

## Differential Equations Reducible to First Order

Solve each of the following differential equations; if initial values are given, you only need to find the *particular* solution that satisfies the differential equation *and* the initial values. Pay attention to the possibility of singular solutions.

1.  $y'' = (y')^3$ ; do this *two* ways: as an equation with “x” missing, and as an equation with “y” missing; (General Solution).

2.  $y y'' = \frac{1}{2} (y')^2$ ; (General Solution).

3.  $y'' + y y' = 0$ ;  $y(0) = 1$ ,  $y'(0) = -1$ .

4.  $(y + 1)y'' = (y')^2$ ; (General Solution).

5.  $y' y'' = 4x$ ;  $y(1) = 5$ ,  $y'(1) = 2$ .

6.  $2y'' = 3y^2$ ;  $y(0) = 1$ ,  $y'(0) = 1$ .

7.  $y'' + y(y')^3 = 0$ ; (General Solution).

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**Answers:**

1.  $y = c_1 \pm \sqrt{c_2 - 2x}$ , or  $y = c_3$ .

2.  $y = (c_1x + c_2)^2$ .

3.  $y = \tan\left(\frac{\pi}{4} - \frac{x}{2}\right)$ .

4.  $y = -1 + c_1 e^{c_2 x}$ .

5.  $y = x^2 + 4$ .

6.  $y = \frac{4}{(x-2)^2}$ .

7.  $x = \frac{y^3}{6} + c_1y + c_2$ , or  $y = c_3$ .

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