Practice for first PDE

Why?

Exercise 1 *Solve*

a) $u_t + 9u_x = 0, \quad u(x,0) = \sin(x),$

b) $u_t - 8u_x = 0, \quad u(x,0) = \sin(x),$

c) $u_t + \pi u_x = 0, \quad u(x,0) = \sin(x),$

d) $u_t + \pi u_x + u = 0, \quad u(x,0) = \sin(x).$

Exercise 2 *Solve*

a) $u_t - 5u_x = 0,\ u(x,0) = \dfrac{1}{1+x^2},$

b) $u_t + 2u_x = 0,\ u(x,0) = \cos(x).$

Exercise 3 *Solve* $u_t + 3u_x = 1,\ u(x,0) = x^2.$

Exercise 4 *Solve* $u_x + u_t + tu = 0,\ u(x,0) = \cos(x).$

Exercise 5 *Solve* $u_t + 3u_x = x,\ u(x,0) = e^x.$

Exercise 6 *Solve* $u_x + u_t + xu = 0,\ u(x,0) = \cos(x).$

Exercise 7 *Solve* $u_x + u_t = 5,\ u(x,0) = x.$

Exercise 8

a) *Find the characteristic coordinates for the following equations:*
1) $u_x + u_t + u = 1, \quad u(x,0) = \cos(x),$ *2)* $2u_x + 2u_t + 2u = 2, \quad u(x,0) = \cos(x).$

b) *Solve the two equations using the coordinates.*

c) *Explain why you got the same solution, although the characteristic coordinates you found were different.*

Exercise 9 *Solve* $(1+x^2)u_t + x^2u_x + e^xu = 0,\ u(x,0) = 0.$ *Hint: Think a little out of the box.*