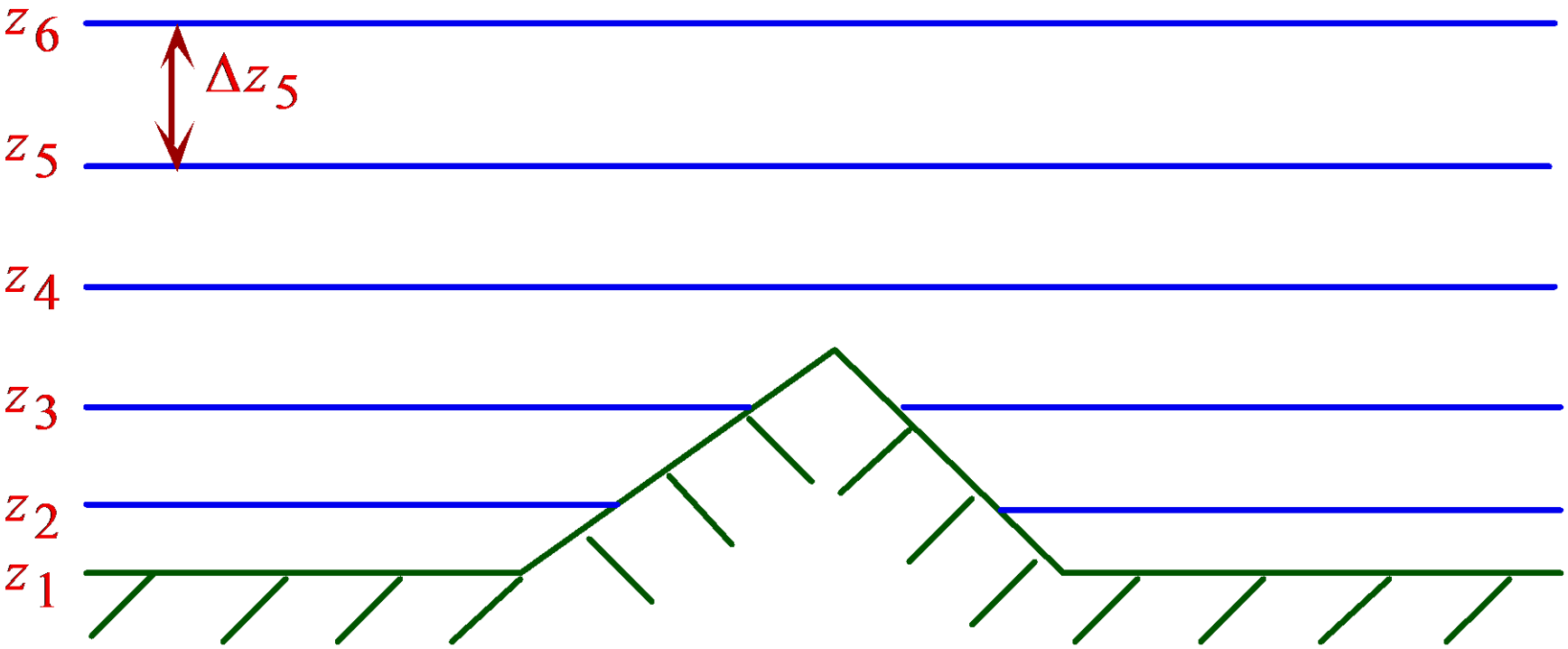
