2. Find $\left.\dfrac{d^2y}{dx^2}\right|_{(x,y)=(\sqrt{e},1/e)}$ if y is a differentiable function of x satisfying the equation:

$$\ln(xy) = (\ln x)(\ln y)$$

$$\Big\Downarrow \; d/dx$$

$$\frac{1}{xy}\cdot(y+xy') = \frac{1}{x}\ln y + \ln x \cdot \frac{1}{y}\cdot y'$$

$$\Big\Downarrow$$

$$y + xy' = y\ln y + x\ln x \cdot y'$$

$$\xLeftarrow{(x,y)=(\sqrt{e},1/e)}$$

$$\frac{1}{e} + \sqrt{e}\,y' = \frac{1}{e}\cdot(-1) + \sqrt{e}\cdot\frac{1}{2}\cdot y'$$

$$\Big\Downarrow$$

$$\boxed{y' = -\frac{4}{e\sqrt{e}} \text{ at } (x,y)=(\sqrt{e},1/e)}$$

$$\Big\Downarrow \; d/dx$$

$$y' + y' + xy'' = y'\ln y + y' + \ln x \cdot y' + y' + x\ln x \cdot y''$$

$$\Big\Downarrow \; (x,y)=(\sqrt{e},1/e), \quad y' = -\frac{4}{e\sqrt{e}}$$

$$\left(-\frac{4}{e\sqrt{e}}\right) + \left(-\frac{4}{e\sqrt{e}}\right) + \sqrt{e}\,y'' = \left(-\frac{4}{e\sqrt{e}}\right)\cdot(-1) + \left(-\frac{4}{e\sqrt{e}}\right) + \frac{1}{2}\cdot\left(-\frac{4}{e\sqrt{e}}\right) + \left(-\frac{4}{e\sqrt{e}}\right) + \sqrt{e}\cdot\frac{1}{2}\cdot y''$$

$$\Big\Downarrow$$

$$y'' = \frac{4}{e^2} \text{ at } (x,y)=(\sqrt{e},1/e)$$