

4-4. The diameter of a particle of contamination (in micrometers) is modeled with the probability density function  $f(x) = 2/x^3$  for  $x > 1$ . Determine the following:

- (a)  $P(X < 2)$                       (b)  $P(X > 5)$   
 (c)  $P(4 < X < 8)$                 (d)  $P(X < 4 \text{ or } X > 8)$   
 (e) Determine  $x$  such that  $P(X < x) = 0.95$ .

4-26.

Determine the probability density function for each of the following cumulative distribution functions.

$$F(x) = \begin{cases} 0 & x < -2 \\ 0.25x + 0.5 & -2 \leq x < 1 \\ 0.5x + 0.25 & 1 \leq x < 1.5 \\ 1 & 1.5 \leq x \end{cases}$$

4-46. The volume of a shampoo filled into a container is uniformly distributed between 374 and 380 milliliters.

- (a) What are the mean and standard deviation of the volume of shampoo?  
 (b) What is the probability that the container is filled with less than the advertised target of 375 milliliters?  
 (c) What is the volume of shampoo that is exceeded by 95% of the containers?  
 (d) Every milliliter of shampoo costs the producer \$0.002. Any more shampoo in the container than 375 milliliters is an extra cost to the producer. What is the mean extra cost?

4-50. Use Appendix Table III to determine the following probabilities for the standard normal random variable  $Z$ :

- (a)  $P(-1 < Z < 1)$     (b)  $P(-2 < Z < 2)$   
 (c)  $P(-3 < Z < 3)$     (d)  $P(Z > 3)$   
 (e)  $P(0 < Z < 1)$

4-54. Assume  $X$  is normally distributed with a mean of 10 and a standard deviation of 2. Determine the value for  $x$  that solves each of the following:

- (a)  $P(X > x) = 0.5$   
 (b)  $P(X > x) = 0.95$   
 (c)  $P(x < X < 10) = 0.2$   
 (d)  $P(-x < X - 10 < x) = 0.95$   
 (e)  $P(-x < X - 10 < x) = 0.99$

4-58. The time until recharge for a battery in a laptop computer under common conditions is normally distributed with a mean of 260 minutes and a standard deviation of 50 minutes.

- (a) What is the probability that a battery lasts more than four hours?
- (b) What are the quartiles (the 25% and 75% values) of battery life?
- (c) What value of life in minutes is exceeded with 95% probability?

4-68. The demand for water use in Phoenix in 2003 hit a high of about 442 million gallons per day on June 27, 2003 (<http://phoenix.gov/WATER/wtrfacts.html>). Water use in the summer is normally distributed with a mean of 310 million gallons per day and a standard deviation of 45 million gallons per day. City reservoirs have a combined storage capacity of nearly 350 million gallons.

- (a) What is the probability that a day requires more water than is stored in city reservoirs?
- (b) What reservoir capacity is needed so that the probability that it is exceeded is 1%?
- (c) What amount of water use is exceeded with 95% probability?
- (d) Water is provided to approximately 1.4 million people. What is the mean daily consumption per person at which the probability that the demand exceeds the current reservoir capacity is 1%? Assume that the standard deviation of demand remains the same.

4-98. The time between the arrival of electronic messages at your computer is exponentially distributed with a mean of two hours.

- (a) What is the probability that you do not receive a message during a two-hour period?
- (b) If you have not had a message in the last four hours, what is the probability that you do not receive a message in the next two hours?
- (c) What is the expected time between your fifth and sixth messages?