Flux to Current

Graph and calculate what a changing magnetic field does in a loop

HS-PSII-7.2 "Develop graphical and mathematical representations that describe the relationship between the rate of change of magnetic flux and the amount of voltage induced in a simple loop circuit according to Faraday's Law of Induction and apply..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the rule that connects changing magnetic flux to voltage, circle the rule that connects voltage to current, and number the two axes named for a voltage graph.

Power from a Passing Magnet

1. During a bicycle ride, a magnet passes a wire loop that powers a small lamp. Magnetic flux describes how much magnetic field passes through the loop. Moving the magnet changes that flux. A faster change produces a larger induced voltage. A stationary magnet can provide flux, but if the flux stays constant, it induces no voltage.

2. For one loop, the magnitude of induced voltage is $V = |\Delta\Phi|/\Delta t$: divide the change in magnetic flux, in webers, by the time, in seconds. For example, a 0.050 Wb change over 0.20 s gives 0.25 V. If the only resistance is 5 Ω, the current is $I = V/R = 0.050$ A.

3. For the data below, the loop has one turn and a 10 Ω resistor; wire resistance is negligible. Each row records a positive flux change during a short interval. On a graph, place flux change per second on the horizontal axis and induced voltage on the vertical axis. A second graph can compare voltage and current.

FLUX CHANGES IN A SINGLE LOOP

Interval	Flux change (Wb)	Time (s)
A	0.010	0.10
B	0.020	0.10
C	0.030	0.10
D	0.040	0.10

2 ANSWER WITH EVIDENCE

Use the passage

1. For intervals A and B, calculate the flux-change rate and induced voltage. Write each as a point (rate in Wb/s, voltage in V) for a graph.

2. Calculate the voltage-graph points for C and D. What is the slope of the line through those points?

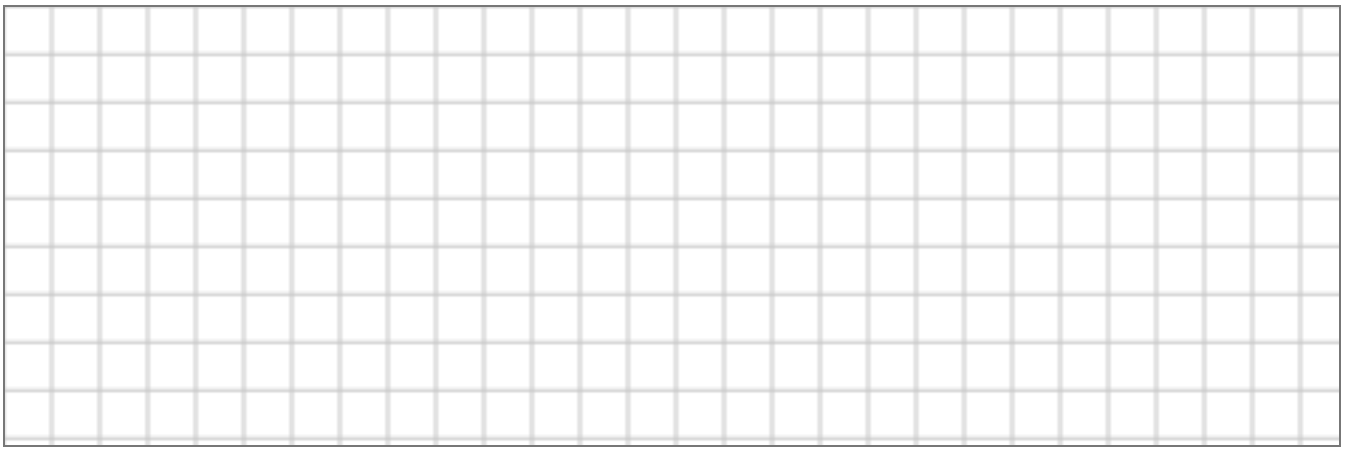
3. Use the resistor value to calculate the current in interval D. How does it compare with the current in A?

4. Suppose C has the same flux change but takes 0.20 s. Calculate the new voltage and current. How would its voltage-graph point move?

3 YOUR TURN

Your own words

Invent three different positive flux-change rates that are not in the table for a single loop with a 20 Ω resistor. On the grid, graph induced voltage against flux-change rate, including the origin; then write the voltage rule and calculate the current at your highest rate.



Flux to Current

PART 1 · READ AND MARK

Underline the rule that connects changing magnetic flux to voltage, circle the rule that connects voltage to current, and number the two axes named for a voltage graph. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	For intervals A and B, calculate the flux-change rate and induced voltage. Write each as a point (rate in Wb/s, voltage in V) for a graph.	**A: (0.10 Wb/s, 0.10 V). B: (0.20 Wb/s, 0.20 V).**
2	Calculate the voltage-graph points for C and D. What is the slope of the line through those points?	**C: (0.30 Wb/s, 0.30 V); D: (0.40 Wb/s, 0.40 V). Slope = (0.40 − 0.30) V ÷ (0.40 − 0.30) Wb/s = 1 V per (Wb/s).**
3	Use the resistor value to calculate the current in interval D. How does it compare with the current in A?	**D: 0.40 V ÷ 10 Ω = 0.040 A. A: 0.10 V ÷ 10 Ω = 0.010 A, so D has four times the current.**
4	Suppose C has the same flux change but takes 0.20 s. Calculate the new voltage and current. How would its voltage-graph point move?	**V = 0.030 Wb ÷ 0.20 s = 0.15 V; I = 0.15 V ÷ 10 Ω = 0.015 A. The point moves from (0.30, 0.30) to (0.15, 0.15), down and left.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Label the horizontal axis flux-change rate (Wb/s) and the vertical axis induced voltage (V). Plot (0, 0), (0.15, 0.15), (0.25, 0.25), and (0.45, 0.45), then connect them with a straight line. For one loop, $V = |\Delta\Phi|/\Delta t$. At 0.45 Wb/s, I = 0.45 V ÷ 20 Ω = 0.0225 A.

Accept equivalent rounded values with units. For the open task, accept any three distinct positive rates absent from the table if each plotted voltage equals its rate numerically and the current uses 20 Ω.