1. Find the Laplace transform of $e^{-\alpha t} \sin(\omega_0 t + \theta)$ and $e^{-\alpha t} \cos(\omega_0 t + \theta)$. What is the abscissa of convergence in each case?

2. Show that $\mathcal{L}\{tf(t)\} = -\frac{d}{ds}F(s)$. Repeat for $\mathcal{L}\{t^2f(t)\}$.

3. Given 
   \[ F(s) = \frac{5(s + 4)}{s(s + 1)(s + 2)} \]
   (a) Determine $f(\infty)$ without finding the inverse transform.
   (b) What is $f(0)$?

4. It is known that $\mathcal{L}\{e^{-\frac{t^2}{2}}\} = \sqrt{2\pi}se^{s^2/2}Q(-s)$, where $Q(\cdot)$ is the standard $Q$-function defined as $Q(x) = \frac{1}{\sqrt{2\pi}} \int_{x}^{\infty} e^{-r^2/2}dr$.
   (a) What is the abscissa of convergence in this case?
   (b) Use the time-differentiation property to find the Laplace transform of $te^{-\frac{t^2}{2}}$. What is the abscissa of convergence in this case?