1. In class we have been using the classical wave equation

$$\frac{\partial^2 U}{\partial x^2} = \frac{1}{\mathrm{v}^2}\frac{\partial^2 U}{\partial t^2}$$

where U(x,t) describes the amplitude of a traveling wave propagating in time, t, in the x-direction with velocity, v. Show that this differential equation that we used as our starting point is a consequence of the mathematical equation for a traveling wave given by

$$U(x,t) = C\sin(kx + \omega t) \text{ , where } k = \frac{2\pi}{\lambda} \text{ and } \omega = 2\pi\nu = \frac{2\pi \mathrm{v}}{\lambda} \text{ .}$$

2. In class this week, we will be learning about operators, mathematical instructions that work on functions. If a function, *f*, is an eigenfunction of the operator, $\hat{A}$, then $\hat{A}f = af$, where "*a*" is a constant and referred to as an eigenvalue. Determine in each of the following cases if the function in the first column is an eigenfunction of the operator in the second column. If the answer is yes, give its eigenvalue.

$f(x) = x^2$	$\hat{A} = \frac{x^2}{8}\frac{d^2}{dx^2}$	Is *f* an eigenfunction of $\hat{A}$?	eigenvalue =
$f(x,y) = x^3 + y^3$	$\hat{A} = x^3\frac{\partial^3}{\partial x^3} + y^3\frac{\partial^3}{\partial y^3}$		
$f(\theta,\phi) = \sin 2\theta \cos\phi$	$\hat{A} = \frac{\partial^4}{\partial \theta^4}$		