

**Exercise 1.** (25 points)

Solve the differential equation  $y' - y = e^x \sin x$ .

**Exercise 2.** (25 points)

a) Find the zeros of the polynomial  $y^2 + 2y - 3$ .

b) Solve the differential equation

$$y' = y^2 + 2y - 3.$$

**Exercise 3.** (15 points)

Solve the differential equation

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

**Exercise 4.** (25 points)

Solve the Bernoulli equation

$$y' + 2xy = y^3.$$

**Exercise 5.** (10 points)

Let  $\varphi(t)$  be the solution (defined on some interval  $I$ ) of the initial value problem

$$\varphi'(t) = \ln(\varphi(t))$$

$$\varphi(0) = 2.$$

Show that  $\varphi$  is an increasing function.