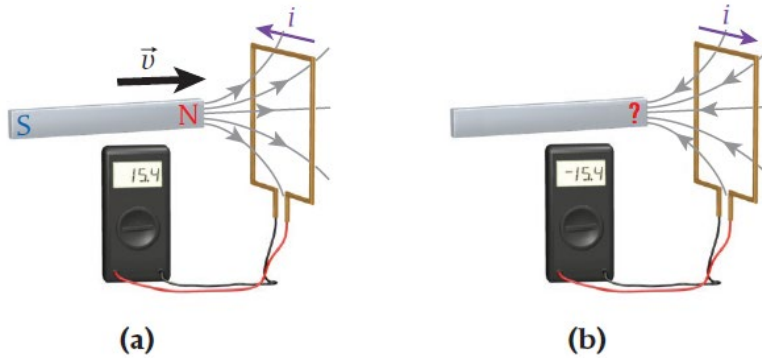


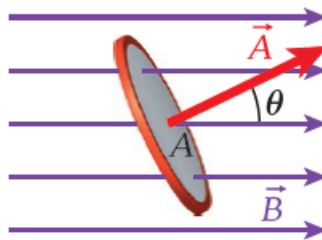
Physics 12 ADV-Final Revision - T3 -2023

What will be the possible magnet pole and type of motion to produce **an induced current in fig.b**



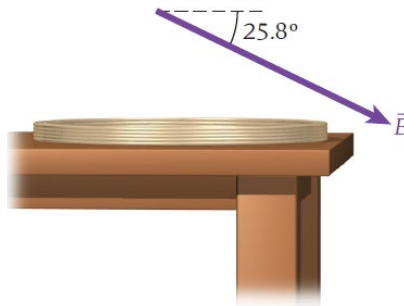
	pole	Type of motion
A	N	→
B	S	No motion
C	N	←
D	S	←

A circular area with a radius of 6.50 cm. **What is the magnitude of the angle θ** If a magnetic field 0.23 T paths through the area as shown producing magnetic flux of 1.83 mWb



	Angle θ
A	25.4°
B	53.1°
C	30°
D	36.9°

circular coil of wire with 20 turns is laying flat on a horizontal tabletop as shown in the figure. There is a uniform magnetic field extending over the entire table with a magnitude of 5.00 T making an angle of 25.8° with the horizontal. **What is the magnitude of coil radius** if the magnetic flux through the coil is 21.9 T m^2



	Radius (r)
A	60 cm
B	40.0 cm
C	1600 cm
D	2 cm

Which of the following is **not** a correct unit of magnetic flux?

A	H.A/s
B	V.s
C	H.A
D	T.m ²

Q. Which of the following equations represent the Gauss's law for magnetic fields?

A. $\Delta V_{ind} = vlB$

B. $\Delta V_{ind} = -N \frac{d\phi_B}{dt}$

C. $\oint B \cdot dA = 0$

D. $\oint \vec{E} \cdot d\vec{s} = -\frac{d\phi_B}{dt}$

What does the equation $\oint \mathbf{B} \cdot d\mathbf{A} = 0$ represent?

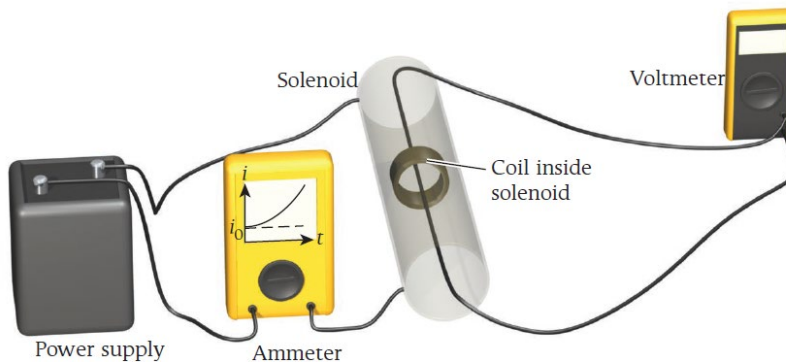
- I. Magnetic field lines must form closed loops
- II. Moving charges create magnetic field
- III. There exist no magnetic monopoles

A	I only
B	II only
C	III only
D	I and III only

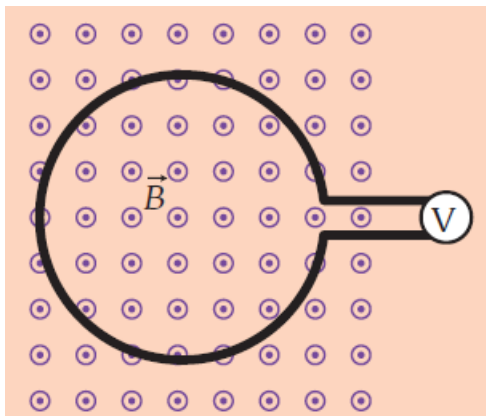
A current of 600 mA is flowing in an ideal solenoid, resulting in a magnetic field of 0.025 T inside the solenoid. Then the current increases with time, t , according to

$$i(t) = i_0 \left[1 + (2.4 \text{ s}^{-2})t^2 \right]$$

If a circular coil of radius 3.4 cm with $N = 200$ windings is located inside the solenoid with its normal vector parallel to the magnetic field, **what is the induced potential difference in the coil at $t = 2.0$ s?**



The plane of the circular loop shown in the figure is perpendicular to a magnetic field with magnitude $B = 0.500 \text{ T}$. The magnetic field goes to zero at a constant rate in 0.250 s . The induced voltage in the loop is 1.24 V during that time. **What is the radius of the loop and the direction of induced current?**



	Radius (cm)	Direction of induced current
A	78.7	Clockwise
B	44.4	counterclockwise
C	88.8	Clockwise
D	1971.4	counterclockwise

29.1 A solenoid with 200 turns and a cross-sectional area of 60 cm^2 has a magnetic field of 0.60 T along its axis. If the field is confined within the solenoid and changes at a rate of 0.20 T/s , the magnitude of the induced potential difference in the solenoid will be

- a) 0.0020 V . b) 0.02 V . c) 0.001 V . d) 0.24 V .

