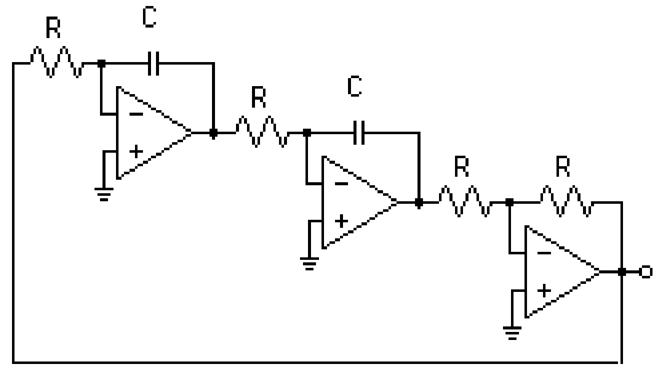
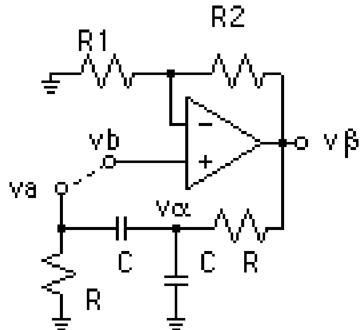
Oscillator Examples

(1) Assume idealized OpAmps. Verify that the output voltage Vo is sinusoidal.

'Take' Vo, integrate it twice, invert the signal, and set the result equal to Vo. This is a 'quadrature' oscillator. The oscillation frequency is $1/(2\pi RC)$. How is amplitude determined?



(2) Determine the oscillation conditions for the circuit shown.



$$v\alpha = va\left(1 + \frac{1}{sRC}\right)$$

$$v\beta = v\alpha + \left(sCv\alpha + \frac{va}{R}\right)R$$

$$= va\left(3 + SRC + \frac{1}{sRC}\right)$$

$$vb = v\beta\,\frac{R1}{R1 + R2}$$

$$= va \text{ (Barkhausen Condition)}$$

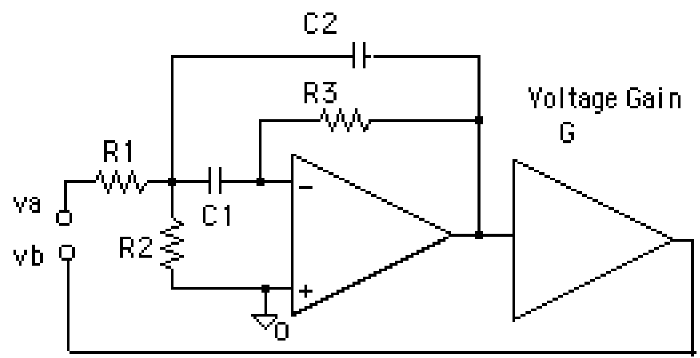
Solve: $\frac{R2}{R1} = 2 \qquad \omega RC = 1$

(3) Apply the Barkhausen Condition to the circuit shown to determine to determine oscillation is initiated when

$$\omega^2 R1\ R2\ C1\ C2 = 1 + \frac{R1}{R3}$$

$$G = -\frac{R1}{R3}\left(1 + \frac{C1}{C2}\right)$$

Assume idealized OpAmps.

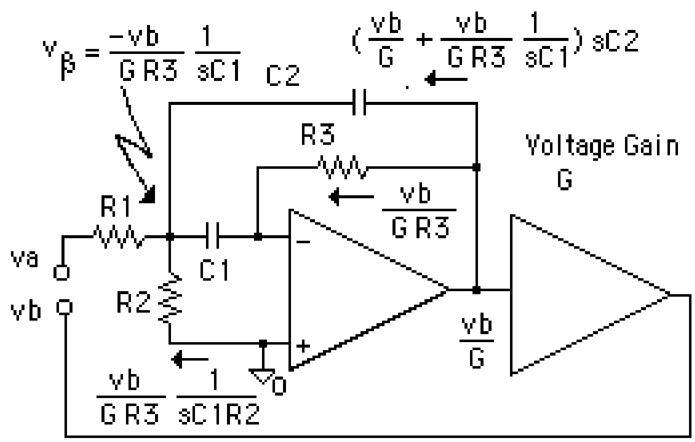


$$va = -\left[\left(\frac{vb}{G} + \frac{vb}{G\,R3}\,\frac{1}{sC1}\right)sC2 + \frac{vb}{G\,R3} + \frac{vb}{G\,R3}\,\frac{1}{sC1R2}\right]R1 - \frac{vb}{G\,R3}\,\frac{1}{sC1}$$

$$= vb \text{ (Barkhausen Condition)}$$

$$\omega^2 R1\ R2\ C1\ C2 = 1 + \frac{R1}{R3}$$

$$G = -\frac{R1}{R3}\left(1 + \frac{C1}{C2}\right)$$



(4) Assume idealized OpAmps. Verify that this circuit will oscillate with $\omega RC = 1$.