18. (a) First, the equivalent capacitance of the two $4.0\,\mu$F capacitors connected in series is given by $4.0\,\mu\text{F}/2 = 2.0\,\mu$F. This combination is then connected in parallel with two other 2.0-μF capacitors (one on each side), resulting in an equivalent capacitance $C = 3(2.0\,\mu\text{F}) = 6.0\,\mu$F. This is now seen to be in series with another combination, which consists of the two 3.0-μF capacitors connected in parallel (which are themselves equivalent to $C' = 2(3.0\,\mu\text{F}) = 6.0\,\mu\text{F}$). Thus, the equivalent capacitance of the circuit is

$$C_{\text{eq}} = \frac{CC'}{C + C'} = \frac{(6.0\,\mu\text{F})(6.0\,\mu\text{F})}{6.0\,\mu\text{F} + 6.0\,\mu\text{F}} = 3.0\,\mu\text{F} .$$

(b) Let $V = 20$ V be the potential difference supplied by the battery. Then $q = C_{\text{eq}}V = (3.0\,\mu\text{F})(20\,\text{V}) = 6.0 \times 10^{-5}$ C.

(c) The potential difference across C_1 is given by

$$V_1 = \frac{CV}{C + C'} = \frac{(6.0\,\mu\text{F})(20\,\text{V})}{6.0\,\mu\text{F} + 6.0\,\mu\text{F}} = 10\,\text{V} ,$$

and the charge carried by C_1 is $q_1 = C_1V_1 = (3.0\,\mu\text{F})(10\,\text{V}) = 3.0 \times 10^{-5}$ C.

(d) The potential difference across C_2 is given by $V_2 = V - V_1 = 20\,\text{V} - 10\,\text{V} = 10\,\text{V}$. Consequently, the charge carried by C_2 is $q_2 = C_2V_2 = (2.0\,\mu\text{F})(10\,\text{V}) = 2.0 \times 10^{-5}$ C.

(e) Since this voltage difference V_2 is divided equally between C_3 and the other 4.0-μF capacitors connected in series with it, the voltage difference across C_3 is given by $V_3 = V_2/2 = 10\,\text{V}/2 = 5.0\,\text{V}$. Thus, $q_3 = C_3V_3 = (4.0\,\mu\text{F})(5.0\,\text{V}) = 2.0 \times 10^{-5}$ C.