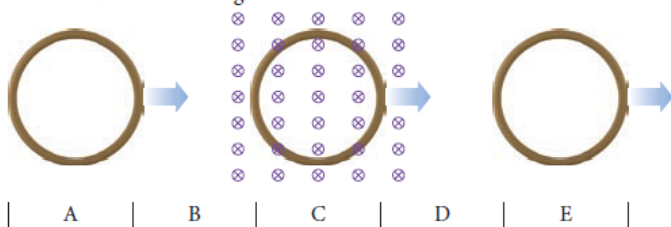
29.3 Which of the following will induce a current in a loop of wire in a uniform magnetic field?

- a) decreasing the strength of the field
- b) rotating the loop about an axis parallel to the field
- c) moving the loop within the field
- d) all of the above
- e) none of the above

29.4 Faraday's Law of Induction states that

- a) a potential difference is induced in a loop when there is a change in the magnetic flux through the loop.
- b) the current induced in a loop by a changing magnetic field produces a magnetic field that opposes this change in magnetic field.
- c) a changing magnetic field induces an electric field.
- d) the inductance of a device is a measure of its opposition to changes in current flowing through it.
- e) magnetic flux is the product of the average magnetic field and the area perpendicular to it that it penetrates.

29.5 A conducting ring is moving from left to right through a uniform magnetic field, as shown in the figure. In which region(s) is there an induced current in the ring?



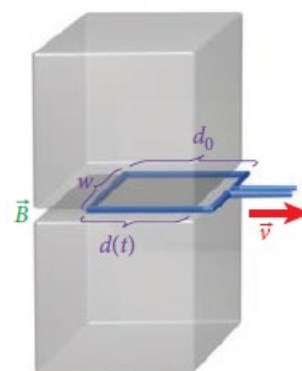
- a) regions B and D
- b) regions B, C, and D
- c) region C
- d) regions A through E

29.7 Which of the following statements regarding self-induction is correct?

- a) Self-induction occurs only when a direct current is flowing through a circuit.
- b) Self-induction occurs only when an alternating current is flowing through a circuit.
- c) Self-induction occurs when either a direct current or an alternating current is flowing through a circuit.
- d) Self-induction occurs when either a direct current or an alternating current is flowing through a circuit as long as the current is varying.

29.2 The rectangular loop of wire in Figure 29.9 is pulled with a constant acceleration from a region of zero magnetic field into a region of a uniform magnetic field. During this process, the current induced in the loop

- a) will be zero.
- b) will be some constant value that is not zero.
- c) will increase linearly with time.
- d) will increase exponentially with time.
- e) will increase linearly with the square of the time.



29.9 Calculate the potential difference induced between the tips of the wings of a Boeing 747-400 with a wingspan of 64.67 m when it is in level flight at a speed of 913 km/h. Assume that the magnitude of the downward component of the Earth's magnetic field is $B = 5.00 \cdot 10^{-5} \text{ T}$.

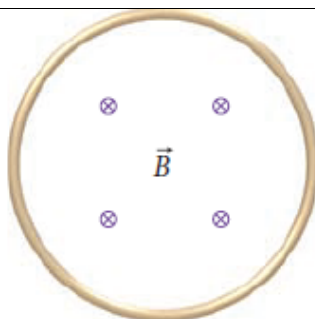
- a) 0.820 V c) 10.4 V e) 225 V
b) 2.95 V d) 30.1 V



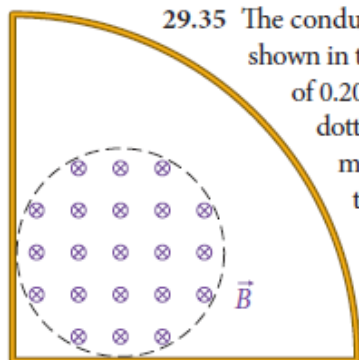
29.11 A long solenoid has a circular cross section of radius $r = 8.10 \text{ cm}$, a length $\ell = 0.540 \text{ m}$, and $n = 2.00 \cdot 10^4 \text{ turns/m}$. The solenoid is carrying a current of magnitude $i = 4.04 \cdot 10^{-3} \text{ A}$. How much energy is stored in the magnetic field of the solenoid?

- a) $2.11 \cdot 10^{-7} \text{ J}$ c) $4.57 \cdot 10^{-5} \text{ J}$ e) $4.55 \cdot 10^{-1} \text{ J}$
b) $8.91 \cdot 10^{-6} \text{ J}$ d) $6.66 \cdot 10^{-3} \text{ J}$

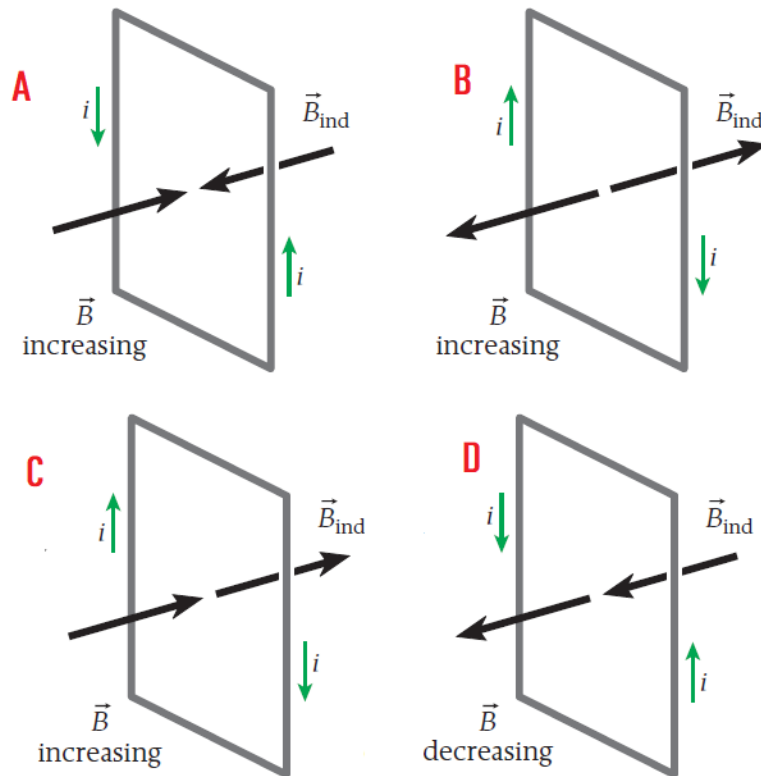
29.69 A single loop of wire with an area of 5.00 m^2 is located in the plane of the page, as shown in the figure. A time-varying magnetic field in the region of the loop is directed into the page, and its magnitude is given by $B = 3.00 \text{ T} + (2.00 \text{ T/s})t$. At $t = 2.00 \text{ s}$, what are the induced potential difference in the loop and the direction of the induced current?



