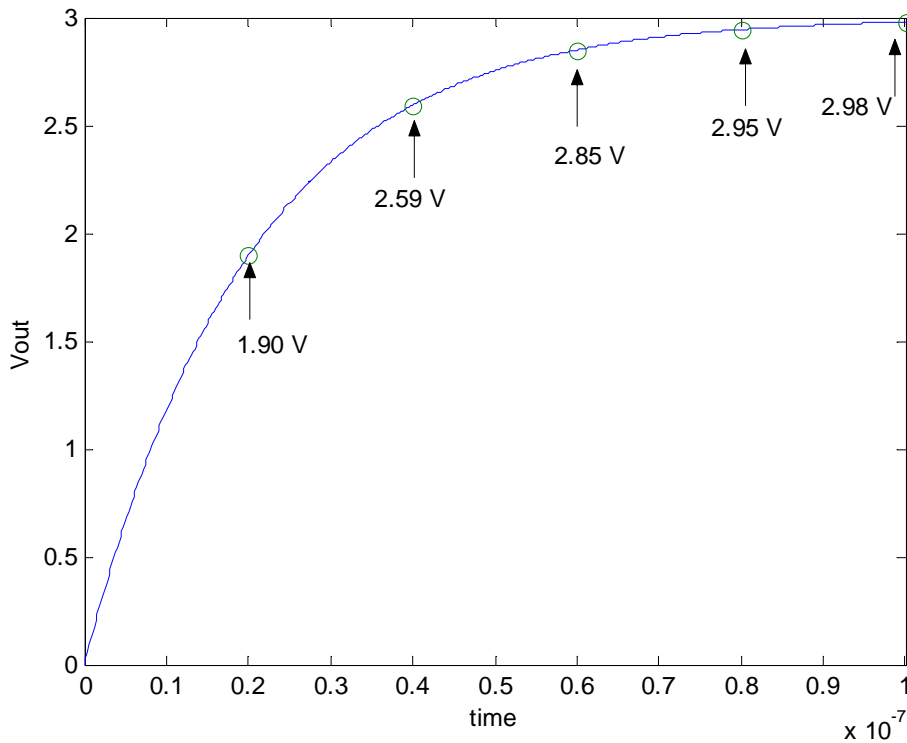


Homework #3

Solutions and Grading

Problem 1: 50 Total Points Possible

a) Answer: 10 Points Possible



15 points for correct graph with all 5 values for V_{out} at time constants shown
 15 points if values written elsewhere on page, or correct expressions for values given
 10 points for graph with non-major errors
 5 points for graph with significant errors

b) Answer: 10 Points Possible

$$V_{out}(t) = 3 - 3e^{\frac{-t}{20ns}} \text{ V}$$

10 points for correct equation (no derivation needed)
 5 points for errors such as signs, miscalculated time constant or initial value

c) Answer: 15 Points Possible

$$v_R(t) = V_{in}(t) - V_{out}(t) = 3 - (3 - 3e^{\frac{-t}{20ns}}) = 3e^{\frac{-t}{20ns}} \text{ V}$$

$$i_R(t) = \frac{v_R(t)}{R} = \frac{3e^{\frac{-t}{20ns}}}{1000} = .003e^{\frac{-t}{20ns}} \text{ A}$$

$$p_R(t) = v_R(t)i_R(t) = .009e^{\frac{-t}{10ns}} \text{ W}$$

15 points for correct equation

10 points for math errors

5 points if wrong voltage used (such as V_{in} or V_{out})

d) Answer: 10 Points Possible

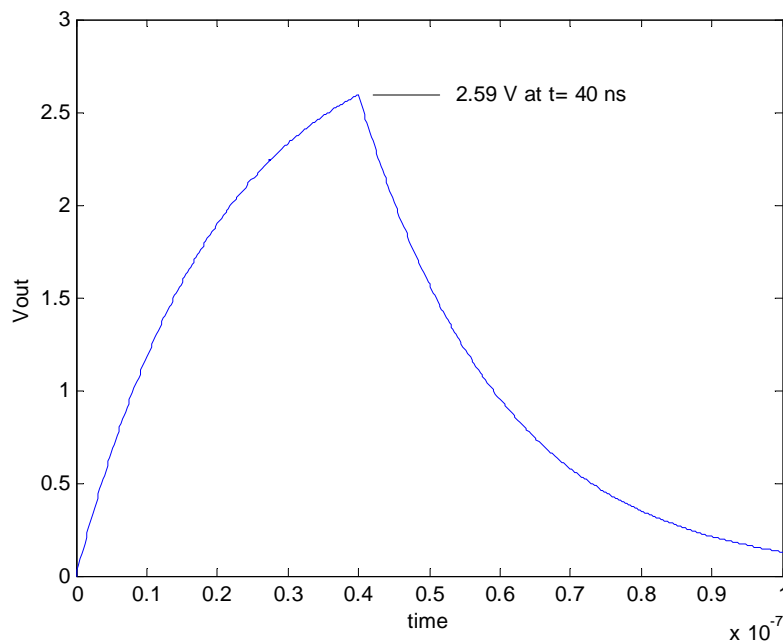
$$E_R = \int_{t=0}^{t \rightarrow \infty} p_R(t) dt = \int_{t=0}^{t \rightarrow \infty} .009e^{\frac{-t}{10ns}} dt = -10ns(.009e^{\frac{-t}{10ns}}) \Big|_{t=0}^{t \rightarrow \infty} = -10ns(0 - .009) = 90 \text{ pJ}$$

10 points for correct answer

5 points for math errors or correct energy calculation with wrong equation for power

Problem 2: 30 Total Points Possible

a) Answer: 15 Points Possible



15 points for correct graph with correct peak value/time shown on graph or elsewhere

10 points for peak voltage shown but peak time not indicated somehow

5 points for incorrect peak voltage or graph concavity wrong

If Problem 1, part b (V_{out} equation) wrong, grade the correctness of the method used here (full credit if correct method, etc.)

b) Answer: 15 Points Possible

$$V_{out}(t) = \begin{cases} 3 - 3e^{\frac{-t}{20ns}} & \text{for } 0 \leq t \leq 40ns \\ 2.59e^{\frac{-(t-40ns)}{20ns}} & \text{for } t > 40ns \end{cases}$$

15 points for correct equation (no derivation needed)

10 points for missing $-40ns$ shift in exponent or incorrectly/not defined time interval of validity

7 points for incorrect peak value

5 points for more errors in second part of graph

If Problem 1, part b (V_{out} equation) wrong, grade the correctness of the method used here (full credit if correct method, etc.)

Problem 3: 20 Total Points Possible

Answer: 20 Points Possible

Let PW denote the pulse width.

$$V_{out}(PW) = 3 - 3e^{\frac{-PW}{20ns}} = 2.1V$$

$$e^{\frac{-PW}{20ns}} = 0.3V$$

$$-PW / 20 ns = \ln 0.3 = -1.2$$

$$PW = 24 ns$$

20 points for correct answer, or right method but wrong $V_{out}(t)$ equation from Problem 1 part b

10 points for math errors

5 points for conceptual/setup errors