

Homework Week 10

113-2 General Physics II

Due before 4:10 PM on April 28, 2025

Name 徐克宇

1. [20 points] Derivation of the motional emf (Force model vs Farady's law)

寫下推導每個步驟

Motional emf

動生電動勢

- Sliding conducting bar
 $\vec{F}_B = \vec{F}_E \Rightarrow \Delta V =$
- Sliding conducting bar in a circuit
 $\mathcal{E} =$
 $I =$
- The applied force does work on the conducting bar
 $F_B = = F_{app}$
 $P =$

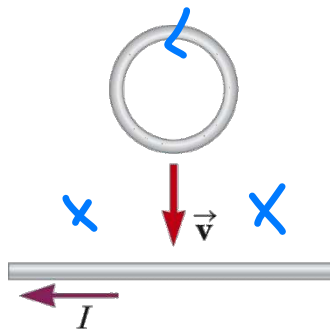
A counterclockwise current I is induced in the loop. The magnetic force \vec{F}_B on the bar carrying this current opposes the motion.

$R=0$ for the sliding bar

2. [5 points] Quick Quiz 31.3

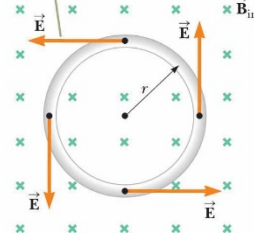
Figure 31.12 shows a circular loop of wire falling toward a wire carrying a current to the left. What is the direction of the induced current in the loop of wire?

(a) clockwise (b) counterclockwise (c) zero (d) impossible to determine



3. [20 points] The General Form of Faraday's Law

If \vec{B} changes in time, an electric field is induced in a direction tangent to the circumference of the loop.



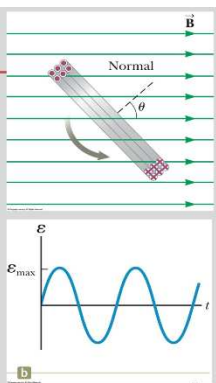
Rotating Loop

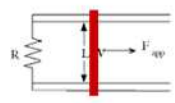
- N turns loop rotating in a magnetic field
- The flux through the loop at any time t is $\Phi_B = BA \cos \theta = BA \cos \omega t$
- The induced emf in the loop is

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

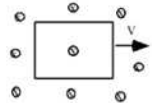
$$=$$

- $\mathcal{E}_{\max} = NBA\omega$, when $\omega t = 90^\circ$ or 270°
- $\mathcal{E} = 0$, when $\omega t = 0^\circ$ or 180°

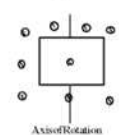




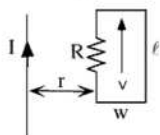
A



B



C



D

4. [5 points] The induced emf in a rotation loop

5. [5 points] Quiz

For which of the following is an emf induced?

- A.** conducting rod is pulled on conducting rails that are placed in a uniform magnetic field directed into the page.
- B.** conducting loop moves through a uniform magnetic field directed into the page.
- C.** conducting loop rotates in a uniform magnetic field directed into the page.
- D.** conducting loop moves in a magnetic field produced by an infinite current-carrying wire.

6. [5 points] According to our course schedule, what topic will be covered in the next lecture? _____.

7. [10 points] 銀河便車指南”說,「42」是生命、宇宙和一切的終極答案。如果我們看不懂答案,是因為一開始就不知道問題是什麼。真正重要的,是_____。

當眼界不夠開闊的時候,我們可能會問錯問題。因此,我們必須保持對世界的好奇,拓展知識的邊界,勇敢地提出笨的問題,有一天就會問到對的問題。

學習物理,要連結日常生活,把物理圖像化。

8. [30 points] 有沒有覺得課堂、作業、考試可以如何調整,幫助學習?

此題可留白,無論是否作答都給分,但禁止使用生成式 AI 工具

勇敢地提出笨的問題, 有一天就會問到對的問題

1. • Sliding Conducting Bar

$$F_B = F_E \Rightarrow qvB = qE \Rightarrow E = vB$$

$$\Delta V = El = vBl$$

• Sliding conducting bar in a circuit

$$\mathcal{E} = - \frac{d\Phi_B}{dt} = - \frac{d(Blx)}{dt} = -Blv$$

$$I = \frac{|\mathcal{E}|}{R} \text{ (Ohm's Law)} = \frac{Blv}{R}$$

• The applied force F_{app} does work on the conducting bar

$$F_{app} = I\vec{L} \times \vec{B} = IlB = F_B$$

$$P = \frac{dW}{dt} = \vec{F} \cdot \frac{d\vec{z}}{dt} = \vec{F}_{app} \cdot \vec{v}$$

$$= (IlB) \cdot v \quad \leftarrow F_{app} = IlB$$

$$= \frac{B^2 l^2 v^2}{R}$$

2. (B into the plane) ↗

Lenz's Law

generates B out of the plane

$R + IR$

✓ counter clockwise I

3. The General Form of Faraday's Law

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

$$\Rightarrow \int \vec{E} \cdot d\vec{s} = - \frac{d(BA)}{dt}$$

$$\Rightarrow E (2\pi r) = - \frac{dB}{dt} (\pi r^2)$$

$$\Rightarrow E = - \frac{r}{2} \frac{dB}{dt} \# \checkmark$$

4. The Induced emf in a rotational loop

$$\mathcal{E} = - N \frac{d\Phi_B}{dt} \text{ (Faraday's Law)}$$


$$= - N \frac{d(BA \cos \theta)}{dt}$$

$$= - N B A \frac{d \cos(\omega t)}{dt}$$

$$\left[\begin{array}{l} \theta = \omega t \end{array} \right.$$

$$\left(\frac{d \cos(\omega t)}{dt} = -\omega \sin(\omega t) \right)$$

$$= \omega N B A \sin(\omega t) \# \checkmark$$

5. AC 

6. inductance ✓

7. 3 解該問什麼樣的問題 ✓

8.