ELECTROSTATICS
Part - III

Dr. Ranjit Baishya
Associate Professor
Department of Physics
J. N. College, Boko

In last classes, we have discussed - -

1. **Charge:**
2. **Coulomb's Law:**
3. **Electric Field:**
4. **Electric Lines of Force and Flux**
5. **Gauss's Law:**
6. **Electric Potential:**
7. **Electric Dipole:**

Now, we will discuss - -

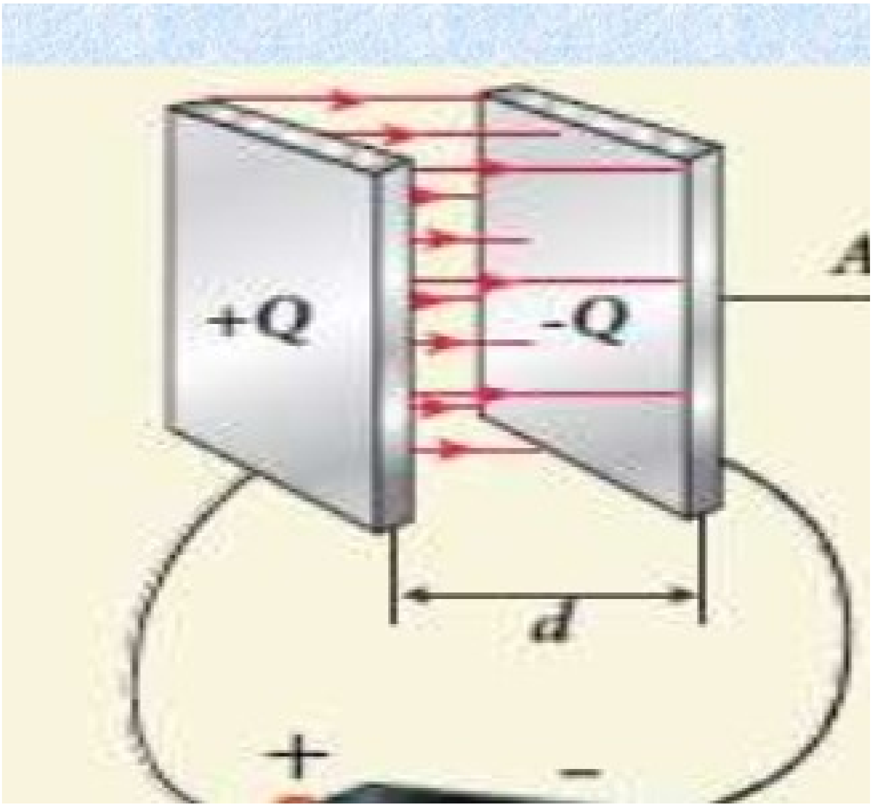
1. **Capacitors:**
2. **Capacitance:**
3. **Unit of Capacitance:**
4. **Parallel plate Capacitor:**
5. **Combination of Capacitor:**

