**Q1. We could approach this in two ways (a) local (b) average over the plate**

**Local approach :**

$$\frac{dI(x, y, z)}{I} = \frac{\text{Photons absorbed an incremental area}}{\text{Photons incident in an incremental area}} = \frac{-\sigma N_0 e^{-\frac{2(x^2+y^2)}{a^2}} dx\, dy\, dz}{dx\, dy}$$

$$I(x, y, z) = e^{\sigma N_0 e^{-\frac{2\sqrt{x^2+y^2}}{a^2}} z}$$

**Average approach :**

$$\frac{dI(z)}{I(z)} = \frac{-\left(\int_{-a}^{a}\int_{-a}^{a}\sigma N_0 e^{-\frac{2(x^2+y^2)}{a^2}} dx\, dy\right) dz}{a^2}$$

$$\int_{-a}^{a}\int_{-a}^{a}\sigma N_0 e^{-\frac{2(x^2+y^2)}{a^2}} dx\, dy$$

$$\frac{1}{2} a^2 \pi \sigma \operatorname{Erf}\left[\sqrt{2}\right]^2 N_0$$

$$I(z) = I_0 e^{-\frac{1}{2} a^2 \pi \sigma \operatorname{Erf}\left[\sqrt{2}\right]^2 N_0 z}$$

**Q2.**

```
λ = 1.06 10^-3;
D1 = 5;
z1 = 25.4;
M2 = 1.1;
D2 = 0.1
```

0.1

$$\theta = \frac{4 \lambda M2}{3.1415\, D1}$$

0.000296928

$$\text{Solve}\left[D2 == \sqrt{1\Big/\left(\frac{1}{D1^2}\left(1-\frac{z1}{f}\right)^2+\frac{1}{f^2\,\theta^2}\right)},\ f\right]$$

{{f → -336.86}, {f → 336.839}}

**f = 336.839;**

$$z2 = f + \frac{(z1-f)\,f^2}{(z1-f)^2+\frac{D1^2}{\theta^2}}$$

**z2 = 336.715**

**Depth of focus**

In[10]:= **D2 = 0.1;**

$$\theta 2 = \frac{4\,\lambda\,M2}{3.1415\,D2};$$

**Df = 1.05 D2;**

**M2 = 1.1;**

$\lambda = 1.06\ 10^{-3};$

In[15]:= $\text{Solve}\left[Df == \sqrt{D2^2 + z2^2\,\theta 2^2},\ z2\right]$

**{{z2 → -2.15645527357368`}, {z2 → 2.15645527357368`}}**

**Depth of focus = 4.3 mm**