PS 250: Lecture 22

Faraday's Law and Induction

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Today's Class

- Faraday's Law
- Motional Electromotive Force
- Summary

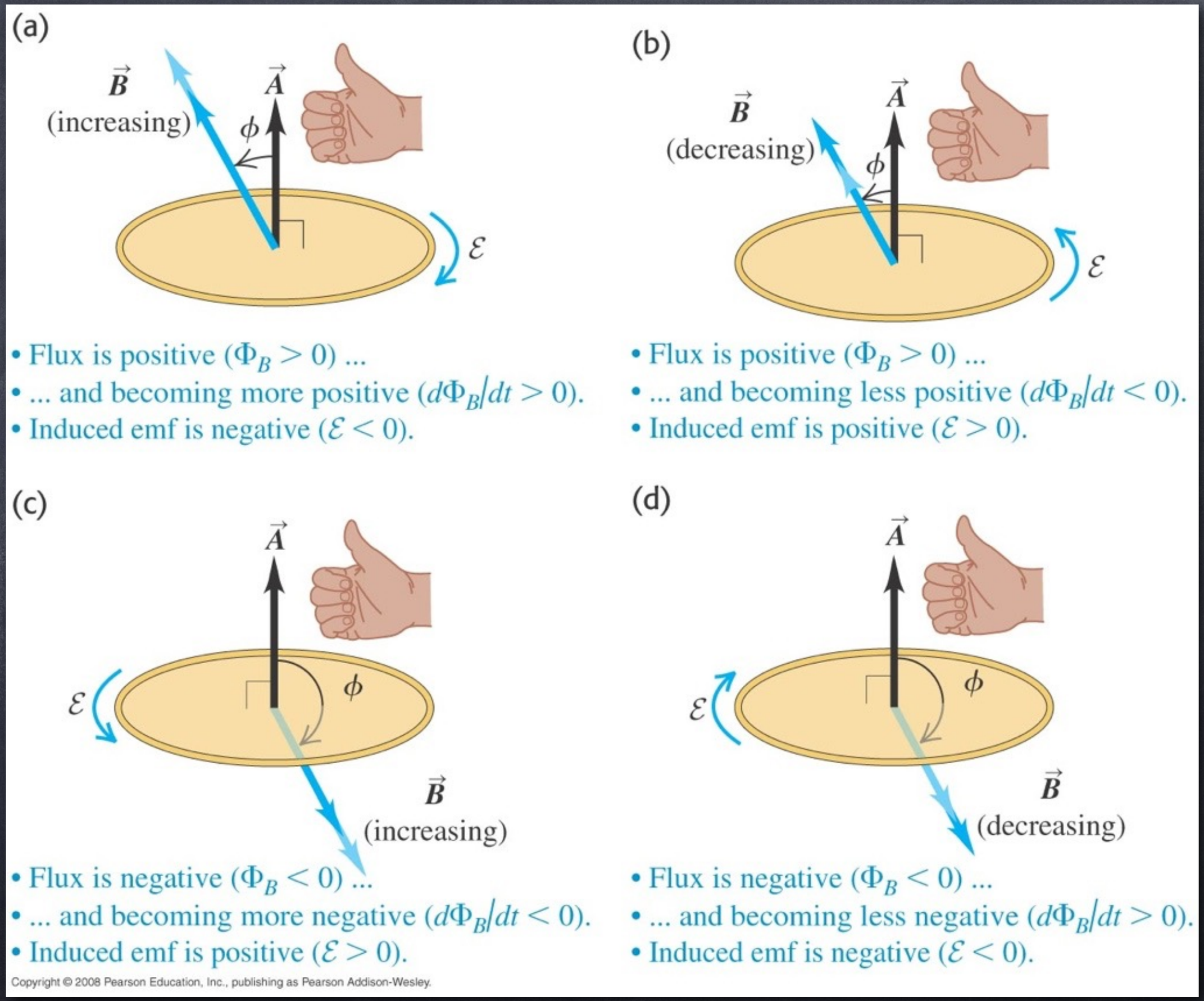
Faraday's Law

States that **changing flux** through a closed loop **leads to an induced emf** within the loop.

"...induced emf in a closed loop equals the negative of the time rate of change of magnetic flux through the loop."

$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$

Note: Flux that doesn't change does not induce emf!