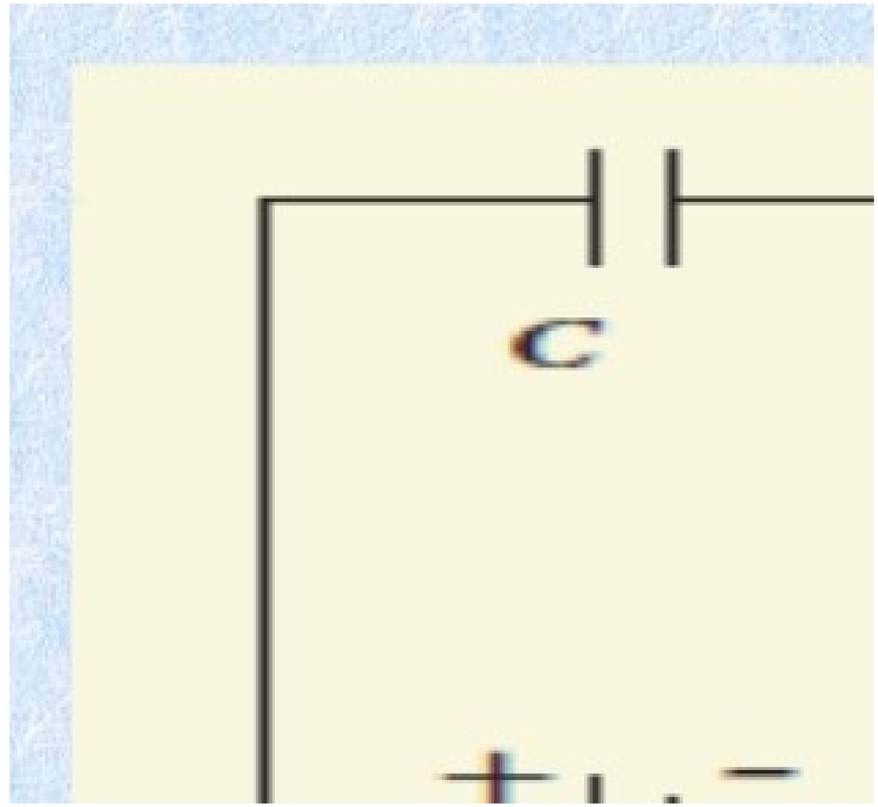
Various types of capa

Capac

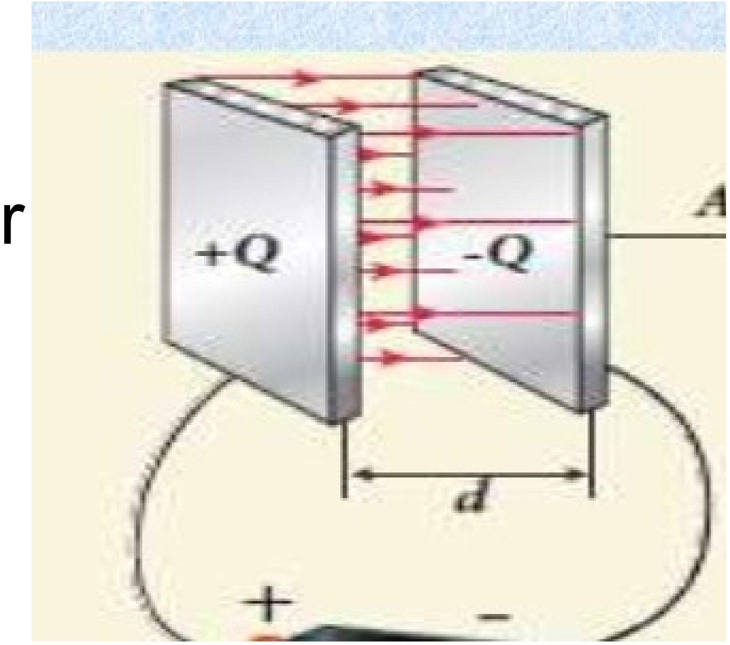
- Capacitor is a device used to store
charge and electrical energy.
- It consists of two conducting object
plates or sheets) separated by some c
- Capacitors are widely used in many e
circuits and have applications in many
science and technology.

Capacitor connected with a ba





Capacitance



The charge stored in the capacitor is proportional to the Potential Difference between the plates.

i.e. $Q \propto V$

or, $Q = CV$

Here, C is the proportional constant called ***Capacitance***. C depends on the medium between two plates and effective are of the plates.

The Capacitance of a Capacitor is defined as the ration of the magnitude of charge on either of the conductor plates to the Potential difference between the plates. ***C = Q/V***

Unit of Capacitance:

Unit of Capacitance is ***Farad***. A capacitance of 1 ***Farad (F)*** produces 1 Volt of potential difference for an electric charge of one coulomb (1 C). Thus

1 ***Farad*** = 1 Coulomb / 1 Volt

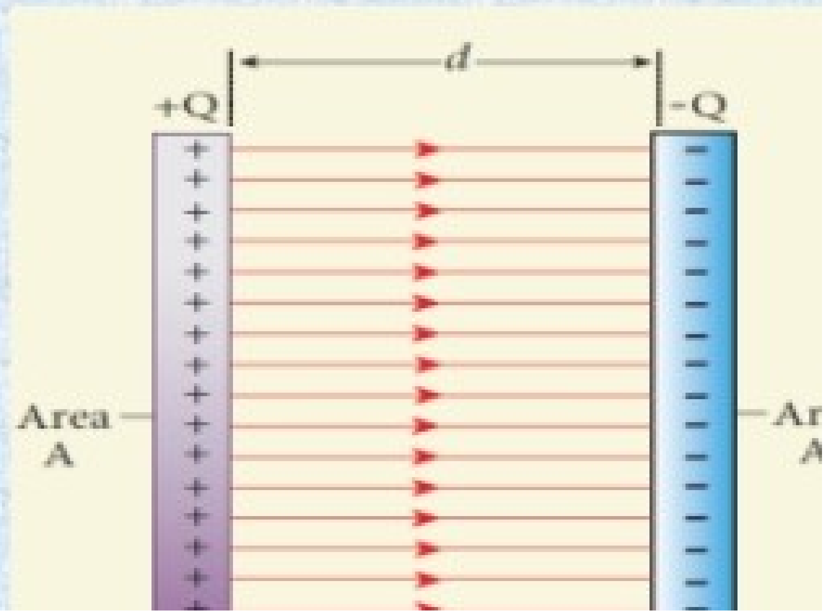
The ***Farad*** is an extremely large unit of capacitance. Generally used units are

