

## Homework #2

Sept 10, 2015

Bell's Notes 02\_Fundamental Definitions.pdf  
Which of the following equations are linear

1. [#1 pg 7] Define the following
  - (a) order of a PDE.
  - (b) superposition principle
  - (c) classical solution
  - (d) elliptic PDE
2. [#2a,b,c pg 8] Which of the following operates are linear:
  - (a)  $L(u) = u_x + xu_y$
  - (b)  $L(u) = u_x + uu_y$
  - (c)  $L(u) = u_x + u_y^2$
3. [#3a,c,d,g pg 8] For the following equations, give the order, and state whether each is linear or nonlinear. If it is linear, indicate whether it is homogeneous or nonhomogeneous.
  - (a)  $u_t - u_{xx} + 1 = 0$
  - (b)  $u_t - u_{xxt} + uu_x = 0$
  - (c)  $u_{tt} - u_{xx} + x^2 = 0$
  - (d)  $u_t - u_{xxxx} + \sqrt{1+u} = 0$
4. Let  $L$  and  $M$  be linear partial differential operators. Prove that the following are also linear partial differential operators:
  - (a)  $L - M$
  - (b)  $3L$
  - (c)  $fL$ , where  $f$  is an arbitrary function of the independent variables
5. Solve the following inhomogeneous linear ODEs:
  - (a)  $u' - 4u = x - 3$
  - (b)  $5u'' - 4u' + 4u = e^x \cos(x)$
  - (c)  $u'' - 3u' = e^{3x}$