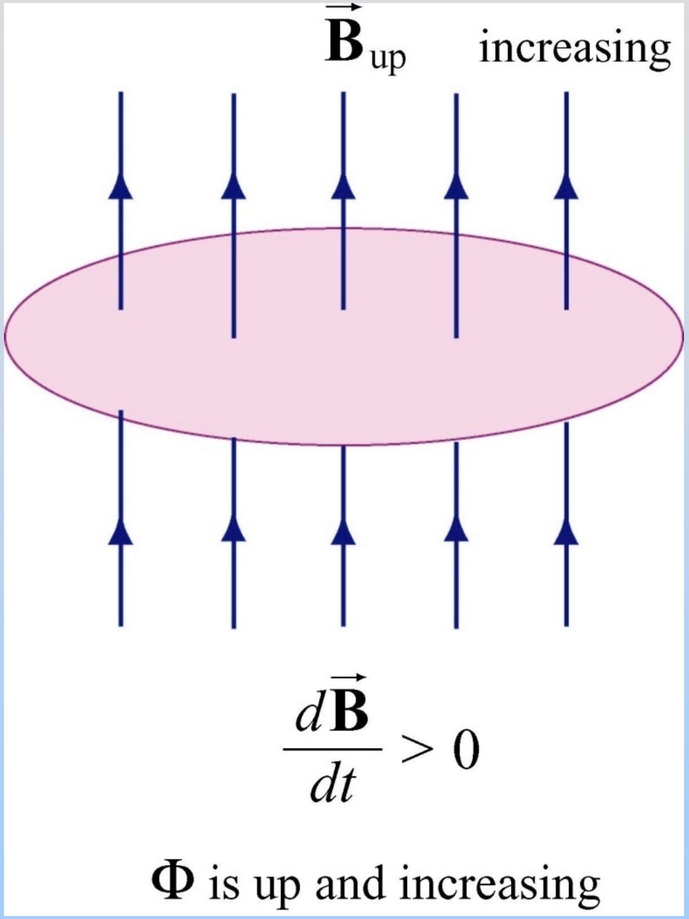
Concept Question: Loop

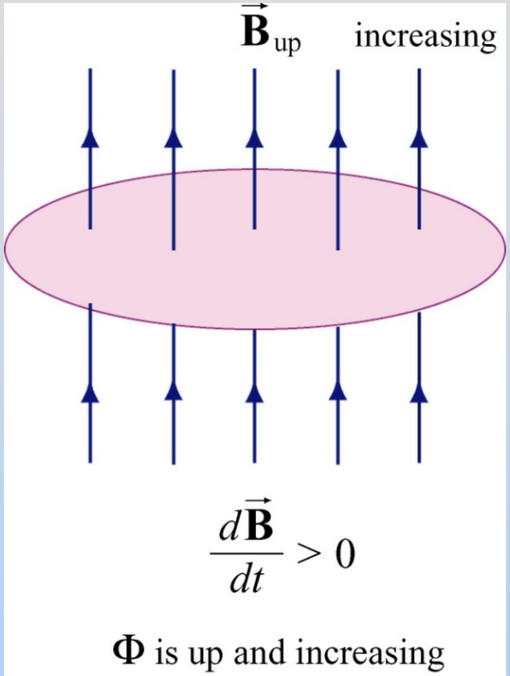
The magnetic field through a wire loop is pointed upwards and *increasing* with time. The induced current in the coil is



1. Clockwise as seen from the top
2. Counterclockwise

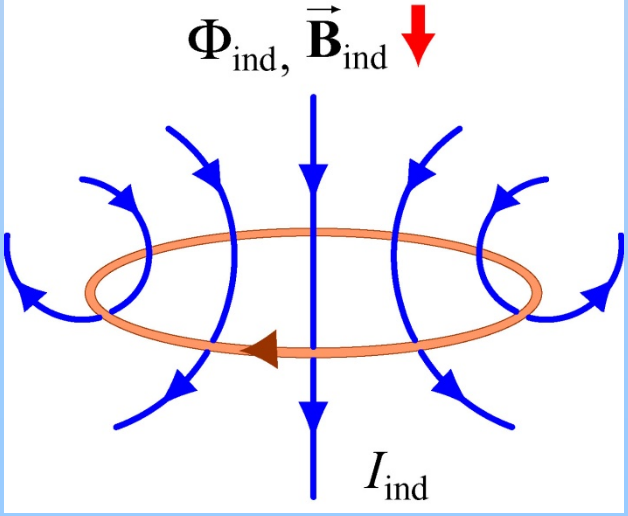
Concept Question Answer: Loop

Answer: 1. Induced current is **clockwise**



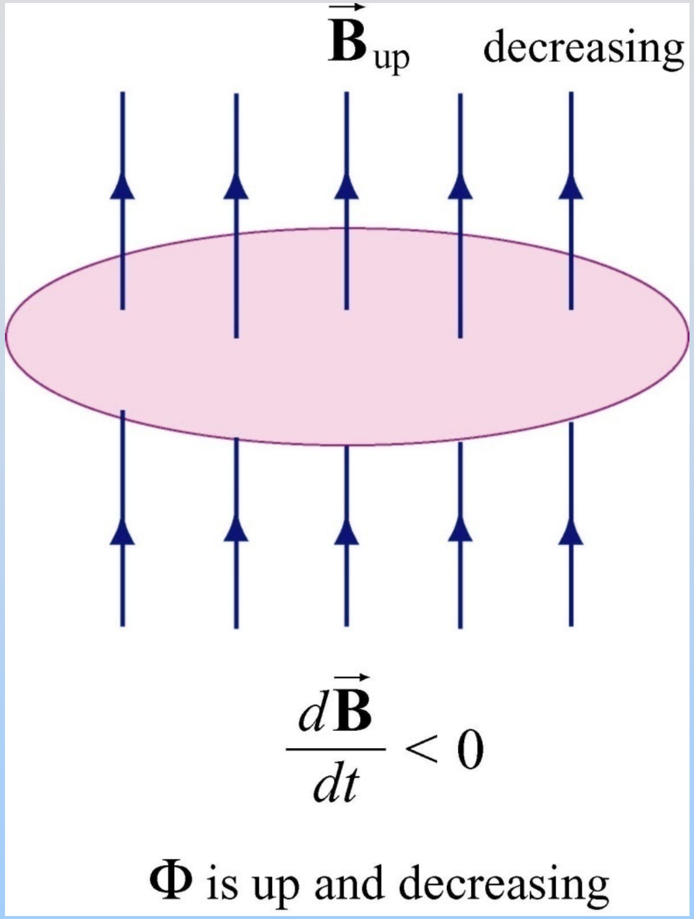
This produces an "induced" B field pointing down over the area of the loop.

