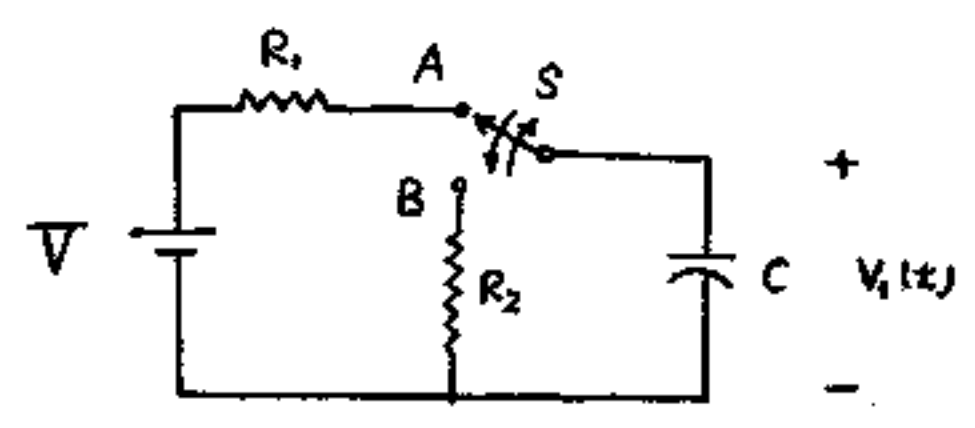
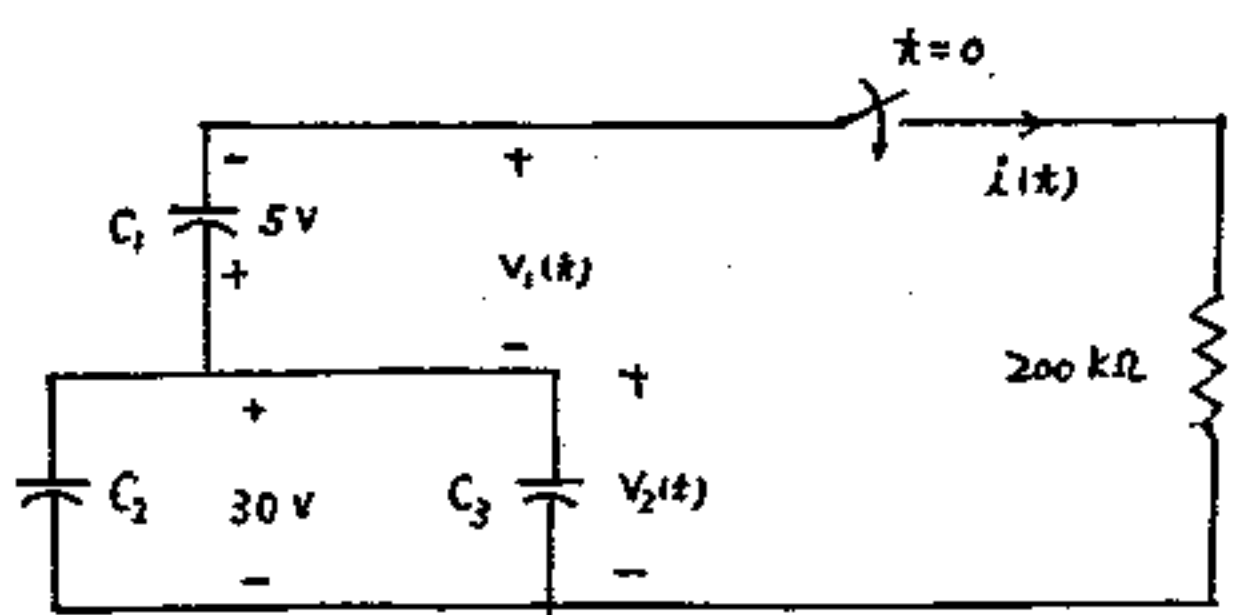


1. If  $v_1(0) = 0$ , sketch  $v_1(t)$ ,  $t \geq 0$ , for  $R_1 > R_2$  and  $R_1 < R_2$  respectively when switch S swings between points A and B periodically. (10 points)



2. Consider the following circuit. The initial voltages in the capacitors are shown in the Fig., and the switch is closed at  $t = 0$ .
- Find the current  $i(t)$ . (5 points)
  - Find the voltages  $v_1(t)$  and  $v_2(t)$ . (5 points)
  - Find the initial energy stored in capacitors  $C_1$ ,  $C_2$ , and  $C_3$  respectively. (5 points)
  - Find the energy dissipated by  $200k\Omega$ , and the energy stored in  $C_1$ ,  $C_2$ , and  $C_3$  respectively when  $t \rightarrow \infty$ . (5 points)

