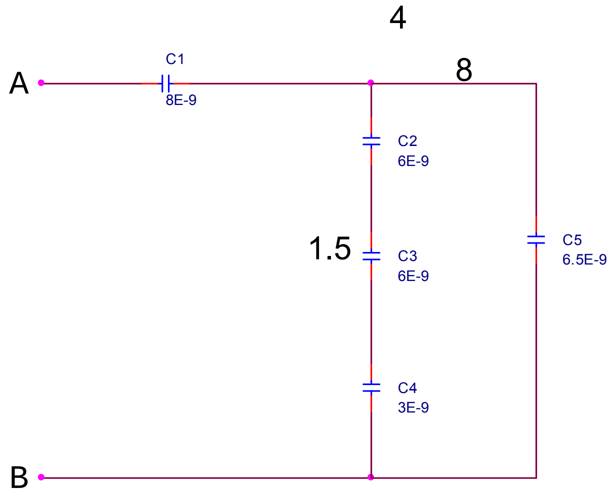
1) Equivalent impedances

a

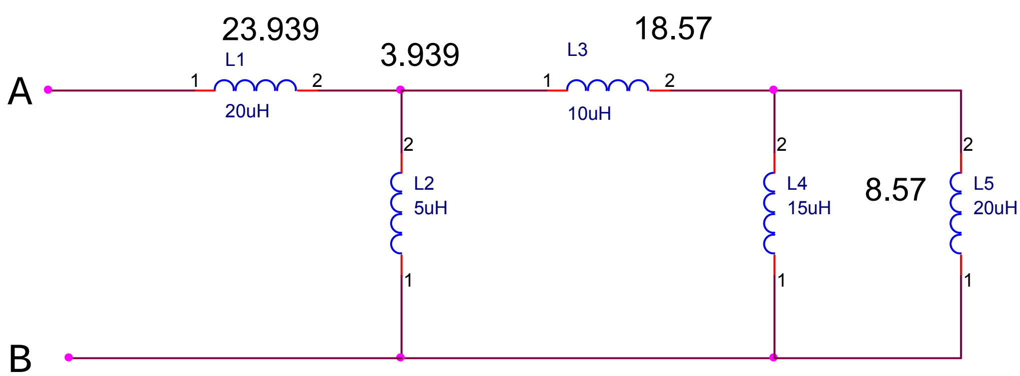
.



$C_1 := 8 \cdot 10^{-9} F$ $C_2 := 6 \cdot 10^{-9} F$ $C_3 := 610^{-9} F$ $C_4 := 3 \cdot 10^{-9} F$ $C_5 := 6.5 \cdot 10^{-9} F$

1.1: For the above circuit, determine the equivalent capacitance between A and B

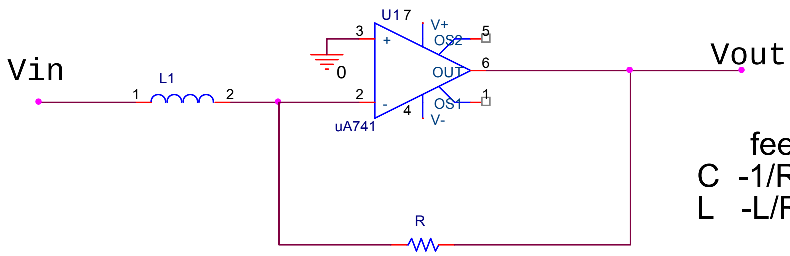
4nF



1.2: For the above circuit, determine the equivalent inductance between A and B

23.939uH

2) Amplifier circuits



	feedback	in
C	-1/RC int(Vin)dt	-RC d/dt Vin
L	-L/R d/dt Vin	-R/L int(Vin)dt

2.1: For the RL amplifier circuit, determine the relationship between Vout and Vin. As with RC amplifier circuits, KCL is a good starting point. (The power is taken out for simplicity but the op amp is powered).