$$1\ mF = 10^{-3}\ F$$

$$1\ \mu F = 10^{-6}\ F$$

Capacitance of a parallel pla capacitor

- Consider a capacitor with two parallel p each of cross-sectional area A and sepa by a distance d



The electric field between two i
parallel plates is uniform and is gi

$E=\frac{\sigma}{\varepsilon_{\circ}}$ where σ is the surface charge

on the plates $\left(\sigma=\frac{Q}{A}\right)$. If the sep
distance d is very much smaller th
size of the plate ($d^2 << A$), then the
result is used even for finite-sized p

- The electric field between the plates is

$$E = \frac{Q}{A\varepsilon_o}$$

- Since the electric field is uniform, the e potential between the plates having separation d is given by

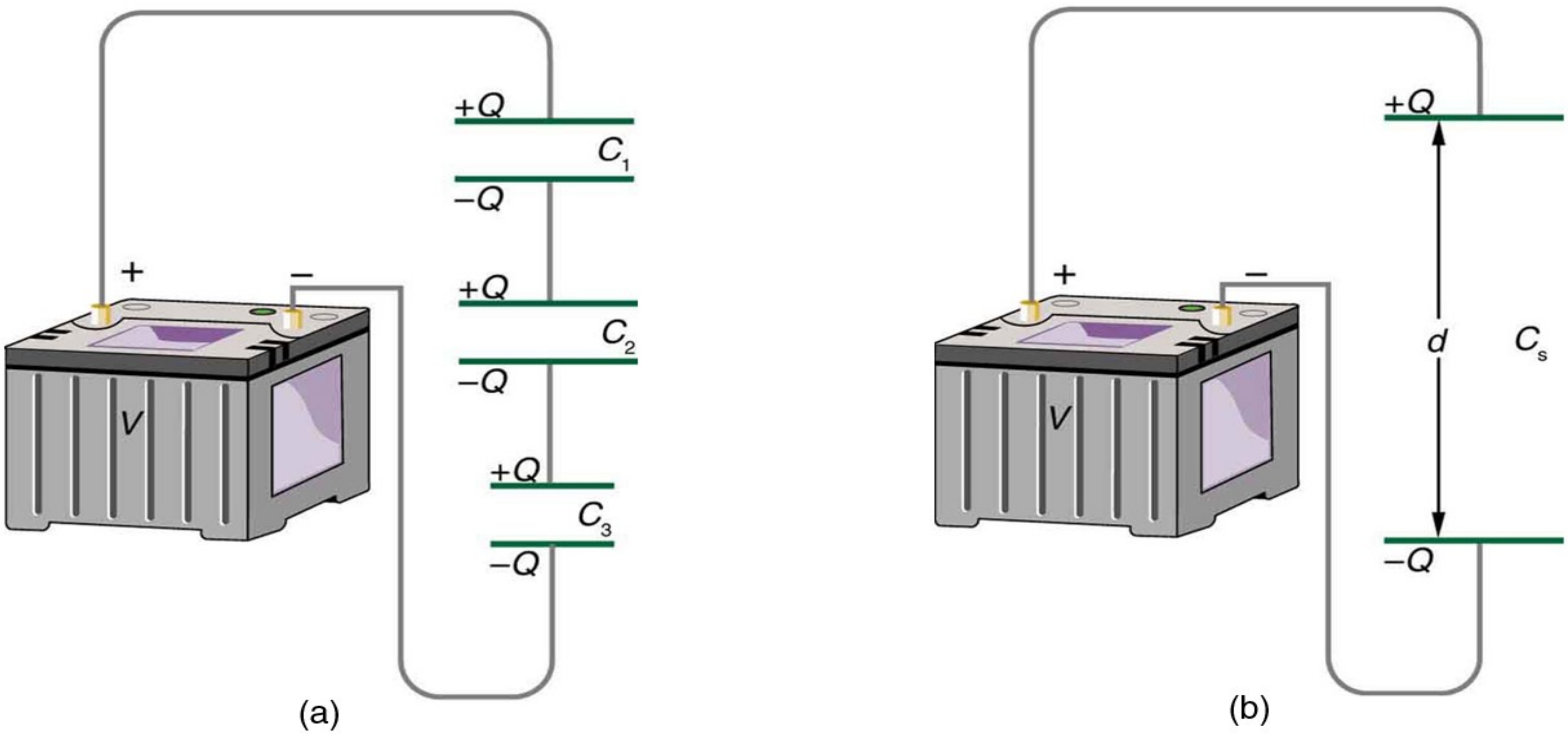
$$V = Ed = \frac{Qd}{A\varepsilon_0}$$

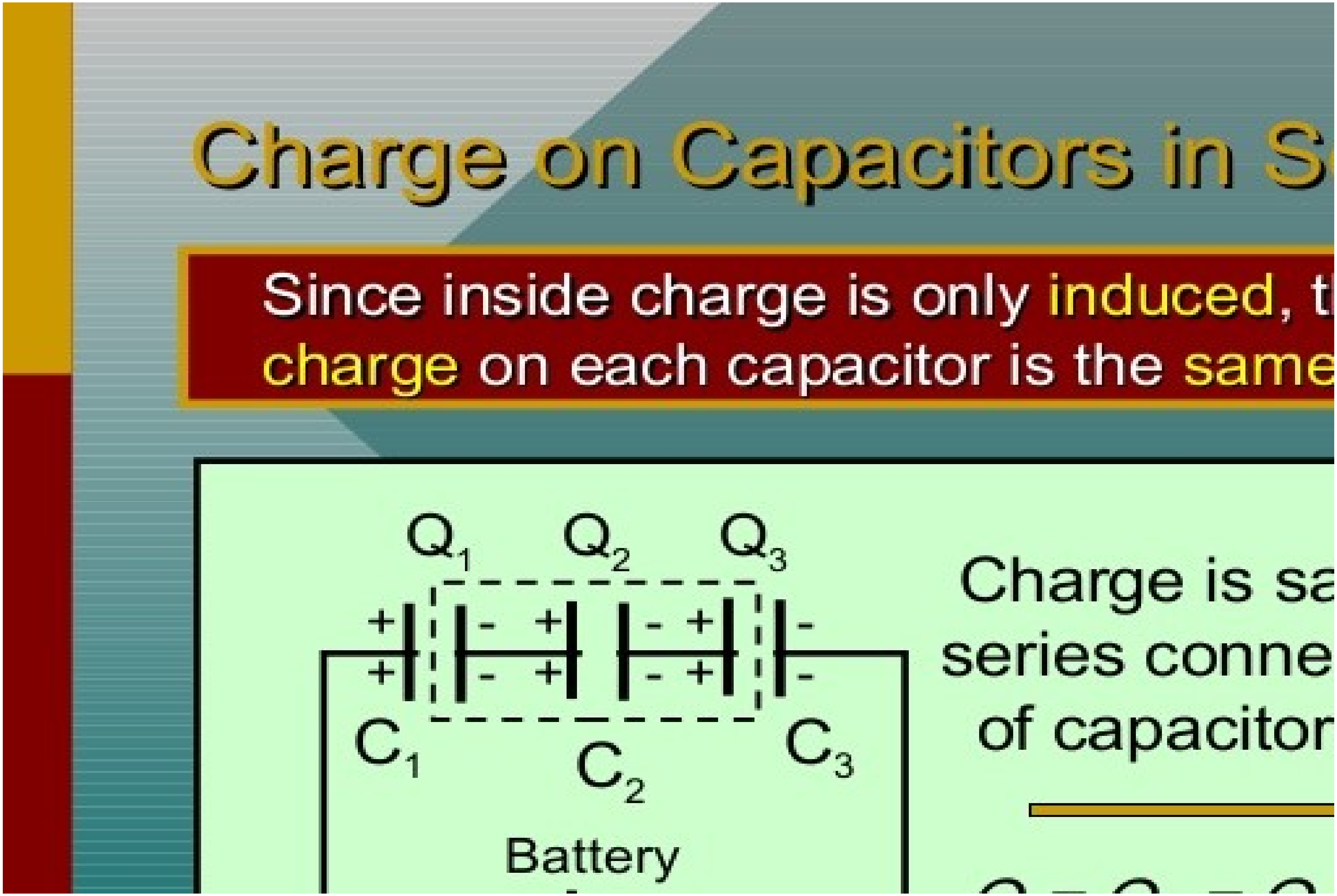
- Therefore the capacitance of the capac given by