The "induced" B field opposes the increasing flux through the loop – Lenz's Law



Concept Question: Loop

The magnetic field through a wire loop is pointed upwards and *decreasing* with time. The induced current in the coil is



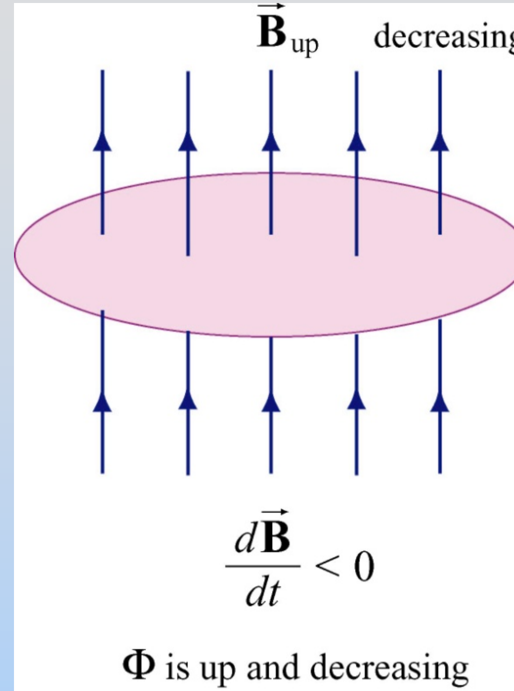
1. Clockwise as seen from the top
2. Counterclockwise

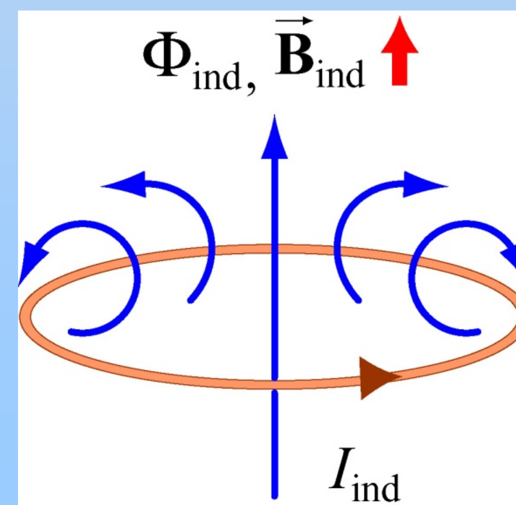
Concept Question Answer: Loop

Answer: 2. Induced current is **counterclockwise**

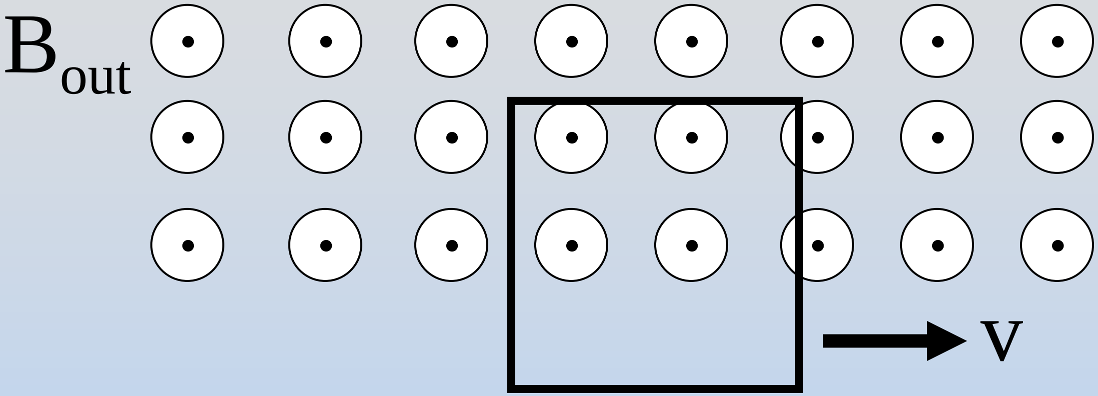
This produces an “induced” B field pointing up over the area of the loop.

The “induced” B field opposes the decreasing flux through the loop – making up for the loss – Lenz’s Law





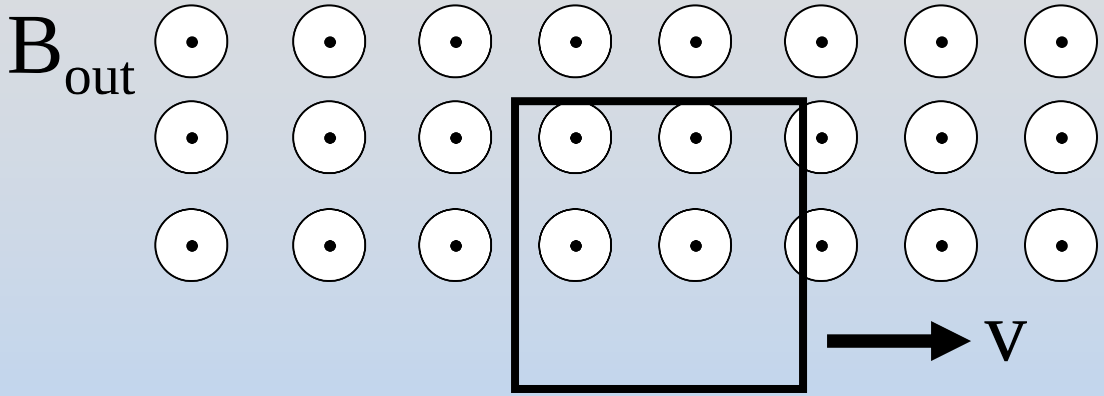
Concept Question: Loop in Uniform Field



A rectangular wire loop is pulled thru a uniform B field penetrating its top half, as shown. The induced current and the force and torque on the loop are:

1. Current CW, Force Left, No Torque
2. Current CW, No Force, Torque Rotates CCW
3. Current CCW, Force Left, No Torque
4. Current CCW, No Force, Torque Rotates CCW
5. No current, force or torque

Concept Question Answer: Loop in Uniform Field



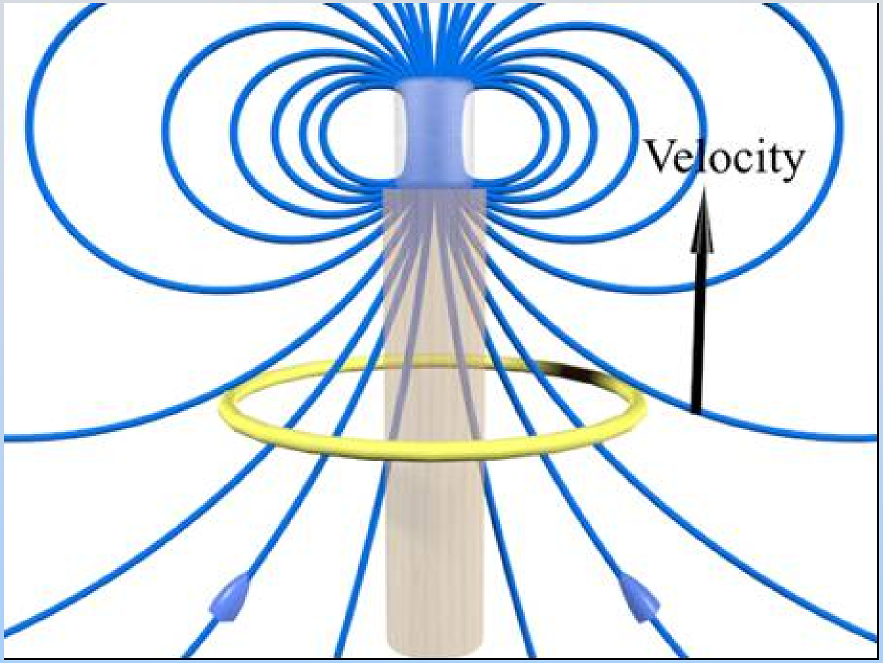
Answer: 5. No current, force or torque

The motion does not change the magnetic flux, so Faraday's Law says there is no induced EMF, or current, or force, or torque.

Of course, if we were pulling at all up or down there would be a force to oppose that motion.

Concept Question: Faraday's Law: Loop

A coil moves up from underneath a magnet with its north pole pointing upward. The current in the coil and the force on the coil:

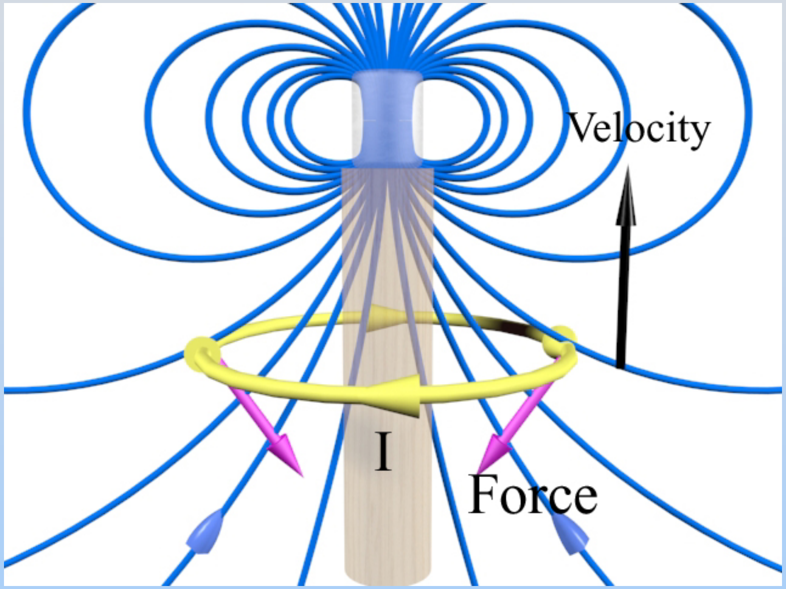


1. Current clockwise; force up
2. Current counterclockwise; force up
3. Current clockwise; force down
4. Current counterclockwise; force down

Concept Question Answer: Faraday's Law: Loop

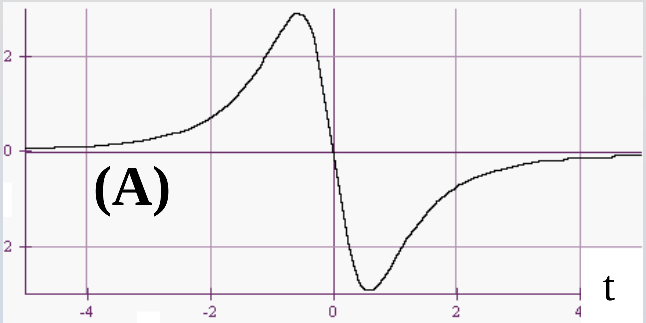
Answer: 3. Current is clockwise; force is down

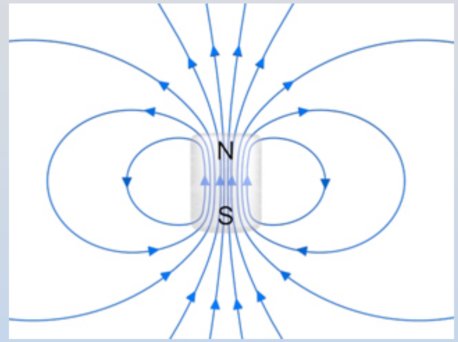
The clockwise current creates a self-field downward, trying to offset the increase of magnetic flux through the coil as it moves upward into stronger fields (Lenz's Law).

