

Figure 1.18 Illustration of KCL.

Kirchoff's Laws The Kirchoff Current Law (KCL) states that the sum of all currents flowing into a node is zero (Fig. 1.18):

$$\sum_j I_j = 0. \tag{1.5}$$

KCL in fact results from conservation of charge: a nonzero sum would mean that either some of the charge flowing into node X *vanishes* or this node *produces* charge.

The Kirchoff Voltage Law (KVL) states that the sum of voltage drops around any closed loop in a circuit is zero [Fig. 1.19(a)]:

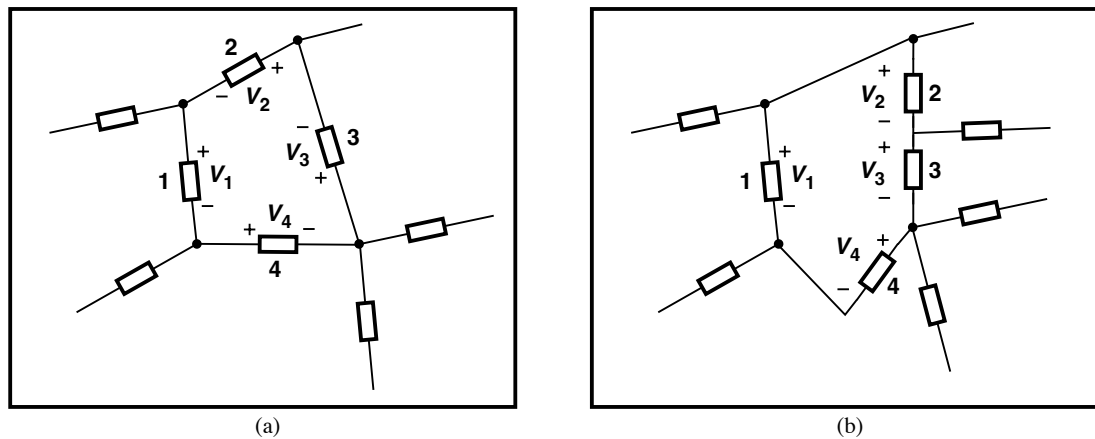


Figure 1.19 (a) Illustration of KVL, (b) slightly different view of the circuit .

$$\sum_j V_j = 0, \tag{1.6}$$

where V_j denotes the voltage drop across element number j . KVL arises from the conservation of the “electromotive force.” In the example illustrated in Fig. 1.19(a), we may sum the voltages in the loop to zero: $V_1 + V_2 + V_3 + V_4 = 0$. Alternatively, adopting the modified view shown in Fig. 1.19(b), we can say V_1 is *equal* to the sum of the voltages across elements 2, 3, and 4: $V_1 = V_2 + V_3 + V_4$. Note that the polarities assigned to V_2 , V_3 , and V_4 in Fig. 1.19(b) are different from those in Fig. 1.19(a).

In solving circuits, we may not know a priori the correct polarities of the currents and voltages. Nonetheless, we can simply assign arbitrary polarities, write KCLs and KVLs, and solve the equations to obtain the actual polarities and values.