Closed book, closed notes, one page of formulas allowed.

Select Problem #1 OR Problem #2, but not both! Problems #3, #4, and #5 required.

1. Solve the differential equation below subject to the given input (e^{-2t}) and the initial condition for v(0).

$$\frac{dv}{dt} = \frac{-1}{3}v + e^{-2t}, \qquad v(0) = -6\frac{m}{sec}$$

OR

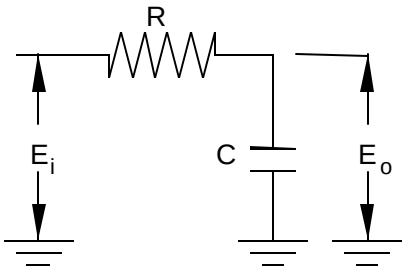
2. a) Find the Laplace Transform – <u>in least common denominator form</u> - for the following function of time:

$$f(t) = 3 + \frac{1}{e^{+2t}} + t\,e^{-4t}$$

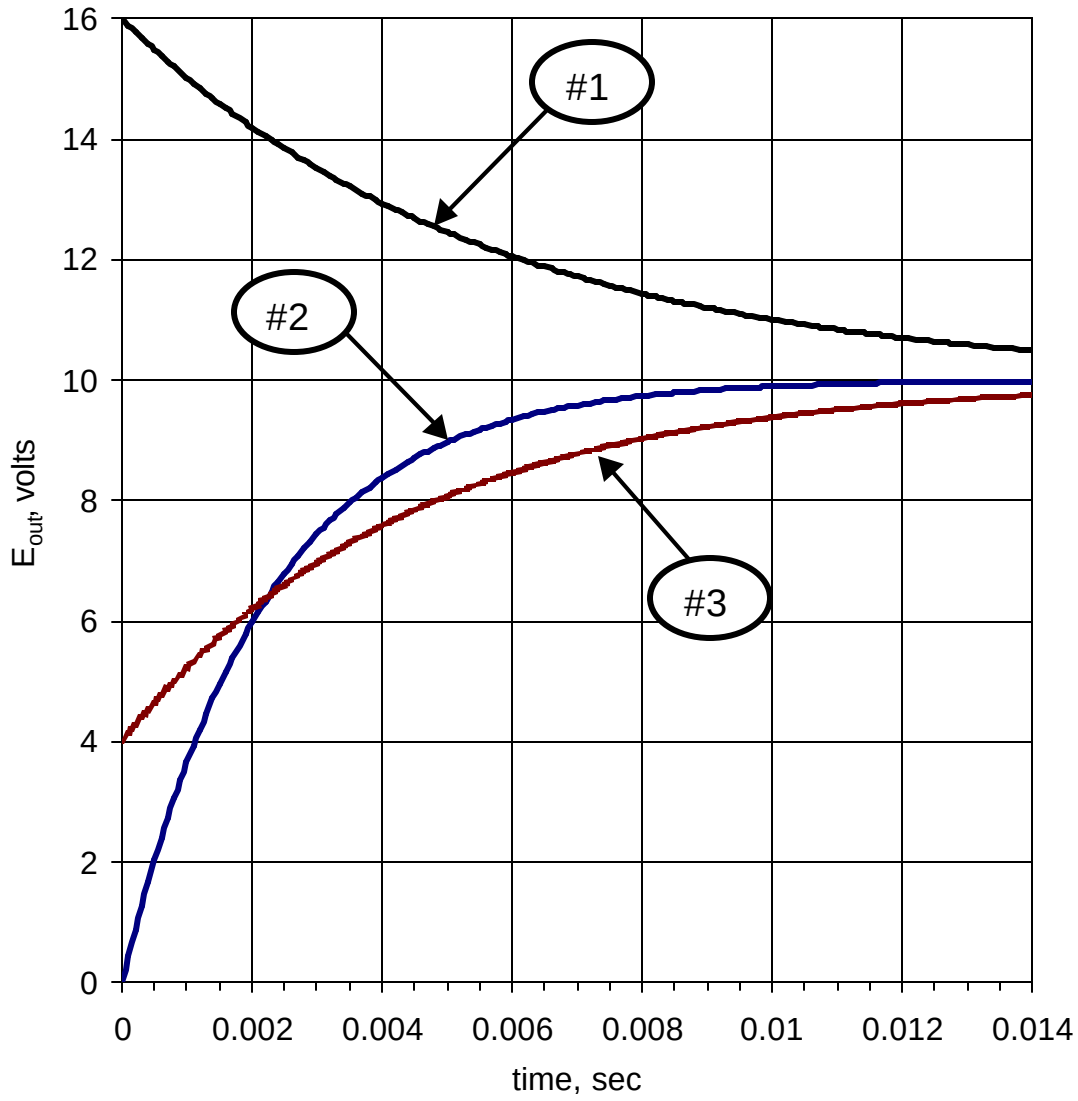
b) Find the inverse Laplace Transform of the following function of "s":

$$F(s) = \frac{3s+7}{s(s^2+5s+23)+s(s+2)}$$

3. Three different step responses for the electric circuit are shown in the figure below. All have a steady-state value of 10.0 volts. Match the response with the appropriate resistor – capacitor combination.



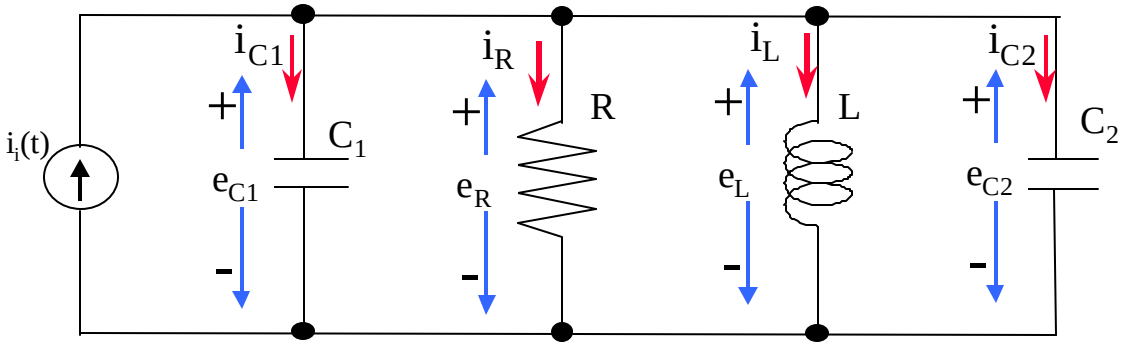
	Resistance	Capacitance
Set A	10 kΩ	0.22 μF
Set B	20 kΩ	0.22 μF
Set C	10 kΩ	0.10 μF
Set D	56 kΩ	0.10 μF



4. An electric circuit containing 1 inductor, 2 capacitors, and 1 resistor is shown below.

   a) What are your choices for state variables for this system?

   b) Write the ***Maple***™ commands that you would use to solve for the unknowns in order to find the state variable equations.



5. An electro-mechanical system is shown below. The DC motor has an armature resistance (R_a) and inductance (L_a). The DC motor's rotor has mass-moment-of-inertia J_m. The rotor is connected to a load (J_L) by a pair of gears. The first gear (with radius r_1) is assumed to be massless, but the second gear (with radius r_2) has mass moment of inertia J_2. Both shaft stiffnesses are assumed to be infinite. Parts of the free-body-diagrams are given.

   Define the angular velocity of the load as one of the state variables and write the state variable equations for the entire electro-mechanical system.