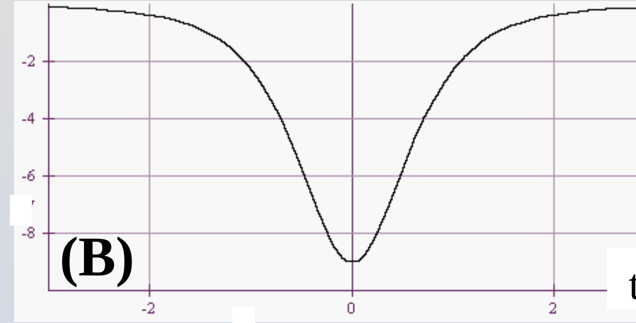


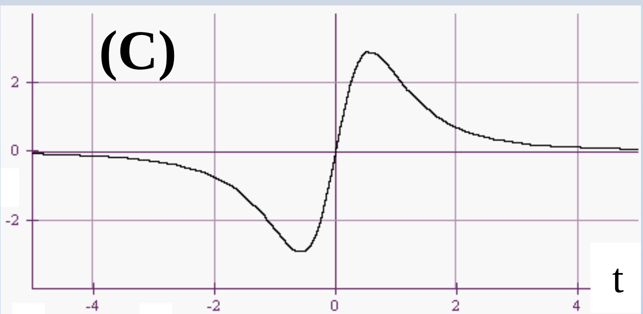
The I dl x B force on the coil is a force which is trying to keep the flux through the coil from increasing by slowing it down (Lenz's Law again).

Concept Q. : Flux Measurement





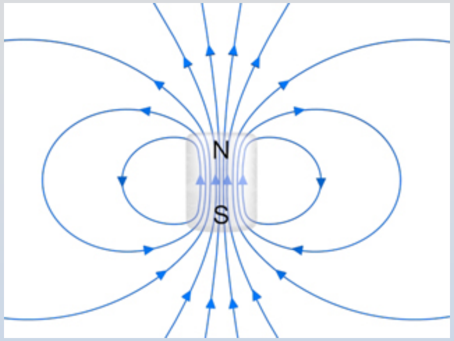




Moving from above to below and back, you will measure a *flux* of:

1. A then A
2. C then C
3. A then C
4. C then A
5. B then B
6. D then D
7. B then D
8. D then B

Concept Q. Ans.: Flux Measurement

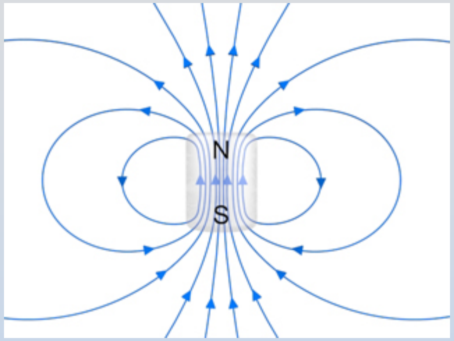


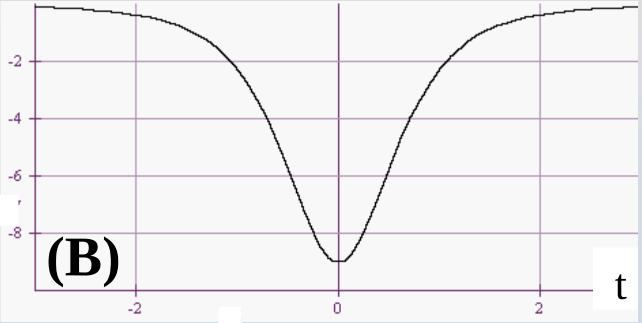
(D)

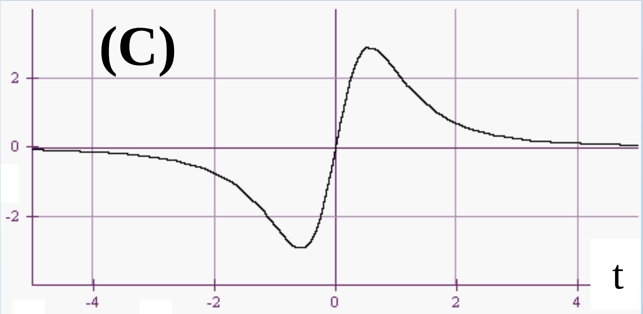
Answer: 6. D then D

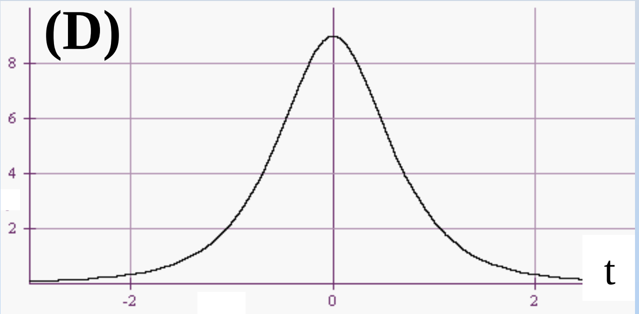
The direction of motion doesn't matter – the field and hence flux is always upwards (positive) and it increases then decreases when moving towards and away from the magnet respectively.

Concept Q.: Current Measurement







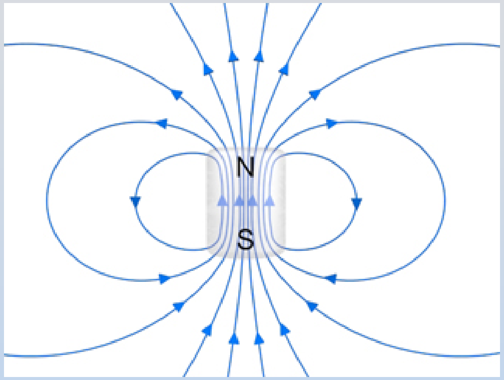


NOTE: CCW is positive!

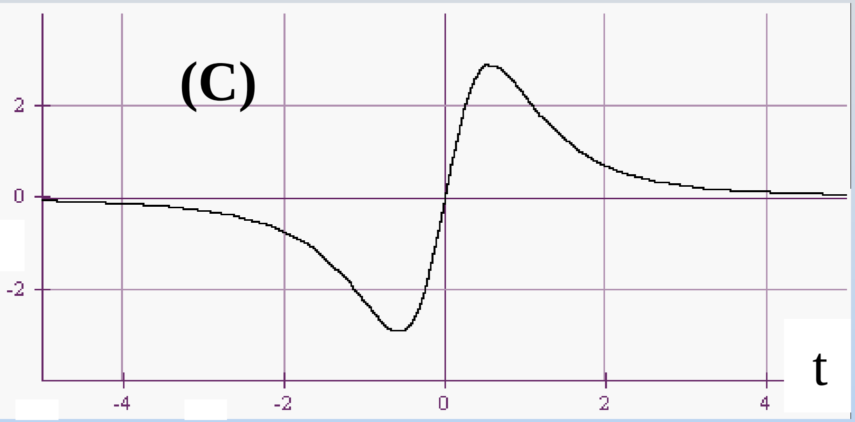
Moving from above to below and back, you will measure a *current* of:

