key

PETE 301

Exam A

September 29, 2003

(Turn in your 1 cheat sheet with your exam. Show your work. Don't forget the units, if appropriate.)

1. (15 points) Production rate for exponential decline is calculated by $q = q_o e^{at}$. Calculate the rate at t = 5 years if q_o is estimated to be 830 stb/d ± 13% and the decline exponent, a, is estimated to be 0.1 (fraction)/year ± 0.012 (fraction)/year. Indicate the relative error in %.

$$q = 830\, e^{-(0.1)(5)} = \boxed{503.4 \text{ stb/d}}$$

5

10

$$dq = \left|\frac{\partial q}{\partial q_0}\right| dq_0 + \left|\frac{\partial q}{\partial a}\right| da$$

$$= |e^{-at}|(830 \times 0.13) + |q_0(-t)e^{-at}|(0.012)$$

$$= |0.6065|(830 \times 0.13) + |503.4(-5)|(0.012)$$

$$= |65.44| + |30.2|$$

$$= 95.64 \text{ stb/d}$$

rel. error $= \dfrac{95.64}{503.4} \times 100 = \boxed{19.0\ \%}$

2. (15 points) Suppose an equation of state is written in following nonlinear "Z-factor form":

$$z^3 + 2.4\,z - 1.2 = 0$$

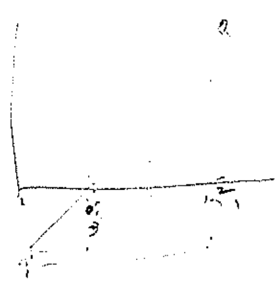
(a) calculate f(0), then (b) calculate f(1), then (c) calculate the next trial of z with the False Position method, then (d) calculate the next trial of z with the Binary Halving method. (Then stop. Do not continue the iteration process!)

-3 (a) $f(0) = \boxed{-1.2}$

-3 (b) $f(1) = 1 + 2.4 - 1.2 = \boxed{2.2}$

-4 (c) $x_3 = 1 - \dfrac{2.2}{(1.2 + 2.2)/1} = 1 - \dfrac{2.2}{3.4}$

$= \boxed{0.353}$

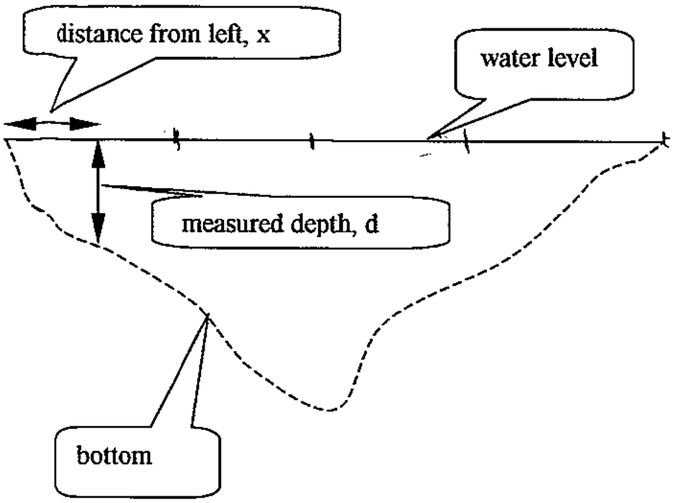


$f(x_3) = (0.353)^3 + 2.4(0.353) - 1.2$

$= -0.308$

-4 (d) $x_4 = \dfrac{(x_3 + x_2)}{2} = \dfrac{0.353 + 1}{2} = \boxed{0.676}$

3. (15 points) The depth of a 360 ft wide river is measured from a boat (see the sketch). The results are shown in the table. Calculate (a) the cross-sectional area of the river, and (b) the water flow down the river (in ft³/sec) if the water velocity is uniform at 0.8 ft/sec. (Note: Because of the equidistant measurements and correct number of panels, use repeated Simpson's rule.)



