

Math 456-556

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Due January 23, 2009

Home Work No. 1.

1. Determine, which equations are linear:

(a)

$$u_t + x u_x + u_{xxx} = 0$$

(b)

$$u_{tt} - u_{xx} + u = 0 \quad (\text{Klein - Gordon equation})$$

(c)

$$u_{tt} - u_{xx} + \sin u = 0 \quad (\text{Sine - Gordon equation})$$

(d)

$$S_x^2 + S_y^2 = u(x, y) \quad (\text{Eikonal equation})$$

(e)

$$\phi_t \phi_x + \phi \phi_{xt} + \phi_x^2 + \phi \phi_{xx} = 0$$

(f)

$$u_t + u u_x = u_{xx} \quad (\text{Burgers equation})$$

(g)

$$u_{xy} = e^u \quad (\text{Poincare equation})$$

2. Find general solutions of the following linear first order equations:

(a)

$$x u_x + y u_y = 0$$

(b)

$$x u_x - y u_y = 0$$

(c)

$$x u_y + y u_x = 0$$

(d)

$$x u_y - y u_x = 0$$

3. Solve the following equation:

$$u_x + u_y + u = e^{x+2y}$$

if $u(x, 0) = 0$.

4. Solve problems 1,2,4 on page 31 of Strauss textbook.

5. Show that

$$u = \sin nx \cos ny + 2 \cos mx \sin my$$

satisfies the equation

$$u_{xx} - u_{yy} = 0$$