## Answer on Question 58074, Physics, Electric Circuits

## Question:

The capacitances of the four capacitors shown in the figure are given in terms of a certain quantity $C$. If $C=37 \mu F$, what is the equivalent capacitance (a) between points $A$ and $B$ and (b) between points $A$ and $D$ ?

## Solution:


a) Let's look at the picture above and let's find the equivalent capacitance between points $A$ and $B$ step-by-step. Here the capacitors $4 C$ and $6 C$ are in series, then the equivalent capacitance will be:

$$
C_{e q 1}=\frac{C_{1} C_{2}}{\left(C_{1}+C_{2}\right)}=\frac{4 C \cdot 6 C}{(4 C+6 C)}=\frac{24 C^{2}}{10 C}=\frac{12 C}{5} .
$$

The combination of these two capacitors is in parallel to capacitor $2 C$, then the equivalent capacitance will be:

$$
C_{e q 2}=C_{1}+C_{2}=C_{e q 1}+2 C=\frac{12 C}{5}+2 C=\frac{22 C}{5} .
$$

Finally, that combination of capacitors is in series with capacitor $1 C$, then the equivalent capacitance will be:

$$
\begin{gathered}
C_{e q(A B)}=\frac{C_{1} C_{2}}{\left(C_{1}+C_{2}\right)}=\frac{\frac{22 C}{5} \cdot 1 C}{\left(\frac{22 C}{5}+1 C\right)}=\frac{\frac{22}{5} C^{2}}{\frac{27 C}{5}}=\frac{22 C}{27} \\
C_{e q(A B)}=\frac{22 C}{27}=\frac{22 \cdot 37 \cdot 10^{-6} F}{27}=30.15 \mu \mathrm{~F}
\end{gathered}
$$

b) Let's look at the picture above and let's find the equivalent capacitance between points $A$ and $D$ step-by-step. Here the capacitors $2 C$ and $6 C$ are in series, then the equivalent capacitance will be:

$$
C_{e q 1}=\frac{C_{1} C_{2}}{\left(C_{1}+C_{2}\right)}=\frac{2 C \cdot 6 C}{(2 C+6 C)}=\frac{12 C^{2}}{8 C}=\frac{3 C}{2} .
$$

The combination of these two capacitors is in parallel to capacitor $4 C$, then the equivalent capacitance will be:

$$
C_{e q 2}=C_{1}+C_{2}=C_{e q 1}+4 C=\frac{3 C}{2}+4 C=\frac{11 C}{2} .
$$

Finally, that combination of capacitors is in series with capacitor $1 C$, then the equivalent capacitance will be:

$$
\begin{gathered}
C_{e q(A D)}=\frac{C_{1} C_{2}}{\left(C_{1}+C_{2}\right)}=\frac{\frac{11 C}{2} \cdot 1 C}{\left(\frac{11 C}{2}+1 C\right)}=\frac{\frac{11}{2} C^{2}}{\frac{13 C}{2}}=\frac{11 C}{13} \\
C_{e q(A D)}=\frac{11 C}{13}=\frac{11 \cdot 37 \cdot 10^{-6} F}{13}=31.31 \mu \mathrm{~F}
\end{gathered}
$$

## Answer:

a) $C_{e q(A B)}=30.15 \mu F$.
b) $C_{e q(A D)}=31.31 \mu F$.