i.e. C ∞ A or, C ∞ A/d

C ∞ 1/d

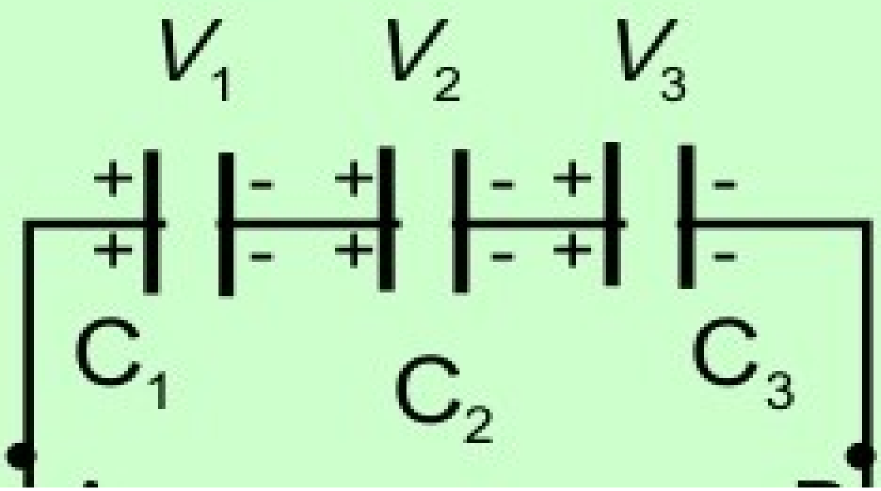
Combination of Capacitor:




Charge on Capacitors in S
Since inside charge is only induced, t
charge on each capacitor is the same
Q1 Q2 Q3
C1 C2 C3
Battery
Charge is sa
series conne
of capacitor

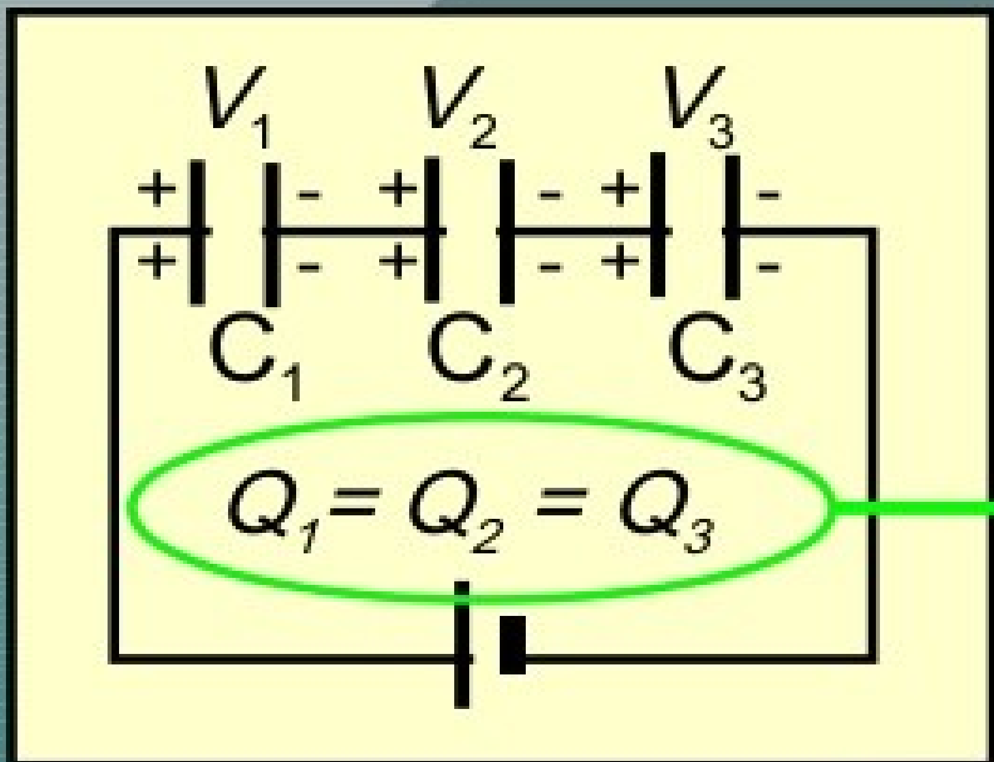
Voltage on Capacitors i
Series

Since the potential difference between
points A and B is independent of path,
battery voltage V must equal the sum
the voltages across each capacitor.