x, ft	d, ft
0	0.00
90	3.59
180	11.23
270	8.20
360	0.00

10 (a)

$$I = \frac{h}{3}\left(f_1 + 4f_2 + 2f_3 + 4f_4 + f_5\right)$$

$$h = 90$$

$$\text{Area} = \frac{90}{30}\left(0 + 4(3.59) + 2(11.23) + 4(8.20) + 0\right)$$

$$= 30\left[0 + 14.36 + 22.46 + 32.80 + 0\right)$$

$$= 30\left[69.62\right] = \boxed{2088.6\ ft^2}$$

5 (b) flow rate $= 2088.6\ ft^2 \times 0.8\ ft/sec$

$$= \boxed{1670.88\ ft^3/sec}$$

4. (10 points) What is the difference between a VBA program that uses "Option Explicit" and a VBA program does not use Option Explicit? Be complete but concise.

option Explicit: you need to declare all the variables on the program

No option Explicit: you don't have to declare all variables and all variables will be default (double)

5. (15 points) Using Taylor's series, derive a finite difference formula for $f'(x_i)$ using data at points x_{i-1} and x_{i+1}. Show the order and the first truncated term.

$$f_{i+1} = f_i + h f_i' + \frac{h^2}{2!} f_i'' + \frac{h^3}{3!} f_i''' + \cdots$$

$$f_{i-1} = f_i - h f_i' + \frac{h^2}{2!} f_i'' - \frac{h^3}{3!} f_i''' + \cdots$$

$$f_{i+1} - f_{i-1} = 0 + 2h f_i' + 0 + \frac{2h^3}{3!} f_i''' + \cdots$$

$$f_i' = \frac{f_{i+1} - f_{i-1}}{2h} - \frac{\cancel{2} h^{\cancel{3}\,2}}{\cancel{2h}\, 3!} f_i'''$$

$$- \frac{h^2}{3!} f'''$$

$$O(h^2)$$

6. (15 points) The following VBA code calculates the *sin (x)* by using function *call sine1*. Answer the following questions:-

1- In Sub VBA021, which variables are declared integer? Maxterms.
2- Read xdeg from cells (2,1) in sheets data.
3- Call the function sine1 in line 11.
4- Write the result of sine1(x) in cells(2,2) in sheet data.
5- Complete any missing statements noted by .... in the program and function.

```
Option Explicit
Const Pi As Double = 3.14159278
Dim K, MaxTerms As Integer
Dim Err, sine, term, Xdeg, x As Double
Sub VBA021()
MaxTerms = 10
Err = 0.000001
With ....sheets ("data")
Xdeg = ....cells (2, 1)

 x = Xdeg * Pi / 180
 x = ..........  sine1 (x)
..cells(2, 2) = x
End Sub                       end with

Function sine1(x As Double) As ..........
 term = x
 sine = term
  K = 1
 While ((Abs(term) > Err) And (K <= MaxTerms))
  term = -term * x * x / (2 * K * (2 * K + 1))
  K = K + 1
  sine = sine + term

 Wend
..sine1 = sine

End ..function
```

7. (15 points) Suppose you have the following data:

x	f(x)
2.3	3.6
2.4	3.9
2.5	4.2
2.6	4.7

x_{i-1}

x_i

x_{i+1}

Use three different Taylor's series approximations (forward, backward, and central) to estimate f ' (2.5). For each method (a) write the formula with proper notation, (b) calculate the value, and (c) state the order of accuracy. Clearly identify each method.

5 forward,

$$f'(2.5) = \frac{4.7 - 4.2}{0.1} \qquad \frac{x_{i+1} - x_i}{h} \qquad O(h)$$

$$= 5.0$$

5 backward

$$f'(2.5) = \frac{4.2 - 3.9}{0.1} \qquad O(h)$$

$$= 3.0$$

5 central

$$f'(2.5) = \frac{4.7 - 3.9}{0.2} \qquad O(h^2)$$

$$= 4.0$$

	max score	score	
1	15	—	RAW
2	15	—	RAW
3	15	—	RTB
4	10	—	MHI
5	15	—	RAW
6	15	—	MHI
7	15	—	RTB
sum	100		