1. A study shows that consumers in one city will buy q hundred bottles of a new perfume when the price is $p = 30 - 8q + \sin\left(\frac{\pi q}{3}\right)$ dollars per bottle. Find the consumer's surplus for this product when 220 units are demanded and produced.

2. When placed in a container of water, sugar dissolves at a rate proportional to the amount $Q(t)$ of undissolved sugar remaining in the container at that time. If one-quarter of the sugar has dissolved after 2 minutes, approximately how long does it take for half of the sugar to dissolve?

3. A manufacturer has found that marginal cost is $(2q+1)e^{-0.02q}$ dollars per unit when q units have been produced. The total cost of producing the first 10 units is $100. What is the total cost of producing the first 30 units?

4. It is projected that t years from now the population of a city will be changing at the rate of $t^2 e^{0.01t}$ thousand people per year. If the current population is 1 million, what will the population be 4 years from now?

5. The weekly output for a manufacturer is $Q(x,\ y) = 12x + 50y - 2x^2 + y^2$ units. Use marginal analysis to estimate the change in weekly output as a result of changing x from 20 to 21 while y remains constant at 10.