key

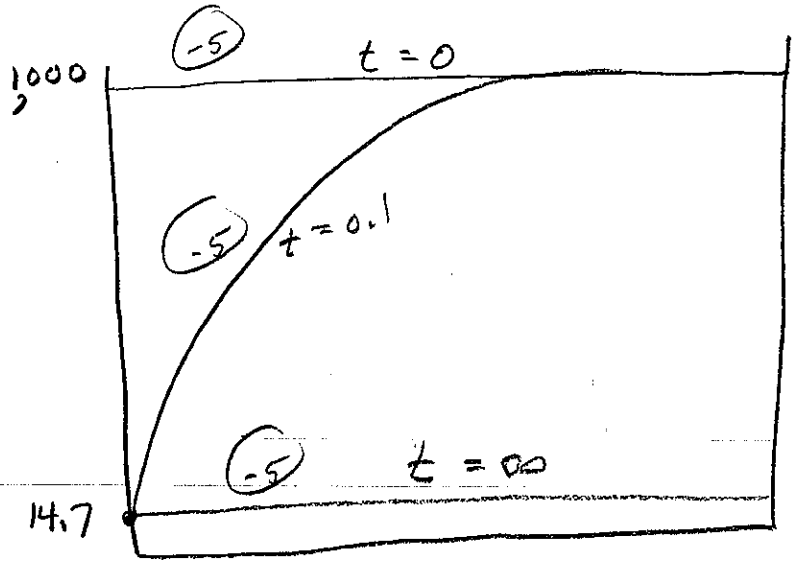
PETE 301

Exam C

November 24, 2003

(Turn in your 3 cheat sheets with your exam. Show your work. Don't forget the units, if appropriate.)

1. (15 points) Suppose we have a sand packed core container 10 ft long. We pressure it with air at 1,000 psia. Then we open a valve on the left end to the atmospheric pressure, 14.7 psia, while leaving the right end closed. Make a sketch of the pressure profiles at $t_o = 0$, $t_1 = 0.1$ second, and $t_{infinity}$ = a very long time.



2. (15 points) For a set of two linear equations we can represent the equations as a straight lines on a graph. We may find that the lines: (A) are parallel, (B) are coincident (same line), or (C) are non-parallel and intersect. For each of the following sets of equations, indicate (a) whether it is A, B, or C and (b) how may solutions it has.

	$3x + 2y = 8$ $6x + 5y = 17$	$3x + 2y = 8$ $6x + 4y = 17$	$3x + 2y = 8$ $6x + 4y = 16$
(a)	C	A	B
(b)	1	0	∞
	-5	-5	-5

3. (20 points) Consider the following matrix problem. Begin with initial values of $x_1 = x_2 = x_3 = 0$ and make the first iteration of the Gauss-Seidel method. Show all your steps and your answers for all three variables. Do only one iteration.

$$\begin{aligned} 2x_1 &+ 2x_2 - 3x_3 &&= 5 \\ 2x_1 &- 3x_2 + x_3 &&= 4 \\ -x_1 &+ x_2 - 2x_3 &&= -2 \end{aligned}$$

Eq. 1

$$2x_1 + 2(0) - 3(0) = 5$$

$$\boxed{x_1 = \frac{5}{2} = 2.5}$$

-7

Eq. 2

$$2\left(\frac{5}{2}\right) - 3x_2 + (0) = 4$$

$$-3x_2 = 4 - 5$$

$$\boxed{x_2 = \frac{1}{3}}$$

-7

Eq. 3

$$-\left(\frac{5}{2}\right) + \left(\frac{1}{3}\right) - 2x_3 = -2$$

$$-2x_3 = -2 + \frac{5}{2} - \frac{1}{3} = -\frac{12}{6} + \frac{15}{6} - \frac{2}{6} = \frac{1}{6}$$

$$\boxed{x_3 = -\frac{1}{12}}$$

-7

4. (15 points) Consider a problem with three variables: x_1, x_2, and x_3.

(a) Write a system of linear equations that has an infinite number of feasible solutions.

(b) Show the x values for one feasible solution for your system of equations.

[Note: each student will probably have a different answer to this problem].

$$\begin{cases} x_1 + x_2 + x_3 = 3 \\ 2x_1 + 2x_2 + 2x_3 = 6 \\ 3x_1 + 3x_2 + 3x_3 = 9 \end{cases}$$

-10

Solution $x_1 = x_2 = x_3 = 1$

-5

15

5. (~~20~~ points) Consider the finite difference equation for Problem 1 in the form:

$p_{i-1}^{n+1} - 2p_i^{n+1} + p_{i+1}^{n+1} = \alpha\,(p_i^{n+1} - p_i^n)$. Suppose we are using 5 grid points. Fill in the following table of the coefficients for a timestep. Include the proper boundary conditions. Use exact values where you can, but use the math symbols elsewhere.

-5

-5

-5

i	a_i	b_i	c_i
1	—	1	0
2	1	$-(2+\alpha)$	1
3	1	$-(2+\alpha)$	1
4	1	$-(2+\alpha)$	1
5	1	-1	—

6. (20 points) Write a complete VBA program to multiply a 4 x 2 matrix, A(4,2), by a 2 x 5 matrix, B(2,5), and calculate the result in matrix C. [C = AB]. Your VBA should read the data for A and B from sheet "Data" and put the output in sheet "Output".

```
option Explicit
sub multArray
Dim A(4, 2) as double, B(4, 5) as double, C(4,5) as double
Dim i, j, k as integer, S as double

with sheet("data")
For i = 1 To 4
   For j = 1 To 2
   A(i,j) = .cell(i,j)
   next j
next i

For i = 1 To 2
   For j = 1 To 5
   B(i,j) = .cells(i,j)
   next j
next i

For i = 1 To 4
   For j = 1 To 5
   S = 0
   For k = 1 To 2
   S = S + A(i,k) * B(k,j)
   next k
   C(i,j) = S
   next j
next i

For i = 1 To 4
   For j = 1 To 5
   .cells(i,j) = C(i,j)
next j
next i
end with
end sub
```

Read A (-3)

Read B (-3)

Calculate C(4,5) (-8)

write C (-3)