29.35 The conducting loop in the shape of a quarter-circle shown in the figure has a radius of 10.0 cm and a resistance of 0.200Ω . The magnetic field strength within the dotted circle of radius 3.00 cm is initially 2.00 T. The magnetic field strength then decreases from 2.00 T to 1.00 T in 2.00 s. Find (a) the magnitude and (b) the direction of the induced current in the loop.

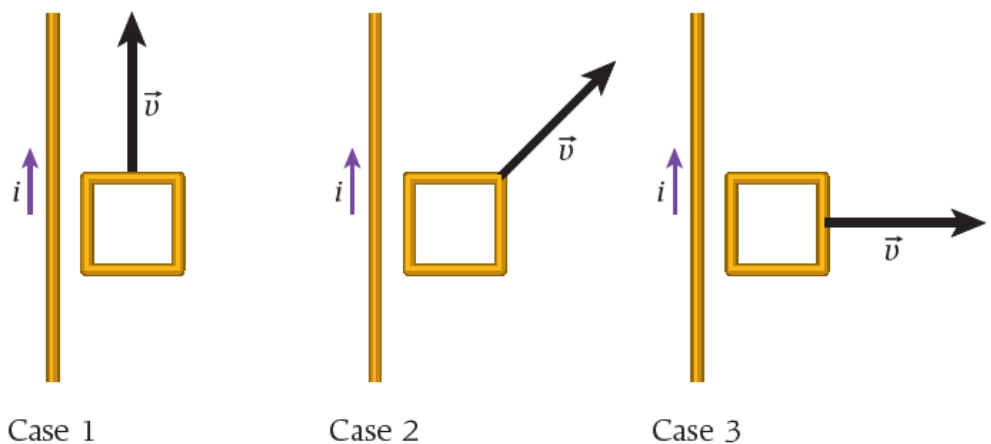


Which of the following diagrams is **not** correct according to Lenz's Law?

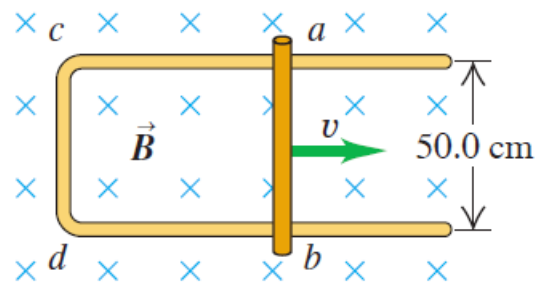


A long wire carries a current, i , as shown in the figure. A square loop moves in the same plane as the wire, as indicated. In which cases will the loop have an induced current?

- a) cases 1 and 2
- b) cases 1 and 3
- c) cases 2 and 3
- d) None of the loops will have an induced current.
- e) All of the loops will have an induced current.

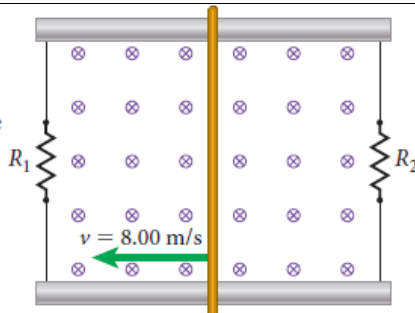


The conducting rod ab shown in Fig. makes contact with metal rails ca and db . The apparatus is in a uniform magnetic field of 0.800 T , perpendicular to the plane of the figure.



- Find the magnitude of the emf induced in the rod when it is moving with a speed 7.50 m/s .
- In what direction does the current flow in the rod?
- If the resistance of the circuit $abdc$ is $1.50\ \Omega$ (assumed to be constant), find the force required to keep the rod moving to the right

•29.75 A conducting rod of length 50.0 cm slides over two parallel metal bars placed in a magnetic field with a magnitude of 1.00 kG , as shown in the figure. The ends of the rods are connected by two resistors, $R_1 = 100.\ \Omega$ and $R_2 = 200.\ \Omega$. The conducting rod moves with a constant speed of 8.00 m/s .



- What are the currents flowing through the two resistors?
- What power is delivered to the resistors?
- What force is needed to keep the rod moving with constant velocity?

29.62 A wire of length $\ell = 10.0\text{ cm}$ is moving with constant velocity in the xy -plane; the wire is parallel to the y -axis and moving along the x -axis. If a magnetic field of magnitude 1.00 T is pointing along the positive z -axis, what must the velocity of the wire be in order for a potential difference of 2.00 V to be induced across it?

Induced Electric Field

A circular coil of radius $R = 8.5$ cm exists in an increasing magnetic field that has a rate of 0.13 T/s

Find the induced electric field in the following regions:

- a- $r = 5.2$ cm
- b- at the surface of the coil
- c- $r = 12.5$ cm

take $R = 8.5$ cm and $dB/dt = 0.13$ T/s.

(a) Find an expression for the magnitude E of the induced electric field at points within the magnetic field, at radius r from the center of the magnetic field. Evaluate the expression for $r = 5.2$ cm.

$$\oint \vec{E} \cdot d\vec{s} = \oint E ds = E \oint ds = E(2\pi r)$$

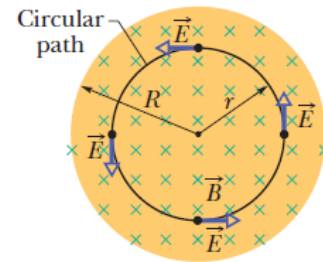
$$\Phi_B = BA = B(\pi r^2)$$

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

$$E = \frac{r}{2} \frac{dB}{dt}$$

$$E = \frac{(5.2 \times 10^{-2} \text{ m})}{2} (0.13 \text{ T/s})$$

$$= 0.0034 \text{ V/m} = 3.4 \text{ mV/m.}$$

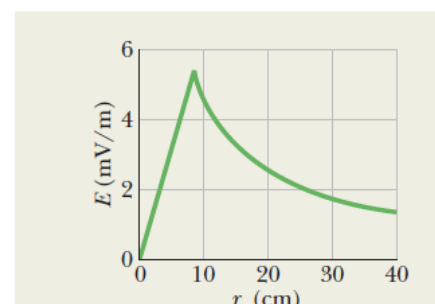
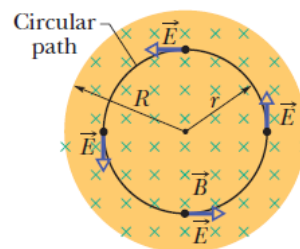


