

## CIVE 1331 Computing for Engineers

Purpose: MatLab and FORTRAN Practice Examination

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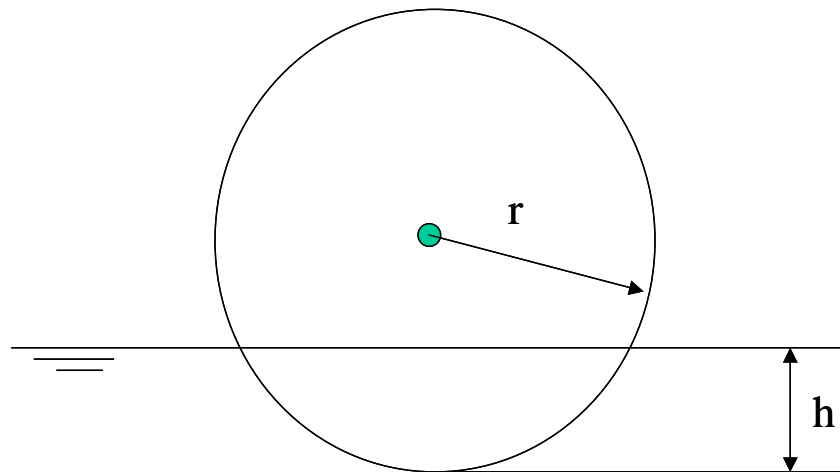
**Problem –1 FORTRAN**

Use your FORTRAN root finding program to determine the depth a sphere of specific weight 0.6 (specific weight of water is 1) sinks into water as a function of its radius. The

weight of the sphere as a function of its radius is  $weight = \gamma \frac{4}{3} \pi r^3$  where the specific

weight is denoted by gamma. The volume of a spherical segment (see figure) is

$$volume = \frac{1}{3} \pi (3rh^2 - h^3)$$



**Figure 1. Bouyant Sphere in Water**

The force balance is that the weight of water displaced is equal to the weight of the floating object. To compute the forces, multiply the specific weight of water and the volume displaced and set this value equal to the weight of the sphere, then solve for h.

In your program, you want to rewrite your function as

$$f(h) = \gamma \frac{4}{3} \pi r^3 - \frac{1}{3} \pi (3rh^2 - h^3)$$

and solve for  $f(h) = 0$ , using a realistic initial guess. Verify your numerical result using the MatLab symbolic solver on the actual equation, then substitute the numerical values and see how they compare with your FORTRAN result.

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**Problem –2 Linear Systems (use MatLab)**

Use the linear algebra method and the polyval() function to analyze the following experimental results of fuel mileage versus vehicle weight.

Weight (lbs)	Mileage (mpg)	Weight (lbs)	Mileage (mpg)
2775	33	3325	20
2495	27	3200	21
2405	29	3450	19
2545	28	3515	21
2270	34	3495	19
2560	24	4010	19
3050	23	4205	17
3710	24	2900	24
3085	23	2555	28
2940	21	2790	21
2395	26	2190	34

From these data determine the linear equation that relates fuel mileage to vehicle weight.

Based on your analysis how well are the data represented by a straight line?

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**Problem 3 Integration (MatLab)**

Fugacity is a term used in engineering to describe the available work from an isothermal process. For an ideal gas, the fugacity  $f$  is equal to its pressure  $P$ , but for real gasses

$$\ln\left(\frac{f}{P}\right) = \int_0^P \frac{C-1}{P} dP$$

Where  $C$  is the experimentally determined compressibility factor. For methane, values of  $C$  are tabulated as

P(atm)	C
1	0.9940
10	0.9370
20	0.8683
40	0.7043
60	0.4515
80	0.3429
120	0.4259
160	0.5252
250	0.7468
400	1.0980

Develop a script that calculates  $f$  given the tabulation for all values of  $P$  between 1 and 400 atmospheres in 2 atm increments. Plot your result of  $f$  versus pressure. Assume that the value  $C$  varies linearly between the tabulated values.

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**Problem 4 Ordinary Differential Equations – Use MatLab**

Use the Euler method to solve for y at x=0.1 from

$$\frac{dy}{dx} = x + y + xy$$

With the initial condition that y=1.0 at x=0.0. Use a stepsize of  $\Delta x = 0.01$  and again using 0.001. Compare the results.