Assignment 5 ENGR 220

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Problem 1

The surface to volume ratio of the earth is 7.5753 x 10-4 miles-1. Determine an approximate diameter for the earth.

```
clc;     % Clear command window
clear;  % Clear workspace

% Calculate the surface to volume ration conversion factor
surfToVol = 7.5753e-4;  % mile^-1

%Calculate the diameter of the earth
earthDiameter = 6/surfToVol;    % miles

fprintf("\nThe approximate diameter of the earth if: %4.0f miles\n",
 earthDiameter);
```

```
The approximate diameter of the earth if: 7920 miles
```

Problem 2

The length L of a belt that traverses two pulley wheels, one of radius R and one of radius r and whose centers are distance S apart is given by

$$L = 2Scos(\theta) + \pi(R + r) + 2\theta(R - r); Wherea\theta = sin^{-1}((R - r)/S)$$

Determine L when R = 30 cm, r =12 cm, and S =50 cm. (Remember: MATLAB likes angles in radians).

```
clear;  % Clear workspace

R = 30;
r = 12;
S = 50;
theta = asin((R-r)/S);

beltLength = (2 * S * cos(theta)) + (pi * (R + r)) + (2 * theta * (R - r));
fprintf("\nThe length of the belt is: %3.1f cm\n", beltLength);
```

The length of the belt is: 238.5 cm

Problem 3

A geometric series is defined as

$$sequence = x^0, x^1, x^2, x^3 ...$$

in which the powers of x range over the integers from 0 to infinity. The sum of the terms in a geometric series converges to the limiting value of

$$1/(1-x)\ if\ |x| < 1$$

otherwise the sum diverges.

Problem 3.a

For x = 0.63, compute the sum of the first 11 terms in the series, and compare the result with the limiting value. Repeat for 51 and 101 terms. Do this by generating a vector of integers to use as the exponent of x; then use the sum function.

```
problem3a = 0.63;

limitingValuea = LimitingValue(problem3a);

geo11a = GeometricSeries(problem3a,11);
geo11aSum = sum(geo11a);

geo51a = GeometricSeries(problem3a,51);
geo51aSum = sum(geo51a);

geo101a = GeometricSeries(problem3a,101);
geo101aSum = sum(geo101a);

fprintf("\nWith a x value of %1.2f yields a limiting value of %1.4f and ending
 the series at 11, 51, and 101 yields %1.4f, %1.4f, and %1.4f respectively.
\n", problem3a, limitingValuea, geo11aSum, geo51aSum, geo101aSum);
fprintf("Comparing the limiting value to the calculated values, there is no
 change after the value of 51 for the first 4 significant figures.\n")
```

Problem 3.b

Repeat part (a) using x = -0.63.

```
problem3b = -0.63;

limitingValueb = LimitingValue(problem3b);

geo11b = GeometricSeries(problem3b,11);
geo11bSum = sum(geo11b);

geo51b = GeometricSeries(problem3b,51);
```

```
geo51bSum = sum(geo51b);

geo101b = GeometricSeries(problem3b,101);
geo101bSum = sum(geo101b);

fprintf("\nWith a x value of %1.2f yields a limiting value of %1.4f and ending
 the series at 11, 51, and 101 yields %1.4f, %1.4f, and %1.4f respectively.
\n", problem3b, limitingValueb, geo11bSum, geo51bSum, geo101bSum);
fprintf("Comparing the limiting value to the calculated values, there is no
 change after the value of 51 for the first 4 significant figures.\n")
```

Problem 4

A water tank consists of a cylindrical part of radius r and height h, and a hemispherical top. The tank is to be constructed to hold 500 m^3 of fluid when filled. The surface area of the cylindrical part is $2\pi rh$ (cylindrical part) + πr^2 (flat bottom), and its volume is $\pi r^2 h$. The surface area of the hemispherical top is given by $2\pi r^2$, and its volume is given by $\frac{2\pi r^3}{3}$. The cost to construct the cylindrical part of the tank is $300.00/m^2 surface area; the hemispherical part costs $400.00/m^2. Plot the cost versus r for the interval 2 m < r < 10 m, and determine the radius that results in the least cost. Compute the corresponding height, h.

```
function geoVector = GeometricSeries(xValue, upperLimit)
%GeometricSeries - A geometric series is defined as x^0, x^1, x^2, x^3...
%
    geoVector = zeros (1,upperLimit);   % Create a properly sized array to
 improve performance
    for i = 1:upperLimit    % Iterate through array building geometric
 sequence
        geoVector(i) = xValue^(i-1);
    end
end

function limitValue = LimitingValue(xValue)
%LimitingValue - A limiting value defined as 1 / (1 - x) if |x| < 1
%
    limitValue = 1 / (1 - xValue);
end
```

```
With a x value of 0.63 yields a limiting value of 2.7027 and ending the series
 at 11, 51, and 101 yields 2.6859, 2.7027, and 2.7027 respectively.
Comparing the limiting value to the calculated values, there is no change
 after the value of 51 for the first 4 significant figures.
```

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