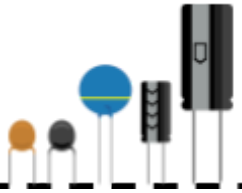
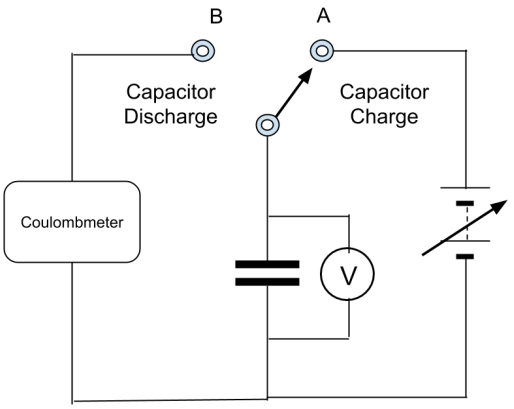
# Electricity

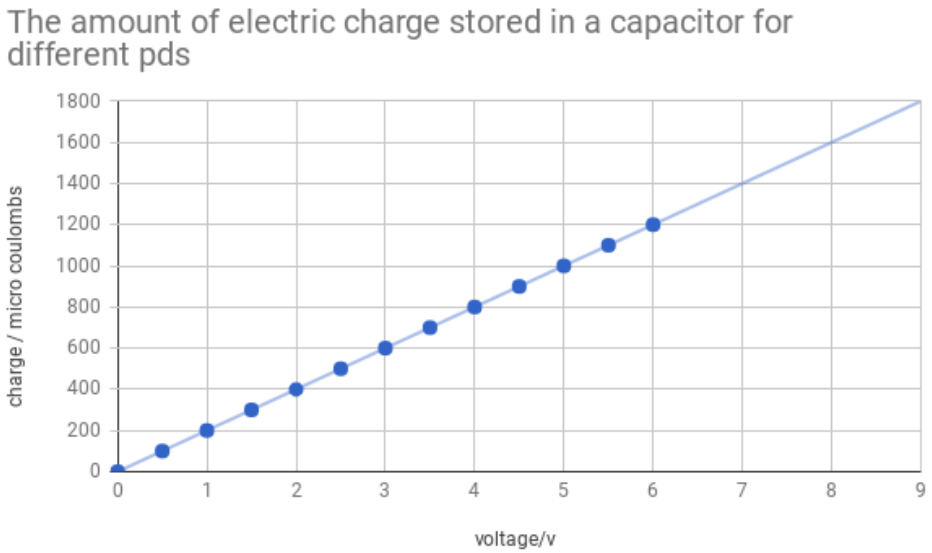
## Capacitors



1) A capacitor was connected to a variable DC source. The amount of electric charge stored on the plates of the capacitor was measured using a coulomb meter as shown




The capacitor is charged by putting the switch in position A and then discharged by putting the switch in position B.
The variable dc voltage supply is changed and the amount of charge stored in the capacitor is noted for different voltages across the capacitor.