Total voltag
Series connec
Sum of voltag

Equivalent Capacitance Series



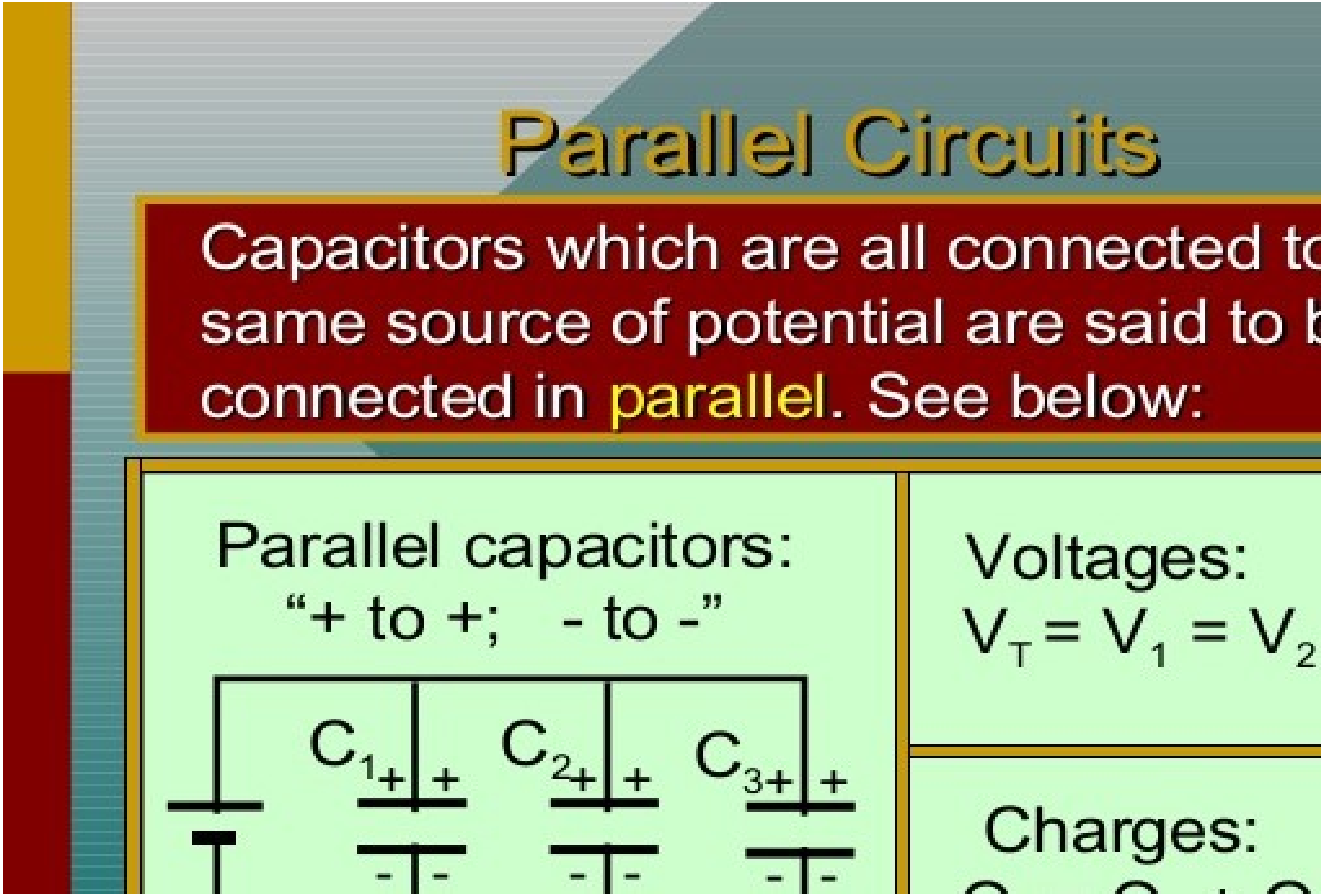
$$C = \frac{Q}{V}; \quad V =$$

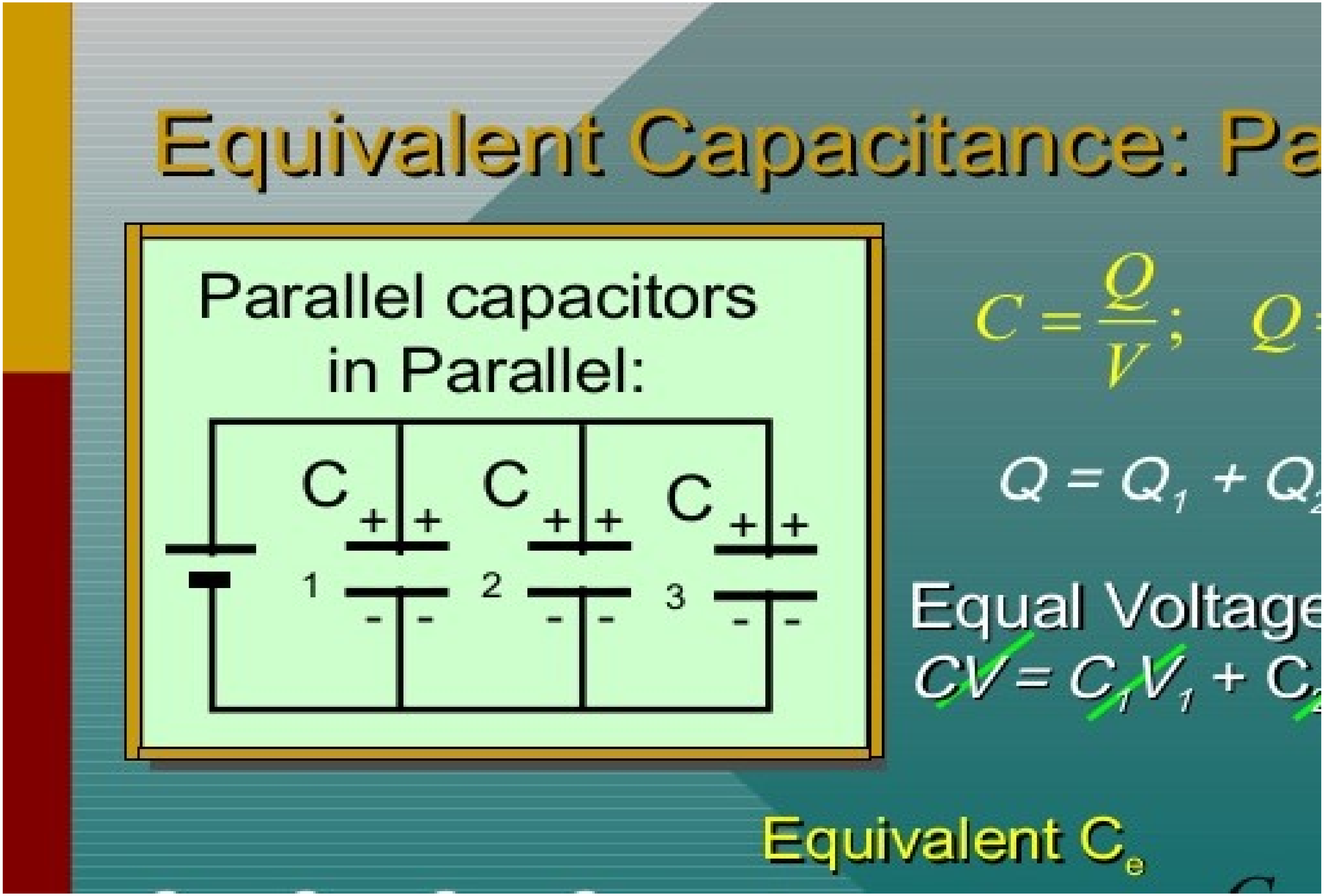
$$V = V_1 + V_2 +$$

$$\frac{Q}{C} = \frac{Q_1}{C_1} + \frac{Q_2}{C_2}$$

Equivalent C_e

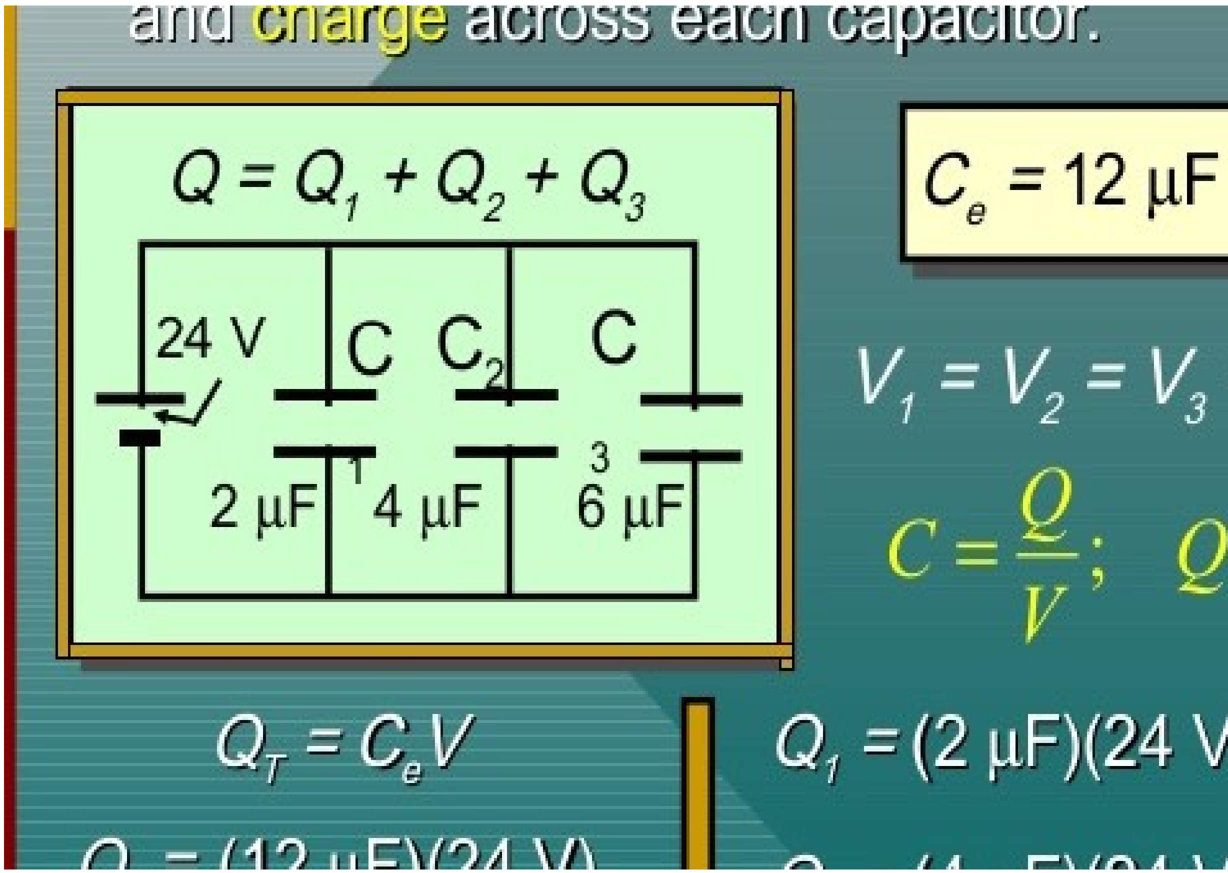
