Essential Pre-Uni Physics I1.5

A Level

Calculate the capacitance of a capacitor needed in a back up power supply if it needs to store $0.24\,\mathrm{J}$ of electrical energy when connected to a $12\,\mathrm{V}$ power supply.

Essential Pre-Uni Physics I1.8

A Level

A mystery capacitor can store $3.0\,\mathrm{J}$ of energy when connected to a $10\,\mathrm{V}$ supply. How much energy can it store when connected to a $5.0\,\mathrm{V}$ supply?

Gameboard:

STEM SMART Physics 33 - Exponentials in capacitors

Physics. You work it out.

Essential Pre-Uni Physics I2.4

A Level

C C C

A $470\,\mu\text{F}$ capacitor is charged using a $10\,\text{V}$ battery. It is then disconnected, and connected to an uncharged $220\,\mu\text{F}$ capacitor. Calculate the voltage across the capacitors once the current has stopped flowing. (Hint: capacitors are effectively in parallel, and total charge has not changed.)

Gameboard:

STEM SMART Physics 33 - Exponentials in capacitors

Essential Pre-Uni Physics I3.1

A Level

Complete the questions in the table, giving your answers to 2 significant figures.

Capacitance	Resistance	Time constant	Halving time
$100\,\mu\text{F}$	$200\,\text{k}\Omega$	(a)	(b)

Part A Time constant

a) What is the time constant?

Part B Halving time

b) What is the halving time?

Gameboard:

STEM SMART Physics 33 - Exponentials in capacitors

Essential Pre-Uni Physics I3.6

A Level

This question is about a $2200\,\mu\text{F}$ capacitor which is charged with a $12\,\text{V}$ battery. It is then discharged through a $10\,\text{k}\Omega$ resistor.

Part A Initial discharge current

What is the initial discharge current?

Part B Discharging at a constant rate

Calculate how long the capacitor would take to discharge if the initial rate of discharge were maintained.

Part C Voltage after $22\,\text{s}$

What will the voltage be across the capacitor after $22\,\text{s}$?

Part D Current when voltage has halved

What will the current be when the voltage across the capacitor has halved?

Part E Voltage of $3.0\,\mathrm{V}$

How much time will it take before the capacitor has a voltage of $3.0\,\mathrm{V}$ across it?

Gameboard:

STEM SMART Physics 33 - Exponentials in capacitors

Capacitors and Resistors 33.5

A Level

P P P

A capacitor with $C = 10\,\text{nF}$ and initial charge $1.5 \times 10^{-7}\,\text{C}$ is discharged through a resistor with $R = 10\,\text{M}\Omega$. What is the current after $0.25\,\text{s}$?

Gameboard:

STEM SMART Physics 33 - Exponentials in capacitors

Capacitors and Resistors 33.6

A Level

An initially uncharged $0.0020\,\mathrm{F}$ capacitor is connected to a $6.0\,\mathrm{V}$ battery via a $9.0\,\Omega$ resistor. How much charge has entered the capacitor after the first $0.020\,\mathrm{s}$?

Gameboard:
STEM SMART Physics 33 - Exponentials in capacitors

Exponential Decay - Using Logarithms 35.9

A Level

P P P

The capacitor in a timer is charged quickly to a battery voltage of $5.3\,\mathrm{V}$. It then discharges through a resistor. The charge and the voltage drop to one third of their initial value in ten seconds.

How long does it take the capacitor voltage to fall from the original value to $2.56\,\mathrm{V}$?

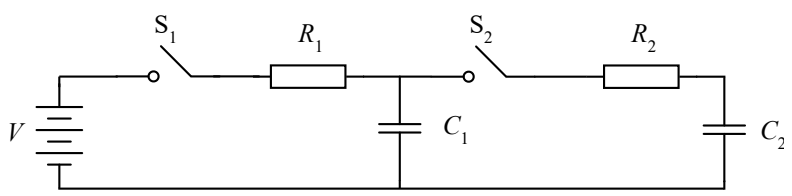
Gameboard:

STEM SMART Physics 33 - Exponentials in capacitors

Charging two Capacitors

A Level

In the circuit shown below, both capacitors are initially uncharged and both switches are initially open.

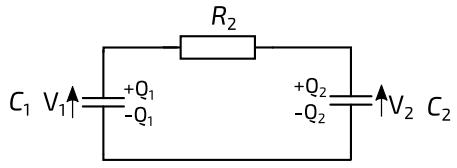


Part A Charge on capacitor

Switch S_1 is closed for $4.0\,\mathrm{s}$ and then opened. With $R_1 = 1.0\,\mathrm{M\Omega}$, $C_1 = 2.0\,\mu\mathrm{F}$ and $V = 120\,\mathrm{V}$ what is the subsequent charge on the capacitor C_1?

Part B Which relationship

S_1 is closed again until C_1 is fully charged. After this, S_1 is opened and S_2 is closed. The circuit eventually reaches a steady state where no current flows.



With charges and voltages defined as in the figure above, which of the following relationships is correct?

- $V_1C_2 = V_2C_1$
- $Q_1 = Q_2$
- $\frac{V_1}{C_1} = \frac{V_2}{C_2} = R_2$
- $V_1 = V_2$
- $V_1 = V_2 + (Q_1 - Q_2)R_2$

Part C Charge on second capacitor

Using information from the previous section, what is the final charge on C_2 if $C_2 = 4.0\,\mu\text{F}$, $C_1 = 2.0\,\mu\text{F}$ and $V = 120\,\text{V}$?

Part D Voltage across capacitors

What is the voltage V_2 across capacitor C_2?

Part E Energy dissipated

How much energy is dissipated in the resistor R_2 after the switch S_2 is closed?

Adapted with permission from UCLES, AO Level Additional Physics, November 1987, Paper 1 Theory, Question 7

Gameboard:

STEM SMART Physics 33 - Exponentials in capacitors

An Oscillating Capacitor

A Level

A capacitor with capacitance C is attached to an AC voltage source, which gives a voltage $V = V_0 \sin \omega t$.

If there is no resistance in the circuit, $C = 330\,\mu\text{F}$, $V_0 = 12.0\,\text{V}$, and $\omega = 5720\,\text{rad}\,\text{s}^{-1}$, what is the magnitude of the current flowing at $t = 3.42\,\text{s}$?

Created for isaacphysics.org by Michael Conterio