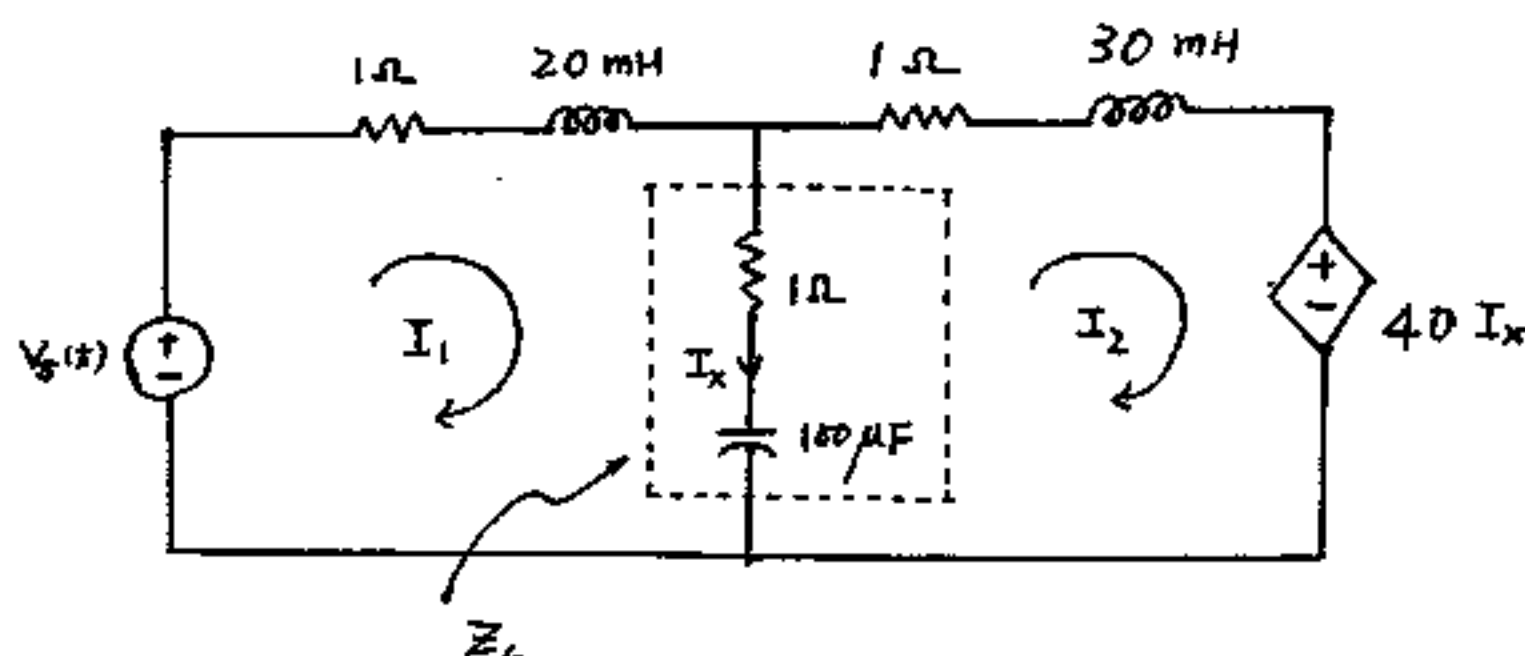


$C_1 = 6 \mu F$  ,  $C_2 = 2 \mu F$  ,  $C_3 = 4 \mu F$

3. Consider the circuit shown below, where  $v_s(t) = 150 \cos 100t$ .

(a) Find the mesh currents  $I_1$  and  $I_2$ . (10 points)

(b) Calculate the average power dissipated by  $Z_L$ . (10 points)



4. Please read the following statements and answer with True or False; please also write down your concise explanations in less than two sentences. (20 points)

(a) Most of the electronic devices are made of group IV chemical elements in the periodic table because of their good electrical conducting properties.

(b) Gallium Arsenide is a good semiconductor for opto-electronic applications because it has direct band-gap property for converting the recombination energy into light.

(c) In a voltage doubler circuit, two capacitors are connected in serial and formed into a bridge with two diodes because the load resistor can be supplied with double voltage.

(d) Bipolar Junction Transistors are named for their two bipolar junctions BE and BC; hence, they are very thermally stable because they operate on only one type of carriers.

(e) Metal Oxide Semiconductor (MOS) are named for the sandwich structure with metal (Al), oxide ( $\text{SiO}_2$ ), and semiconductor substrate; therefore, the MOS devices can be very energy efficient because the field effects on carriers are very easily applied on the MOS structure.

- (f) In the analysis of electronics, most of the fundamental calculations have to be done based on the *small signal assumption* because linear circuit theory can only be applied for those electronic circuits.
- (g) Operational amplifiers, one of the most popular industrial integrated circuits, are employed for its purpose of amplification so that mathematical multiplication and logarithmic operation are impossible to implement.
- (h) Because most of the electronic components have non-linear characteristics, almost all electronic circuits have been designed by making use of the *feedback theory*, which provide major benefits such as bandwidth extension, reduction of nonlinear distortion, and gain sensitivity etc.
- (i) Because Transistor-to-Transistor Logic circuits are the key components for manufacturing personal computers, TTL circuits are mainly defined to operate on 0 to 5 volt DC and three logical states 0, 1, and High Z.
- (j) In digital circuits, combinational logic are employed for resolving the sequence of output signals defined by a clock circuit with given inputs signals.
5. For a rectifying circuit, a transformer is employed for converting 110 volt AC at 60 Hz to 11 volt AC. Then, a silicon full-bridge rectifier is used for converting the 11 volt AC to DC voltage onto a 14 ohm load. Please calculate the turn ratio of the transformer, the maximum diode current, and the value of filter capacitor  $C$  if the ripple voltage  $V_r$  is less than 0.2 volt. The formula for calculating the capacitance is  $C = \frac{V_M}{2fRV_r}$ . (10 points)
6. The basic circuit configurations of operational amplifiers are inverting and non-inverting amplifiers. (a) Given with two resistors  $R_1$  and  $R_2$ , please draw the basic circuit configurations and derive the voltage gain of the circuits. (5 points) (b) If  $R_1$  and  $R_2$  are replaced by a capacitor  $C$  respectively on the inverting amplifier, please derive the gains of the two new circuits. (5 points) (c) If the resistor connecting the input and output of the operational amplifier is replaced by a diode, please explain what could happen for this design. (5 points)
7. Please use both NAND-NAND and AND-OR gates respectively to implement the following function  $F=AB'+C'D+E$ . (5 points)