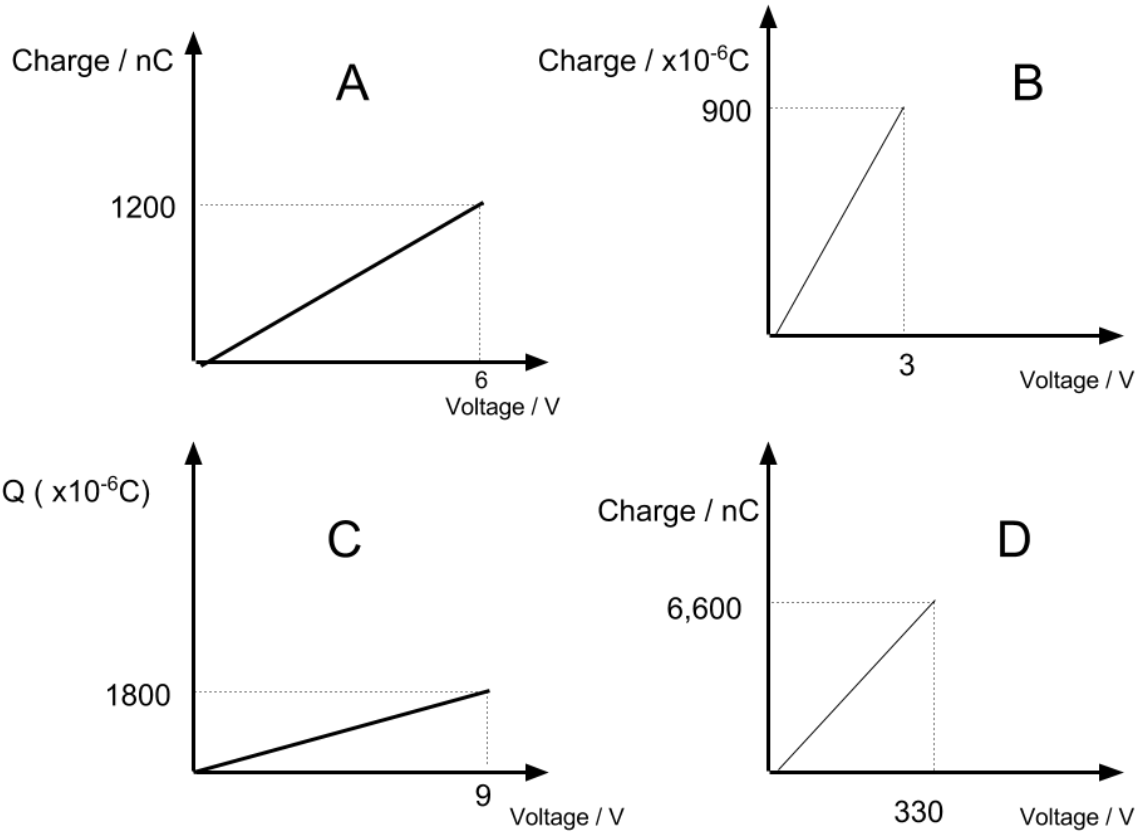

a) State the relationship between the pd across the capacitor and the amount of charge stored on its plates.
b) What does the gradient of the graph measure?
c) State what is meant by the *capacitance* of a capacitor.

2) State what each term means and give units in the equation $C = \frac{Q}{V}$

3) Determine the unknown quantity in the following capacitors.

| | | |
|---|---|---|
| (a)<br>C = ?<br>Q = 40 x $10^{-9}$ C<br>V = 20 V | (b)<br>C = 200 μF<br>Q = ?<br>V = 4 V | (c)<br>C = 10,000 μF<br>Q = 4.5 x $10^{-6}$ C<br>V = ? |
| (d)<br>C = 2.2 pF<br>Q = ?<br>V = 200 V | (e)<br>C = ?<br>Q = 500 C<br>V = 50V | (f)<br>C = 2200 μF<br>Q = 1.1 x $10^{3}$ C<br>V = ? |

4) To determine the capacitance of a batch of capacitors the pd across them is varied and the total charge stored is measured by a coulombmeter.
For each capacitor`s graph of the pd against charge determine the value of the capacitance.



5) Find the maximum electric charge that can be stored in a 5,000 μF can store when it is connected across a 12 V dc supply.

6) A 200 nF capacitor is fully charged from a 6 V dc supply.
   a) Find the maximum electric charge stored in the capacitor.
   b) The capacitor was fully discharged in a time of 8.0 ms determine the average current during discharge.

