

Electricity and Magnetism

- Physics 259 – L02
- Lecture 12



UNIVERSITY OF
CALGARY

Chapter 23

(please read chapter 22 of the textbook)



Last time

- Chapter 22



This time

- Chapter 23



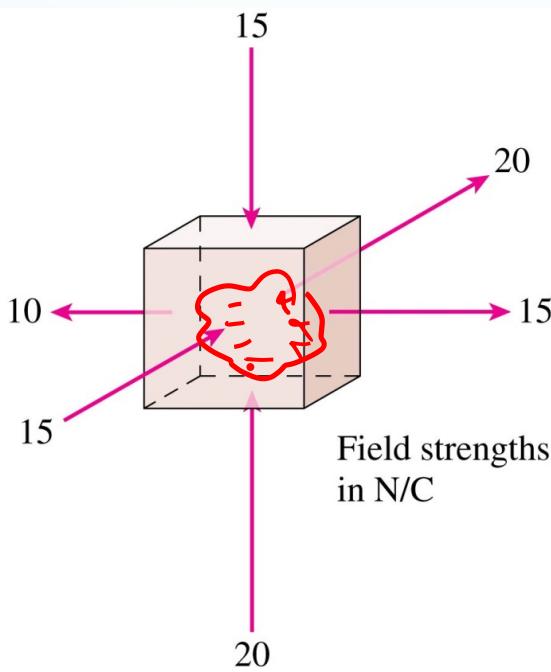
23-1: The Electric Flux



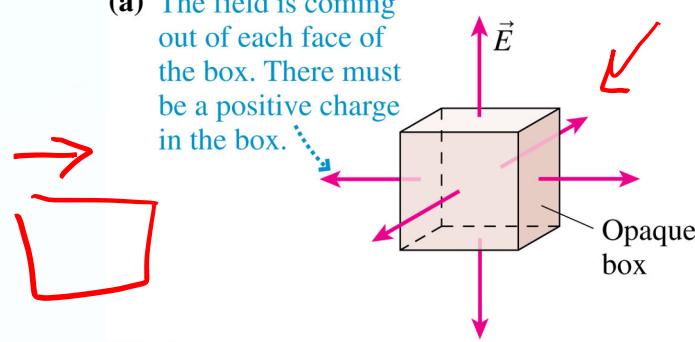
net charge $\rightarrow +$



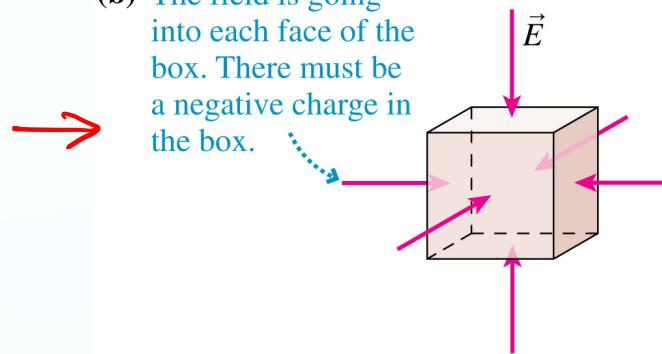
net charge $\rightarrow -$



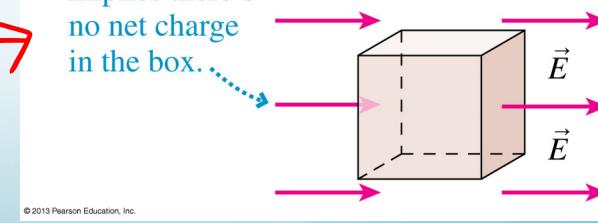
- (a) The field is coming out of each face of the box. There must be a positive charge in the box.



- (b) The field is going into each face of the box. There must be a negative charge in the box.



- (c) A field passing through the box implies there's no net charge in the box.



