1. A particle moves along a vertical line, so that its coordinate at time \( t \) is 
\[ s(t) = t^3 - 75t + 1, \] 
where \( t \) is in seconds and \( s \) is in cm.
   a. At what value(s) of \( t \) is \( s'(t) = 0 \)? Where is the particle then?

   b. On what intervals of \( t \) is \( s'(t) \) positive? 
      What does this mean in terms of the direction in which the particle is going?

   c. Find the location and velocity of the particle at time \( t = 0 \). In which direction is the particle moving?

2. The half-life of Actinium-225 is 10.0 days.
   a. Find the function \( A(t) \) for the amount of Ac-225 as a function of time. 
      Round \( k \) to 3 significant digits.

   b. If a sample originally had 40 g of Ac-225, determine how much it will have in 14 days. 
      Give your answer to the nearest .01.

   c. Use derivatives to determine the decay rate in 14 days. 
      Give your answer to the nearest .01

3. A bacteria culture originally contains 200 cells and is growing exponentially.
   a. Find the function \( P(t) \) for the population of the culture as a function of time, if after half an hour, the 
      population is 360 cells. Round \( k \) to 3 significant digits.

   b. Find the number of bacteria after 4 hours. Round to the nearest whole number.

   c. Find the growth rate after 4 hours. Round to the nearest .1.

4. Water is being poured into a tank in the shape of an inverted cone at a rate of 25 ft\(^3\)/min. 
The radius of the tank is 30 ft, and the height of the tank is 80 ft. How fast is the water level rising when 
the water level is 20 ft? Round to the nearest .001.

5. A granite sphere will be used to make a world globe sculpture for the UN Plaza Hotel in New York. If the 
diameter is measured to be 6 feet, measured to the nearest 1/24 ft, find the following:
   a. The estimated volume of the globe, in terms of \( \pi \). Give an exact answer.

   b. The maximum error of the volume, in terms of \( \pi \). Give an exact answer.

   c. The relative error of the estimate, as a fraction.

   d. The exact percent error of the estimate.