# Lesson Element

# Modelling decay of charge

## Task 1 – Capacitor discharge

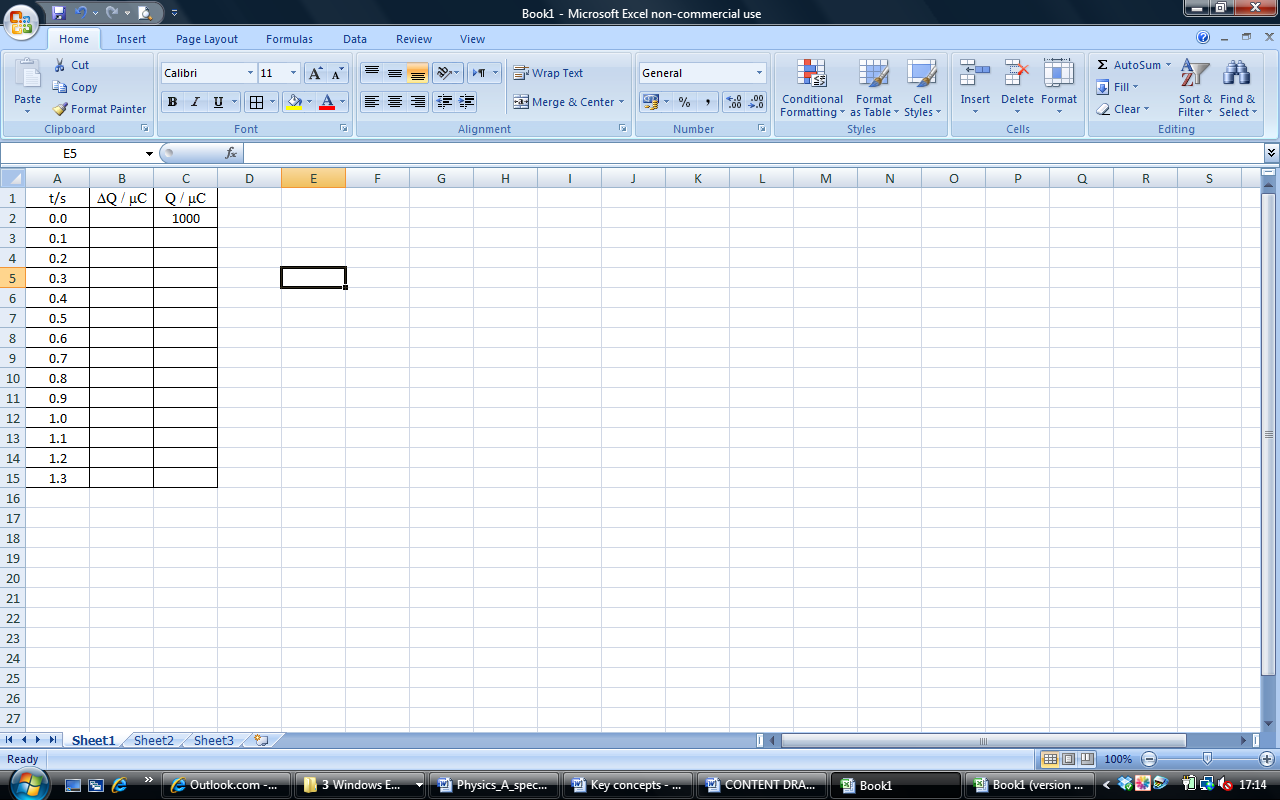
This worksheet shows how to model the discharge of a capacitor for the following initial conditions:

* charge on capacitor at time *t* = 0 is 1000 μC
* CR = 5.0 s
* Δt of 0.1 s

You can choose your own values for your own task.

