Handout 8: Solving First Order Differential Equations

Find the solution for each of the differential equations listed below. In some cases Separation of Variables may be the appropriate technique to use and in others, integrating factors may be a more helpful approach. In some cases, the equation includes parameters (constants labeled by letters). Before you start to rearrange the equation, be sure to decide which letter represents the independent variable, which letter represents the dependent variable are and which letters represent constants.

The answers are given at the end of this handout so that you can check your work.

(a) $\frac{dr}{dt} = -2 \cdot t \cdot r$ $\qquad r(0) = r_0$

(b) $9x + 4y \cdot \frac{dy}{dx} = 0$ $\qquad$ No initial condition given.

(c) $L \cdot \dfrac{dI}{dt} + R \cdot I = 0$ $\qquad I(0) = I_0$

(d) $e^{-2\theta} \cdot \dfrac{dr}{d\theta} - 2r \cdot e^{-2\theta} = 0$ $\qquad$ No initial condition given.

(e) $\left(\cos(\omega \cdot x) + \omega \cdot \sin(\omega \cdot x)\right) + e^{x} \cdot \dfrac{dy}{dx} = 0$ $\qquad y(0) = 1$

Answers

(a) $r(t) = r_0 \cdot e^{-t^2}$

(b) y can be implicitly defined in terms of x by the equation: $9x^2 + 4y^2 = C$, where C is a constant.

(c) $I(t) = I_0 \cdot e^{-Rt/L}$

(d) $r(\theta) = A \cdot e^{2\theta}$ where A is a constant.

(e) $y(x) = e^{-x} \cdot \cos(\omega \cdot x)$