Suppose $f :R\rightarrow R$ is twice differentiable with both $f'$ and $f''$ continuous in an interval around 0. Suppose further that $f\left(0\right)=0.$ Let

$$h\left(x\right)=\left\{\begin{array}{c}\frac{f\left(x\right)}{x}, if x\ne 0,\\f^{'}\left(0\right), if x=0.\end{array}\right.$$

Show that

1. $h$ is differentiable at $x=0.$
2. $h$ is differentiable at $x=0$ with $h^{'}\left(0\right)=\frac{1}{2}f^{''}\left(0\right).$
3. $h'$ is continuous at $x=0.$