### Procedure

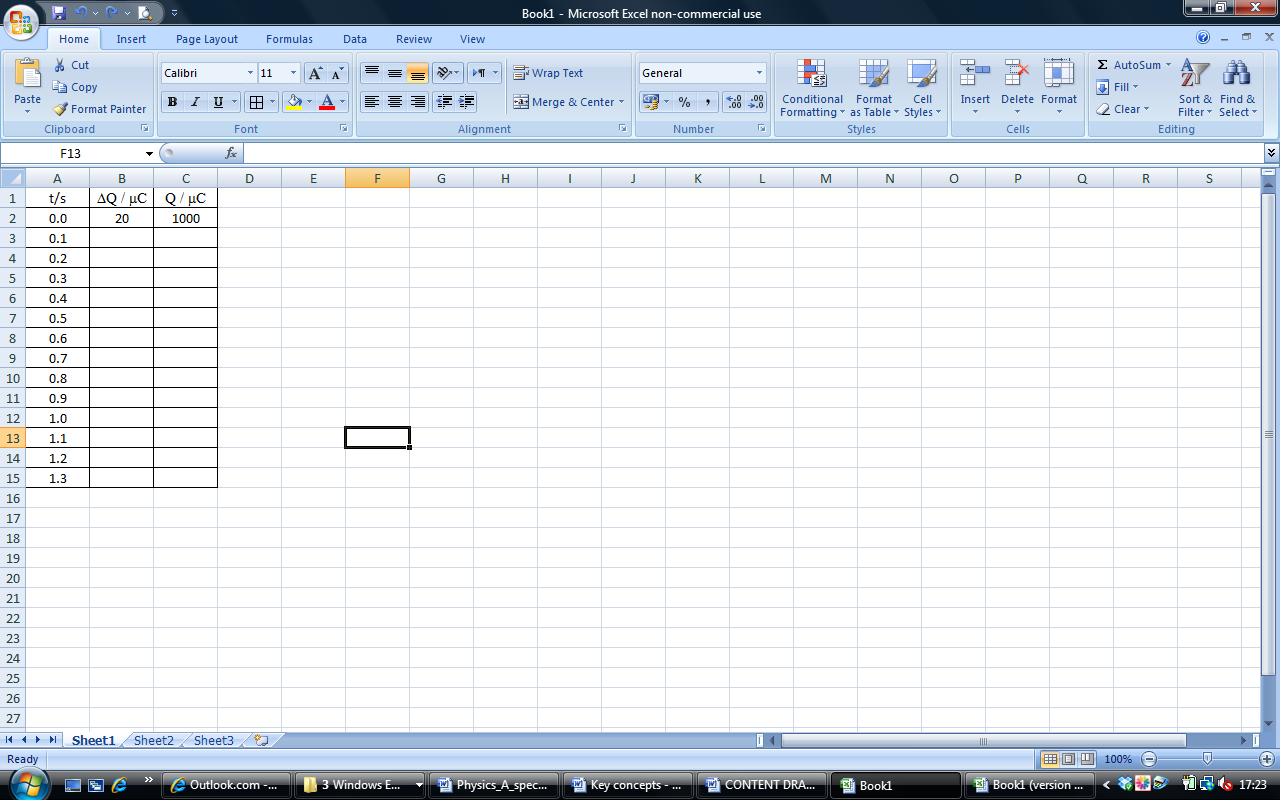
1. Open up an Excel spreadsheet.
2. Start with headings and columns as shown.



1. In the **B2** cell, insert the ‘equation’ for charge leaving in the short time interval Δtof 0.1 s. You do this by typing the following in this cell:

