INKPHYSICS FLASHCARDS

Capacitance

Year 13 · 22 cards · fronts and backs

Print double-sided, flipping on the long edge, and each answer lands behind its question. Cut along the card borders.

Definitions in mark-scheme wording, the equations that are not on the AQA data sheet, each lesson's check question, and the misconceptions that lose marks. The same cards run on the website with spaced-repetition scheduling, at inkphysics.co.uk/physics/flashcards.

DEFINITION

Define: Capacitance.

CAPACITORS AND ENERGY STORED

RECALL

State the effect of a dielectric on capacitance.

CAPACITORS AND ENERGY STORED

RECALL

State how to find the energy stored from a pd-charge graph.

CAPACITORS AND ENERGY STORED

RECALL

State the effect of doubling the pd on the energy stored.

CAPACITORS AND ENERGY STORED

RECALL

State what Q means for a charged capacitor.

CAPACITORS AND ENERGY STORED

RECALL

State the combined capacitance of capacitors in parallel.

CAPACITORS AND ENERGY STORED

RECALL

State the combined capacitance of capacitors in series.

CAPACITORS AND ENERGY STORED

RECALL

Explain why capacitors in series all carry the same charge.

CAPACITORS AND ENERGY STORED

RECALL

A dielectric of relative permittivity ε_r multiplies the capacitance by ε_r.

CAPACITORS AND ENERGY STORED

DEFINITION

The charge stored per unit potential difference: $C = Q/V$, in farads.

CAPACITORS AND ENERGY STORED

RECALL

The energy quadruples, since $E = \frac{1}{2}CV^2$.

CAPACITORS AND ENERGY STORED

RECALL

The energy stored is the area under the graph of pd against charge, $\frac{1}{2}QV$.

CAPACITORS AND ENERGY STORED

RECALL

$C = C_1 + C_2 + \ldots$, because every capacitor takes the same pd and their charges add. The result is always larger than the largest capacitor in the group. (CIE and OCR only.)

CAPACITORS AND ENERGY STORED

RECALL

Q is the magnitude of the charge on one plate; the capacitor as a whole is neutral.

CAPACITORS AND ENERGY STORED

RECALL

The conductor running between the facing plates of two series capacitors is isolated, and it started neutral, so charge is conserved on it: the charge drawn onto one plate leaves an equal and opposite charge on the next. (CIE and OCR only.)

CAPACITORS AND ENERGY STORED

RECALL

$1/C = 1/C_1 + 1/C_2 + \ldots$, because every capacitor carries the same charge and their pds add. The result is always smaller than the smallest capacitor in the group. (CIE and OCR only.)

CAPACITORS AND ENERGY STORED

RECALL

State which capacitor in a series pair takes the larger pd.

CAPACITORS AND ENERGY STORED

RECALL

State the capacitance of an isolated spherical conductor.

CAPACITORS AND ENERGY STORED

SPOT THE ERROR

Say what is wrong with this claim:

A capacitor is a small battery.

CAPACITORS AND ENERGY STORED

RECALL

State how to find current from a charge-time graph.

CHARGING AND DISCHARGING

RECALL

State how to find charge from a current-time graph.

CHARGING AND DISCHARGING

RECALL

State the initial current when a capacitor charges through a resistor.

CHARGING AND DISCHARGING

RECALL

State the shape of the three discharge graphs.

CHARGING AND DISCHARGING

SPOT THE ERROR

Say what is wrong with this claim:

A capacitor charges at a steady rate until it is full.

CHARGING AND DISCHARGING

RECALL

$C = 4\pi\varepsilon_0 r$, from $C = Q/V$ with $V = Q/(4\pi\varepsilon_0 r)$, the potential measured from zero at infinity. It depends on the radius alone. (CIE only.)

CAPACITORS AND ENERGY STORED

RECALL

The smaller one. Both hold the same charge, and $V = Q/C$, so the poorer rating needs more volts to hold it. This is the reverse of a series resistor chain. (CIE and OCR only.)

CAPACITORS AND ENERGY STORED

RECALL

The current is the magnitude of the gradient of the charge-time graph. On discharge that gradient is negative, the minus sign meaning charge is leaving the plates.

CHARGING AND DISCHARGING

SPOT THE ERROR

A battery is a source of emf, converting chemical energy at a near-steady voltage; a capacitor only stores separated charge, and its pd falls as soon as it discharges.

CAPACITORS AND ENERGY STORED

RECALL

$I_0 = V/R$, because the uncharged capacitor has no pd and the full supply pd sits across the resistor.

CHARGING AND DISCHARGING

RECALL

The charge transferred is the area under the current-time graph.

CHARGING AND DISCHARGING

SPOT THE ERROR

Charging is exponential, not steady. As charge builds, the capacitor's pd rises and the pd driving the current falls, so the charging current decays; it never becomes strictly full.

CHARGING AND DISCHARGING

RECALL

Charge, pd and current all fall along the same exponential decay curve.

CHARGING AND DISCHARGING

DEFINITION

Define: Time constant.

THE TIME CONSTANT AND EXPONENTIAL DECAY

RECALL

State the fraction of final charge reached one time constant after charging begins.

THE TIME CONSTANT AND EXPONENTIAL DECAY

RECALL

State the gradient of a ln V against t discharge graph.

THE TIME CONSTANT AND EXPONENTIAL DECAY

RECALL

State the unit of the time constant RC.

THE TIME CONSTANT AND EXPONENTIAL DECAY

EQUATION · NOT ON THE AQA DATA SHEET

Halving time for a discharging capacitor:

$T_{½}$ = ?

THE TIME CONSTANT AND EXPONENTIAL DECAY

SPOT THE ERROR

Say what is wrong with this claim:

After one time constant the capacitor is empty.

THE TIME CONSTANT AND EXPONENTIAL DECAY

RECALL

63%, the complement of the 37% left behind in discharge.

THE TIME CONSTANT AND EXPONENTIAL DECAY

DEFINITION

The time RC for the charge on a capacitor to fall to 1/e, about 37%, of its initial value.

THE TIME CONSTANT AND EXPONENTIAL DECAY

RECALL

Ohms times farads gives seconds.

THE TIME CONSTANT AND EXPONENTIAL DECAY

RECALL

The gradient is -1/RC, so the time constant is the negative reciprocal of the gradient.

THE TIME CONSTANT AND EXPONENTIAL DECAY

SPOT THE ERROR

After one time constant the charge has fallen to 1/e, about 37%, of its initial value, not zero. Each further time constant loses the same fraction, so it never quite empties.

THE TIME CONSTANT AND EXPONENTIAL DECAY

EQUATION · NOT ON THE AQA DATA SHEET

$T_{½} = 0.69RC$

THE TIME CONSTANT AND EXPONENTIAL DECAY