V_{out}=-R/L \int_0^t V_{in} dt

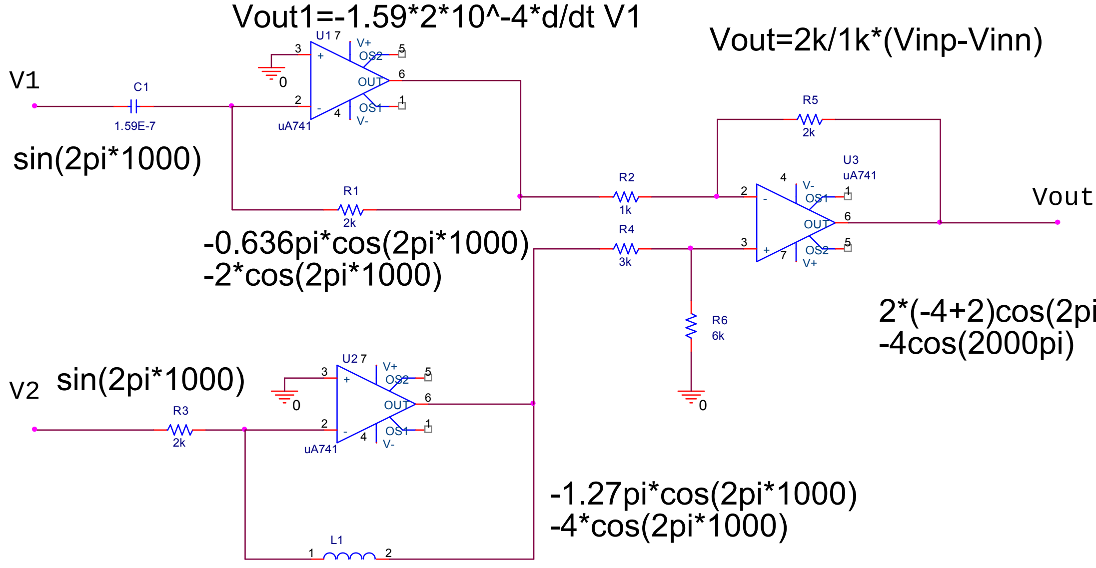
2.2: What type of op amp is this? integrator

differentiator

Vout1=-1.59*2*10^-4*d/dt V1

differential

Vout=2k/1k*(Vinp-Vinn)



sin(2pi*1000)

-0.636pi*cos(2pi*1000)
-2*cos(2pi*1000)

2*(-4+2)cos(2pi*1000)
-4cos(2000pi)

sin(2pi*1000)

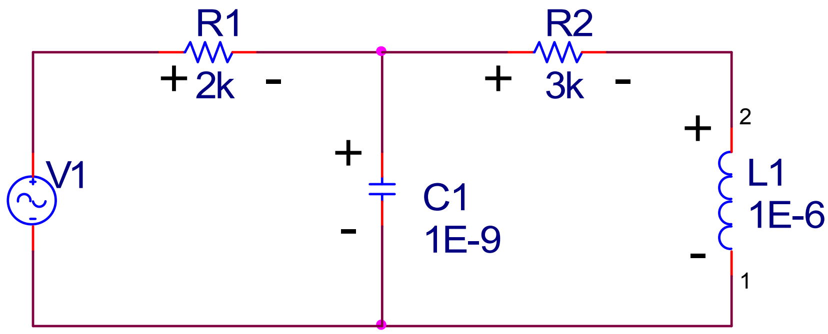
-1.27pi*cos(2pi*1000)
-4*cos(2pi*1000)

Vout1=-1.27/2*10^-3*d/dt V2
differentiator

2.3: In the above circuit V1=V2=1sin(2π f t) where the frequency is 1 kHz. Determine Vout.

-4cos(2000pi)

3) Voltage/Current continuity



In the above circuit, the voltage is defined as follows:

$$V1 = \begin{cases} 5V & t < 0 \\ 10V & 0 < t \end{cases}$$ (the voltage source turns on at t = 0)

3.1: Determine a mathematical expression for the source.

