Objectives.
(1) Review some mathematical tools.
(2) Classify second-order PDEs.
(3) Identify the keep questions for a PDE and approximations to the PDE.

Questions.
(1) Use the product rule to expand
$$\nabla (fg)$$
(2) Use the product rule to expand
$$\nabla (w \nabla u)$$
(3) Suppose that
$$\int_{a}^{b} f(x)g'(x)dx$$
Suppose that $f$ and $g$ are continuously differentiable. What does integration by parts yield? Prove it?
(4) Use the previous on
$$\int_{\Omega} f \nabla \cdot \nabla g d\vec{x}$$
(5) Suppose $u$ is $n + 1$ times continuously differentiable. What is the Taylor Series (with remainder)?
(6) Suppose that
$$u_t + au_x = 0$$
with $u(0, x) = f(x)$. Along which contours is the solution $u(t, x)$ constant?
(7) Suppose $a = 2$. And $f(x) = \begin{cases} 1 & x < 0 \\ 0 & x \geq 0 \end{cases}$. Draw the solution at $t = 2$.
(8) Write the advection equation as a linear operator $Lu = 0$.
(9) Give an example of an elliptic, hyperbolic, and parabolic second-order PDE. What do they represent?