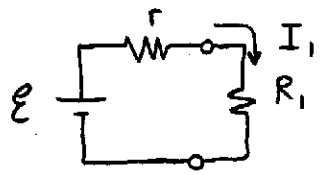
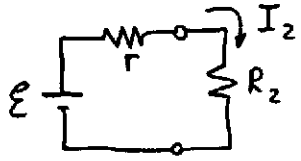
C1. When a 25.0-Ω resistor is connected across the terminals of a real battery, the current in the circuit is 0.477 A. If this resistor is then replaced by a 100-Ω resistor, the current in the circuit changes to 0.120 A. Calculate the internal resistance and the emf of the battery.

resistance	emf
0.210 Ω	12.0 V



① $\mathcal{E} = I_1(r+R_1)$ where $R_1 = 25.0\,\Omega$, $I_1 = 0.477\,A$



② $\mathcal{E} = I_2(r+R_2)$ where $R_2 = 100\,\Omega$, $I_2 = 0.120\,A$

so $I_1(r+R_1) = I_2(r+R_2)$

$I_1 r + I_1 R_1 = I_2 r + I_2 R_2$

$I_1 r - I_2 r = I_2 R_2 - I_1 R_1$

$$r = \frac{I_2 R_2 - I_1 R_1}{I_1 - I_2}$$

$$r = \frac{(0.120\,A)(100\,\Omega) - (0.477\,A)(25.0\,\Omega)}{0.477\,A - 0.120\,A}$$

$r = 0.210\,\Omega$

from ①

$\mathcal{E} = 0.477\,A(0.210\,\Omega + 25.0\,\Omega)$

$\mathcal{E} = 12.0\,V$