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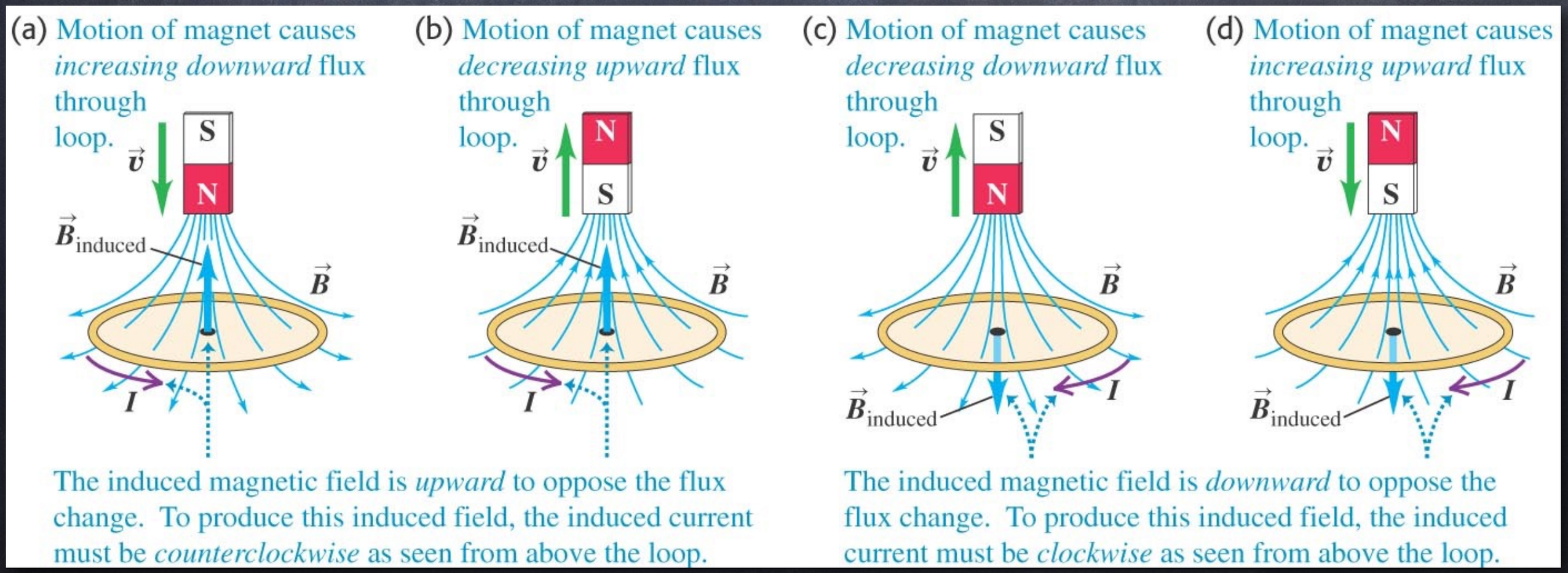
Lenz's Law

"The direction of any magnetic induction effect is such as to oppose the cause of the effect."

(i.e., The induced current will produce a change of flux opposite to that applied)



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Motional emf

Consider a **Moving Conductor** in a B-Field...
An internal electric field, and thus emf, is generated due to the magnetic forces on mobile charges.

Forces Balance, so:

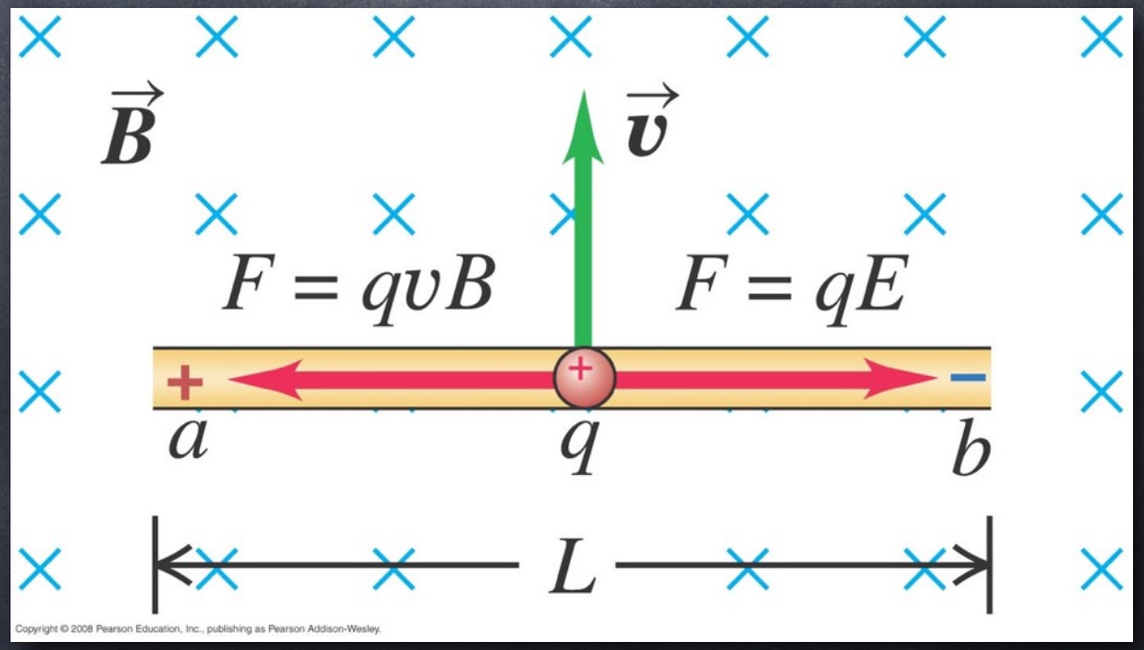
$$qvB = qE$$

And, recall that:

$$\mathcal{E} = EL$$

Therefore:

$$\boxed{\mathcal{E} = vBL}$$



Motional emf

This is really a re-expression of Faraday's Law,
Applicable specifically to moving conductors.

For the simple case before,

$$\mathcal{E} = vBL$$

Or, more generally:

$$\boxed{\mathcal{E} = \oint (\vec{v} \times \vec{B}) \cdot d\vec{l}}$$

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Summary / Next Class:

- Mastering Physics due **Wednesday**
- Work on Homework for **Friday**