1. A then A
2. C then C
3. A then C
4. C then A
5. B then B
6. D then D
7. B then D
8. D then B

Concept Question Answer: Current Measurement



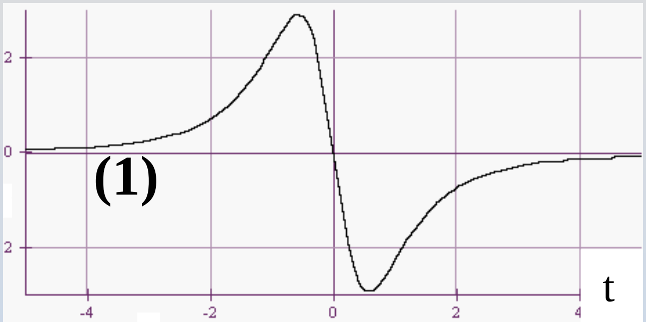
NOTE: CCW is positive!

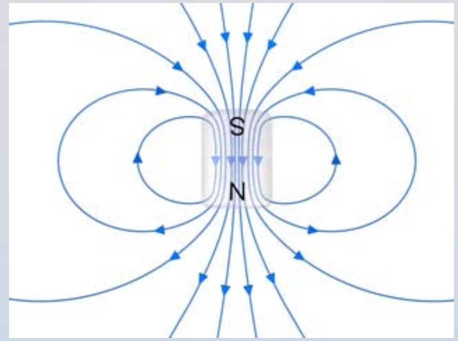


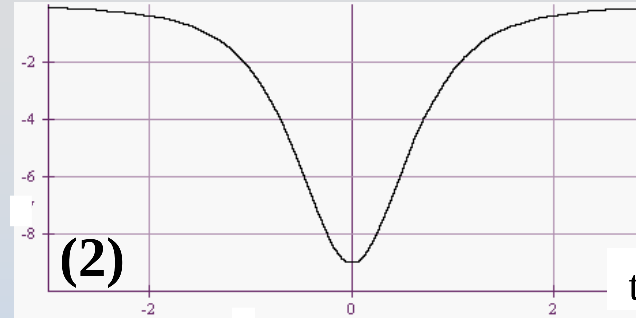
Answer: 2. C then C

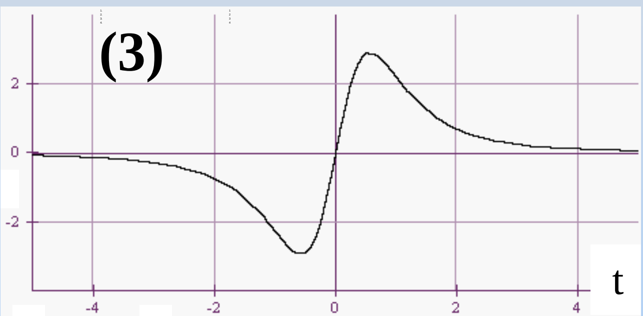
The direction of motion doesn't matter – the upward flux increases then decreases so the induced current will be clockwise to make a downward flux then counterclockwise to make an upward one.

Concept Question: Flux Behavior

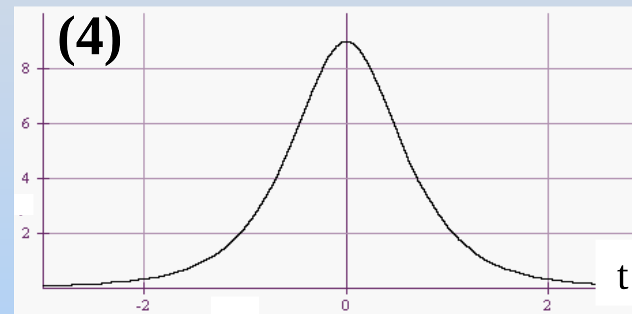






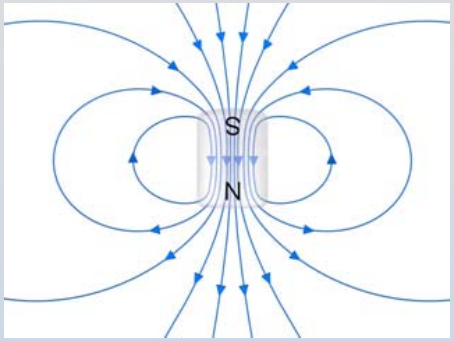


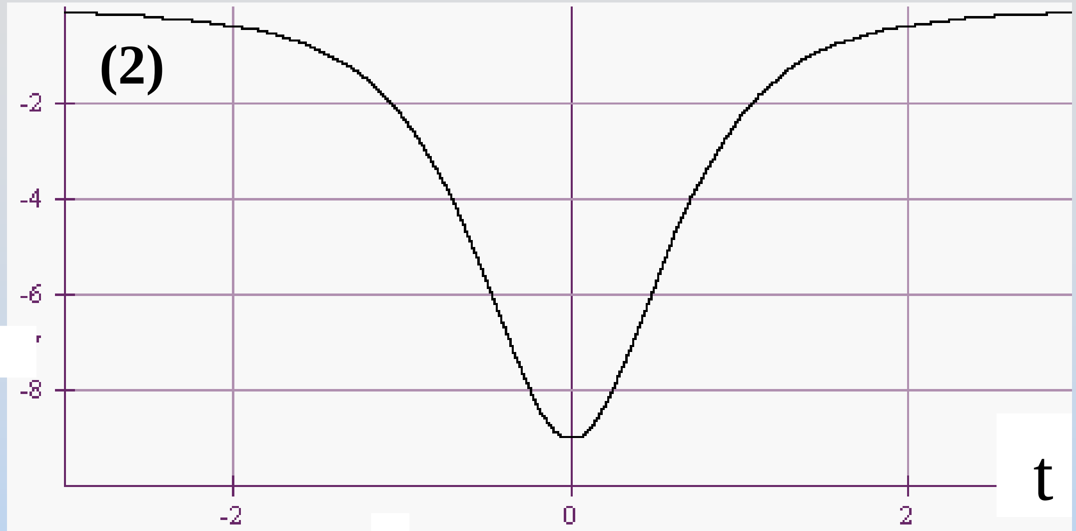
NOTE: Magnet "Upside Down"



Moving from below to above, you would measure a *flux* best represented by which plot above (taking upward flux as positive)?

