Fermat's principle states that a ray of light will follow the path that requires the shortest traveling time. For a two dimensional case, that path is obtained by minimizing the integral

$$\int_{x_1}^{x_2} n(x,y)\sqrt{1+y'^2}\,dx$$

where $n(x,y)$ is the index of refraction and $y' = dy/dx$.

(a) For the special case that the integrand F does not depend explicitly on x, use the *Euler-Lagrange Equation* to prove that

$$F - y'\frac{\partial F}{\partial y'} = \text{constant}.$$

(b) Find all possible $y(x)$ for the particular case $n = 1 + a|y|$ with $a > 0$.

(c) Take the limit $a \to 0$ of your $y(x)$ from part (b), and discuss the results.