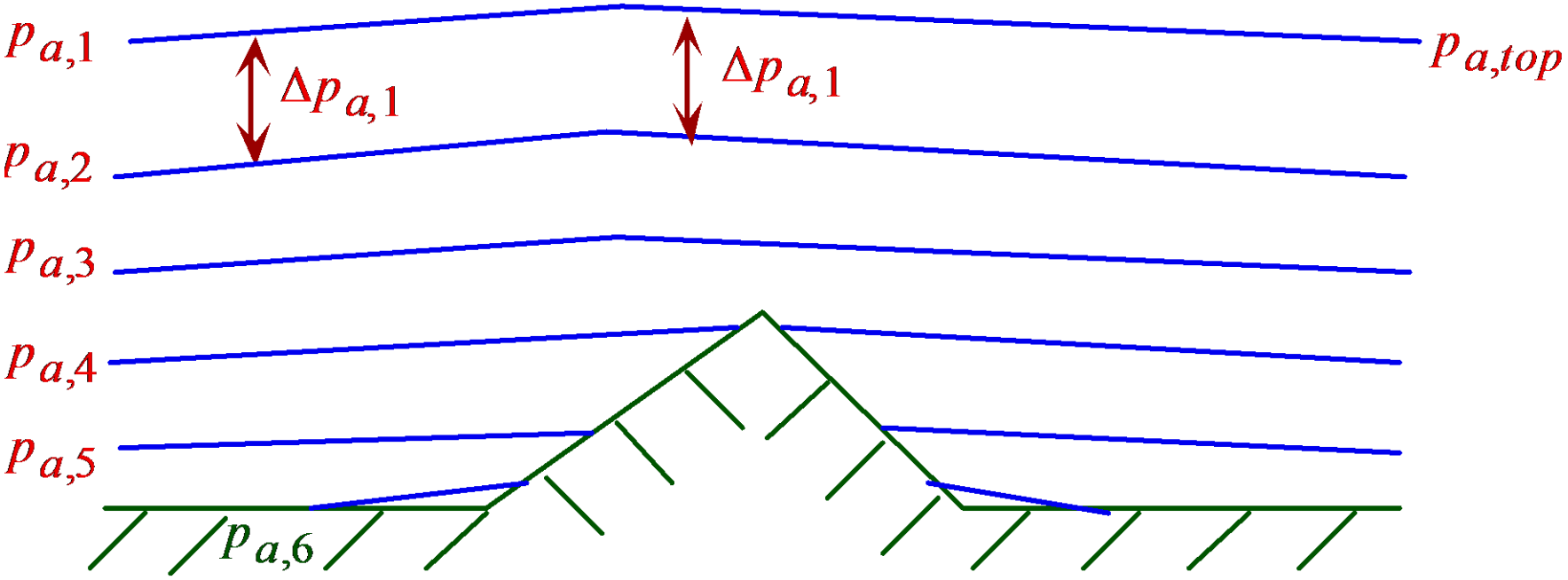
Vertical coordinate transformations