Concept Q. Answer: Flux Behavior

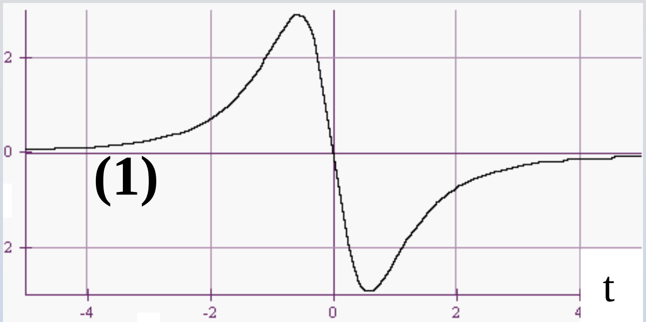


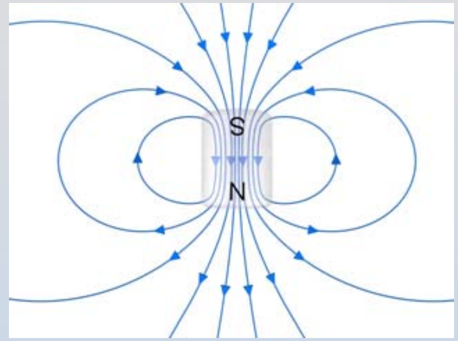


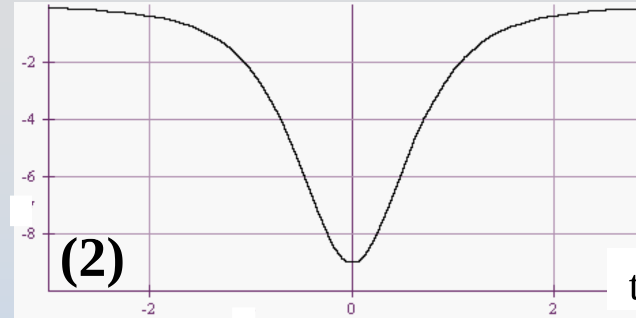
Answer: 2.

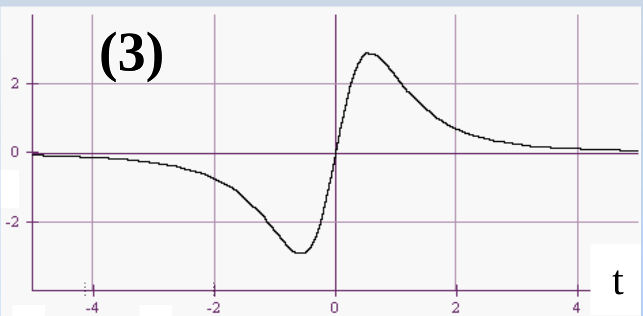
The field is downward so the flux is negative. It will increase then decrease as you move over the magnet.

Concept Q.: Current Behavior

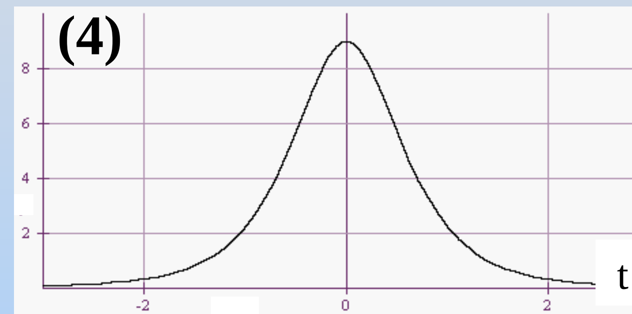






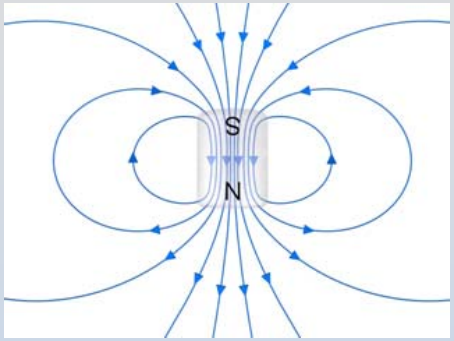


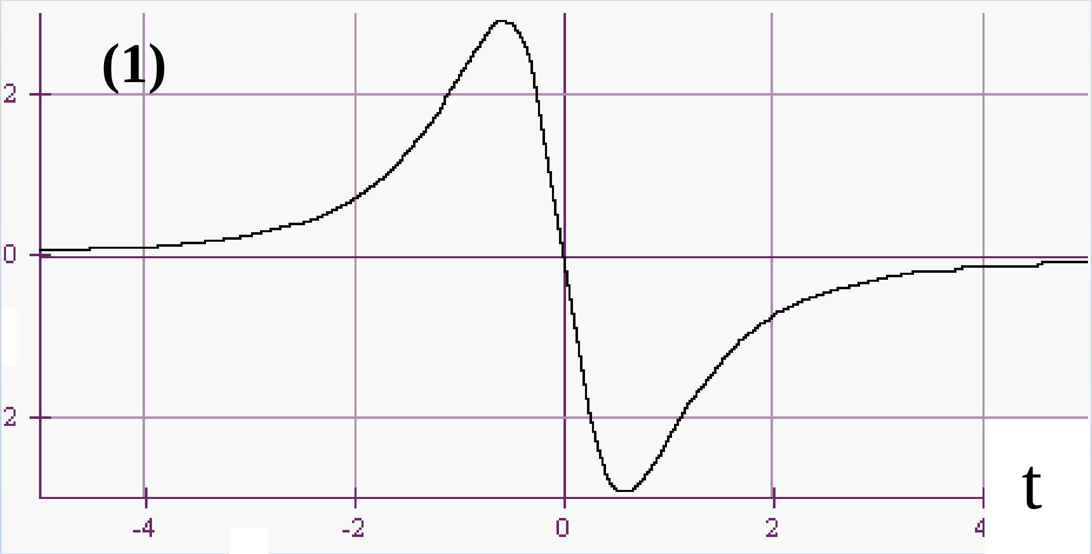
NOTE: Magnet "Upside Down"



Moving from *above* to *below*, you would measure a *current* best represented by which plot above (taking counterclockwise current as positive)?

