STRING FUNCTIONS TEST:

1. a) Determine the output for the following program. (3 marks)

    String SchoolName;

    SchoolName = "St. Mary's Secondary School";

    SchoolName.Length
    SchoolName.Substring(8,5);
    SchoolName.IndexOf('d');

    b) Provide the string function statement that will extract the string "on" from SchoolName. (2 marks)

2.   This problem requires you to take a positive integer and add up all of the digits in that integer. If the answer is a single digit, you're finished. If it isn't, you do it again, and you keep doing it until your answer does become a single digit. (15 marks)

Below are a some sample runs for various numbers.

Sample input data
1234567
11
795
4
8897
123
987667
44441
999

Sample Output:
Sum of digits in 1234567 = 1
Sum of digits in 11 = 2
Sum of digits in 795 = 3
Sum of digits in 4 = 4
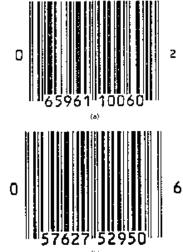Sum of digits in 8897 = 5
Sum of digits in 123 = 6
Sum of digits in 987667 = 7
Sum of digits in 44441 = 8
Sum of digits in 999 = 9

3.   UPC's (Universal Product Codes) are found on almost all things that we buy. Two examples of typical UPC's are shown below. For a bar code to be valid the following relationship must be true. (10 marks)

C= 3 H (sum of the digits in even positions) + (sum of the digits in odd positions) must be evenly divisible by 10

Note: The first digit is considered to be in position zero, an even position.

For the first UPC the calculation would look like this:
C=3(0+5+6+1+0+0)   +   (6+9+1+0+6+2)
   = 3(12) + 24
   = 60 which is evenly divisible by 10 -> so it's valid!

Write a program which will input a UPC and determine whether it is valid or not.

4.   Most credit cards have an account number in which the last digit is called the check digit. Its value depends on the values of the other digits. When the account number is input, the last digit is compared with what it should be based on the other digits in the number. Suppose an account number has **10** digits (including the check digit). One method of calculating the check digit is as follows:

Find the sum of the **2nd, 4th, 6th and 8th** digits (beginning from the left) call this **S1**.
Form a number consisting of the **1st, 3rd, 5th, 7th and 9th** digits. Multiply this value by **2** and add the digits in the results. Call this **S2**.
Add **S1** and **S2** and subtract the **last** digit from **ten** to obtain the check digit.

Example: 2520764263
             S1 = 5+0+6+2 = 13
             2*22746 = 45492
             S2 = 4+5+4+9+2 = 24
             S1 + S2 = 37
             check digit should be 10-7 = 3

Write an event procedure which determines whether a 10 digit account number is valid.
(15 marks)

5. The VIN Problem (The Challenge Problem - this is a bonus – 5 marks – no part marks)

Each automobile and truck has a Vehicle Identification Number or VIN associated with it. A VIN usually consists of 17 characters (a combination of letters and digits) and encodes vehicle information, such as manufacturer, plant location, engine type, body style, model year, and type of restraint system. It also contains a serial number and a check digit. Each car company uses a slightly different method to encode vehicle information into the 17 character VIN. The only constant is that the check digit is stored in the ninth position. Here, the VIN system for 1998 Hondas is presented.

Sample Honda VIN: JHMEJ854*WC123456

The first three characters indicate the manufacturer, make, and type of vehicle.

JHMEJ854*WC123456

JHL	Honda Motor Co., Ltd. Honda Multipurpose Passenger Vehicle
JHM	Honda Motor Co. Ltd - Honda passenger car
1HG	Honda of America Mfg Inc - Honda passenger car
2HG	Honda of Canada Mfg Inc - Honda passenger car

The fourth through sixth characters indicate the model of the vehicle along with the vehicles engine displacement.

JHMEJ854*WC123456

BB6	Prelude	2 Dr	H22A4
CF8	Accord	4 Dr	SOHC,F23A5
CG1	Accord	4 Dr	V6 VTEC, J30A1
CG2	Accord	2 Dr	V6 VTEC, J30A1
CG3	Accord	2 Dr	VTEC, F23A1
	Accord	2 Dr	ULEV, F23A4
CG5	Accord	4 Dr	VTEC, F23A1
CG6	Accord	4 Dr	ULEV, F23A4
EJ6	Civic	2/4 Dr	D16Y7
	Civic Hatchback		D16Y7
EJ7	Civic	2 Dr	D16Y5
EJ8	Civic	2/4 Dr	D16Y8

The seventh character encodes the body and transmission type of the vehicle.

JHMEJ8<u>5</u>4*WC123456

1	2 Dr.	Coupe	M/T
2	2 Dr.	Coupe	A/T or CVT
3	3 Dr.	Hatchback	M/T
4	3 Dr.	Hatchback	A/T
5	4 Dr.	Sedan	M/T
6	4 Dr.	Sedan	A/T
7	5 Dr.	Wagon or Multipurpose Passenger Vehicle	M/T
8	5 Dr.	Wagon or Multipurpose Passenger Vehicle	A/T

The eighth character indicates the series/model type and the type of restraint system used.