A closed surface through which an electric field passes
is called **Gaussian surface**

An imaginary mathematical surface

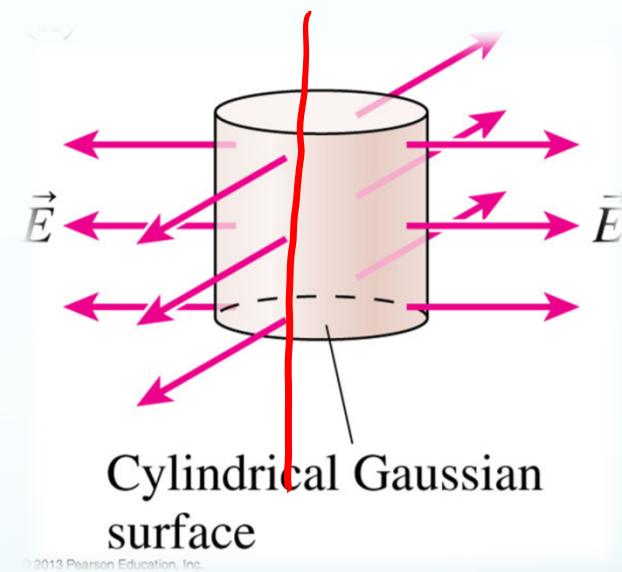
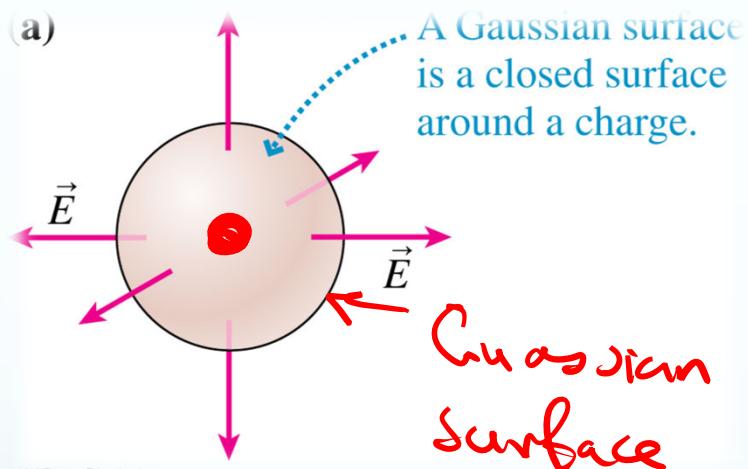


Electric Flux; Gauss' Law

Gauss' Law is equivalent to Coulomb's law. It will provide us:

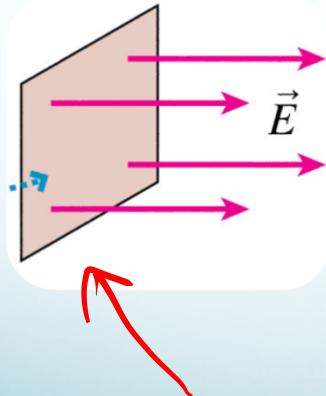
- (i) an **easier way to calculate the electric field** in specific circumstances (especially situations with a **high degree of symmetry**)
- (ii) a better understanding of the properties of conductors in electrostatic equilibrium (more on this as we go)
- (iii) It is valid for moving charges – not limited to electrostatics.

The Gaussian surface is most useful when it matches the shape of the field

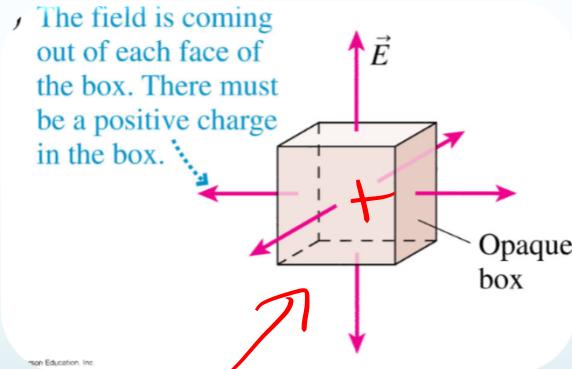


Electric Flux (Φ_e)