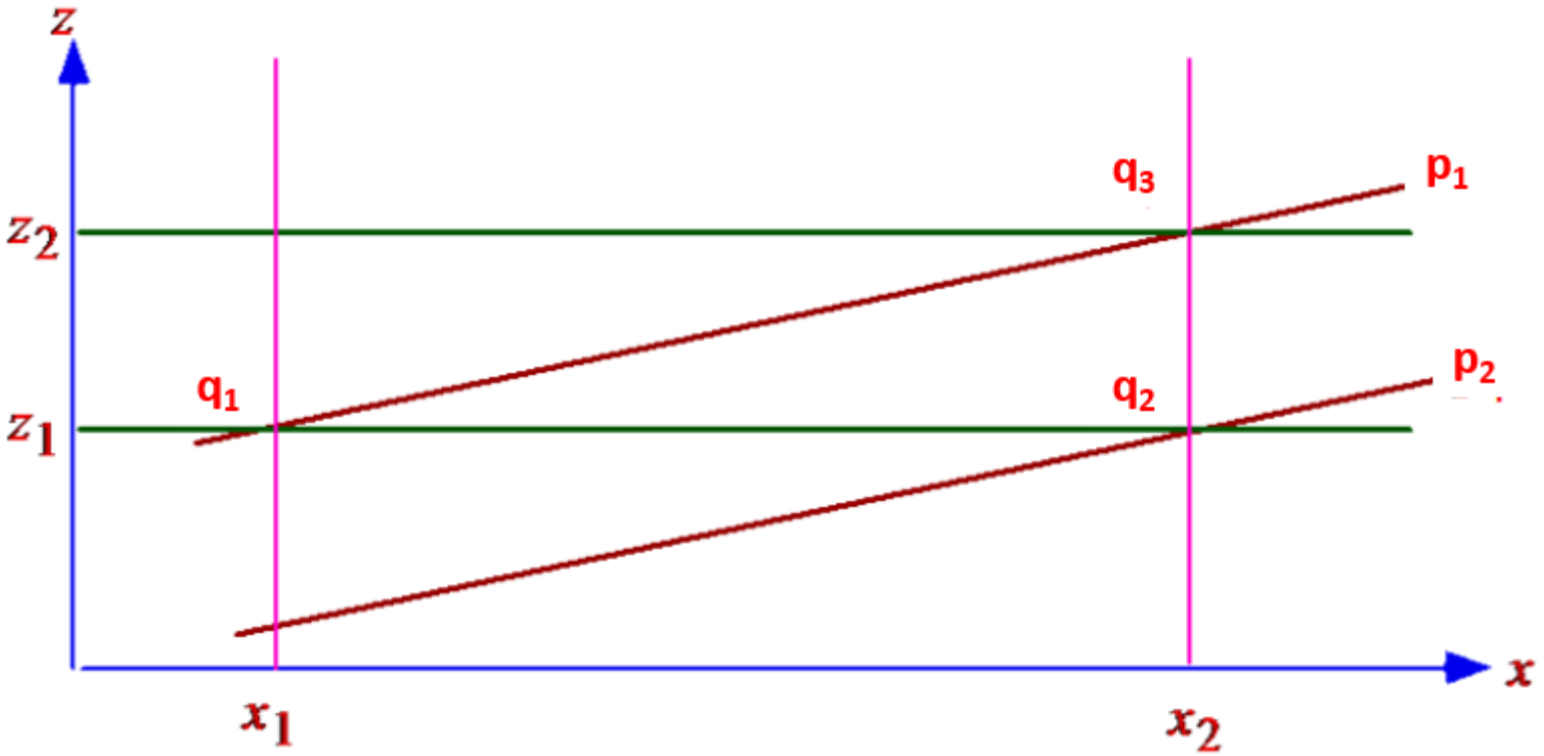
Altitude Coordinate Surfaces



Atmospheric Pressure Coordinate Surfaces



Intersections of *z* and *p* surfaces



Change in "q" over distance; q is a generic scalar variable

$$\frac{q_3-q_1}{x_2-x_1}=\frac{q_2-q_1}{x_2-x_1}+\left(\frac{q_3-q_2}{z_2-z_1}\right)\left(\frac{z_2-z_1}{x_2-x_1}\right)$$

z to *p* Coord. Gradient Conversion

Change in q over distance

$$\frac{q_3-q_1}{x_2-x_1}=\frac{q_2-q_1}{x_2-x_1}+\left(\frac{q_3-q_2}{z_2-z_1}\right)\left(\frac{z_2-z_1}{x_2-x_1}\right)$$

As x_2-x_1-->0, z_1-z_2-->0 Chain rule!

Subscript on () references constant surface

$$\left(\frac{\partial q}{\partial x}\right)_p=\frac{q_3-q_1}{x_2-x_1} \qquad \left(\frac{\partial q}{\partial x}\right)_z=\frac{q_2-q_1}{x_2-x_1}$$

$$\left(\frac{\partial q}{\partial z}\right)_x=\frac{q_3-q_2}{z_2-z_1} \qquad \left(\frac{\partial z}{\partial x}\right)_p=\frac{z_2-z_1}{x_2-x_1}$$

Gradient conversion from the *p* to *z* coordinate along x axis

$$\left(\frac{\partial q}{\partial x}\right)_p=\left(\frac{\partial q}{\partial x}\right)_z+\left(\frac{\partial q}{\partial z}\right)_x\left(\frac{\partial z}{\partial x}\right)_p$$

z to *p* Coord. Gradient Conversion

Likewise, gradient conversion from the *p* to *z* coordinate along y axis

$$\left(\frac{\partial q}{\partial y}\right)_p = \left(\frac{\partial q}{\partial y}\right)_z + \left(\frac{\partial q}{\partial z}\right)_y \left(\frac{\partial z}{\partial y}\right)_p$$