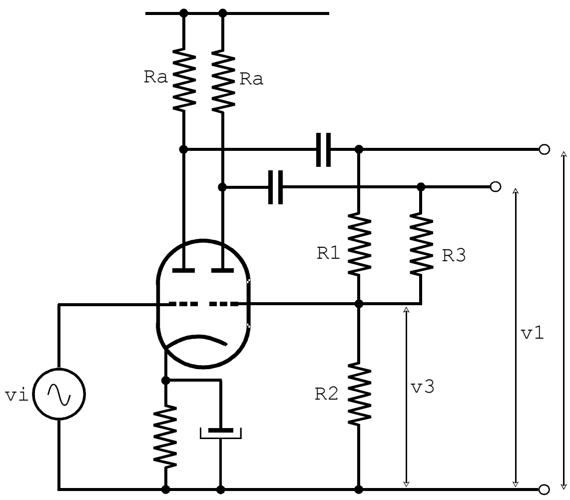
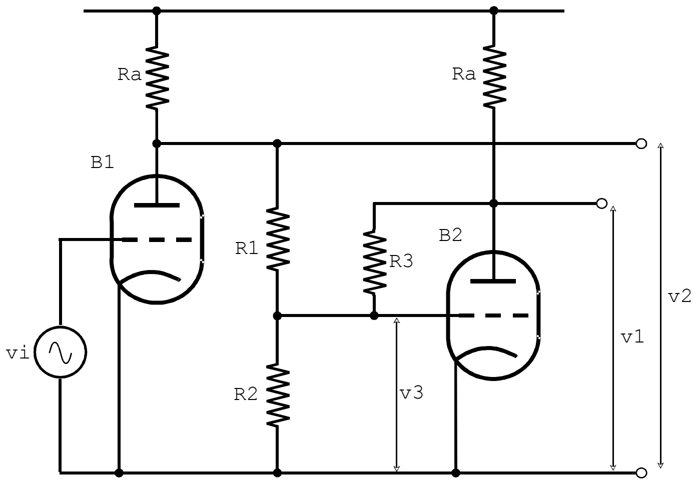
$\mu = 100$;
Ri= 20kΩ;
Ra= 80kΩ;
R1= 400kΩ;
R3= 20kΩ;
v2=-v1

Calculate the value of R2.

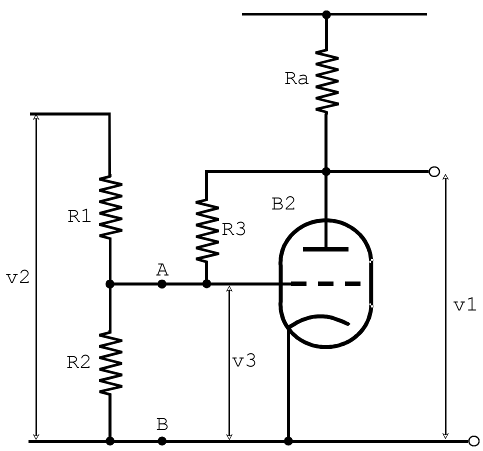


1.

For the calculation I draw an AC schematic leaving out the capacitors and using two (equal)triodes:



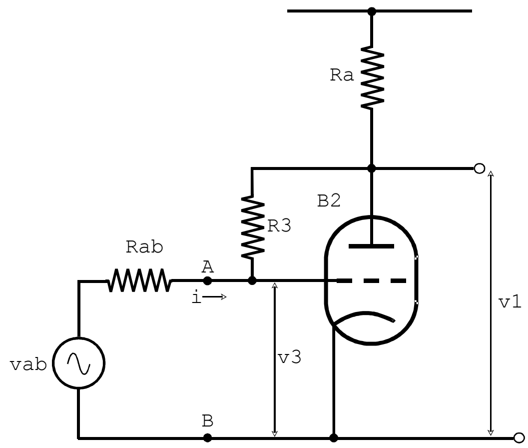
I draw again the AC diagram of the second triode from the anode of the first via the voltage divider R1-R2 to the second triode:



Using Thevenin's theorem by opening the circuit between terminals A-B and calculating the equivalent voltage Vab and the equivalent impedance Rab:

$$vab=\frac{R2}{R1+R2}\cdot v2 \quad ; \quad Rab=\frac{R1\cdot R2}{R1+R2}$$

We can redraw the circuit:



In the circuit above:

$$i=\frac{vab-v3}{Rab+R3} \qquad i=\frac{v3-v1}{R3}$$

And:

$$\frac{vab-v3}{Rab+R3}=\frac{v3-v1}{R3}$$

$$\frac{vab}{Rab}-\frac{v3}{Rab}=\frac{v3}{R3}-\frac{v1}{R3}$$

$$\frac{vab}{Rab}=\frac{v3}{Rab}+\frac{v3}{R3}-\frac{v1}{R3}$$

$$\frac{vab}{Rab}=v3\left(\frac{1}{Rab}+\frac{1}{R3}\right)-\frac{v1}{R3}$$

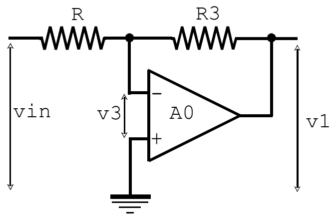
We also know that:

$$\frac{vab}{Rab}=\frac{R2}{R1+R2}\cdot\frac{R1+R2}{R1\cdot R2}\cdot v2$$

$$\frac{vab}{Rab}=\frac{v2}{R1}$$

$$\frac{v2}{R1}=v3\left(\frac{1}{Rab}+\frac{1}{R3}\right)-\frac{v1}{R3} \qquad (1)$$

To calculate the open loop gain remember opamp theory:



In op-amps the open loop gain is very high so the value of v3 is always neglected when calculating the transfer function, but with the triode this gain can be maximum μ theoretically.

$v3 = \frac{v1}{A0}$ where A0 is the open loop gain of the triode.

Substituting this in (1) gives:

$$\frac{v2}{R1} = \frac{v1}{A0}\left(\frac{1}{Rab} + \frac{1}{R3}\right) - \frac{v1}{R3} \qquad \text{(1a)}$$

$$v2 = \frac{v1}{A0}\left(\frac{R1}{Rab} + \frac{R1}{R3}\right) - \frac{R1}{R3} \cdot v1$$

$$v2 = v1\left\{\frac{1}{A0}\left(\frac{R1}{Rab} + \frac{R1}{R3}\right) - \frac{R1}{R3}\right\}$$

$$\frac{v2}{v1} = \frac{1}{A0}\left(\frac{R1}{Rab} + \frac{R1}{R3}\right) - \frac{R1}{R3} \qquad \text{(1b)}$$

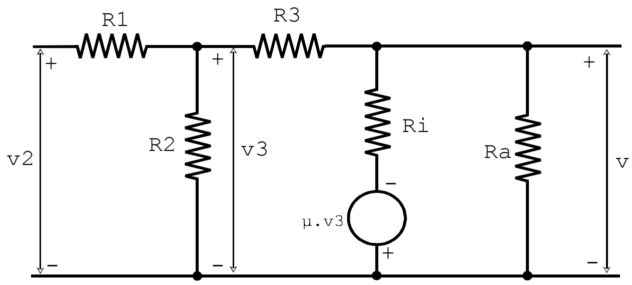
And because:

$$Rab = \frac{R1 \cdot R2}{R1 + R2}$$

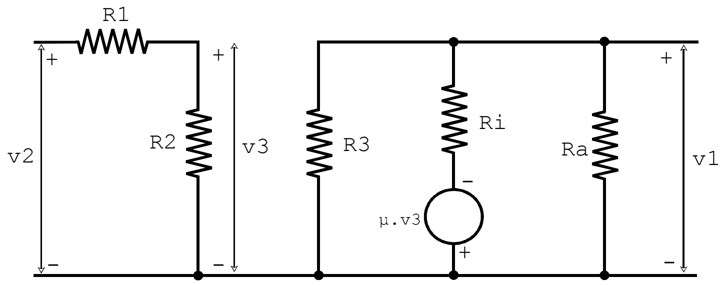
Substituting this in (1b):

$$\frac{v2}{v1} = \frac{1}{A0}\left(1 + \frac{R1}{R2} + \frac{R1}{R3}\right) - \frac{R1}{R3} \qquad \text{(2)}$$

Now we have to calculate A0 drawing the equivalent 'pi' circuit:



And disconnect the feedback resistor R3 and connect it to the common:



And calculate the open loop gain:

$$v1 = \frac{Rv}{Ri + Rv} \cdot \mu \cdot v3$$

Where Rv is the equivalent of Ra//R3

$$\frac{v1}{v3} = Ao = \frac{\mu \cdot Rv}{Ri + Rv}$$

Substituting the values:

$$Ao = \frac{100 \cdot 16}{20 + 16} = 44{,}4$$

Writing eq. (2) again and substituting the values:

$$\frac{v2}{v1} = \frac{1}{A0}\left(1 + \frac{R1}{R2} + \frac{R1}{R3}\right) - \frac{R1}{R3} \qquad (2)$$

$\frac{v2}{v1} = -1$; R1= 400kΩ ; R3= 20kΩ ; A0=44,44

$$-1 = \frac{1}{44{,}44}\left(1 + \frac{400}{R2} + \frac{400}{20}\right) - \frac{400}{20}$$

$$-1 = 0{,}0225 + \frac{9}{R2} + 0{,}45 - 20$$

$$-1 = \frac{9}{R2} - 19{,}53$$

$$18{,}53 \cdot R2 = 9$$

$$\boxed{R2 = \frac{9}{18{,}53} = 0{,}486\, k\Omega = 486\,\Omega}$$