(b) Find an expression for the magnitude E of the induced electric field at points that are outside the magnetic field, at radius r from the center of the magnetic field. Evaluate the expression for $r = 12.5$ cm.

$$E = \frac{R^2}{2r} \frac{dB}{dt}$$

$$E = \frac{(8.5 \times 10^{-2} \text{ m})^2}{(2)(12.5 \times 10^{-2} \text{ m})} (0.13 \text{ T/s})$$

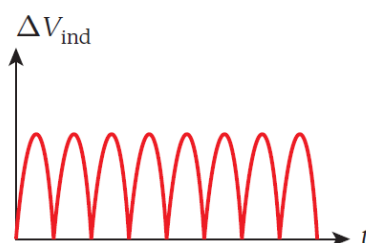
$$= 3.8 \times 10^{-3} \text{ V/m} = 3.8 \text{ mV/m.}$$



29.43 A simple generator consists of a loop rotating inside a constant magnetic field (see Figure 29.19). If the loop is rotating with frequency f , the magnetic flux is given by $\Phi(t) = BA \cos(2\pi ft)$. If $B = 1.00 \text{ T}$ and $A = 1.00 \text{ m}^2$, what must the value of f be for the maximum induced potential difference to be 110. V?

•29.44 A motor has a single loop inside a magnetic field of magnitude 0.870 T. If the area of the loop is $300. \text{ cm}^2$, find the maximum angular speed possible for this motor when connected to a source of emf providing 170. V.

Look at the following fig and determine Which of the following is **NOT** true for Induced potential difference as a function of time.

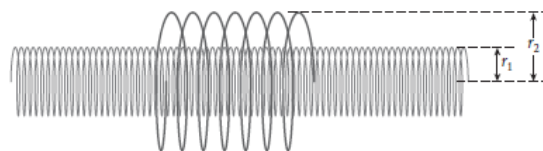


- A. This curve is the output voltage as a function of time for DC generator
- B. The working principle of generator is based on electromagnetic induction.
- C. The generator structure has two have slip-rings
- D. The generator structure has commutator to make the current flow in one direction only.

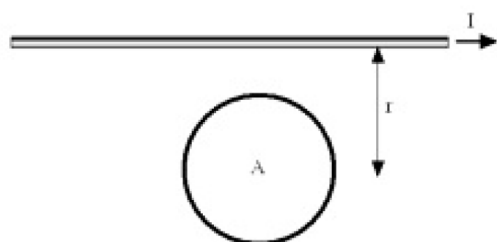
29.46 Find the mutual inductance of the solenoid and the coil described in Example 29.1 and the induced potential difference in the coil at $t = 2.0$ s using the techniques described in Section 29.7. How do the results for the induced potential difference compare?

29.10 A long solenoid with a circular cross section of radius $r_1 = 2.80$ cm and $n = 290$ turns/cm is inside of and coaxial with a short coil that has a circular cross section of radius $r_2 = 4.90$ cm and $N = 31$ turns. Suppose the current in the short coil is increased steadily from zero to $i = 2.80$ A in 18.0 ms. What is the magnitude of the potential difference induced in the solenoid while the current in the short coil is changing?

- a) 0.0991 V c) 0.233 V e) 0.750 V
b) 0.128 V d) 0.433 V



The current in the wire is given by the equation $I = 2.5 - 0.6t$, with positive to the right as shown. Which of the statements concerning the current induced in the loop is correct?



- a. There is no induced current.
b. The current is clockwise always.
c. The direction of current depends on the value of r .
d. The current is first clockwise then counterclockwise.
e. The direction of current depends on the value of A .

The unit of inductance is equivalent to

A $\frac{\text{volt} \times \text{ampere}}{\text{second}}$

B $\frac{\text{ampere}}{\text{volt} \times \text{second}}$

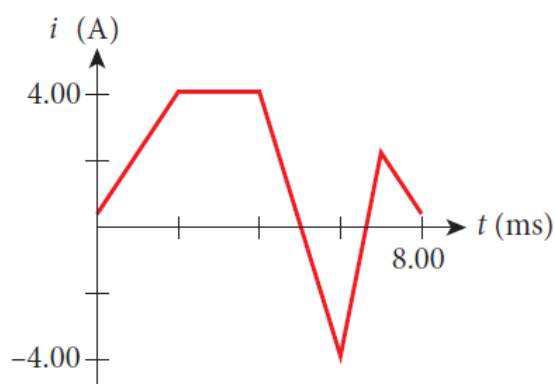
C $\frac{\text{volt}}{\text{Ampere} \times \text{second}}$

D $\frac{\text{volt} \times \text{second}}{\text{ampere}}$

$$1 \text{ H} = 1 \text{ Wb/A} = 1 \text{ V} \cdot \text{s/A} = 1 \Omega \cdot \text{s} = 1 \text{ J/A}^2$$

The figure shows the current through a 10-mH inductor. What is maximum magnitude of the potential difference ΔV_L across the inductor over the period shown?

- a. 20 V
- b. 40 V
- c. 60 V
- d. 60 mV



What will happen to the inductance of a solenoid when the number of turns and the length are doubled, keeping the area of cross-section same?

A $\frac{L}{2}$

B L

C $2L$

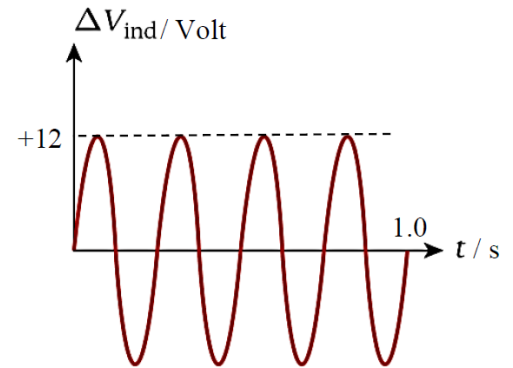
D $4L$

•29.48 A short coil with radius $R = 10.0$ cm contains $N = 30.0$ turns and surrounds a long solenoid with radius $r = 8.00$ cm containing $n = 60$ turns per centimeter. The current in the short coil is increased at a constant rate from zero to $i = 2.00$ A in a time of $t = 12.0$ s. Calculate the induced potential difference in the long solenoid while the current is increasing in the short coil.

