

Student Name (last) \_\_\_\_\_

(first) \_\_\_\_\_

Student Number \_\_\_\_\_ Section C

**Question 1 (5 marks)**

The function  $f(x) = x^2 - 5x + 6$  has a root between 2.5 and 4. Illustrate your understanding of the bisection search technique by completing the table below.

$x_L$	$x_U$	$x_R$	$f(x_R)$	$E_{MAX}$
2.5	4			

After 10 iterations of a bisection search (i.e. after 10 values for  $x_R$  have been chosen,  $E_{MAX}$  is 0.01953. If the original lower bound ( $x_L$ ) was 10, what was the original upper bound ( $x_U$ )?

**Question 2 (5 marks)**

The function  $f(x) = \sin(x)\cos(x)$  has a maximum between 0 and 2 radians (**NOTE** - radians)  
One way of locating the maximum involves converting the problem into a root finding problem.  
Illustrate your understanding of this approach by giving all of the Matlab commands necessary to locate the maximum.

The maximum can also be located by using a Golden section search (note that the principle is as applicable to finding maximums as it is to finding minimums) Illustrate your understanding of this approach by filling in the empty spaces the table below.

$x_L$	$x_U$	$x_2$	$x_1$	$f(x_2)$	$f(x_1)$
0	2				
		XXXX	XXXX	XXXX	XXXX

If you had to give a "best guess" answer on the basis of your work, what would it be?

best guess = \_\_\_\_\_

What is the maximum possible difference between your best guess and the actual answer (i.e. what is  $E_{MAX}$  for your best guess)?

max possible error = \_\_\_\_\_

There is another way of using Matlab to locate the maximum (one that does not involve root finding). In the space below, give all of the necessary commands.

**Question 3 (5 marks)**

The function  $f(x) = x^2 - 5x - 6$  has two roots.

Demonstrate your understanding of the Newton-Raphson search process by completing the following table.

<b>k</b>	<b><math>x_{k-1}</math></b>	<b><math>x_k</math></b>	<b><math>y_k</math></b>	<b><math>E_A</math></b>
1	3			
2				
3				

Suppose that we would like to use a secant search instead and decide to start with  $x_0 = 1.0$  and  $x_1 = 4.0$ . Explain what will happen and suggest a means of overcoming the problem. Assume that we would like to find the larger of the two roots.

**Question 4 (5 marks)**

A rectangular swimming pool is surrounded by a walkway which is 1m wide. The pool's width is 8m less than its length. The depth of the concrete in the walkway is 1% of the length of the pool. The walkway contains  $13.6 \text{ m}^3$  of concrete. What are dimensions of the pool ( $L \times W$ ) and the depth  $D$  of the walkway?

In the space below, formulate the problem for solution (i.e. get it into a form where one of the numerical techniques taught in this course can be applied).

Give two values for  $L$ , the length of the pool that bracket the correct answer. Briefly justify your choice.

Give the all of the Matlab commands necessary to determine  $L$  and  $D$  and output a message of the form "The value of  $L$  is xxx m. and the value of  $D$  is xxx m".