## SECTION A

*Answer **all** questions.*

**1.** Describe **one** reason why MICR might be used rather than OCR to input data. *[2 marks]*

**2.** Determine how many bits per second a device transmits if it sends 16kB of data per second (where 1 byte = 8 bits). *[2 marks]*

**3.** Identify the **three** types of programming error, and give an example of **each**. *[6 marks]*

**4.** Define the term *controller*. *[1 mark]*

**5.** Outline the difference between *batch processing* and *on-line processing*, stating an example of when **each** would be used. *[4 marks]*

**6.** Two types of error-checking during data entry are verification and validation.

(a) Describe verification and identify the type of error that it tries to prevent. *[3 marks]*

(b) Describe **one** validation technique and identify **one** situation in which it might be used. *[3 marks]*

**7.** Compare **two** aspects of the storage of numbers using integer and floating-point representations. *[4 marks]*

**8.** Describe how a hashing algorithm is used to access a record in a direct access file and identify **one** advantage and **one** disadvantage of this file organisation. *[6 marks]*

**9.** Outline **two** uses of a stack in a computer system. *[4 marks]*

**10.** Outline **two** features of object-oriented programming (OOP) and identify **one** disadvantage of OOP. *[5 marks]*

## SECTION B

*Answer **four** questions.*

**11.** The following algorithm carries out an error-checking routine:

```
function CHECK(val DATA integer array [1..8])
   result boolean
   declare POS, COUNT integer

   COUNT <-- 0
   for POS <-- 1 upto 8 do
      if DATA[POS] = 1 then
         COUNT <-- COUNT+1
      endif
   endfor

   return (COUNT mod 2)=0
endfunction CHECK
```

(a) State the result of CHECK for DATA

| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |

by copying and completing the following trace table:

| POS | DATA [POS] = 1 | COUNT | CHECK |
|---|---|---|---|
| | | 0 | |
| 1 | false | 0 | |
| 2 | true | 1 | |
| | | | |

*[4 marks]*

(b) Deduce the result of CHECK for:

| 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |

DATA

*[1 mark]*

(c) Identify the error-checking method that the function CHECK is performing. *[2 marks]*

(d) State a situation when this type of error-checking would be used. *[1 mark]*

(e) Describe **one** problem with this error-checking method. *[2 marks]*

**12.** The standard length of a byte to store one character is 8 bits, which can represent up to 256 different characters. Writing in the Chinese language requires over 400 characters. These can be represented in a computer by increasing the number of bits used to store a character (that is, to change the size of a byte).

(a) State the minimum number of bits required in a byte to store 400 of the Chinese characters. *[1 mark]*

(b) Explain the implications of a change in the number of bits used in a byte on a computer system with respect to:

(i) hardware. *[3 marks]*

(ii) software. *[3 marks]*

(iii) communication. *[3 marks]*

**13.** Part of an algorithm used in a drawing package is given below:

```
if DATA[1] = 0 then
   LINE(DATA[2],DATA[3],DATA[4],DATA[5])
elsif DATA[1] = 1 then
      CIRCLE (DATA[2], DATA[3], DATA[4])
elsif DATA[1] = 2 then
      MOVE (DATA[2], DATA[3])
endif
```

Where `DATA` is a one-dimensional integer array of order 5, and `LINE`, `CIRCLE` and `MOVE` are procedures that control drawing routines.

`LINE(X1,Y1,X2,Y2)` outputs a straight line from the co-ordinates (X1,Y1) to (X2,Y2).
`CIRCLE(X,Y,R)` outputs a circle with its centre at co-ordinates (X,Y) and radius length R.
`MOVE(X,Y)` moves the cursor position to co-ordinates (X,Y).

(a) State the effect of using the above algorithm with the following data in `DATA`:

(i) `DATA`

| 0 | 3 | 6 | 2 | 0 |
|---|---|---|---|---|
| [1] | [2] | [3] | [4] | [5] |

*[1 mark]*

(ii) `DATA`

| 2 | 12 | 45 | 2 | 0 |
|---|---|---|---|---|
| [1] | [2] | [3] | [4] | [5] |

*[1 mark]*

(b) State why `DATA` would need to be redefined to order 31 if a new module was written to process a shape with 15 sides. *[1 mark]*

(c) (i) Explain why the use of a static data structure (an array) is inefficient. *[2 marks]*

(ii) Suggest a better data structure to store the required data within the program. As part of your answer, draw a sketch of the data structure and explain why it is better than an array. *[5 marks]*

**14.** A programmer implements an object (using Object-Oriented Programming, OOP) called `QUEUE`, with the usual properties associated with such a structure, for example: initialise and add a data item to the rear.

(a) State **one** further property associated with a queue. *[1 mark]*

(b) Describe **one** use of a queue in a computer system. *[2 marks]*

(c) Explain the OOP term *encapsulation* with reference to the example above. *[3 marks]*

(d) The queue could be implemented using either an array or a dynamic structure with pointers. Explain the advantage of using OOP in this situation. *[4 marks]*

**15.** The user interface of a computer system is very important and includes the display of data (such as menus), as well as any specialised input/output hardware.

(a) Identify **four** factors that would be considered when selecting suitable hardware. *[4 marks]*

(b) Suggest **three** ways in which the design of the layout of data to be displayed could be decided. *[3 marks]*

(c) Explain how the interface will be tested before the final implementation. *[3 marks]*

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