The graph represent the changes in the potential that is produced by an AC generatoure, which equation represent these changes?

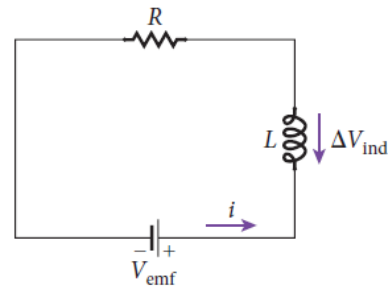
يمثل الرسم البياني تغيرات فرق الجهد الكهربائي الذي يتم توليده بواسطة مصدر جهد متردد، أي المعادلات التالية تمثل تلك التغيرات؟

- A. $\Delta V_{\text{ind}} = 6.0 \sin(4\pi t)$
- B. $\Delta V_{\text{ind}} = 12 \sin(4\pi t)$
- C. $\Delta V_{\text{ind}} = 12 \cos(8\pi t)$
- D. $\Delta V_{\text{ind}} = 12 \sin(8\pi t)$



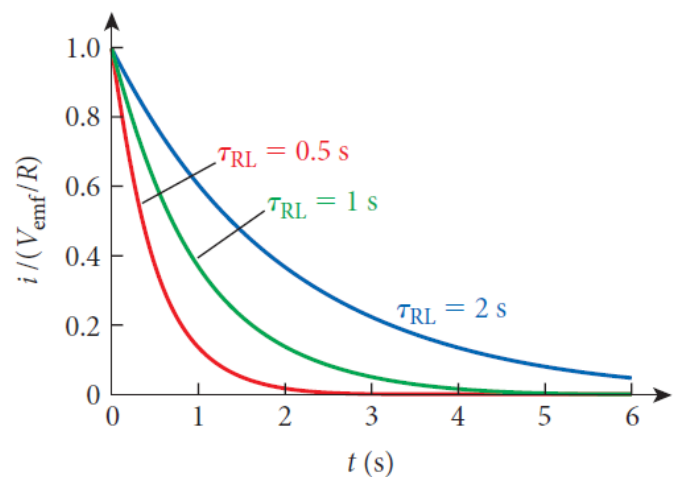
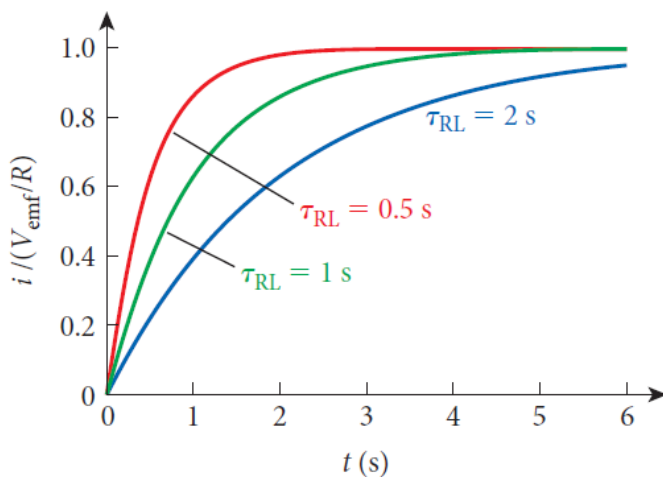
$$V_{\text{emf}} - iR - L \frac{di}{dt} = 0$$

$$L \frac{di}{dt} + iR = V_{\text{emf}}$$



$$i(t) = \frac{V_{\text{emf}}}{R} \left(1 - e^{-t/(L/R)} \right)$$

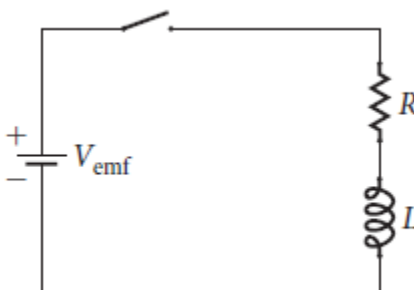
$$\tau_{\text{RL}} = \frac{L}{R}$$



29.49 Consider an RL circuit with resistance $R = 1.00 \text{ M}\Omega$ and inductance $L = 1.00 \text{ H}$, which is powered by a 10.0-V battery.

- What is the time constant of the circuit?
- If the switch is closed at time $t = 0$, what is the current just after that time? After $2.00 \mu\text{s}$? When a long time has passed?

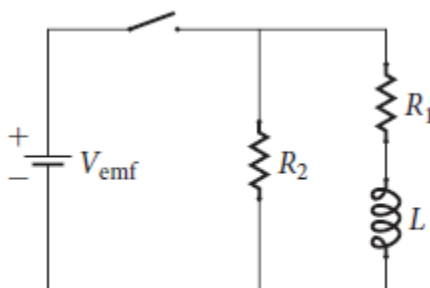
29.50 In the circuit in the figure, $R = 120. \Omega$, $L = 3.00 \text{ H}$, and $V_{\text{emf}} = 40.0 \text{ V}$. After the switch is closed, how long will it take the current in the inductor to reach $300. \text{ mA}$?



29.51 The current is increasing at a rate of 3.60 A/s in an RL circuit with $R = 3.25 \Omega$ and $L = 440. \text{ mH}$. What is the potential difference across the circuit at the moment when the current in the circuit is 3.00 A ?

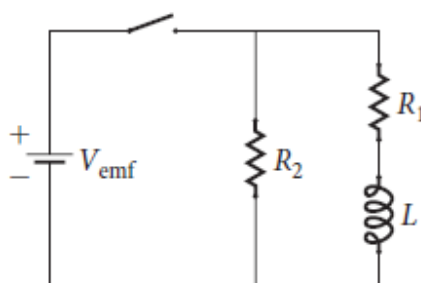
•29.52 In the circuit in the figure, a battery supplies $V_{\text{emf}} = 18.0 \text{ V}$ and $R_1 = 6.00 \, \Omega$, $R_2 = 6.00 \, \Omega$, and $L = 5.00 \text{ H}$. Calculate each of the following *immediately* after the switch is closed:

- the current flowing out of the battery
- the current through R_1
- the current through R_2
- the potential difference across R_1
- the potential difference across R_2
- the potential difference across L
- the rate of current change across R_1

