W4L6 - LAPLACE TRANSFORM BASIC PROPERTIES

Already proven:

$$\mathcal{L}[y'(s)] = s\mathcal{L}[y(s)] - y(0)$$

Suppose that y and y' are piecewise differentiable and continuous and that y'' is piecewise continuous. Also suppose that y, y', y'' are all of exponential order.

Then:

$$\mathcal{L}[y''(s)] = s^2\mathcal{L}[y(s)] - sy(0) - y'(0)$$
$$= s^2 Y(s) - sy(0) - y'(0)$$

$$\mathcal{L}[y''(s)] = s\mathcal{L}[y'(s)] - y'(0)$$
$$= s[s\mathcal{L}[y(s)] - y(0)] - y'(0)$$
$$= s^2\mathcal{L}[y(s)] - sy(0) - y'(0)$$

More generally, if y and all of its derivatives up to order k-1 are piecewise differentiable and continuous and $y^{(k)}$ is piecewise continous, and all of them have exponential order, then

$$\mathcal{L}[y^{(k)}(s)] = s^k\mathcal{L}[y(s)] - s^{k-1}y(0) - \ldots - sy^{(k-2)}(0) - y^{(k-1)}(0)$$