Concept Q. Ans.: Current Behavior

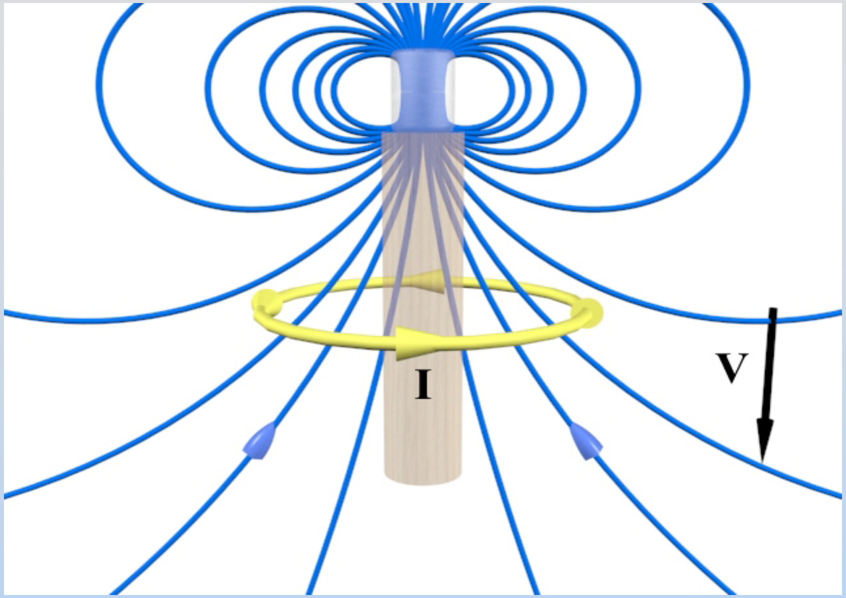




Answer: 1.

The field is downward so the current will first oppose it (CCW to make an upward flux) then try to reinforce it (CW to make a downward flux)

Concept Q.: Loop Below Magnet



A conducting loop is below a magnet and moving downwards. This induces a current as pictured. The *I ds x B* force on the coil is

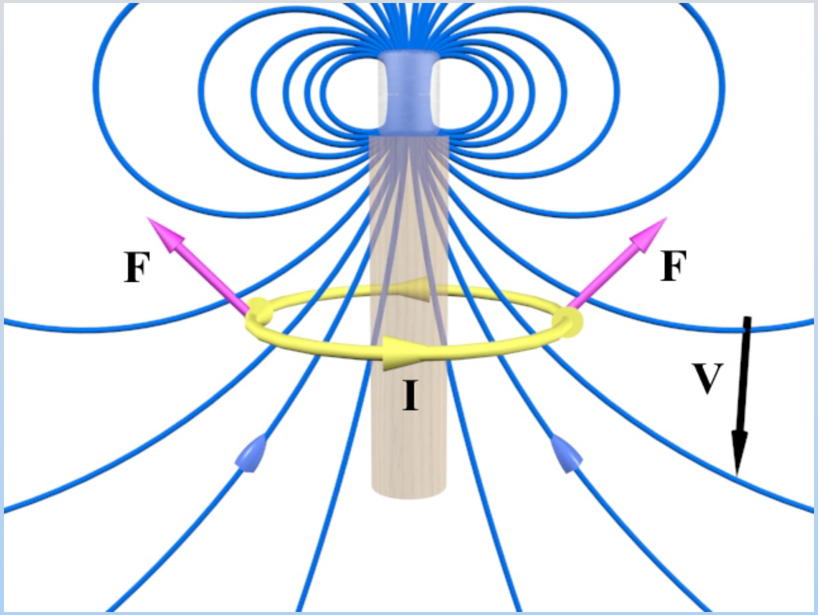
0% 1. Up

0% 2. Down

0% 3. Zero

Concept Question Answer: Loop Below Magnet

Answer: 1. Force is Up



Lenz' Law:

Must oppose motion – force is up

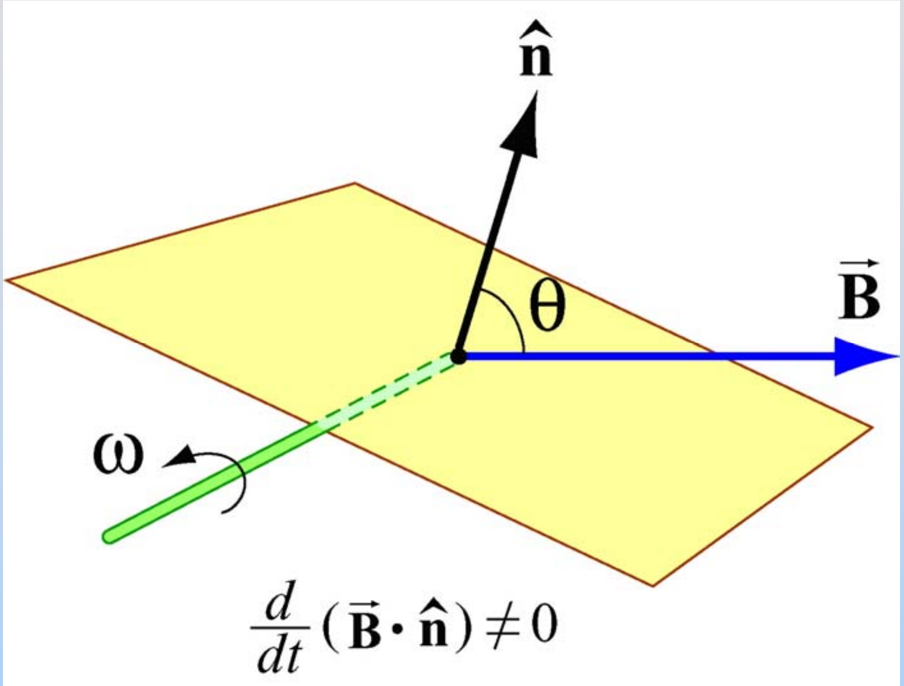
More detail:

Induced current is counter-clockwise to oppose drop in upward flux.

