1. The number of bacteria, Q in a culture is increasing at a rate proportional to the number of bacteria present. The initial population of bacteria is $Q_0 = 100$ and after 3 hours, $Q(3) = 150$.

(a) Find $Q(t)$ for $t > 0$.

(b) How long will it take for the population to double?
$$\sum_{n=1}^{23} 2n^2$$

2. Suppose a substance decays at a yearly rate equal to half the square of the mass of the substance present. If the initial quantity is 50 g of the substance, how long will it be until only 25 g remain?

3. A person deposits \$25,000 in a bank that pays 5% per year interest, compounded continuously. The person continuously withdraws from the account at the rate of \$750 per year. Find $V(t)$, the value of the account at time t after the initial deposit.

4. A fluid initially at 100°C is placed outside on a day when the temperature is 10°C, and the temperature of the fluid drops 20°C in one minute. Find the temperature $T(t)$ of the fluid for $t > 0$.

5. An object is placed in a room where the temperature is 20°C. The temperature of the object drops by 5°C in 4 minutes and by 7°C in 8 minutes. What was the temperature of the object when it was initially placed in the room?

6. A container initially contains 10 L of water in which there is 20 g of salt dissolved. A solution containing 4 g/L of salt is pumped into the container at a rate of 2 L/min, and the well-stirred mixture runs out at a rate of 1 L/min. How much salt is in the tank after 40 minutes?

1. (a) $Q(t) = 100e^{\frac{\ln(3/2)}{3}t}$

(b) $\dfrac{\ln(8)}{\ln(3/2)}$ hours

2. $Q(t) = \dfrac{50}{25t+1}$; $\dfrac{1}{25}$ years

3. $V(t) = 25{,}000 + 10{,}000e^{t/20}$

4. $T(t) = 10 + 90e^{-\ln(9/7)t}$

5. $T_0 = \left(\dfrac{85}{3}\right)^{\circ}\mathrm{C}$

6. $Q(t) = \dfrac{4(t+10)^2 - 200}{t+10}$; $Q(40) = 196$ g