1. Find the solutions to the following problems:

(a) \( \frac{dy}{dx} = \sqrt{x}, \ y(4) = 0. \)

(b) \( \frac{dy}{dx} = y \sin x. \)

(c) \( \frac{dy}{dx} + x = 2xy. \)

(d) \( \frac{dy}{dx} = xy^2 + 3x^2y^2, \ y(1) = 1. \)

(e) \( e^x + y \frac{dy}{dx} = 1. \)

(f) \( \frac{dy}{dx} + 3y = 2xe^{-2x}. \)

(g) \( x \frac{dy}{dx} + 5y = 7x^2. \)

(h) \( 2xy \frac{dy}{dx} = x^2 + 2y^2. \)

(i) \( \frac{dy}{dx} = y + y^3. \)

(j) \( x^2 \frac{dy}{dx} + 2xy = 5y^3. \)

(k) \( \frac{dx}{dt} = 3x(x - 5), \ x(0) = 2. \)

2. Find the position function \( x(t) \) of a moving particle with the given acceleration \( a(t) = 4t - 2, \) initial position \( x(0) = 0, \) and initial velocity \( v(0) = 2. \)

3. In a certain culture of bacteria, the number of bacteria increased sixfold in 10 hours. How long did it take for the population to double?

4. Verify that the given differential equation is exact, then solve it.

(1) \( (2x + 3y)dx + (3x + 2y)dy = 0. \)

(2) \( (3x^2y^3 + y^4)dx + (3x^3y^2 + y^4 + 4xy^3)dy = 0. \)

5. The acceleration of a sports car is proportional to the difference between 250km/h and the velocity of this sports car. If the car can accelerate from rest to 100 km/h in 10 s, how long will it take for the car to accelerate from rest to 200km/h?

6. Apply Euler’s method with step size \( h = 0.25 \) to approximate the solution of the following initial value problem on the interval \( 0 \leq x \leq 1: \)

(1) \( \frac{dy}{dx} = y - x - 1, \ y(0) = 1. \)

(2) \( \frac{dy}{dx} = 2xy, \ y(0) = 2. \)