1. Use the definition of the Laplace Transform (and maybe some intgration by parts?) to find the transform to

   (a) $f(t) = t$

   (b) $g(t) = \mathrm{e}^{-4\mathrm{t}}$

   (c)

$$f(t) = \begin{cases} 3, & 0 < t < 2 \\ 0, & 2 \leq t \leq 4 \\ -3, & t < 4 \end{cases}$$

2. State the two shifting theorems for Laplace Transforms.

   Use the shifting theorems to find the inverse transforms of

   (a) $F(s) = \frac{3}{s+4} e^{-\pi s}$

   (b) $F(s) = \frac{2s-8}{(s^2-10s+29)}$

   (c) $G(s) = \frac{e^{-2s}}{s(s^2+6s+34)}$

3. Consider the following initial value problem:

$$y'' + 4y' + 40y = t; \;\; y(0) = 0, \; y'(0) = 5$$

   Solve this problem TWO ways: (1) Use 'regular' method to find homogeneous and particular solution (using undetermined coefficients) and (2) use LAPLACE TRANSFORMS.

4. Solve the following forced ODE using transforms:

$$q' + 5q = f(t), \quad q(0) = 1$$

   where the forcing function is given by:

$$f(t) = \begin{cases} 1 & t < 3 \\ -1 & t \geq 3 \end{cases}$$

5. Use Laplace Transform techniques to solve the following IVP:

$$y'' + 36y = f(t); \;\; y(0) = 0, \; y'(0) = 0$$

   where the forcing function is given by:

$$f(t) = \begin{cases} 1 & 2 \leq t \leq 3 \\ 0 & \text{otherwise} \end{cases}$$