1. Consider the following initial value problem:

$$\frac{dy}{dt} = 0.3y, \qquad y(0) = 20.$$

Solve this initial value problem. Determine the value of the solution at $t = 1$, $y(1)$.

Use Euler's method to approximate the solution $y(1)$ using a stepsize of $h = 0.2$ for $t \in [0, 1]$. Compute the error between the actual solution and the approximate solution using Euler's method.

2. Consider the following initial value problem:

$$\frac{dy}{dt} = 10 - 0.3y, \qquad y(0) = 10.$$

Solve this initial value problem. Determine the value of the solution at $t = 1$, $y(1)$.

Use Euler's method to approximate the solution $y(1)$ using a stepsize of $h = 0.2$ for $t \in [0, 1]$. Compute the error between the actual solution and the approximate solution using Euler's method.

3. A population of animals that includes emigration satisfies the differential equation

$$\frac{dP}{dt} = 0.25P - 15, \qquad P(0) = 320.$$

a. Solve this differential equation and find the value of the solution at $t = 1$, $P(1)$.

b. Use Euler's method with $h = 0.25$ to approximate the solution at $t = 1$. Find the percent error between the actual solution and this approximate solution at $t = 1$.

4. The body temperature of a particular animal is normally $36°C$. Suppose this animal is hit by a car at midnight ($t = 0$), and the environmental temperature is approximately $22°C$. From Newton's Law of Cooling, the temperature of the roadkill satisfies the differential equation

$$\frac{dT}{dt} = -0.2(T - 22),$$

where t is in hours.

a. Solve this differential equation, and find the temperature of the body at 2 am, *i.e.*, find the value of the solution at $t = 2$.

b. Use Euler's Method with $h = 0.5$ to approximate the temperature at $t = 2$. Find the percent error between the actual solution and this approximate solution at $t = 2$.

c. Suppose that the temperature is actually dropping about $0.5°C$/hr, then the differential equation describing the temperature of the roadkill is

$$\frac{dT}{dt} = -0.2(T - (22 - 0.5t)).$$

Use Euler's Method with $h = 0.5$ to approximate the temperature at $t = 2$.

5. a. Radioactive elements are often the products of the decay of another radioactive element. A differential equation describing this situation is given by the following:

$$\frac{dR}{dt} = -0.25R + 7e^{-0.05t}, \qquad R(0) = 70,$$

where t is in years. Use Euler's method with a stepsize of $h = 1$ to find the approximate solution at $t = 3$.

b. Show that the actual solution is

$$R(t) = 35e^{-0.05t} + 35e^{-0.25t}.$$

Evaluate the solution at $t = 3$ and use this solution to find the percent error of Euler's method at $t = 3$.