1. Consider each time-domain function shown below. **Plot** each function, and **write** the corresponding Laplace domain function:
   a. $a(t) = -0.5 + 2t$
   b. $b(t) = 3e^{-2t}$
   c. $c(t) = 3\left(1 - e^{2t}\right)$
   d. $d(t) = e^{-0.5t}\sin(3t)$
2. Consider the Laplace-domain functions below. For each one, list all time domain functions that are included in the corresponding time-domain functions (e.g. sin function: $\sin(2t)$; exponential: e^{-2t}, ramp: $2t$; constant 2; a time delay by amount θ, etc.). This may require you to find some terms in the partial fraction expansion, but you do not need to find the coefficients of each function of time.
   a. $A(s) = \dfrac{5}{s(s^2 + 6s + 5)}$
   b. $B(s) = \dfrac{2}{s^2 + 4s}$
   c. $C(s) = \dfrac{0.5}{s^2 + 0.25}$
   d. $D(s) = \dfrac{1}{s+1} + \dfrac{1}{s-1}$
   e. $E(s) = \dfrac{3e^{-5s}}{s(s+2)}$
3. For each function in the previous question, indicate whether the time-domain function converges to a final value. If it has a final value, show that it can be found using the *final value theorem.*
4. Use Laplace transforms to solve the ODE:
   $$\frac{dy}{dt} + ay(t) = ct; \qquad y(0) = 0$$
5. a. Consider the integral in the time domain:
   $$\int_0^t f(t^*)dt^*$$
   Use the definition of the Laplace transform and integration by parts to find
   $$\mathcal{L}\left[\int_0^t f(t^*)dt^*\right] = \int_0^\infty \left[\int_0^t f(t^*)dt^*\right] e^{-st}\,dt$$
   b. Use your result from above to find the Laplace transform of
   $$\tau_1 \frac{dy}{dt} + y(t) = K\left(u(t) + \frac{1}{\tau_a}\int_0^t u(t^*)dt^*\right); \qquad y(0) = u(0) = 0$$
   c. Find the ratio:
   $$\frac{Y(s)}{U(s)}$$
6. Use the MATLAB functions 'laplace' and 'ilaplace' to confirm the answers to problem 1(d) and problem 2(d).