Discussion 1A

The material from both Lecture 1 and Note 1 are important prerequisites for this worksheet. Please review and have them on hand while doing the problems.

1. Current, Power, and Energy for a Capacitance (Hambley Example 3.3)

Suppose that the voltage waveform shown in Figure 1 is applied to a 10-μF capacitance.

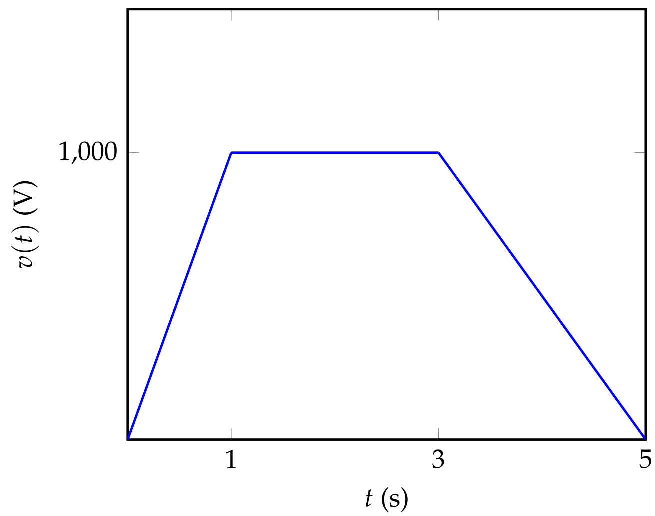

Figure 1: Plot of $v(t)$

Find and plot the current, the power delivered, and the energy stored for time between 0 and 5 s.

2. Determining Voltage for a Capacitance Given Current (Hambley Example 3.2)

After t_0 the current in a 0.1 μF capacitor is given by

$$i(t) = 0.5 \sin 10^4 t \tag{1}$$

(The argument of the sin function is in radians.) The initial charge on the capacitor is $q(0) = 0$.

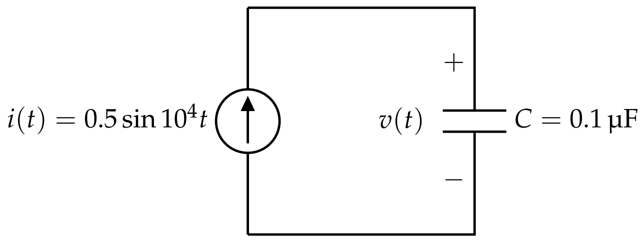

Figure 2: Example Circuit

Plot $i(t)$, $q(t)$, and $v(t)$ to scale versus time.

3. Analyzing an RC Circuit with a Constant Source (Adapted from Hambley Example 4.4)

Assume you are given the following circuit, where the capacitor is initially charged so that $v_C(t) = 1V$.

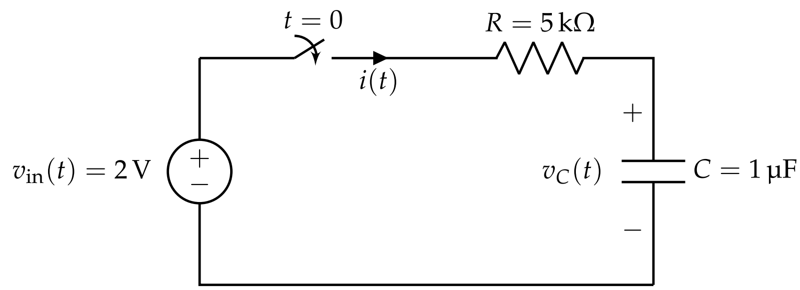

Figure 3

(a) **Set up a differential equation for the voltage $v_C(t)$ across the capacitor in the form:**

$$\frac{\mathrm{d}v_C(t)}{\mathrm{d}t} = \lambda v_C(t) + u(t) \tag{2}$$

(b) **Solve for the voltage $v_C(t)$ using the homogeneous and particular solution method.** *(HINT: Recall, that $v_C(t)$ is composed of a homogeneous and a particular solution. First, use your work from the previous part to find the homogeneous solution form. Then, to solve for both the unkown coefficient and the particular solution, find the initial condition of $v_C(t)$ using steady-state properties. As an extra check, you can always plug your final solution back into the differential equation to confirm.)*

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