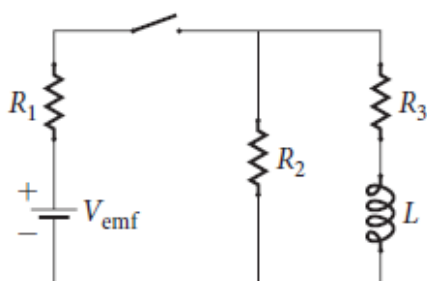


•29.53 In the circuit in the figure, a battery supplies $V_{\text{emf}} = 18.0 \text{ V}$ and $R_1 = 6.00 \, \Omega$, $R_2 = 6.00 \, \Omega$, and $L = 5.00 \text{ H}$. Calculate each of the following a *long time* after the switch is closed:

- the current flowing out of the battery
- the current through R_1
- the current through R_2
- the potential difference across R_1
- the potential difference across R_2
- the potential difference across L
- the rate of current change across R_1



•29.54 A circuit contains a battery, three resistors, and an inductor, as shown in the figure. What will be the current through each resistor (a) immediately after the switch is closed and (b) a long time after the switch is closed? (c) Suppose the switch is reopened a long time after it has been closed. What is the current in each resistor? After a long time?



•29.58 An emf of 20.0 V is applied to a coil with an inductance of 40.0 mH and a resistance of 0.500 Ω .

- Determine the energy stored in the magnetic field when the current reaches $\frac{1}{4}$ of its maximum value.
- How long does it take for the current to reach this value?

•29.71 A long solenoid with length 3.00 m and $n = 290$ turns/m carries a current of 3.00 A. It stores 2.80 J of energy. What is the cross-sectional area of the solenoid?

29.80 What is the resistance in an RL circuit with $L = 33.03$ mH if the time required for the current to reach 75% of its maximum value is 3.350 ms?

•4 A wire loop of radius 12 cm and resistance $8.5 \, \Omega$ is located in a uniform magnetic field $\vec{B}$ that changes in magnitude as given in Fig. 30-35. The vertical axis scale is set by $B_s = 0.50 \, \text{T}$, and the horizontal axis scale is set by $t_s = 6.00 \, \text{s}$. The loop's plane is perpendicular to $\vec{B}$.

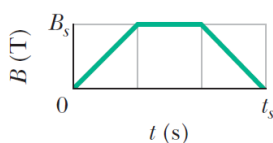
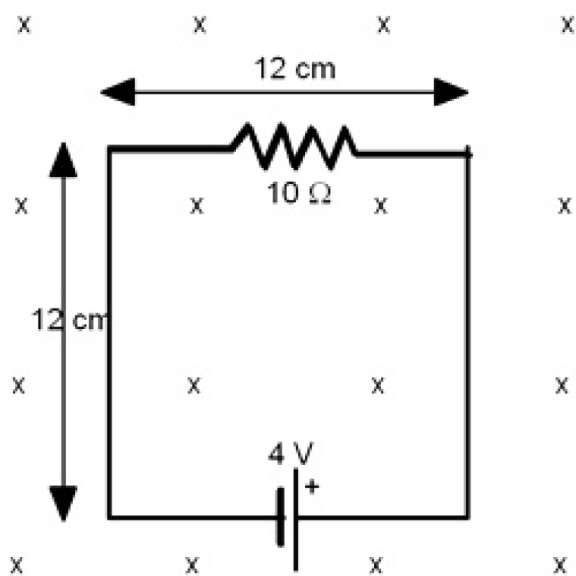


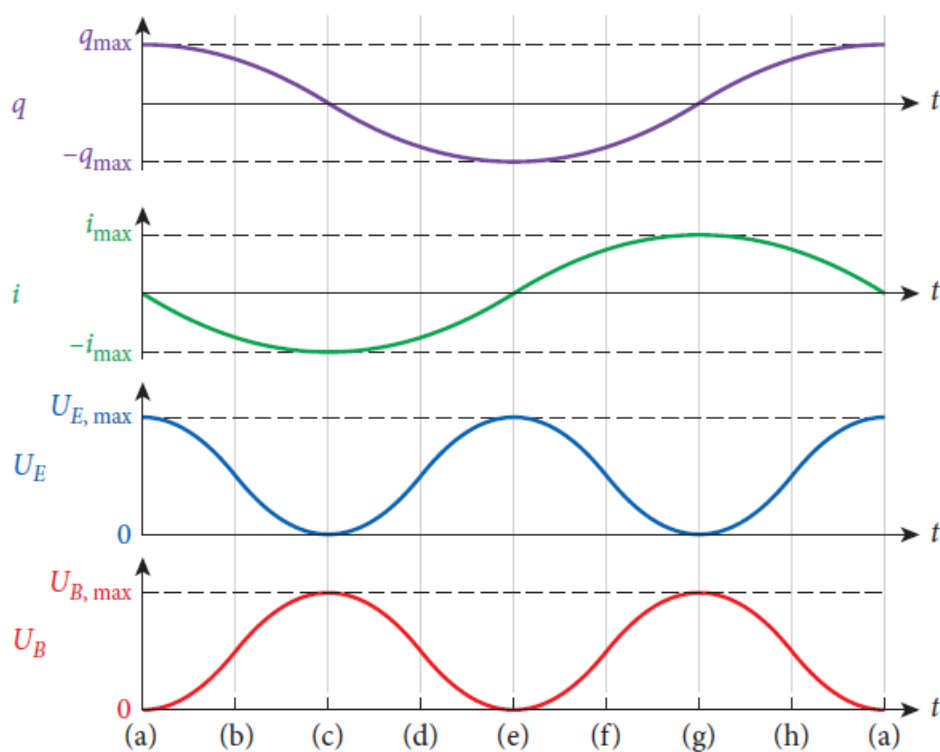
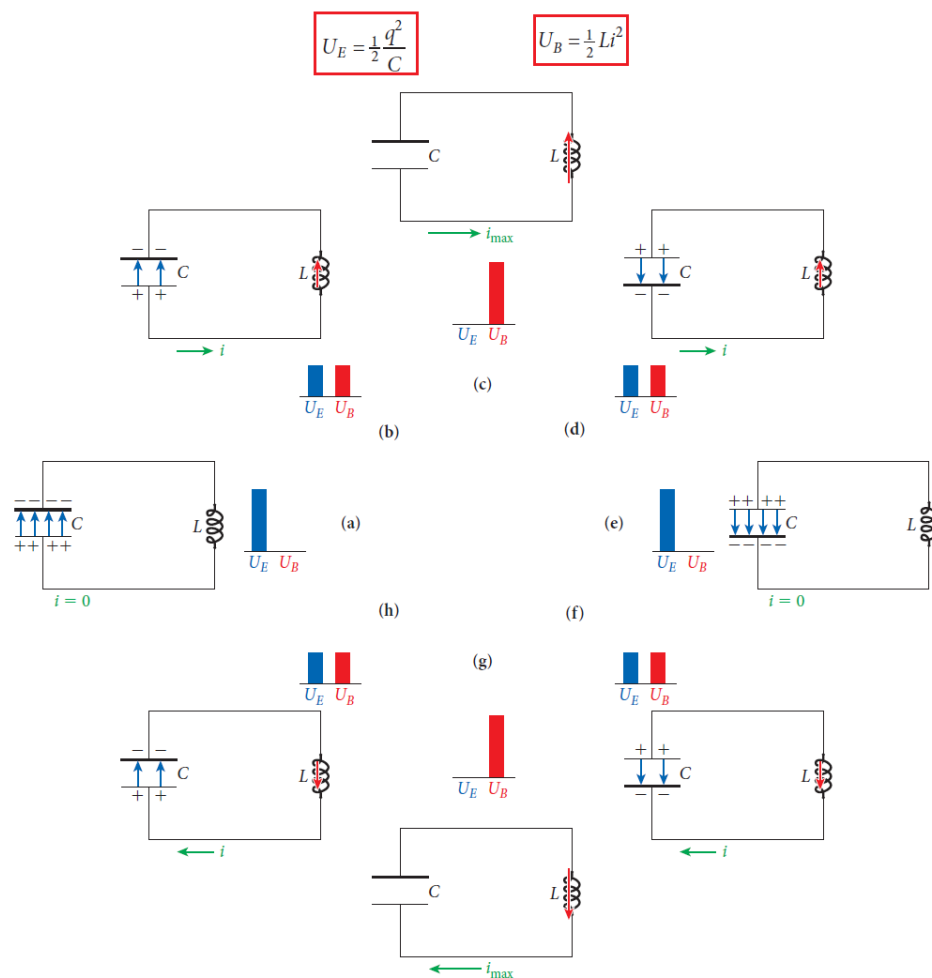
Figure 30-35 Problem 4.

