WS7 Solutions

(1) $[k] = \frac{N}{m} = \frac{J}{m^2}$, $[C] = \frac{C}{\frac{J}{C}} = \frac{C^2}{J}$

$[x] = m$, $[V] = \frac{J}{C}$

Can increase/decrease both x and V externally

Can't really change k, could have a "variable capacitor", but often practical to build "circuits" of both, with different k, C.

(2) $C = \frac{Q}{V} \Rightarrow Q = CV = 3.15 \times 10^{-4} \cdot 470\ F V = 0.148\ [C]$

(3) $U = \frac{CV^2}{2} = \frac{3.15 \times 10^{-4} \cdot 470^2}{2} = 34.8\ J$

(4) $U = \frac{CV^2}{2} = \frac{4.71 \times 10^{-4} \cdot 200^2}{2} = 9.42\ J$

Perhaps the decrease is due to:

- Increased Safety (lower V)
- Better* power production elsewhere in the car *= faster
- Lighter car (less power needed)
- Faster responsiveness (higher C)

(5) $C = \varepsilon_0 \frac{A}{d} = 8.854 \times 10^{-12} \frac{F}{m} \cdot \frac{20}{(100)^2} m^2 \cdot \frac{1}{0.002 m} = 8.854 \times 10^{-12} F$

(6) It doesn't

(7) $C \to 10C = 8.854 \times 10^{-11} F$

(8) More surface area → higher capacitance ← wrap spirals
Easier manufacture / more durable

(9) It will increase! (Capacitance goes down, but voltage goes up more)

(10) $\frac{1}{C} = \frac{1}{2} + \frac{1}{3} \Rightarrow C = \frac{1}{\frac{1}{2}+\frac{1}{3}} = \frac{6}{5}$

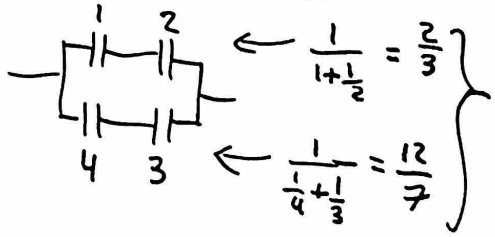
(11) $C = 3 + 2 = 5$

(12) $C = 5 + \frac{6}{5} = \frac{31}{5}$

(13) $\frac{1}{C} = \frac{1}{\frac{31}{5}} + \frac{1}{\frac{31}{5}} \Rightarrow C = \frac{1}{\frac{10}{31}} = \frac{31}{10}$

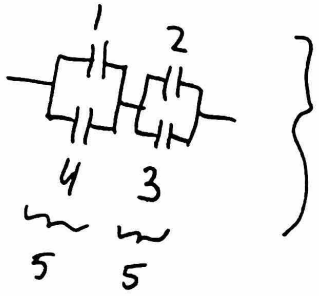
(14) $\frac{1}{C} = \frac{1}{10} + \frac{1}{2\cdot\frac{6}{5}} \Rightarrow C = \frac{1}{\frac{1}{10}+\frac{5}{12}} = \frac{120}{62}$

(15) Equivalent circuit:



$C = \frac{2}{3} + \frac{12}{7} = \frac{50}{21}$

(16) Equivalent Circuit:



$C = \frac{1}{\frac{1}{5}+\frac{1}{5}} = \frac{5}{2}$