Solution to "Zoom lens for a photographic camera"

1. Object at infinity with angle θ=300m/1km, size of image= 50mm*θ=15mm.
2. size image*2⇒ f_{total}*2⇒ f_{total}=100mm. $f'_{total}=f'_1*(g_y)_2\Rightarrow(g_y)_2=\pm 2$. For real image with diverging L_2, only $(g_y)_2=+2$ is possible.
3. L_2 is 25 mm to the left of the final image The intermediate image is 12,5mm to the right of L_2. L_1 is 50mm to the left of the intermediate image, thus the distance between L_1 and L_2 is 37,5mm.
4. 1/50−1/25−37,5/(50*-25)=1/100
5. F' is 25mm to the right of L2. H'F'=100mm thus H' is 75mm to the left of L2, and at 37,5mm to the left of L1.
6. $(g_y)_2=f'_{total}/f'_1$. Transverse magnification for L2 using Newton's formula: $g_{y_2}=-\frac{\overline{F_2'F'}}{f_2'}=1-\frac{x_2}{f_2'}\Rightarrow\boxed{x_2=f_2'(1-g_{y_2})}$.

   $g_{y_2}=-\frac{f_2}{F_2F_1'}=\frac{f_2'}{f_2'-e+f_1'}=\frac{f_2'}{f_2'-x_1+x_2+f_1'}\Rightarrow\boxed{x_1=-f_2'\frac{(1-g_{y2})^2}{g_{y2}}+f_1'}$
7. Verification $(g_y)_2=+2$ gives $x_2=-f_2'$ and $x_1=-f_2'/2+f_1'$

   f'_{total} =75mm gives $(g_y)_2=+1,5$, $x_2=-f_2'/2=12,5mm$, $x_1=-f_2'/6+f_1'=54,2mm$

   f'_{total} =150mm gives $(g_y)_2=+3$, $x_2=-2f_2'=50mm$, $x_1=-4f_2'/3+f_1'=83,3mm$