Problem Set 7

Use Matlab to calculate the answers to the following:

Problem 1

The radius, r, of a sphere can be calculated from its surface area, s, by:

$$r = \frac{\sqrt{s/\pi}}{2}$$

The volume, V, is given by:

$$V = \frac{4\pi r^3}{3}$$

Determine the volume of spheres with surface area of 50, 100, 150, 200, 250, and 300 ft^2. Display the results in a two-column table where the values of s and V are displayed in the first and second columns, respectively.

Problem 2

The electric field intensity, $E(z)$, due to a ring of radius R at any point z along the axis of the ring is given by:

$$E(z) = \frac{\lambda}{2\epsilon_0} \frac{Rz}{(z^2 + R^2)^{3/2}}$$

where λ is the charge density, $e_0 = 8.85x10^{-12}$ is the electric constant, and R is the radius of the ring. Consider the case where $\lambda = 1.7 \times 10^{-7} C/m$ and $R = 6\,cm$.
(a) Determine E(z) at z = 0, 2, 4, 6, 8, and 10 cm.
(b) Determine the distance z where E is maximum. Do it by creating a vector z with elements ranging from 2 cm to 6 cm and spacing of 0.01 cm. Calculate E for each value of z and then find the maximum E and associated z with MATLAB's built-in function *max*

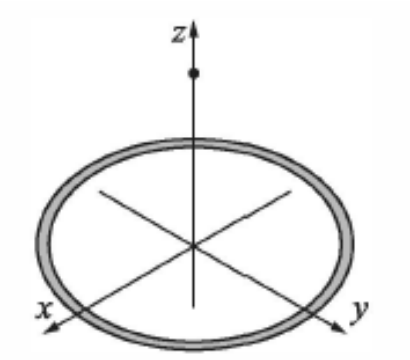

Figure 1: Problem 2 Diagram

Problem 3

The following two vectors are defmed in MATLAB:

$$v = [15, 8, -6] \quad u = [3, -2, 6]$$

By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB.
(a) $v./u$
(b) $u' * v$
(c) $u * v'$

Problem 4

Two vectors are given:

$$u = 5\mathbf{i} - 6\mathbf{j} + 9\mathbf{k} \,\text{and}\, v = 11\mathbf{i} + 7\mathbf{j} - 4\mathbf{k}$$

Use MATLAB to calculate the dot product u · v of the vectors in three ways:
(a) Write an expression using element-by-element calculation and the MATLAB built-in function *sum*.
(b) Define **u** as a row vector and **v** as a column vector, and then use matrix multiplication.
(c) Use the MATLAB built-in function *dot*.

Problem 5

Define r and s as scalars $r = 1.6x10^3$ and $s = 14.2$, and, t, x, and y as vectors $t = [1, 2, 3, 4, 5]$,$x = [0, 2, 4, 6, 8]$, and$y = [3, 6, 9, 12, 15]$. Then use these variables to calculate the following expressions using element-by-element calculations for the vectors.

(a) $G = xt + \frac{r}{s^2}(y^2 - x)t$
(b) $R = \frac{r(-xt+yt^2)}{15} - s^2(y - 0.5x^2)t$

Problem 6

Create the following three matrices:

$$A = \begin{bmatrix} 1 & -3 & 5 \\ 2 & 2 & 4 \\ -2 & 0 & 6 \end{bmatrix} \quad B = \begin{bmatrix} 0 & -2 & 1 \\ 5 & 1 & -6 \\ 2 & 7 & -1 \end{bmatrix} \quad C = \begin{bmatrix} -3 & 4 & -1 \\ 0 & 8 & 2 \\ -3 & 5 & 3 \end{bmatrix}$$

(a) Calculate A+ B and B +A to show that addition of matrices is commutative.
(b) Calculate A+ (B +C) and (A+ B)+ C to show that addition of matrices is associative.
(c) Calculate 3(A +C) and 3A + 5C to show that, when matrices are multiplied by a scalar, the multiplication is distributive.
(d) Calculate A*(B+C) and A*B+A*C to show that matrix multiplication is distributive

Problem 7

Solve the following system of three linear equations:
$-4x + 3y + z = -18.2$
$5x + 6y - 2z = -48.8$
$2x - 5y + 4.5z = 92.5$