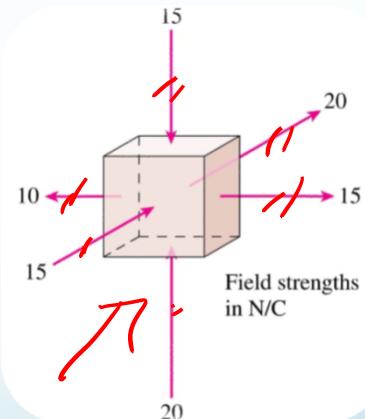
- Amount of electric field going through a surface
- The number of field lines coming through a surface



$$\Phi_e \neq 0$$

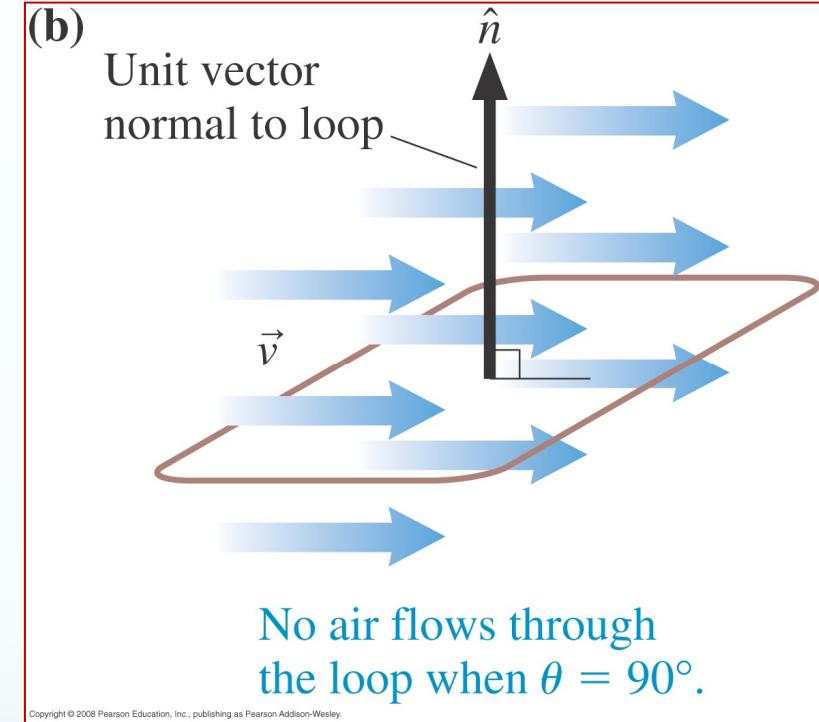
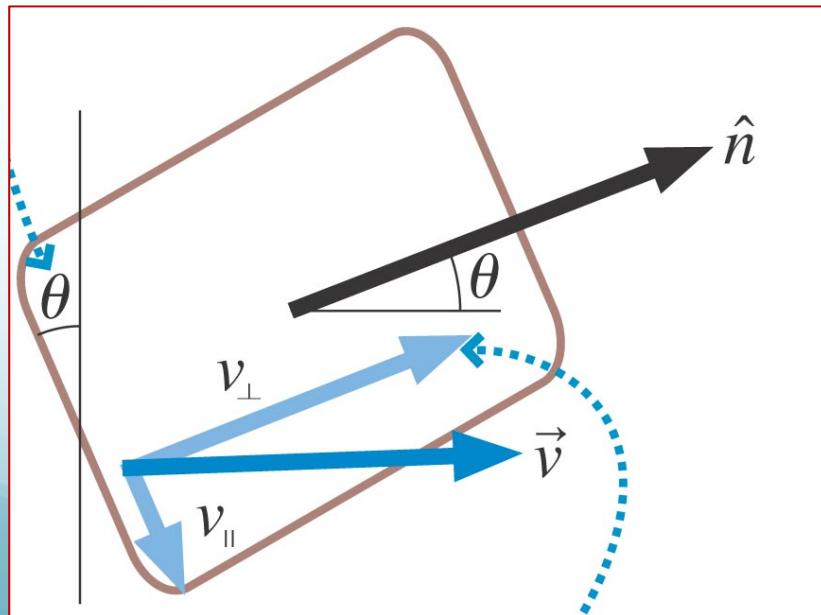
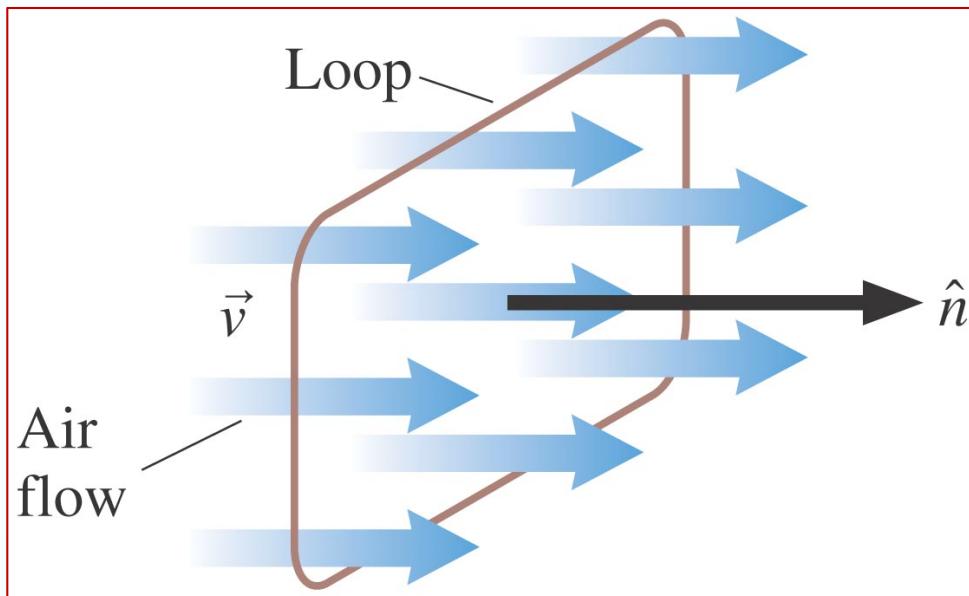