**=C2\*0.1/5.0**

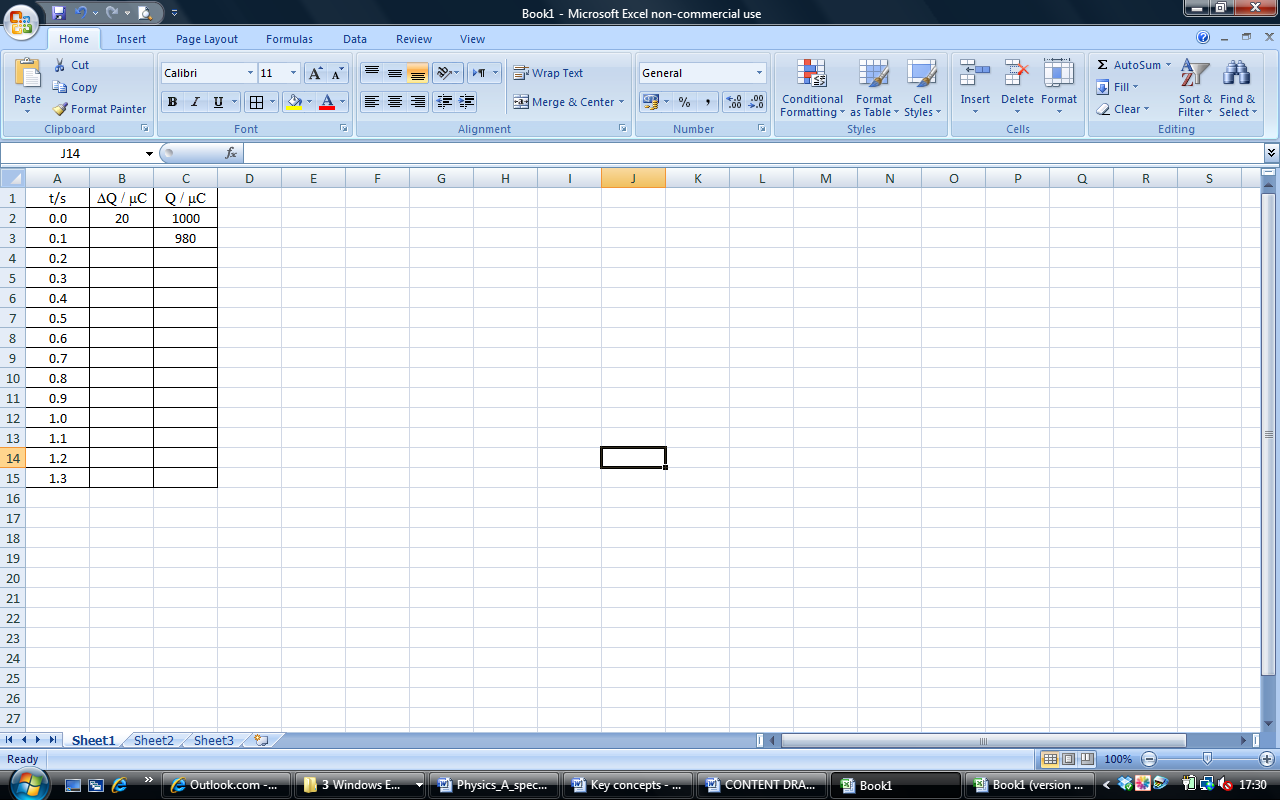
This will give the following results:

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1. Now in the **C3** cell, insert the charge left on the capacitor after an interval of 0.1 s. You do this by typing the following in this cell:

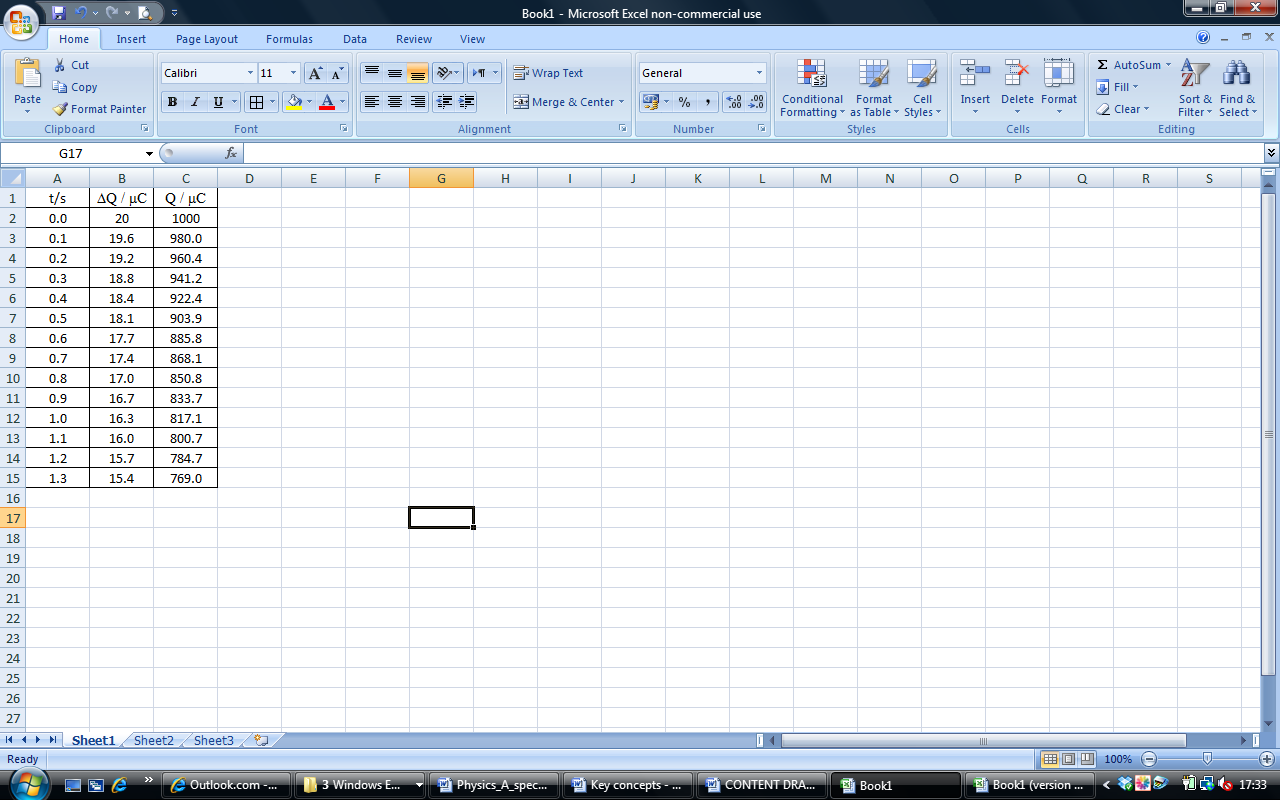
**=C2-B2**

This will give the following results:



1. Just two more steps now and you will have all the values you require for your task. Click on the **B2** cell and then drag the bottom right hand side corner all the way down the B column. This will copy the equation in all the B cells. Carry out the same procedure with the **C3** cell and the C column.

If all goes well, you will end up with the following:



1. Use your table to plot a graph of *Q* against *t*.
2. If possible, try different values for the time constant and observe what happens to the results in the table and to the *Q*-*t* graph. (See the list below of the things you could try.)
3. The charge on the capacitor decays exponentially. How can you use the table of results or your graph to confirm this?
4. The charge *Q* on the capacitor after a time t is given by the equation Q = Q0 e, where *Q*0 is the initial charge and *CR* is the time constant. Do you results agree with this equation?

Things to try:

Investigate the discharge of a capacitor for a total time of about 10.0 s

* with initial charge = 1000 μC, CR = 5.0 s and Δt = 0.1 s
* with initial charge = 2000 μC, CR = 5.0 s and Δt = 0.1 s
* with initial charge = 1000 μC, CR = 10.0 s and Δt = 0.1 s
* with initial charge = 1000 μC, CR = 2.5 s and Δt = 0.1 s
* with initial charge = 1000 μC, CR = 5.0 s from t = 0 to t = 6.0 s and CR = 1.0 s for t > 6.0 s and Δt of 0.1 s