

# Differential Equations & First-Order Separable Equations

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## SUGGESTED REFERENCE MATERIAL:

As you work through the problems listed below, you should reference your lecture notes and the relevant chapters in a textbook/online resource.

## EXPECTED SKILLS:

- Be able to verify that a given function is a solution to a differential equation.
- Be able to solve first-order separable equations by separating and integrating.
- Be able to solve initial-value problems for first-order separable equations.

## PRACTICE PROBLEMS:

1. Verify that  $y = x^2 + 1$  is a solution to the differential equation  $y - \frac{dy}{dx} = (x - 1)^2$ .
2. Find the value(s) of the constant  $A$  for which  $y = e^{Ax}$  is a solution to the differential equation  $y'' + 5y' - 6y = 0$ .

**For problems 3-9, use separation of variables to solve the given differential equation. If possible, express your answer as an explicit function of  $x$ .**

3.  $\frac{dy}{dx} = \frac{x^2 - 1}{y^2}$
4.  $\frac{dy}{dx} - \sqrt{xy} \ln x = 0$
5.  $y' = yx^2$
6.  $\frac{dy}{dx} - e^{-y} \sec^2 x = 0$
7.  $\frac{dy}{dx} = xy^3$
8.  $\frac{dy}{dx} = \frac{1}{(x^2 - 5x + 6)y}$
9.  $\left( \frac{\sqrt{xy} y'}{2 + y} \right) = 1$ , for  $x \neq 0$ .

**For problems 10-11, find the solution of the differential equation which satisfies the initial condition.**

10.  $\frac{dy}{dx} = \frac{x^2 - 2}{y}, y(0) = 1$

11.  $\frac{dy}{dx} = \frac{\ln x}{xy^2}, y(e) = 1$

12. Find an equation of the curve that passes through the point  $(0, 1)$  and whose slope at  $(x, y)$  is  $xe^y$ .