20. (a) In this situation, capacitors 1 and 3 are in series, which means their charges are necessarily the same:

$$q_1 = q_3 = \frac{C_1 C_3 V}{C_1 + C_3} = \frac{(1.0\,\mu\text{F})(3.0\,\mu\text{F})(12\,\text{V})}{1.0\,\mu\text{F} + 3.0\,\mu\text{F}} = 9.0\,\mu\text{C} \ .$$

Also, capacitors 2 and 4 are in series:

$$q_2 = q_4 = \frac{C_2 C_4 V}{C_2 + C_4} = \frac{(2.0\,\mu\text{F})(4.0\,\mu\text{F})(12\,\text{V})}{2.0\,\mu\text{F} + 4.0\,\mu\text{F}} = 16\,\mu\text{C} \ .$$

(b) With switch 2 also closed, the potential difference V_1 across C_1 must equal the potential difference across C_2 and is

$$V_1 = \frac{C_3 + C_4}{C_1 + C_2 + C_3 + C_4} V = \frac{(3.0\,\mu\text{F} + 4.0\,\mu\text{F})(12\,\text{V})}{1.0\,\mu\text{F} + 2.0\,\mu\text{F} + 3.0\,\mu\text{F} + 4.0\,\mu\text{F}} = 8.4\ \text{V} \ .$$

Thus, $q_1 = C_1 V_1 = (1.0\,\mu\text{F})(8.4\,\text{V}) = 8.4\,\mu\text{C}$, $q_2 = C_2 V_1 = (2.0\,\mu\text{F})(8.4\,\text{V}) = 17\,\mu\text{C}$, $q_3 = C_3(V - V_1) = (3.0\,\mu\text{F})(12\,\text{V} - 8.4\,\text{V}) = 11\,\mu\text{C}$, and $q_4 = C_4(V - V_1) = (4.0\,\mu\text{F})(12\,\text{V} - 8.4\,\text{V}) = 14\,\mu\text{C}$.