

Quiz Date: September 06, 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 exercises 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.

6.2 - Trigonometric Integrals and Substitution

1. A particle moves on a straight line with velocity function $v(t) = \sin(\omega t) \cos^2(\omega t)$. Find the position function $s(t)$ assuming that $s(0) = 0$.
2. Household electricity is supplied in the form of alternating current that varies from 155 V to -155 V with a frequency of 60 Hz. The voltage is thus given by the equation

$$E(t) = 155 \sin(120\pi t)$$

where t is the time in seconds. Voltmeters read the RMS (root-mean-square) voltage, which is the square root of the average value of $[E(t)]^2$ over one cycle.

- a. Calculate the RMS voltage of household current.
 - b. Many electric stoves require an RMS voltage of 220 V. Find the corresponding amplitude A needed for the voltage $E(t) = A \sin(120\pi t)$.
3. A charged rod of length L produces an electric field at point $P(a, b)$ given by

$$E(P) = \int_{-a}^{L-a} \frac{\lambda b}{4\pi\epsilon_0(x^2 + b^2)^{3/2}} dx$$

where λ is the charge density per unit length on the rod and ϵ_0 is the free space permittivity. Evaluate the integral to determine an expression for the electric field $E(P)$.

4. The surface of a machine part is the region between the graphs of $y = |x|$ and $x^2 + (y - k)^2 = 25$ (see Figure 1).
 - a. Find k if the circle is tangent to the graph of $y = |x|$.
 - b. Find the area of the surface of the machine part.
 - c. Find the area of the surface of the machine part as a function of the radius r of the circle.

6.3 - Partial Fractions

5. One method of slowing the growth of an insect population without using pesticides is to introduce into the population a number of sterile males that mate with fertile females but produce no offspring. If P represents the number of female insects in a population, S the number of sterile males introduced each generation, and r the population's natural growth rate, then the female population is related to time t by

$$t = \int \frac{P + S}{P[(r - 1)P - S]} dP.$$

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Suppose an insect population with 10,000 females grows at a rate of $r = 0.10$ and 900 sterile males are added. Evaluate the integral to give an equation relating the female population to time. (Note that the resulting equation can't be solved explicitly for P .)

6. The predicted cost C (in hundreds of thousands of dollars) for a company to remove $p\%$ of a chemical from its waste water is shown in the table.

p	0	10	20	30	40	50	60	70	80	90
C	0	0.7	1.0	1.3	1.7	2.0	2.7	3.6	5.5	11.2

A model for this data is given by

$$C = \frac{124p}{(10+p)(100-p)}, \quad 0 \leq p < 100.$$

Use the model to find the average cost for removing between 75% and 80% of the chemical.

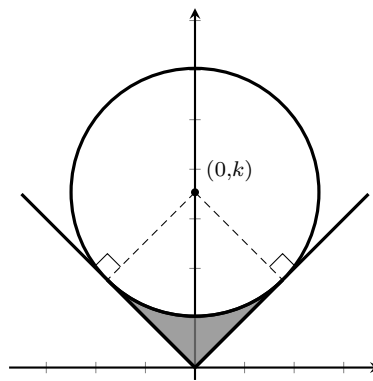


Figure 1: Machined part