1.1.2 Linear: (a), (e). Nonlinear: (b), (c), (d).

1.1.3 (a) second; linear inhomogeneous. (b) second; linear homogeneous. (c) third; nonlinear. (d) second; linear inhomogeneous. (e) second; linear homogeneous. (f) first; nonlinear. (g) first; linear homogeneous. (h) fourth; nonlinear.

1.1.10 Recall that a vector space is closed under addition and scalar multiplication. Take two solutions \( u, v \) of the DE. Show that \( u + v \) and \( cu \) where \( c \) is a scalar constant are also solutions. Characteristic equation of the DE is \[ r^3 - 3r^2 + 4 = (r + 1)(r - 2)^2 = 0. \] A basis of the DE is thus \( \{e^{-1}, e^2, te^2\} \).

1.1.12 Recall that \( d/dx \sinh x = \cosh x, \quad d/dx \cosh x = \sinh x, \) where \[ \sinh x = \frac{e^x - e^{-x}}{2}, \quad \cosh x = \frac{e^x + e^{-x}}{2}. \]

1.2.1 Characteristic lines are \( 3t - 2x = C \), where \( C \) is an arbitrary constant. Thus, the solution has the form \[ u(t, x) = f(3t - 2x). \]

When \( t = 0 \), we have \[ u(0, x) = f(-2x) = \sin x \implies f(x) = \sin(-x/2). \]

That is, the solution is \[ u(t, x) = \sin(x - 3t/2). \]

1.2.4 Direct substitution.

1.2.9 Change variables to \( x' = x + y, y' = x - y \), follow examples on Page 7, we obtain \[ 2u_{x'} = 1 \implies u = \frac{1}{2} x' + f(y') = \frac{1}{2} (x + y) + f(x - y). \]