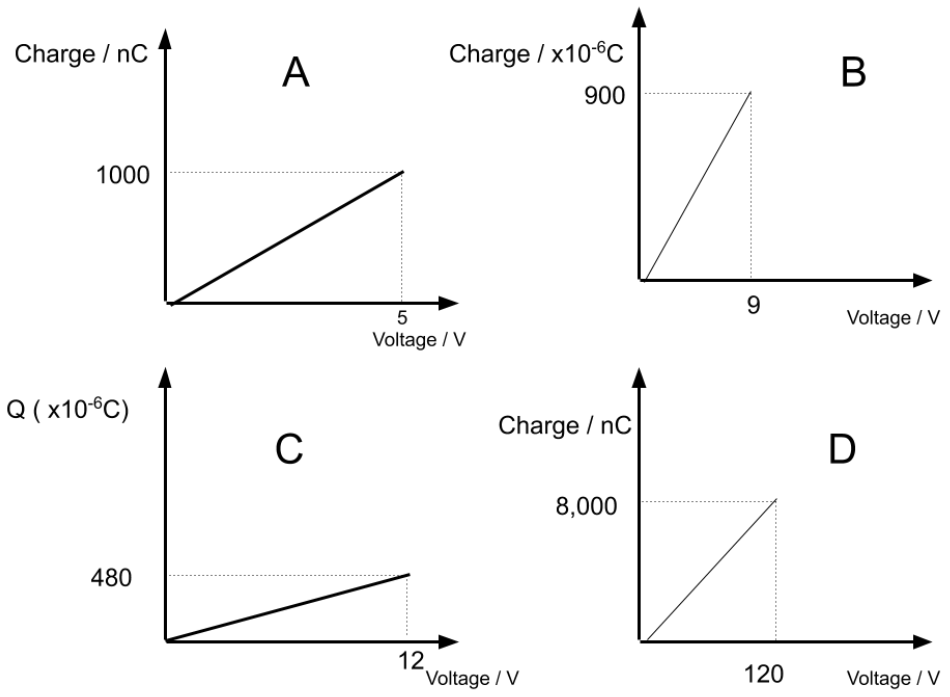
7) A 2,200 μF capacitor is connected across a 12 V dc supply.
   a) Find the maximum charge stored on the capacitor when it is fully charged.
   b) The capacitance was discharged in a time of 0.01 s. Find the average discharge current.

## Energy stored in a capacitor.

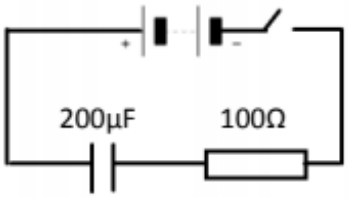
8) Determine the maximum energy stored in a fully charged capacitor of 4.7 nF when the pd across its plates is 6 V

9) A 10 μF capacitor is fully charged. The pd across its plates is 12 V.
   a) Find the energy stored in the capacitor.
   b) Determine the total electric charge stored in the capacitor.

10) In the following graphs of charge and voltage for capacitors A,B,C and D, determine the energy stored in the capacitor.



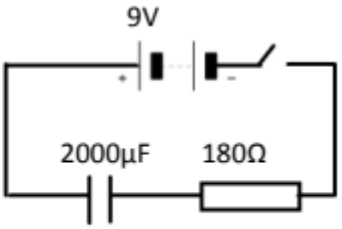
11) A physics pupil builds the following circuit using a 6 volt cell, a resistor and capacitor.




Given the values of the capacitor and resistor in the circuit calculate

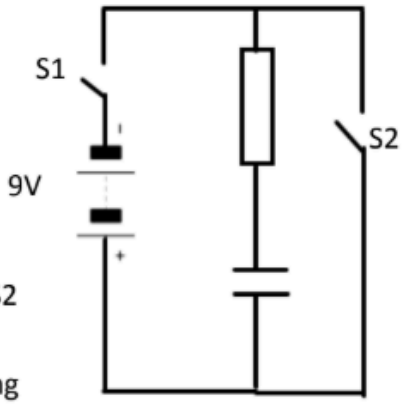
a) the initial current that flows when the circuit is switched
b) the final charge on the capacitor
c) the final energy stored in the capacitor.

12) In the capacitor resistor circuit shown calculate



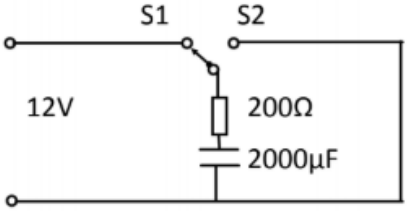

a) The maximum current that initially flows when the circuit is switched on.
b) The energy stored in the capacitor when the pd across the resistor is 4 volts.
c) Describe how a student would know if the capacitor was fully charged.

