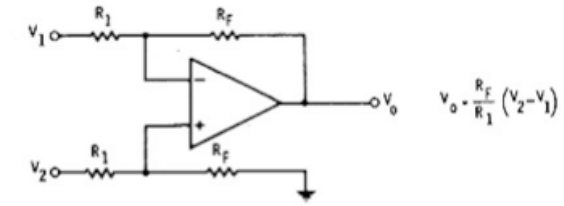
Homework Chapter 9 (Please attach this sheet to your HW solutions.)

#1- Derive the Vout for the Difference Amplifier from Op Amp first principles.

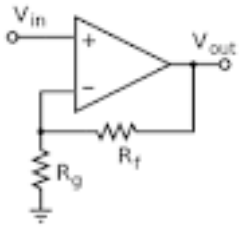


(F) Differential-input amp.

V1 - iR1 = V- or i = (V1-V⁻)/R1
V- = iRF + Vout or i = (V⁻ -Vout)/RF
(V1-V⁻)/R1 = (V⁻ -Vout)/RF
V- = (V1 RF +Vout R1)/(R1+RF)

V+ =V- = V2 RF/(R1+RF) = (V1 RF +Vout R1)/(R1+RF)
(V1 RF +Vout R1) = [V2 RF/(R1+RF)] (R1+RF)

#2 - With RF=100kΩ and Rg=10kΩ determine Vout as a function of Vin. Also evaluate the input impedance of the circuit.

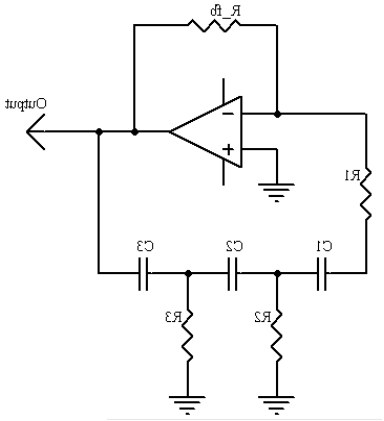


Non-Inverting Amp
Vout = Vin(1+RF/Rg) = 11 Vin
Rin ~ HIGH

#3- An amplifier has a common mode rejection ratio of cmrr=60db and a gain of *Av*=150. If a differential signal of 2mV is applied to the input along with an unwanted common mode noise of 10mV, what is the amplitude of the signal and noise at the output?

60db=10^{-3}
Av = 150 for true signal → Vsignal = 2mV x 150 = **300mV**
Acmrr = Av/80db = 150 x10^{-3} → Vnoise=(10+10)mV 150 x10^{-3} =**3.0mV**
Vout = 300 +/-3mV ~

#4- What is the frequency of the phase shift oscillator shown below. Given R1=R2=R3=1kΩ and C1=C2=C3= 10pf. Also give Rfb.



f=1/2πRC√6 = 6.5MHz
Rfb ~ 30R= 30 kΩ