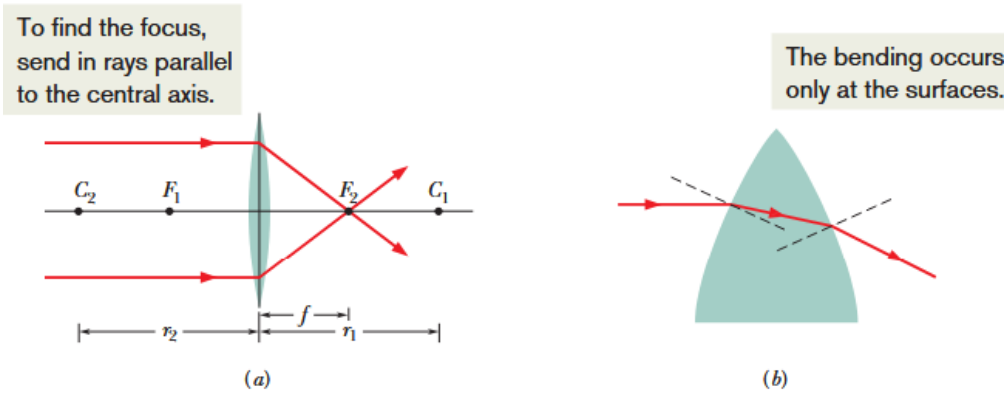
Thin Lens

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{i}$$

Thin lens law: Focal length related to image distance i and object distance p

$$\frac{1}{f} = (n-1)(\frac{1}{r_1} - \frac{1}{r_2})$$

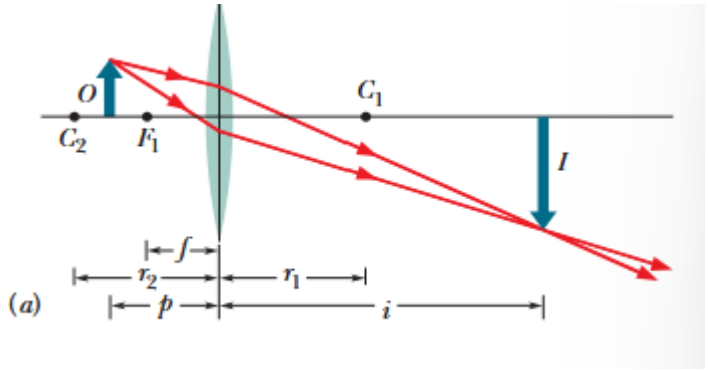
Lens maker's eqn. where r_1 is radius of curvature of lens surface nearer the object and r_2 is that of the other surface. n is the refractive index of the lens. Only valid in air.



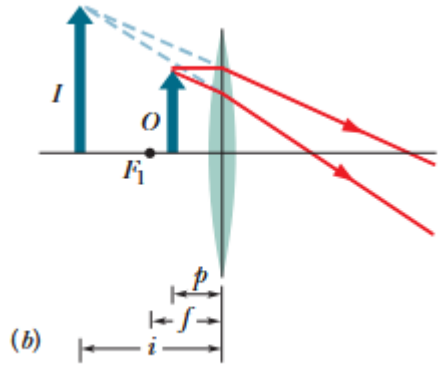
Note: the lens is thinner than drawn

F_1, F_2 are both called the real focus / focal point.

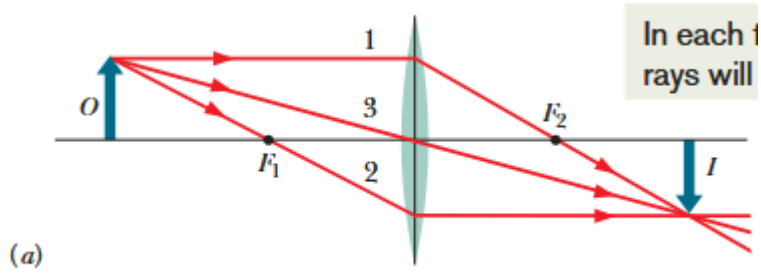
1. If a point src is placed at F_1 then the light will converge on F_2



(a) shows obj O outside of focal point F_1 (meaning farther than F_1 from the lens) and the converging lens forms an real, inverted image (upside down) on the side of the lens opposite the object. A real image is sharp.



When the object is inside the focal point F_1, a virtual image I is formed on the same side. In a virtual image, you can't project it on a sensor since the light rays don't converge. If you look through it you can see the object - example: magnifying glass.



Ray diagrams are drawn with 3 specific rays:

- 1st: Parallel ray will converge to focal point F_2
- 2nd: Ray through F_1 will come out the other side as parallel
- 3rd: Ray through the middle of the lens to the intersection point will have no change in direction

Virtual images are light rays reflected towards you that your brain interprets as an image (mirrors, magnifying glasses), however, the image does not actually exist but is only said to exist at the perceived loc.
Real images are those that can be projected on a sensor and always exist