1. When an airplane is ready to take off, the pilot calls air traffic control to notify them. The number of the airplane, the time it was due to take off and the time called in are added to a list. The due time is taken from a central database containing details of airplanes. A function `DUETIME(PLANE)` returns this value for a given plane identifier. When there is a free runway, the first plane on the list is called to take off.

The airplane identifier, call time and due time are stored in three arrays, `PLANE`, `DUE` and `CALL`. An entry of `ZZZ` in the `PLANE` array indicates that there are no further airplanes waiting. (Due time and call time are both stored as minutes since midnight.)

For example, when there are three planes waiting, the arrays could be as follows.

PLANE	DUE	CALL
AF344	956	850
LH543	955	875
BD556	950	860
ZZZ		

The following procedure returns the identifier of the next airplane to take off and the number of airplanes left in the list. In addition, the procedure moves the remaining airplanes up the list.

```
procedure NEXTPLANE(ref PLANE array of string, ref CALL, DUE array of integer)
   declare COUNT integer
   output PLANE(1)
   COUNT<--1
   while not PLANE(COUNT)="ZZZ"
      PLANE(COUNT)<--PLANE(COUNT+1)
      CALL(COUNT)<--CALL(COUNT+1)
      DUE(COUNT)<--DUE(COUNT+1)
      COUNT<--COUNT+1
   endwhile
   output COUNT-1
endprocedure
```

(a) Using the array values given in the example, complete the following trace table for the procedure. *[2 marks]*

OUTPUT	COUNT	PLANE(COUNT)	DUE(COUNT)	CALL(COUNT)
AF344	1	LH344	956	850

(b) (i) Show the contents of array `PLANE` after three airplanes have been deleted, and state the problem that could now occur. *[2 marks]*

(ii) Amend the algorithm to avoid this happening. *[2 marks]*

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(Question 1 continued)

(c) Construct a function `MIDTIME` that takes time in hours and minutes passed as a real number, and returns the number of minutes since midnight. For example, 16.30, where 16 represents the hours and 30 represents the minutes, would give a value of 990. *[9 marks]*

(d) Construct a procedure which allows an operator to add an airplane to the list, by inputting the airplane ID and the current time. Use your function `MIDTIME` to convert the call time and due time of the airplane into the required format. The call time is taken as the current time and you can assume a function `GETDUETIME(PLANEID)` exists. *[9 marks]*

(e) At the moment, airplanes that call in first can take off first. This leads to some pilots calling in very early.

Explain how the list could be used to identify overdue airplanes and give them priority, to delete airplanes that call in more than one hour before due time and to ensure that airplanes take-off in the correct order. *[6 marks]*

This question requires the use of the Case Study.

2. (a) Discuss the *processor* and *storage* needs of producing CT-scans. *[4 marks]*

(b) An enlarged detail of a CT-scan is in 8-bit grey scale and has 512×512 pixels.

(i) Calculate the number of shades of grey available. *[1 mark]*

(ii) Determine the storage required for this image. *[2 marks]*

(c) Not all computer abuse is illegal. Using the case study as an example, describe the difference between computer crime and computer abuse, giving an example of each. *[6 marks]*

(d) Define the term *data compression* and explain the **two** uses of data compression in the case study. *[6 marks]*

(e) Discuss the implications of incorrect data capture from the scanner in the case of VA and medical diagnosis. *[4 marks]*

(f) Discuss the extent to which major advances in computer technology have affected scientific research. *[2 marks]*

3. A telephone is being developed that can store a list of names and telephone numbers in two arrays. The developer has to decide whether to store the data as it is received and do a *linear search* to find numbers, or to order the data in alphabetical order of name and do a *binary search.*

(a) Outline the difference between a *linear search* and a *binary search.* *[2 marks]*

(b) A *linear search* is faster than a *binary search* for the phone but the developer will want to add extra storage to store more numbers in the future. A *binary search* of sorted data was decided upon. Explain this decision. *[3 marks]*

(c) When all memory is full, new numbers will replace the "least used numbers". Describe how this could be achieved. *[3 marks]*

(d) State the types of *processing* involved in the CPU. *[3 marks]*

(e) Suggest suitable kinds of memory for the telephone and state what they would be used for. *[4 marks]*