

Name: _____ (please print)

Signature: _____

ECE 3455
Quiz 3
October 4, 2010

Quiz duration: 30 minutes

1. You may have one 8 ½ x 11 in. “crib” sheet, written on both sides, during the quiz. You may have any calculator you choose, but no computers. No other notes or materials will be allowed.
2. Show all work necessary to complete the problem on these pages. A solution without the work shown will receive no credit.
3. Show units in intermediate and final results, and in figures.
4. If your work is sloppy or difficult to follow, points will be subtracted.

_____ /20

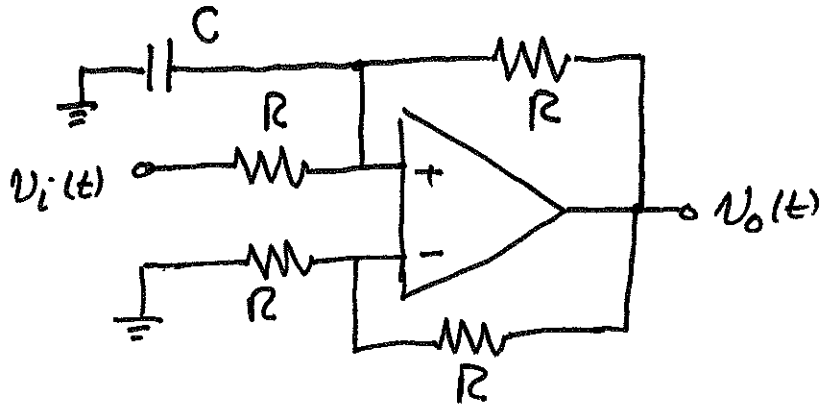
For the circuit below, the op amp is ideal. It is connected to +/- 15 V power supplies.

i) Find the output voltage $v_o(t)$ as a function of the input voltage $v_i(t)$.

ii) Assume $R = 2 \text{ k}\Omega$, $C = 1 \text{ }\mu\text{F}$, and

$$v_i(t) = 10^{-3} [\text{V/s}] t,$$

(t in s). How long does the op amp take to saturate?

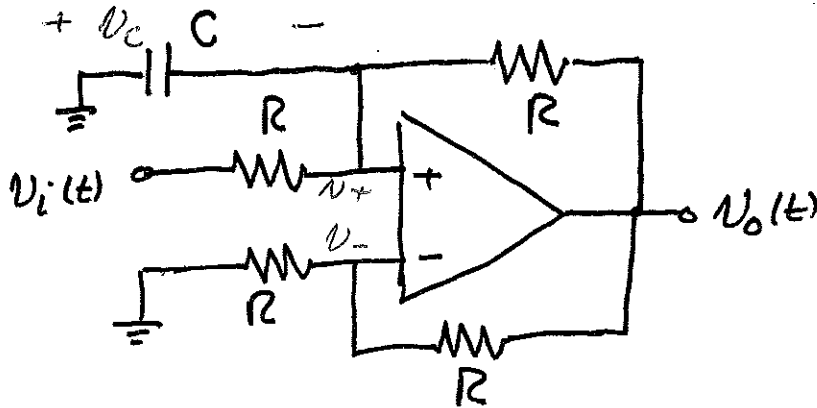


For the circuit below, the op amp is ideal. It is connected to +/- 15 V power supplies. Also, $v_c(t=0) = 0$.

- i) Find the output voltage $v_o(t)$ as a function of the input voltage $v_i(t)$.
- ii) Assume $R = 2 \text{ k}\Omega$, $C = 1 \text{ }\mu\text{F}$, and

$$v_i(t) = 10^{-3} \text{ [V/s] } t,$$

(t in s). How long does the op amp take to saturate?



i)

$$v_+ = v_- = \frac{v_o}{2}$$

$$\frac{v_+ - v_i}{R} + \frac{v_+ - v_o}{R} + C \frac{dv_+}{dt} = 0$$

$$\frac{v_o}{2R} - \frac{v_i}{R} + \frac{v_o}{2R} - \frac{v_o}{R} + \frac{C}{2} \frac{dv_o}{dt} = 0$$

$$v_i(t) = \frac{RC}{2} \frac{dv_o}{dt}$$

$$\Rightarrow v_o(t) = \frac{2}{RC} \int v_i(t) dt$$

$$ii) v_o(t) = \frac{2}{2 \times 10^3 \cdot 1 \times 10^{-6}} \int 10^{-3} t dt$$

$$= 10^3 \cdot 10^{-3} \cdot \frac{1}{2} t^2 = \frac{t^2}{2} \text{ V.}$$

$$\text{Saturation} \Rightarrow \frac{t^2}{2} = 15 \Rightarrow t = \sqrt{30} \text{ s.}$$

Room for Extra Work