



Prince of Songkla University
Faculty of Engineering

Midterm Test
16 December 2012
215-274 Numerical Methods for Mechanical Engineering

Semester 2/2012
09:00-12:00
Room: S817, A205

Name _____ ID _____

Direction:

1. All types of calculator, and dictionary are permitted.
2. There are totally 5 problems.
3. One sheet of hand-written A4 paper is allowed. No photocopy!!

Perapong Tekasakul
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Instructors

Problem No.	Full score	Your mark
1	10	
2	10	
3	10	
4	10	
5	10	
Total	50	

1. You are designing a spherical tank to hold water for a small village in a developing country. The volume of liquid it can hold can be computed as

$$V = \frac{\pi h^2}{3} [3R - h]$$

Where V = volume (m^3), h = depth of water in tank (m), and R = the tank radius (m). If $R = 3$ m, what depth must the tank be filled so that it holds $30 m^3$? Use the Newton-Raphson method to determine your answer. Perform iteration until the approximate relative error falls below 0.1%. (10 point)

2. Give the system of equations (10 point)

$$-3x_2 + 7x_3 = 2$$

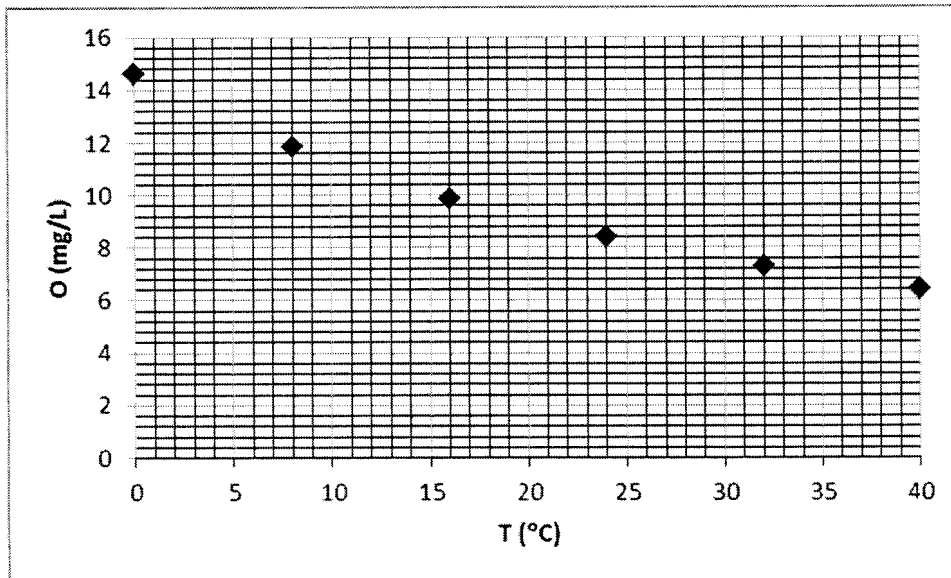
$$x_1 + 2x_2 - x_3 = 3$$

$$5x_1 - 2x_2 = 2$$

- (a) Use Gauss elimination with partial pivoting to solve for the x 's
- (b) Substitute your results back into the original equations to check your solution

3. The following data defines the sea-level concentration of dissolved oxygen for fresh water as a function of temperature: (10 point)

T°C	0	8	16	24	32	40
O, mg/L	14.621	11.843	9.870	8.418	7.305	6.413



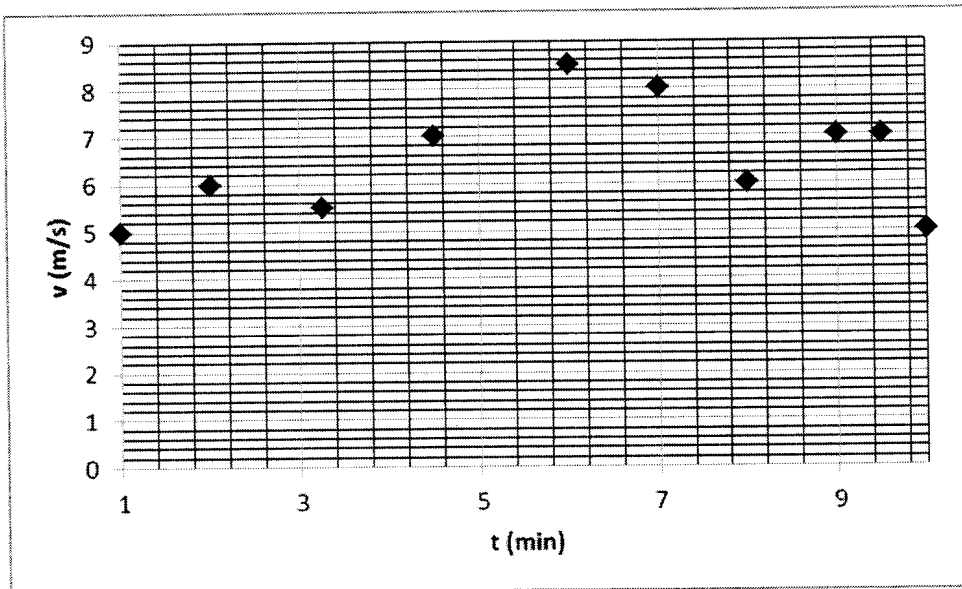
Oxygen at $27^\circ c$ using

- (a) Linear interpolation
- (b) Newton's interpolating polynomial of order 2
- (c) Cubic splines

Note that the exact result is 7.986 mg/L.

4. Determine the distance traveled for the following data: (10 point)

t, min	1	2	3.25	4.5	6	7	8	9	9.5	10
v, m/s	5	6	5.5	7	8.5	8	6	7	7	5



- (a) Use the trapezoidal rule
- (b) Use the best combination of the trapezoidal and Simpson's 1/3 rule
- (c) Analytically integrate second order polynomial determined by regression

5. Use Richardson extrapolation to estimate the first derivative of $y = \cos x$ at $x = \pi / 4$ using step size of $h_1 = \pi / 3$ and $h_2 = \pi / 6$. Employ centered differences of $O(h^2)$ for the initial estimates. (10 point)