What emf is induced in the loop during time intervals (a) 0 to 2.0 s, (b) 2.0 s to 4.0 s, and (c) 4.0 s to 6.0 s?

In the figure shown, the field is decreasing by $150 \, \text{T/s}$. What is the magnitude of the current in amperes?



- 0.18
- 0.22
- 0.40
- 0.62



The instantaneous voltage through a device of impedance 20Ω is $e = 80 \sin 100\pi t$. The effective value of the current is

A 3A

B 2.828A

C 1.732A

D 4A

An AC power supply puts out a voltage $V = 170 \sin(2\pi 60t)$ and is connected to a resistor $R = 20\Omega$. **What is the power in W dissipated in the resistor?**

- a. 100
- b. 310
- c. 720
- d. 1000
- e. 2000

A transformer with 300 turns on its primary coil and 30 turns on its secondary coil is designed to deliver an average power of 600 W with a peak voltage of 24 V. **What is the peak current in the primary coil?**

- a. 2.5 A
- b. 5.0 A
- c. 7.5 A
- d. 10.0 A
- e. 15.0 A

The total amount of energy stored in an LC series circuit is 8.00 J. When the current through the inductor is equal to half its maximum value, **how much energy is stored in the electric field?**

- a. 2.00 J
- b. 4.00 J
- c. 6.00 J
- d. 8.00 J

A Resistive Load

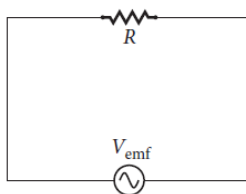


FIGURE 30.7 Single-loop circuit with a resistor and a source of time-varying emf.

$$v_R = V_{\max} \sin \omega t = V_R \sin \omega t$$

$$i_R = \frac{v_R}{R} = \frac{V_R}{R} \sin \omega t = I_R \sin \omega t$$

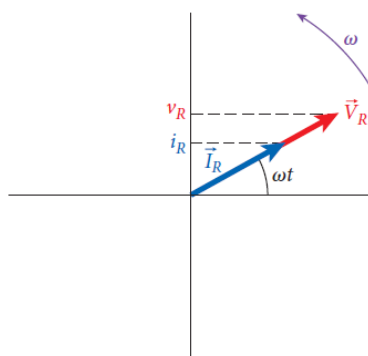
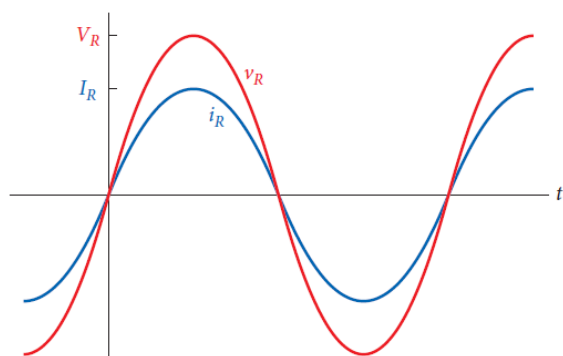
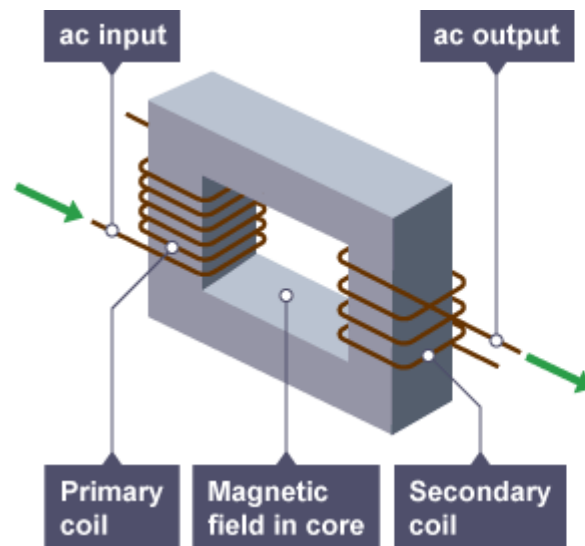


