CS 2113 Midterm Exam, November 6, 2007

Problem 1 [20 pts]

When the following VBA program is executed, what will be displayed in the message box?

```
Option Explicit
Sub problem1()
Dim m As Integer, n As Integer
Dim message As String
m = 2
message = " m, n ="
Do
    For n = m - 1 To 0 Step -1
        message = message & Chr(13) & m & ", " & n
    Next n
    m = m + 1
Loop While m <= 3
MsgBox message
End Sub
```

Problem 2 [40 pts]

Supposed we know that a function f(x), of a single variable x, changes signs somewhere within the interval $[a, b]$. A root of the function f(x) within that interval can be found using the bisection method.

Bisection method begins with the initial interval $[a, b]$ and repeatedly halves its length until a solution has been isolated as accurately as desired. The accuracy is specified by a tolerance tol.

The algorithm for the bisection method expressed in pseudo-code is:

```
while ((b - a ) > tol) do
    m = a + (b - a)/2
    if sign(f(a)) = sign(f(m)) then
        a = m
    else
        b = m
    endif
endwhile
```

where sign is the sign function, which is given by Sgn in VBA. After the desired number of iteration is carried out, the resulting root is given by m, and the function value there is given by $f(m)$.

Write a main Sub procedure to use the bisection method to find a root of a function f(x) within an interval $[a, b]$. Write a Function procedure to evaluate the function f(x) for any given value of x. In this problem, the function f(x) is taken to be

$$f(x) = x^3 - 2x - 5$$

Your main Sub procedure of course will need to call this function many times. The values of a and b are to be input by the user using an InputBox, and you can let tol $= 0.00001$. Some of the program statements that you must use are already shown below. Insert statements in the spaces marked by the dots in order to complete the entire program.

```
Option Explicit
Sub bisection()
...
Const tol As Double = 0.00001
a = InputBox("Enter the left end-point of the interval:")
b = InputBox("Enter the right end-point of the interval:")
...
MsgBox "After " & iterationCount & " iterations," & Chr(13) _
```

```
        & "a root is found at " & midPoint & Chr(13) _
        & "The function value there is: " & fm
End Sub

Function f(x)
...
End Function
```

A typical output is shown below:

```
After 14 iterations,
a root is found at 2.09453
The function value there is: -8.9564E-05
```

Problem 3 [40 pts]

Write a VBA program to calculate the total amount of tuition plus university fees that a student has to pay each semester at a certain university. Any student taking 12 or more credits is considered a full-time student, otherwise the student is a part-time student.

A full-time student taking 12 to 20 credits (inclusively) pays a regular tuition of $14,000.00 per semester. A student taking more than 20 credits has to pay an extra $800.00 of tuition for each credit in excess of 20. A part-time student pays a tuition of $900.00 per credit.

A student, whether full-time or part-time, must also pay university fees. The total of these fees is given by a flat amount of $100 plus $30.00 for each credit taken.

Your program should ask the student to input the last name, and the gender: M for male and F for female.

The student should then be asked to enter the total number of credits he or she is taking.

The program then displays the total tuition, fees, and the total balance (equals to the sum of the total tuition and fees) in the form as shown in the following examples. Use a variable of type Double to represent any tuition or fees, since they may have fractional parts in general.

Example 1:

```
Enter your last name:
Soe

Enter your gender (M for male and F for female):
M

Enter the total number of credits you are taking:
8

Mr. Soe:
Your total tuition is: 7200
Your total fee is: 340
Your total balance is: 7540
```

Example 2:

```
Enter your last name:
Doe
```

```
Enter your gender (M for male and F for female):
F

Enter the total number of credits you are taking:
16

Ms. Doe:
Your total tuition is: 14000
Your total fee is: 580
Your total balance is: 14580
```

Example 3:

```
Enter your last name:
Hoe

Enter your gender (M for male and F for female):
F

Enter the total number of credits you are taking:
23

Ms. Hoe:
Your total tuition is: 16400
Your total fee is: 790
Your total balance is: 17190
```