10 Electric potential and capacitors – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	**中文**	**Write it 3 times** (English)
Electric potential	电势	
voltage	电压	
capacitor	电容器	
capacitance	电容	

Recall

In Part A you met electric charge, force, and field. Now two ideas you use every day without noticing:

- **Voltage** is written on every battery (1.5 V, 9 V). It is really "electric potential."
- A **capacitor** stores charge –it is inside phones, cameras, and flashes.

Each idea has a worked example before the Practice.

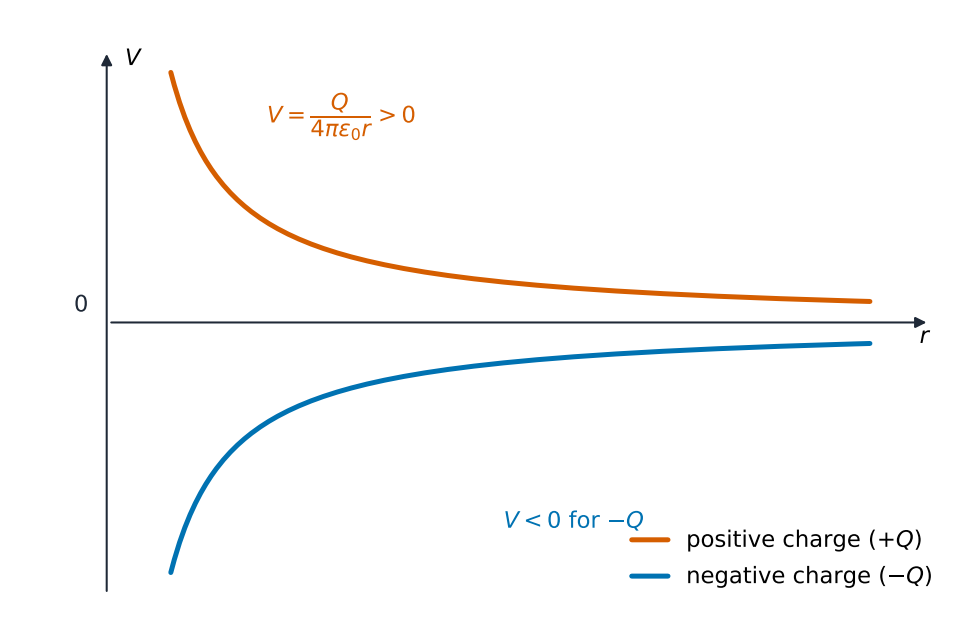
New ideas

1 Electric potential

Electric potential 电势 V is the electric potential energy per unit charge, measured in volts:

$$V = \frac{U}{q}.$$

Unlike the field (a vector), potential is a simple number (a scalar), so it is easier to work with.



2 Voltage

The **voltage** 电压 (potential difference) between two points is the work done per unit charge to move a charge between them: $U = qV$. A positive charge moves from high to low potential on its own –like a ball rolling downhill.

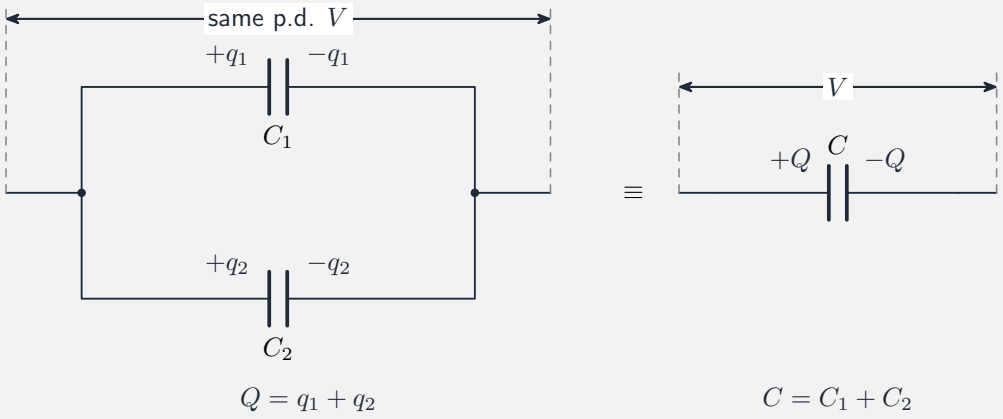
Worked example. Moving a charge of 2.0 C through a potential difference of 6.0 V transfers $U = qV = 2.0 \times 6.0 = 12$ J of energy.

3 Capacitors

A **capacitor** 电容器 stores charge on two plates. Its **capacitance** 电容 links charge to voltage:

$$C = \frac{Q}{V},$$

and it stores energy $U = \frac{1}{2}CV^2$.



$Q = q_1 + q_2$ $\qquad$ $C = C_1 + C_2$

Worked example. A 100 μF capacitor charged to 12 V holds $Q = CV = 100 \times 10^{-6} \times 12 = 1.2 \times 10^{-3}$ C and stores $U = \frac{1}{2}CV^2 = \frac{1}{2} \times 100 \times 10^{-6} \times 12^2 = 7.2 \times 10^{-3}$ J.

■ 4 Charges gain energy from voltage

A charge released across a voltage speeds up, turning electric energy into kinetic energy:

$$qV = \tfrac{1}{2}mv^2.$$

Watch out: electric potential V is a **scalar** (just a number), so potentials from several charges simply **add** –much easier than adding field arrows, which are vectors.

Practice

Try these in order. The methods are all above.

2.1 State what electric potential (voltage) measures, in words. [1]

2.2 Moving a 3.0 C charge through a potential difference of 4.0 V –find the energy transferred. [2]

2.3 A 50 μF capacitor is charged to 10 V. Find the charge it stores. [2]

2.4 For the capacitor in 2.3, find the energy stored ($U = \tfrac{1}{2}CV^2$). [3]

2.5 Explain why electric potential is easier to add up than the electric field, when several

charges are present. [2]