$$\frac{1}{} = \frac{1}{} + \frac{1}{} + \frac{1}{} \qquad 1$$


Parallel Circuits
Capacitors which are all connected to
same source of potential are said to b
connected in parallel. See below:
Parallel capacitors:
"+ to +; - to -"
C1 + + C2 + + C3 + +
- - - - - -
Voltages:
VT = V1 = V2
Charges:

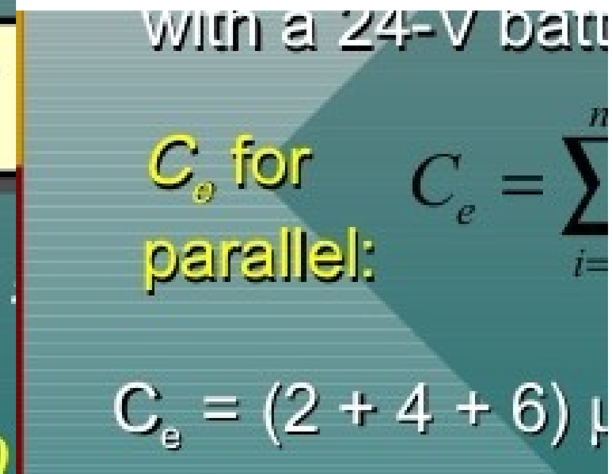

Equivalent Capacitance: Pa
Parallel capacitors in Parallel:
C 1
C 2
C 3
+ +
- -
C = Q/V;   Q
Q = Q1 + Q
Equal Voltage
CV = C1V1 + C
Equivalent Ce

Q. Find the equivalent capacitance of the three capacitors connected in parallel with a 24 V battery. Also calculate the total charge and charge across each capacitor.

A.



Since



THANKS