9. GLASS CYLINDER (7 points) The axis of the half-cylinder is where the stripe and its image coincide (form a straight line). The front edge of the half-cylinder is at the 28^{th} line, counting from the axis, hence the radius of the cylinder $R \approx 28$. Let us consider the refracting ray s which is very close to a total internal reflection. One can see the images of 20 lines (ca 20.2, to be more precise), when counting from the central line upwards; the upper edge of the half-cylinder coincides with the 42^{nd} line at the background.

So, the ray s arrives at the camera at the angle $\alpha = \arcsin(28/42) \approx 41.8^\circ$ with respect to the plane of the paper. The projection of the refraction point to the paper surface lies at the distance $a = 28 \sin\alpha = 28^2/42 \approx 18.7$ lines from the axis. Therefore, before refraction, ray s forms an angle $\beta = \arcsin[(20.2 - 18.7)/(28\cos\alpha)] \approx 4.1^\circ$ with the perpendicular of the paper surface. The incidence angle of the ray s is $\alpha + \beta \approx 45.9^\circ$, hence $n = 1/\sin(\alpha + \beta) \approx 1.39$.