

#3

(a)

$$z - z_0 = a \left((x - x_0)^2 + (y - y_0)^2 \right)$$

$$a(x^2 + y^2) + ax_0^2 + ay_0^2 + z_0 - 2a[x_0x + y_0y]$$

let $\alpha = ax_0$

$\beta = ay_0$

$f = ax_0^2 + ay_0^2 + z_0$

$$\Rightarrow z = a(x^2 + y^2) - 2\alpha x - 2\beta y + f$$

$$x_0 = \frac{\alpha}{a}$$

$$z_0 = f - \frac{\alpha^2}{a} - \frac{\beta^2}{a}$$

$$y_0 = \frac{\beta}{a}$$