This looks like a dipole facing upward, so it is attracted to the other dipole

Concept Question: Generator

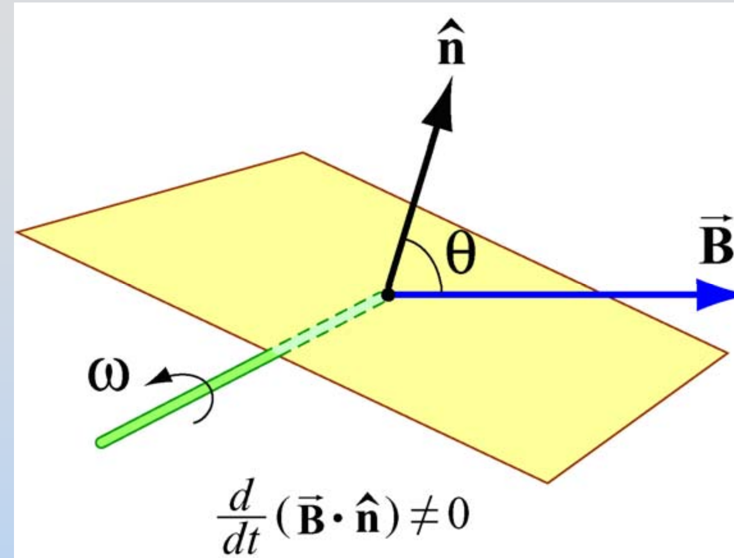
A square coil rotates in a magnetic field directed to the right. At the time shown, the current in the square, when looking down from the top of the square loop, will be



1. Clockwise
2. Counterclockwise
3. Neither, the current is zero
4. I don't know

Concept Q. Answer: Generator

Answer: 1. Induced current is **counterclockwise**

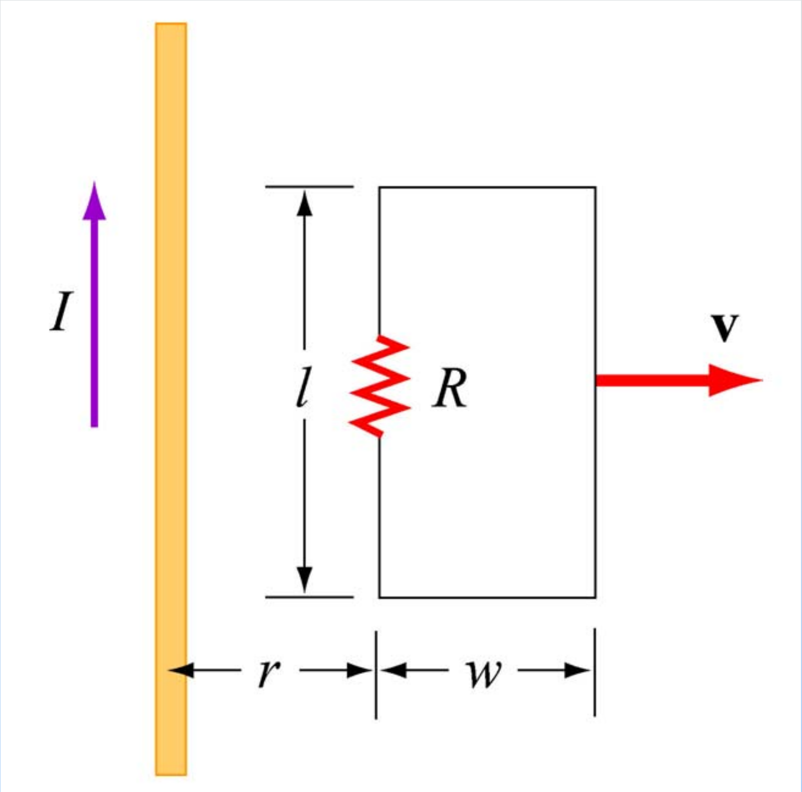


- Flux through loop *decreases* as normal rotates away from B. To try to keep flux from decreasing, induced current will be CCW, trying to keep the magnetic flux from decreasing (Lenz's Law)

Note: $I_{ind}\, dl \times B$ force on the sides of the square loop will be such as to produce a torque that tries to stop it from rotating (Lenz's Law).

Concept Question: Circuit

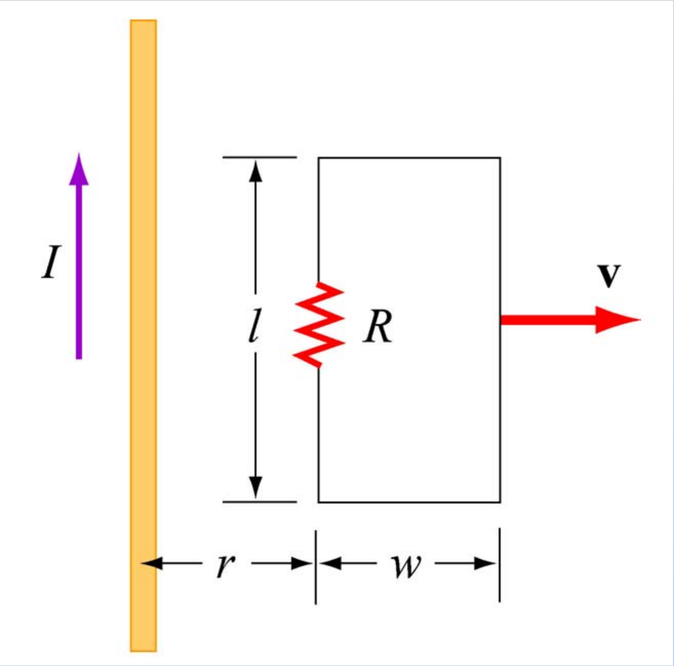
A circuit in the form of a rectangular piece of wire is pulled away from a long wire carrying current ***I*** in the direction shown in the sketch. The induced current in the rectangular circuit is



1. Clockwise
2. Counterclockwise
3. Neither, the current is zero

Concept Question Answer: Circuit

Answer: 1. Induced current is **clockwise**



•B due to I is into page; the flux through the circuit due to that field decreases as the circuit moves away. So the induced current is clockwise (to make a B into the page)

Note: $I_{ind}\, dl \times B$ force is left on the left segment and right on the right, but the force on the left is bigger. So the net force on the rectangular circuit is to the left, again trying to keep the flux from decreasing by slowing the circuit's motion