Homework Set 1

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Problem 1

- A sphere has a radius of 15 cm.
  - Find the length of the sides of a cube that has the same surface area as the sphere.
  - Find the length of the sides of a cube that has the same volume as the sphere.
Problem 2

- The magnitude $M$ of an earthquake on the Richter scale is given by
  
  $$M = \frac{2}{3} \log_{10} \left( \frac{E}{E_0} \right)$$

- Where $E$ is the energy released and $E_0 = 10^{4.4}$ Joules

- Determine the ratios of the energies released for earthquakes of 6.9 and 7.1 on the Richter scale
Problem 3

- The power series for \( \sin(x) \) is given by

\[
\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots
\]

- The script on the next slide will compute this power series for a given value of \( x \).
- What causes the loop to terminate?
- How accurate is the series for \( x = \pi/2 \)? How many terms were needed?
function s=powersin(x)
    s=0;
    t=x;
    n=1;
    while s+t~=s
        s=s+t;
        t=-x.^2/((n+1)*(n+2)).*t;
        n=n+2;
    end
Problem 4

- A ball is dropped from a height \( h \) of 2 meters.
- The velocity when it strikes the floor is given by \( v^2 = 2gh \) and rebounds with a velocity that is 85% of the impact velocity.
- The ball then rebounds to a height of \( h = \frac{v^2}{2g} \)
- What is the height after the 8th bounce?
Problem 5

- The ideal gas law is given by
  \[ P = \frac{nRT}{V} \]

- The van der Waals equation corrects for high pressure effects and is given by
  \[ P = \frac{nRT}{V - nb} - \frac{n^2a}{V^2} \]

- Plot pressure vs. volume for \( n=1 \), \( T=300 \) K, \( R=0.08206 \) L-atm/mol-K, \( a=1.39 \) L^2-atm/mol^2, and \( b=0.0391 \) L/mol. Use \( 0.08<V<6 \) liters