FIGURE 30.8 Alternating voltage and current for a single-loop circuit containing a source of time-varying emf and a resistor: (a) voltage and current as functions of time; (b) phasors representing voltage and current, showing that they are in phase.

phasor

is a counter clockwise rotating vector (with its tail fixed at the origin) whose projection on the vertical axis represents the sinusoidal variation of the particular quantity in time

10.7 Transformers



Step-up Transformer	Step-down Transformer
To increase the output voltage V_s	To decrease the output voltage V_s
$N_s > N_p$	$N_s < N_p$
$V_s > V_p$	$V_s < V_p$
$I_s < I_p$	$I_s > I_p$

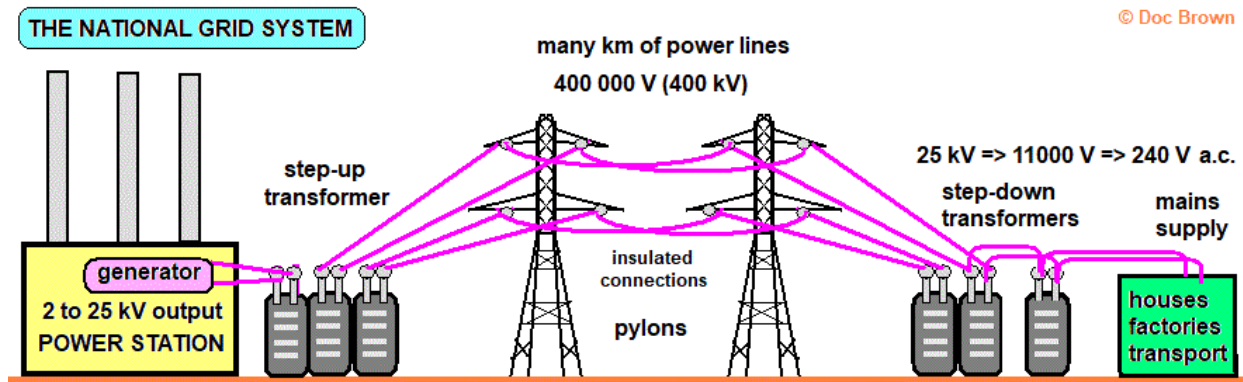
$$V_s = V_p \frac{N_s}{N_p} \quad (\text{transformation of voltage}).$$

$$I_s = I_p \frac{N_p}{N_s} \quad (\text{transformation of currents}).$$

and the equivalent resistance of the secondary circuit, as seen by the generator, is

$$R_{eq} = \left(\frac{N_p}{N_s} \right)^2 R,$$

where R is the resistive load in the secondary circuit. The ratio N_p/N_s is called the transformer's *turns ratio*.



consider a power plant that produces 500. MW of power. If the power is transmitted at 350. kV, the current in the power lines will be

$$I = \frac{P}{V} = \frac{500. \text{ MW}}{350. \text{ kV}} = \frac{5.00 \cdot 10^8 \text{ W}}{3.50 \cdot 10^5 \text{ V}} = 1.43 \text{ kA}.$$

If the total resistance of the power lines is 50. Ω , the power lost in the transmission lines is

$$P = I^2 R = (1.43 \text{ kA})^2 (50.0 \Omega) = 102. \text{ MW},$$

or about 20% of the generated power. A similar calculation would show that transmitting the power at 200. kV instead of 350. kV would increase the power loss by a factor of 3.1.

Thus, approximately 60% of the power generated would be lost in transmission.

- *This is why the transmission of electric power is always done at the highest possible voltage*

The transmission of electric power occurs at the highest possible voltage to reduce losses. By how much could the power loss be reduced by raising the voltage by a factor of 10.0?

If a power station provides power P , and delivers it over potential difference V , then the current out of the station is $I = P/V$. The power loss over the lines is $P' = I^2 R = (P/V)^2 R$. Therefore, if $V \rightarrow 10V$, the power loss over the lines is now $P'' = (P/10V)^2 R = (P/V)^2 R / 100 = P' / 100$. Therefore, if voltage is raised by a factor of 10, the power loss is 100 times smaller.

11-What is the phase difference between the voltage and the current through the resistor?

ما فرق الطور بين فرق الجهد عبر المقاوم والتيار المتدفق عبر المقاوم؟

- A. $\Phi = \pi$
- B. $\Phi = -\pi/2$
- C. $\Phi = \pi/2$
- D. $\Phi = \text{zero}$

12- How can the disipated power through the transmission lines reduce?

كيف يمكن تقليل الطاقة المبددة من خلال خطوط النقل؟

- A. By increasing the voltage to the highest possible value.
- B. By reducing the voltage in the transmission lines.
- C. By increasing the current in the transmission lines.
- D. By reducing the produced power.

13- The transmission of electric power occurs at the highest possible voltage to reduce losses. By how much could the power loss be reduced by raising the voltage by a **factor of 5.0**?

تتم عملية نقل الطاقة الكهربائية عند أعلى جهد ممكن لتقليل الفقد. ما مقدار الفقد في الطاقة الذي يمكن تقليله برفع الجهد بمعامل 5.0؟

- A. It will reduce by a factor of 5
- B. It will reduce by a factor of 10
- C. It will reduce by a factor of 15
- D. It will reduce by a factor of 25

14- A power station produces **12 MW** of power and is transported by an electrical voltage of **450 KV**.what is the disipated power in transmission lines if they are **110 Ω** resistance?

تنتج محطة طاقة ، قدرة كهربائية مقدارها **12 MW** ، ويتم نقلها عبر خطوط النقل بواسطة جهد كهربائي مقداره **450 KV** ما مقدار القدرة المبددة في أسلاك النقل إذا كانت مقاومتها **110 Ω** ؟

- A. $6.5 \times 10^4 \text{ W}$
- B. $7.8 \times 10^4 \text{ W}$
- C. $9.1 \times 10^4 \text{ W}$
- D. $9.6 \times 10^4 \text{ W}$



21- In maxwell's law, $\oint \vec{B} \cdot d\vec{s} = \mu_0 \epsilon_0 \frac{dX}{dt}$, what does the letter X represent in this equation?

في قانون ماكسويل $\oint \vec{B} \cdot d\vec{s} = \mu_0 \epsilon_0 \frac{dX}{dt}$ ماذا يمثل الحرف X في هذه المعادلة؟

- A. The magnetic flux
- B. The electric field
- C. The displacement current
- D. The the electric flux