V=5u(t)+5

3.2: At t =0- (just before the voltage changes), for the polarities indicated, determine the voltage across each component and the current through each component.

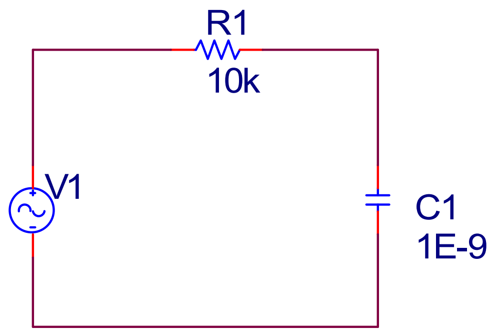
C=open
L=short

R1	2V	1mA
R2	3V	1mA
C	3V	0mA
L	0V	1mA

3.3: At $t=0^+$ (just after the voltage changes), determine the voltage across each component and the current through each component for the polarities indicated in the circuit.

R1	7V	3.5mA
R2	3V	1mA
C	3V	2.5mA
L	0V	1mA

4) First order circuits



4.1: Determine the voltage as a function of time for the source voltage V1 = 10 u(t).

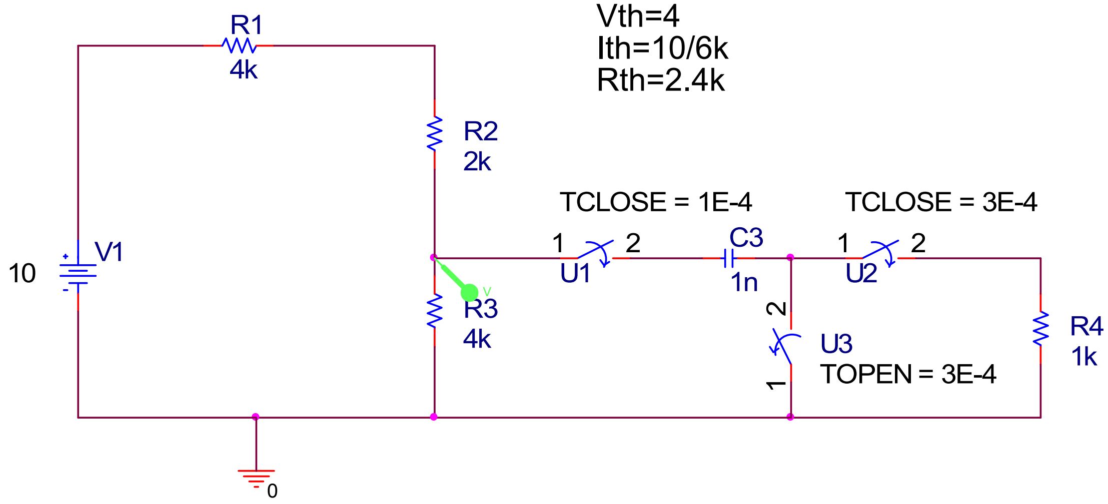
10-10e^{-t 10^5}

4.2: Determine the voltage as a function of time for the source voltage V1=8-3u(t)

5+3e^{-t 10^5} initial+change

final-change*e^{t/T}

5. First order switching circuit



Vth=4
Ith=10/6k
Rth=2.4k

In the above circuit, the voltage source turns on at t = 0. Switch U1 closes at t = 0.1 ms. Switch U2 closes and switch U3 opens at t = 0.3 ms (effectively putting resistor R3 in series with C3 at t = 0.3 ms).

5.1: Determine the voltage across R3 as a function of time for t > 0.

0<t<.1 TH V_TH=4 I_TH=10/6k=1.667mA R_TH=4/1.667m=2.4k

t<0	0
0<t<.1m	4
.1m<t<.3m	4(1-e^{-(t-.0001)/(2.4*10^-6)})
.3m<t	4

.2ms is multitudes times the time constant, so we can say that at t=.3ms^-, V=4. Adding resistance does nothing since the capacitor acts as an open circuit.