1. Vacuum: $\varepsilon_r = 1$

$$C = \frac{\varepsilon_0 \varepsilon_r A}{d}$$

$$C_{nom} = \frac{(8.854)(1)(1\times10^{-3})^2}{2\times10^{-6}} = 4.427\,pF$$

$$C_{max} = \frac{(8.854)(1)(1\times10^{-3})^2}{1\times10^{-6}} = 8.854\,pF$$

$$C_{min} = \frac{(8.854)(1)(1\times10^{-3})^2}{3\times10^{-6}} = 2.951\,pF$$

2. $V_{Oc_{nom}} = \frac{10(3p)}{10p} = 3V$

$V_{Oc_{max}} = \frac{10(5p)}{10p} = 5V$

$V_{Oc_{min}} = \frac{10(2p)}{10p} = 2V$

3. $f \simeq \frac{0.455}{RC}$, $R = 100K\Omega$

$$f_{c_{nom}} = \frac{0.455}{(100{,}000)(3\times10^{-12})} = 1.517\,MHz$$

$$f_{c_{min}} = \frac{0.455}{(100{,}000)(2\times10^{-12})} = 2.275\,MHz$$

$$f_{c_{max}} = \frac{0.455}{(100{,}000)(5\times10^{-12})} = 910\,KHz$$

4. $\bar{V}_{in} = 10V \rightarrow$ AC amplitude

1st case: $C_1 = C_2 = 3pF$

$$\bar{V}_{OUT} = \frac{10\,C_1}{C_1+C_2} = \frac{10(3)}{3+3} = 5V$$

2nd case: $C_1 = 5pF$, $C_2 = 2pF$

$$\bar{V}_{OUT} = \frac{10\,C_1}{C_1+C_2} = \frac{10(5)}{5+2} = 7.14V$$

3rd case: $C_1 = 2pF$, $C_2 = 5pF$

$$V_{out} = \frac{10 C_1}{C_1 + C_2} = \frac{10(2)}{2+5} = 2.86V$$

5. Use $R_{eq} = \frac{1}{fC}$, $f = 250KHz$

$$C_{min} = 2pF \rightarrow R_{eq} = \frac{1}{(250,000)(2\times10^{-12})} = 2M\Omega$$

$$C_{max} = 5pF \rightarrow R_{eq} = \frac{1}{(250,000)(5\times10^{-12})} = 800K\Omega$$

$$C_{nom} = 3pF \rightarrow R_{eq} = \frac{1}{(250,000)(3\times10^{-12})} = 1.33M\Omega$$

6. $\tau = 0.693RC$, $R = 250K\Omega$

$$\therefore \tau_{C_{min}} = 0.693(250,000)(2\times10^{-12}) = 0.347\mu s$$

$$\tau_{C_{max}} = 0.693(250,000)(5\times10^{-12}) = 0.866\mu s$$

$$\tau_{C_{nom}} = 0.693(250,000)(3\times10^{-12}) = 0.520\mu s$$

7. $\sigma_T = \frac{\sigma}{K} = \frac{100}{10} = 10\mu S/m$

$$\therefore \sigma_{25} = \frac{\sigma_T}{1 + a(T-25)} = \frac{10}{1 + 0.02(10-25)} = 14.29\mu S/m$$