JHMEJ85<u>4</u>*WC123456

2	Civic Hatchback	CX	
	Civic	DX	2/4 Dr
	Civic	HX	2 Dr
4	Civic	DX	3 Dr
	Civic	EX	2/4 Dr
	Odyssey	LX 6Passenger	
	Accord	DX	4 Dr.
	Accord	LX	2/4 Dr
	Prelude	w/o SH pkg. Prelude	
	CR-V	LX	
5	Accord.	EX	2/4 Dr
	Prelude	SH pkg.	
	CR-V	LX w/ABS	

The ninth character is the check digit. This is one of the digits 0 - 9 or the letter X. The check digit scheme is described below.

JHMEJ854*WC123456

The tenth character indicates the year of the vehicle.

<div align="center">

JHMEJ854*<u>W</u>C123456

</div>

W	1998

The eleven character indicates the plant where the vehicle was manufactured.

<div align="center">

JHMEJ854*W<u>C</u>123456

</div>

A	Marysville, Ohio (USA)
C	Sayama (Japan)
H	Alliston, Ontario (Canada)
L	East Liberty, Ohio (USA)
S	Suzuka (Japan)

The twelfth through seventeenth characters are the serial number for the vehicle.

<div align="center">

JHMEJ854*WC<u>123456</u>

</div>

The Check Digit Scheme

Let $a_1a_2a_3a_4a_5a_6a_7a_8a_9a_{10}a_{11}a_{12}a_{13}a_{14}a_{15}a_{16}a_{17}$ be a VIN with the check digit in the ninth position. First assigning digits to the non-digit characters in the identification number using the table below. The check digit a_9 is determined by the following calculation:

$a_9 = 8a_1 + 7a_2 + 6a_3 + 5a_4 + 4a_5 + 3a_6 + 2a_7 + 10a_8 + 9a_{10} + 8a_{11} + 7a_{12} + 6a_{13} + 5a_{14} + 4a_{15} + 3a_{16} + 2a_{17}$ (mod 11).

If the remainder is 10 when the weighted sum is divided by 11, the check digit a_9 is assigned the value of X.

Examples:

Determine the check digit for the VIN: JHMEJ854*WC123456.
Digit Assignment: JHMEJ854*WC123456 = 18451854*63123456

Calculation:

$a_9 = 8a_1 + 7a_2 + 6a_3 + 5a_4 + 4a_5 + 3a_6 + 2a_7 + 10a_8 + 9a_{10} + 8a_{11} + 7a_{12} + 6a_{13} + 5a_{14} + 4a_{15} + 3a_{16} + 2a_{17}$ (mod 11)

$= 8 \bullet 1 + 7 \bullet 8 + 6 \bullet 4 + 5 \bullet 5 + 4 \bullet 1 + 3 \bullet 8 + 2 \bullet 5 + 10 \bullet 4 + 9 \bullet 6 + 8 \bullet 3 + 7 \bullet 1 + 6 \bullet 2 + 5 \bullet 3 + 4 \bullet 4 + 3 \bullet 5 + 2 \bullet 6$ (mod 11)

$= 8 + 56 + 24 + 25 + 4 + 24 + 10 + 40 + 54 + 24 + 7 + 12 + 15 + 16 + 15 + 12$ (mod 11)

$= 346$ (mod 11)

$= 5$

Full VIN: JHMEJ8545WC123456

Valid VIN: 1HGBB622XWA000001

Digit Assignment: 1HGBB622XWA000001 = 18722622X61000001

(Note: The check digit is X and is not converted)

Calculation:

$a_9 = 8a_1+7a_2+6a_3+5a_4+4a_5+3a_6+2a_7+10a_8+9a_{10}+8a_{11}+$
$7a_{12}+6a_{13}+5a_{14}+4a_{15}+3a_{16}+2a_{17}$ (mod 11)

$= 8\bullet 1+7\bullet 8+6\bullet 7+5\bullet 2+4\bullet 2+3\bullet 6+2\bullet 2+10\bullet 2+9\bullet 6+8\bullet 1+7\bullet 0+6\bullet 0+5\bullet 0+4\bullet$
$0+3\bullet 0+2\bullet 1$ (mod 11)

$= 8 + 56 + 42 + 10 + 8 + 18 + 4 + 20 + 54 + 8 + 0 + 0 + 0 + 0 + 0 + 2$ (mod 11)

$= 230$ (mod 11)$= 10$

Since the remainder is 10, which corresponds to the check digit X, this is a valid VIN.

Invalid VIN: 2HGRA8773WH101001

Digit Assignment: 2HGRA8773WH101001 = 28791877368101001

Calculation:

$a_9=8a_1+7a_2+6a_3+5a_4+4a_5+3a_6+2a_7+10a_8+9a_{10}+8a_{11}+7a_{12}+6a_{13}+5a_{14}+4a_{15}+3a_{16}+2a_{17}$ (mod 11)

$= 8\bullet 2+7\bullet 8+6\bullet 7+5\bullet 9+4\bullet 1+3\bullet 8+2\bullet 7+10\bullet 7+9\bullet 6+8\bullet 8+7\bullet 1+6\bullet 0+5\bullet 1+4\bullet$
$0+3\bullet 0+2\bullet 1$ (mod 11)

$= 16 + 56 + 42 + 45 + 4 + 24 + 14 + 70 + 54 + 64 + 7 + 0 + 5 + 0 + 0 + 2$ (mod 11)

$= 403$ (mod 11)

$= 7$

• Since the check digit calculation results in a 7, which is not equal to the check digit of 3, this VIN is invalid.

Create a C# program that will ask the user for the VIN # (including the *) and the Digital Assignment string . The output, via Messageboxes, should display the calculated check digit and then the newly created VIN number with the check digit replacing the *.