

Quiz Date: October 2, 2018

Instructions: The following exercises are similar to those found in the course text book. This homework is not due for a grade, but you should know how to do all of the problems and be able to show your work for each. You can expect at least one of these problems to appear on an in-class quiz on the date listed above.

6.6 - Improper Integrals

1. The *average speed* of molecules in an ideal gas is

$$\bar{v} = \frac{4}{\sqrt{\pi}} \left(\frac{M}{2RT} \right)^{3/2} \int_0^{\infty} v^3 e^{-Mv^2/(2RT)} dv$$

where M is the molecular weight of the gas, R is the gas constant, T is the gas temperature, and v is the molecular speed. Show that

$$\bar{v} = \sqrt{\frac{8RT}{\pi M}}.$$

2. A radioactive substance decays exponentially: the mass at time t is $m(t) = m(0)e^{kt}$ where $m(0)$ is the initial mass and k is a negative constant. The *mean life* M of an atom in the substance is

$$M = -k \int_0^{\infty} te^{kt} dt$$

For the radioactive carbon isotope ^{14}C , used in radio-carbon dating, the value of k is -0.000121 . Find the mean life of a ^{14}C atom.

7.1 - Area Between Curves

3. The widths (in meters) of a kidney-shaped swimming pool were measured at 2-meter intervals as indicated in Figure 1. Use Simpson's Rule to estimate the area of the pool.

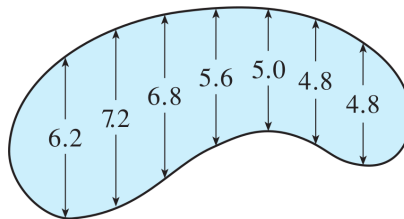


Figure 1: Kidney-shaped pool.

4. The chief financial officer of a company reports that profits for the past fiscal year were \$893,000. The officer predicts that profits for the next 5 years will grow at a continuous annual rate somewhere between 3.5% and 5%. Estimate the cumulative difference in total profit over the 5 years based on the predicted range of growth rates.

7.2 - Volumes

5. A CAT scan produces equally spaced cross-sectional views of a human organ that provide information about the organ otherwise obtained only by surgery. Suppose that CAT scan of a human liver shows cross-sections spaced 1.5 cm apart. The liver is 15 cm long and the cross sectional areas, in square centimeters, are 0, 18, 58, 79, 94, 106, 117, 128, 63, 39, and 0. Use the Midpoint Rule to estimate the volume of the liver.
6. Find the volume of a frustum of a right circular cone with height h , lower base radius R , and top radius r (see Figure 2).

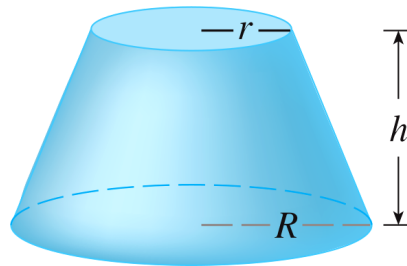


Figure 2: Frustum of a right circular cone.