$$\Phi_e \neq 0$$



$$\Phi_e = 0$$

Wind going through a loop



The Electric Flux

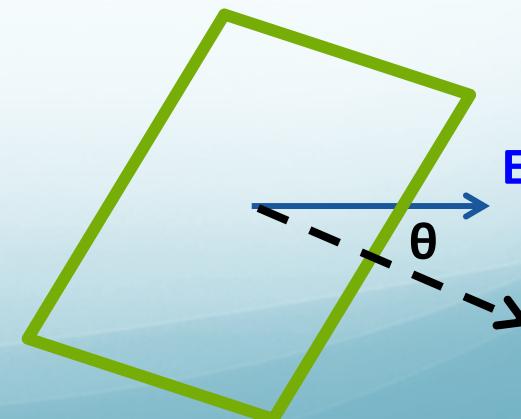
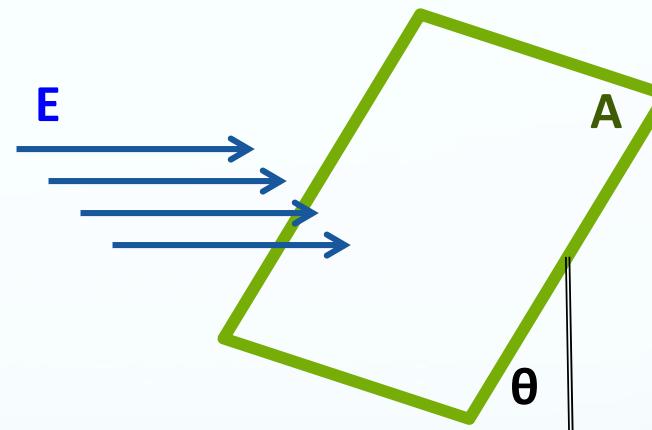
Amount of electric field going through a surface

