1. Compute $\mathcal{L}\{t \sin 2t\}$.

2. Compute (using Lecture 4’s method!) $\mathcal{L}\{t^2 e^{2t}\}$.

3. Compute (using Lecture 4’s method!) $\mathcal{L}\{t^3 e^{-t}\}$.

4. Evaluate
   $$\mathcal{L}\{\int_0^t \tau e^{t-\tau} \, d\tau\}.$$

5. Evaluate (using Lecture 4’s method!)
   $$\mathcal{L}\{\int_0^t \cos \tau \, d\tau\}.$$

6. Use Laplace Transform to solve the following integral equation
   $$f(t) = t e^t + \int_0^t \tau f(t-\tau) \, d\tau.$$

7. Use Laplace Transform to solve the following integral equation
   $$f(t) + \int_0^t f(\tau) \, d\tau = 1.$$

8. Solve the initial value problem
   $$y' + y = t \cos t, \quad y(0) = 0.$$

   Leave your answer in the form $\mathcal{L}^{-1}\{Y(s)\}$ for some $Y(s)$. 