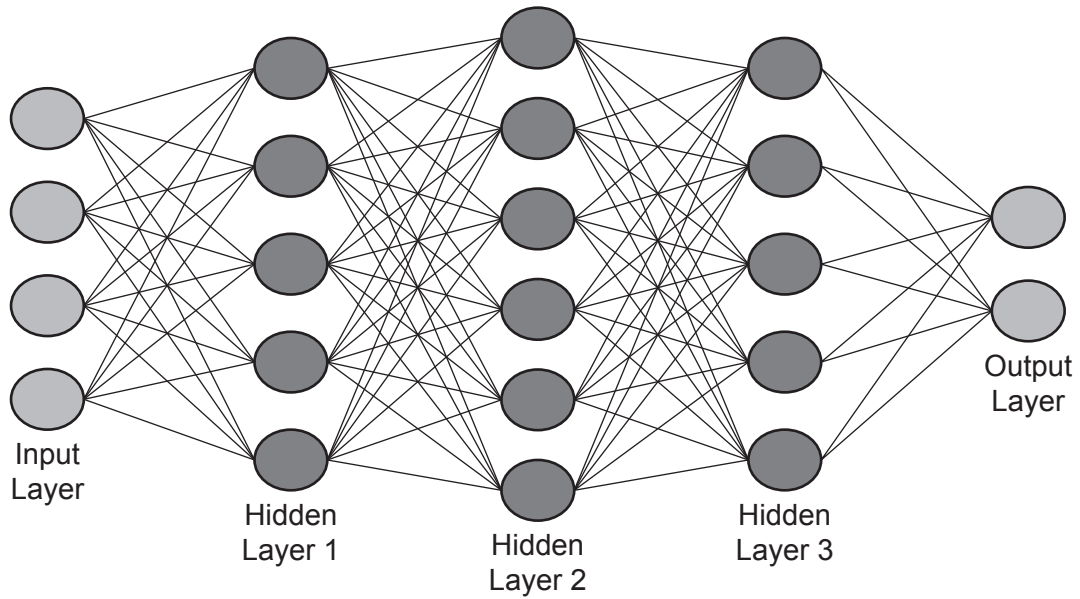
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..... [4]

- 9 (a) The diagram shown represents an artificial neural network.



- (i) State the reason for having multiple hidden layers in an artificial neural network.

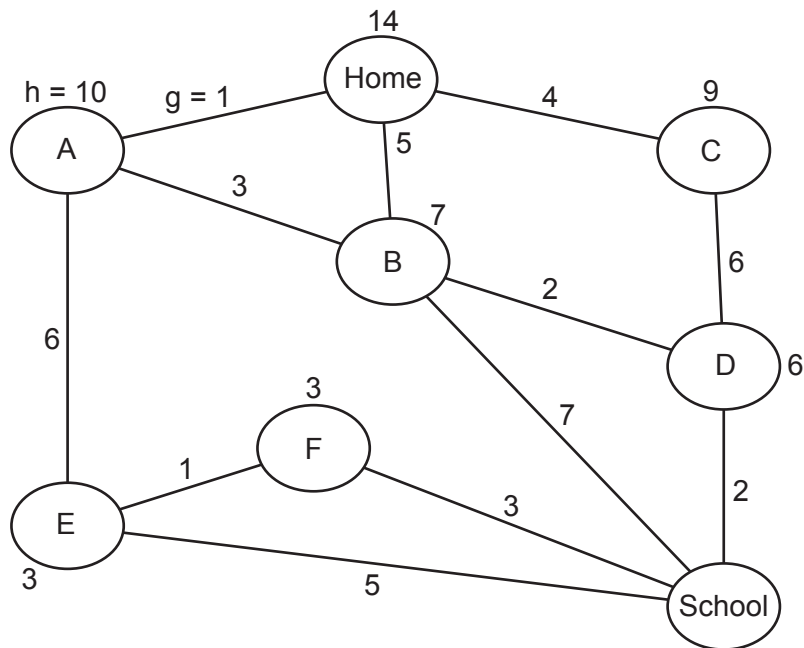
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 ..... [1]

- (ii) Explain how artificial neural networks enable machine learning.

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 .....  
 .....  
 .....  
 .....  
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 .....  
 .....  
 .....  
 ..... [4]

- (b) Find the shortest path between the Home and School nodes using the A\* algorithm. Show your working in the table provided.

The first two rows in the table have been completed.



| Node | Cost from Home node (g) | Heuristic (h) | Total (f = g + h) |
|------|-------------------------|---------------|-------------------|
| Home | 0                       | 14            | 14                |
| A    | 1                       | 10            | 11                |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |
|      |                         |               |                   |

**Final path**

[5]

10 (a) State **three** essential features of **recursion**.

- 1 .....
- .....
- 2 .....
- .....
- 3 .....
- .....
- [3]

(b) Explain the reasons why a stack is a suitable Abstract Data Type (ADT) to implement recursion.

- .....
- .....
- .....
- .....
- .....
- .....
- [3]

(c) Identify **two** ADTs other than a stack.

- 1 .....
- 2 .....
- [2]





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