1. The family of orthogonal trajectories of the family $y^4 = Cx^2 + 3$ is:
   (a) $2x^2 + y^2 - 2y^{-3} = C$
   (b) $2x^2 + y^2 + 3y^{-2} = C$
   (c) $x^2 + 2y^2 - 3y^{-2} = C$
   (d) $\frac{1}{2}x^2 + y^2 + 3y^{-2} = C$
   (e) None of the above.

2. The family of orthogonal trajectories for the family of parabolas with axis parallel to the x-axis and vertex at the point $(2, -1)$ is:
   (a) $2(x + 2)^2 + (y - 1)^2 = C$
   (b) $4(x - 2)^2 + (y + 1) = C$
   (c) $2(x - 2)^2 - (y + 1)^2 = C$
   (d) $2(x - 2)^2 + (y + 1)^2 = C$
   (e) None of the above.

3. If \$1000 is deposited in a bank that pays 5.5% interest compounded continuously, then the amount in the account at the end of 10 years is:
   (a) \$1803.82
   (b) \$1733.25
   (c) \$1685.42
   (d) \$1758.72
   (e) None of the above.

4. A laboratory has 75 grams of a certain radioactive material. Two months ago, it had 100 grams. How much will the laboratory have 4 months from now?
   (a) 39.57 grams
   (b) 51.11 grams
   (c) 42.19 grams
   (d) 46.43 grams
   (e) None of the above.

5. A biologist observed that the population of her bacteria culture obeyed the population growth law. There were 300 bacteria initially and the population increased by 20% after 2 hours. Determine the number of bacteria (rounded off to the nearest bacterium) after 24 hours
   (a) 2675
   (b) 2486
   (c) 2917
   (d) 2249
   (e) None of the above.

6. What is the half-life of a radioactive material if it takes 5 minutes months for 1/4 of the material to decay?

   (a) 2.50 minutes
   (b) 9.47 minutes
   (c) 14.47 minutes
   (d) 12.05 minutes
   (e) None of the above.

7. At 12 noon the count in a bacteria culture was 400; at 3:00 pm the count was 1200. Let $P(t)$ denote the bacteria count at time t and assume that the culture obeys the population growth law. What was the bacteria count at 8 am, rounded off to the nearest bacterium?

   (a) 92
   (b) 114
   (c) 99
   (d) 77
   (e) None of the above.

8. A thermometer is taken from a room where the temperature is $72^o\,F$ to the outside where the temperature is $32^o\,F$. After 2 minutes, the thermometer reads $48^o\,F$. How many minutes does the thermometer have to be outside for it to read $36^o\,F$?

   (a) 6.29 min
   (b) 5.02 min
   (c) 5.62 min
   (d) 4.73 min
   (e) None of the above.

9. A 100-gallon barrel, initially full of oil, develops a leak at the bottom. Let $A(t)$ be the amount of oil in the barrel at time t. Suppose that the oil is leaking out at a rate proportional to the product of the time elapsed and the square root of amount of oil present in the barrel. The mathematical model is

   (a) $\dfrac{dA}{dt} = k\sqrt{A},\ A(0) = 100$
   (b) $\dfrac{dA}{dt} = ktA^2,\ A(0) = 50$
   (c) $\dfrac{dA}{dt} = kt\sqrt{A},\ A(0) = 100$
   (d) $\dfrac{dA}{dt} = k\sqrt{tA},\ A(0) = 100$
   (e) None of the above.

10. Using the information in Problem 9, suppose that 36 gallons of oil leak out in the first 2 hours. At what time t will the barrel be empty?

   (a) 4.47 hours
   (b) 6.27 hours
   (c) 5.33 hours
   (d) 3.91 hours
   (e) None of the above.

11. A disease is spreading through a journey of 100 giraffes. Let $G(t)$ be the number of sick giraffes t days after the outbreak. The disease is spreading at a rate proportional to the number of giraffes that do not have the disease. Suppose that 5 giraffes had the disease initially. The mathematical model is:

   (a) $\frac{dG}{dt} = ktG, \quad G(0) = 5$
   (b) $\frac{dG}{dt} = kG(100 - G), \quad G(0) = 5$
   (c) $\frac{dG}{dt} = kt(100 - G), \quad G(0) = 5$
   (d) $\frac{dG}{dt} = k(100 - G), \quad G(0) = 5$
   (e) None of the above.

12. Using the information in Problem 11, suppose that 20 giraffes have the disease after 6 days. Then the number of healthy giraffes (rounded off to the nearest giraffe) after 18 days is

   (a) 47
   (b) 65
   (c) 57
   (d) 51
   (e) None of the above.

13. A disease is spreading through a parade of 100 elephants. Let $E(t)$ be the number of sick elephants t days after the outbreak. The disease is spreading at a rate proportional to the product of number of elephants that have the disease, the number that do not have the disease and the time elapsed. Suppose that 2 elephants had the disease initially. The mathematical model is:

   (a) $\frac{dE}{dt} = ktE, \quad E(0) = 2$
   (b) $\frac{dE}{dt} = ktE(100 - E), \quad E(0) = 2$
   (c) $\frac{dE}{dt} = kt(100 - E), \quad E(0) = 2$
   (d) $\frac{dE}{dt} = kE(100 - E), \quad E(0) = 2$