Alvl P2: capacitance (ch6) Cheat Sheet

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Definitions

Capacitance	the charge stored per unit pd
capacitor	component that stores charge. composed of two parallel conducting plates with a dielectric between them
dielectric	an insulating material placed between the two plates of a capacitor in order to increase the amount of charge it can store
time constant	time taken for a capacitor to dishcarge 37% of its inital charge
	it is equal to the product of capacitance and the resistance of a fixed resistor (that the capcitor is being discharged through)

intro

- the positive side of the battery attracts electrons from one side of the initally uncharged plate

--> this causes the left plate to become positively charged

- the negative side of the battery repels these new electrons to the right of the parallel plates

--> causing the right to become positively charged

it can also be used to recity ac current by bring the current down gradually instead or sharply (? refer to graph)

these plates store these electrons as charge so if the circuit breaks connection with the battery a separate circuit connected to the capacitor can continue to operate with the capacitor acting as a battery until it runs out of charge

maximum stored charge = pd across the battery

Equations

capacitance	Q/V (farad)
V	EQ
energy stored in a capacitor	1/2 QV
(area under graph)	
	1/2 CV^2
V/Vo (V over V inital)	$e^{-t/RC}$
C	Er Eo A / d
	Er -relative permitivity of a dielectric/insulator between plates
	Eo -relative permitivity of free space
	A area of plates
	d distance between plates
-	-

in a capcitor half the energy is always lost to heat either in resistor or wires etc
(refer to energy = 1/2 QV - this is where the missing energy is going)

Capacitors in series and parallel

capacitor	series	parallel
charge	same	2x
pd	split	same
C total	1/Ct = 1/C1+1/C2	Ct = C1+C2

Decay and Time constant

compared to the V-t graph of a charging capacitor (similar to $x^{1/2}$) which changes to a curved exponential decreasing graph of I-t
the V and I-t graphs for a discharging capacitor are the same (same shape as charging I-t)
V/Vo = $e^{-t/RC}$
r- resistance
c- capacitance
when t = RC we get e^{-1} which is 0.37 (37%)
therefore when the time equals the resistance, we get 37% of the original voltage
this is why RC is our time constant - tc

Capacitance and dielectrics

if you were to increase the distance between the two plates the capacitance would decrese
two things can follow from that:
1. if the battery was connected - you have a constant v
as E = $1/2CV^2$
the energy would decrease
2. if the battery was disconnected - you have a constant Q
as E = $1/2Q^2/C$
energy increases
(2 makes sense as if you try to separate two charged plates that are attracting each other then you are putting energy into the system to do this)