8 A program is being developed to manage student book loans from a college library. Students may borrow up to five books at a time from the library.

The programmer has defined a record type to define each loan.

The record data items are:

Data item	Data type	Comment
`StudentID`	`STRING`	the unique ID of the student who has borrowed the book
`BookID`	`STRING`	the unique ID of the book being borrowed
`OnLoan`	`BOOLEAN`	`TRUE` if the book has **not** been returned

The programmer has defined a global array `Loan` to store 5000 loan records.

There are more elements in the array than books in the library. Unused elements have the `StudentID` set to an empty string. These may occur anywhere in the array.

The programmer has defined the first program module:

Module	Description
`OKToBorrow()`	• called with a parameter of type `STRING` representing a `StudentID` • search the array for loan records for the specified student • output a suitable message to say whether the student may, or may not, borrow another book

(a) Write efficient pseudocode for the module `OKToBorrow()`

[7]

(b) A second module is defined:

Module	Description
`ReturnBook()`	• called with two parameters of type `STRING` representing a `StudentID` and a `BookID` • searches the array for the relevant loan record • when found, sets `OnLoan` to `FALSE` and returns `TRUE` • if a loan record is **not** found, or the book has already been returned, then returns `FALSE`

Write efficient pseudocode for the module `ReturnBook()`

Assume that each student is only allowed to borrow each book only once. That means that there will be no more than **one** loan record for a given combination of student and book.

[8]

(c) It is decided to introduce a system of fines for books that have been borrowed for too long.

Two new requirements are defined:

1. Each loan has a maximum length, represented as a number of days.
2. Each book in the library will be assigned one of three categories. Each category has a different maximum loan length.

Record structure and program design changes are needed to meet these two requirements.

Outline the changes that are necessary to meet the **two** requirements.

[2]

1 The composite data type, `Car`, is defined in pseudocode as:

```
TYPE Car
   DECLARE RegNumber : STRING
   DECLARE Make : STRING
   DECLARE Model : STRING
   DECLARE BodyStyle : STRING
   DECLARE Colour : STRING
   DECLARE IntoStock : DATE
   DECLARE Price : REAL
ENDTYPE
```

(a) (i) Write the **pseudocode** statement to set up a variable for one record of the composite data type, `Car`.

.....

..... [1]

(ii) Write the **pseudocode** statements to assign the following values to the variable set up in part **(a)(i)**:

- `"Blue"` to `Colour`
- `21/10/2025` to `IntoStock`

.....

.....

.....

..... [2]

(b) The data type for `BodyStyle` is changed to an enumerated type, `Body`.

(i) Write the **pseudocode** statement for the type declaration of `Body` to hold the names of the available choices:

Convertible, Hatchback, Saloon, SUV

.....

.....

.....

..... [2]

(ii) Write the new **pseudocode** statement required to update the declaration of `BodyStyle` in the definition of `Car`.

.....

..... [1]

2 Numbers are stored in a computer system using binary floating-point representation with:

- 10 bits for the mantissa
- 6 bits for the exponent
- two's complement form for both the mantissa and the exponent.

(a) Calculate the denary value of the given normalised binary floating-point number. Show your working.

Mantissa										Exponent					
0	1	1	1	1	0	0	1	0	1	0	0	1	0	1	1

Working .....

.....

.....

.....

.....

Denary value .....

[3]

(b) Calculate the normalised binary floating-point representation of +26.6875 in this system. Show your working.

Mantissa										Exponent					

Working .....

.....

.....

.....

.....

.....

[3]

2 Numbers are stored in a computer system using binary floating-point representation with:

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

(a) Outline the effect of changing the number of bits used to store the mantissa to 10 bits, in this system.

.....

.....

.....

.....

.....

..... [3]

(b) Describe **one** example of a situation that could cause an overflow to occur and the consequences of such an overflow.

.....

.....

.....

.....

.....

..... [3]

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

- 10 bits for the mantissa
- 6 bits for the exponent
- two's complement form for both the mantissa and the exponent.

(a) Calculate the normalised binary floating-point representation of +201.125 in this system.

Show your working.

Mantissa										Exponent					

Working .....

.....

.....

.....

.....

.....

[3]

(b) Calculate the denary value of the given normalised binary floating-point number.

Show your working.

Mantissa										Exponent					
1	0	1	0	1	1	0	0	1	1	0	0	0	1	0	1

Working .....

.....

.....

.....

.....

.....

Answer .....

[3]