$$\Phi_e \propto E$$

$$\Phi_e \propto A$$

$$\Phi_e \propto \theta$$

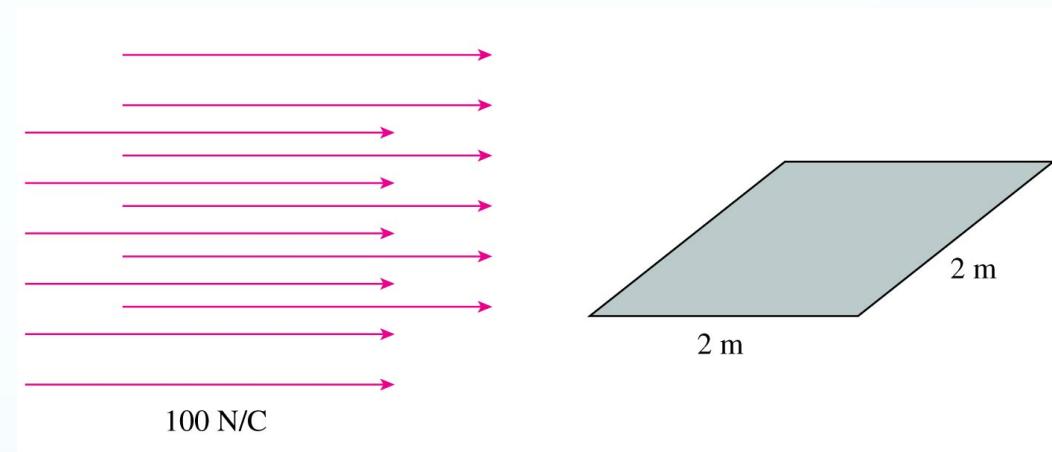
$$\boxed{\Phi_e = E_{\perp}A = EA \cos \theta}$$



QuickCheck 27.2

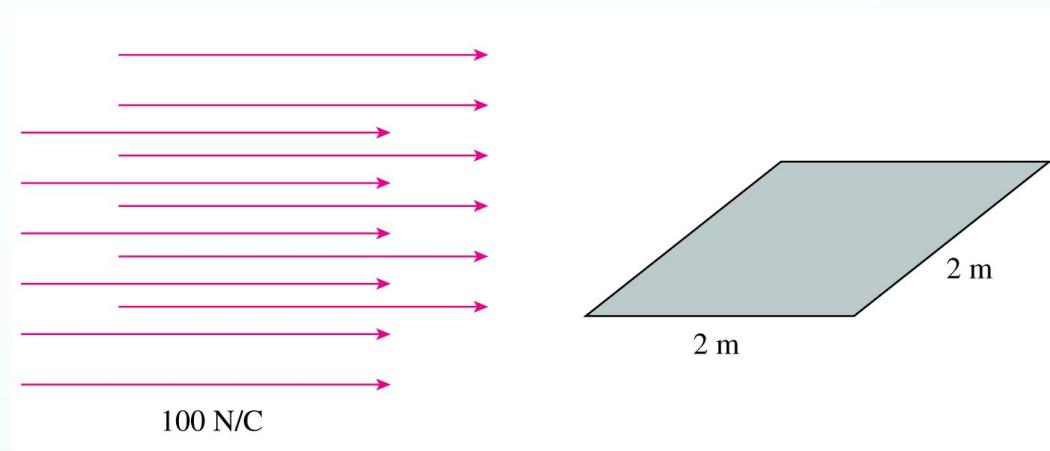
The electric flux through the shaded surface is

- A. 0.
- B. 200 N m/C .
- C. $400 \text{ N m}^2/\text{C}$.
- D. Some other value.



The electric flux through the shaded surface is

- A. 0.
- B. 200 N m/C .
- C. $400 \text{ N m}^2/\text{C}$.
- D. Some other value.



This section we talked about:

Chapter 23.1

See you on Monday

