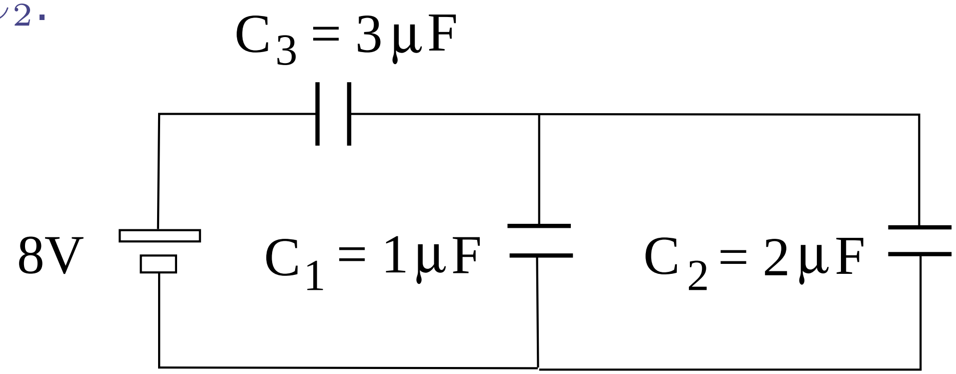
The circuit of capacitors connected to a battery is at equilibrium.

(a) Find the equivalent capacitance C_{eq}.

(b) Find the voltage V_3 across capacitor C_3.

(c) Find the the charge Q_2 on capacitor C_2.



Solution:

(a) $C_{12} = C_1 + C_2 = 3\mu\text{F}, \quad C_{eq} = \left(\frac{1}{C_{12}} + \frac{1}{C_3}\right)^{-1} = 1.5\mu\text{F}.$

(b) $Q_3 = Q_{12} = Q_{eq} = C_{eq}(8\text{V}) = 12\mu\text{C}$

$\Rightarrow \; V_3 = \frac{Q_3}{C_3} = \frac{12\mu\text{C}}{3\mu\text{F}} = 4\text{V}.$

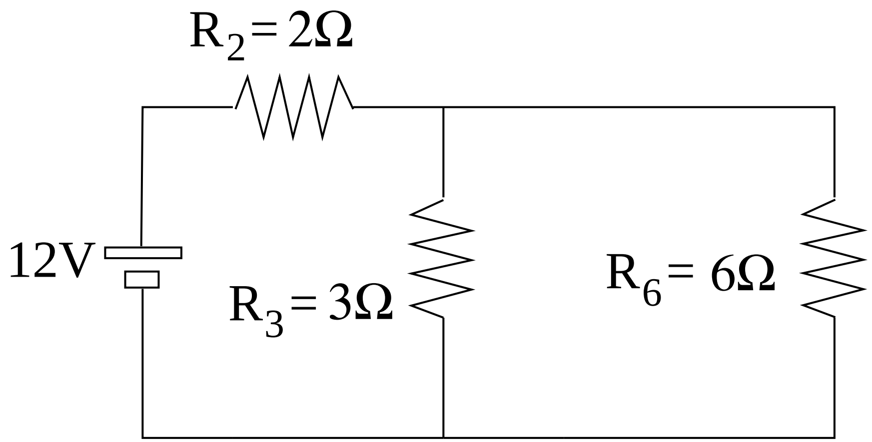
(c) $Q_2 = V_2 C_2 = 8\mu\text{C}$.

Intermediate Exam II: Problem #2 (Spring '05)

Consider the electrical circuit shown.

(a) Find the equivalent resistance R_{eq}.

(b) Find the current I_3 through resistor R_3.