13) A capacitor of value 90 nF is connected in series with a resistor of 200Ω. Connected to a 9 volt battery.
When switch S1 is closed and S2 is open the capacitor is charged.




a) Sketch a graph of the pd across the capacitor as it charges.
b) Calculate the maximum current when S1 is closed and S2 is open.
c) S1 is now open and S2 is closed. Copy the circuit showing the direction of the discharging current.
d) What will be the size of the maximum discharge current?

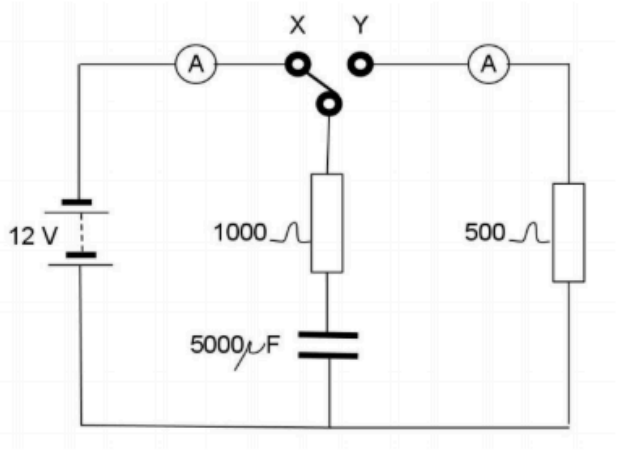
14) When the switch is placed at position S1 the capacitor starts to charge.




a) Calculate the maximum current that flows during charging.
b) When the pd across the capacitor is 8 volts find the amount of charge on the capacitor`s plates.
c) Sketch a graph of the current for charging at position S1 and then discharging at position S2

15)

A physics student built the circuit, shown below, to demonstrate the charging and discharging of a capacitor. The capacitor is charged when it is switched to position X and discharged when it is switched to position Y.




a) Calculate the maximum current on the ammeter when the switch is at position X.

b) When the pd across the capacitor is 9 V during charging calculate the energy stored in the capacitor at this moment in charging.

c) Calculate the maximum discharging current when the switch is set to position Y.

d) When the circuit is switched to position Y explain whether the capacitor will take a longer or shorter time to discharge than it did to charge.

e) Sketch two graphs showing the current against time for charging and discharging.

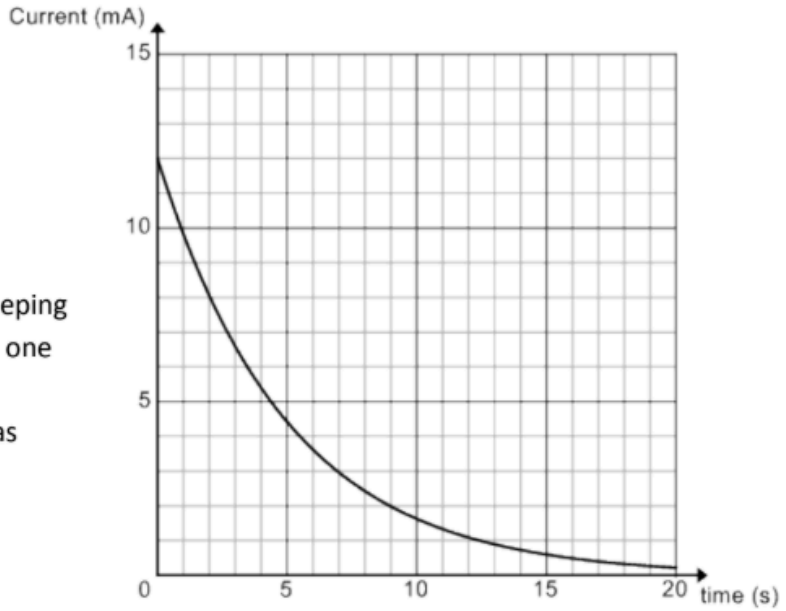
16)

A student investigates the charging current of a capacitor. She charges a 10,000μF capacitor using a 12 V cell.

a) From the graph calculate the value of the resistor that the student charged the resistor through.

b) Calculate the pd across the capacitor 7 seconds into the charging.

c) The student repeats the experiment keeping the same charging voltage but changes one component.
She records the charging current data as shown below.




Current (mA)