Solution:

(a) $R_{36} = \left(\frac{1}{R_3} + \frac{1}{R_6}\right)^{-1} = 2\Omega, \quad R_{eq} = R_2 + R_{36} = 4\Omega.$

(b) $I_2 = I_{36} = \frac{12\text{V}}{R_{eq}} = 3\text{A}$

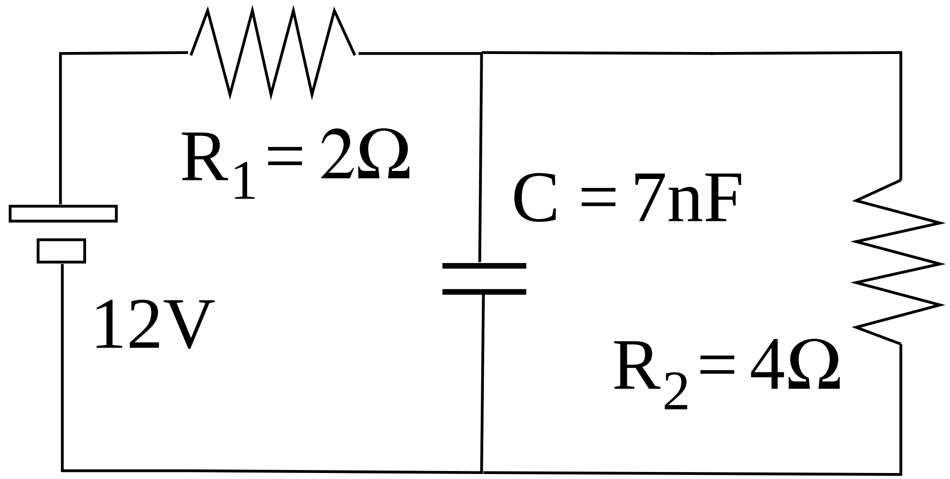
$\Rightarrow V_3 = V_{36} = I_{36}R_{36} = 6\text{V} \quad \Rightarrow I_3 = \frac{V_3}{R_3} = 2\text{A}.$

Intermediate Exam II: Problem #3 (Spring '05)

This RC circuit has been running for a long time.

(a) Find the current I_2 through the resistor R_2.

(b) Find the voltage V_C across the capacitor.



Solution:

(a) $I_C = 0, \quad I_2 = \dfrac{\mathcal{E}}{R_1 + R_2} = \dfrac{12\text{V}}{6\Omega} = 2\text{A}.$

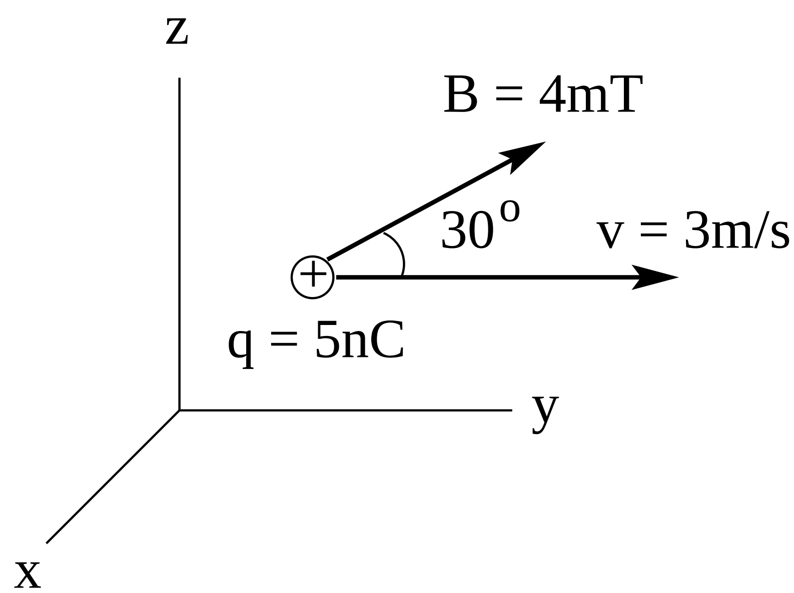
(b) $V_C = V_2 = I_2 R_2 = (2\text{A})(4\Omega) = 8\text{V}.$

Intermediate Exam II: Problem #4 (Spring ’05)

Consider a charged particle moving in a uniform magnetic field as shown. The velocity is in y-direction and the magnetic field in the yz-plane at 30° from the y-direction.

(a) Find the direction of the magnetic force acting on the particle.

(b) Find the magnitude of the magnetic force acting on the particle.



Solution:

(a) Use the right-hand rule: positive x-direction (front, out of page).

(b) $F = qvB\sin 30^\circ = (5\times10^{-9}\text{C})(3\text{m/s})(4\times10^{-3}\text{T})(0.5) = 3\times10^{-11}\text{N}$.