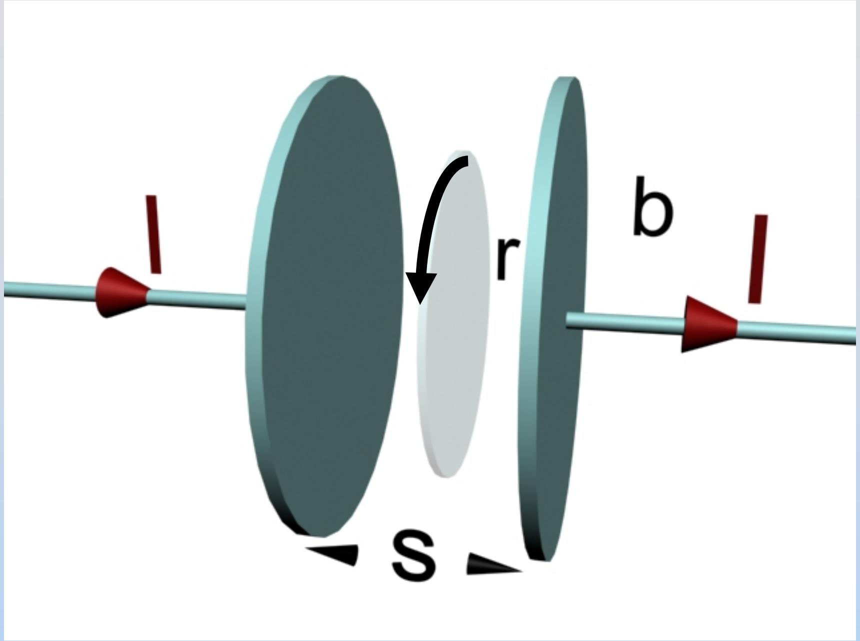
Concept Question: Capacitor

Consider a circular capacitor, with an Amperian loop (radius r) in the plane midway between the plates. When the capacitor is charging, the line integral of the magnetic field around the Amperian loop (in direction shown) is



1. Zero (No current through loop)
2. Positive
3. Negative
4. Can’t tell (need to know direction of E)
5. I don’t know

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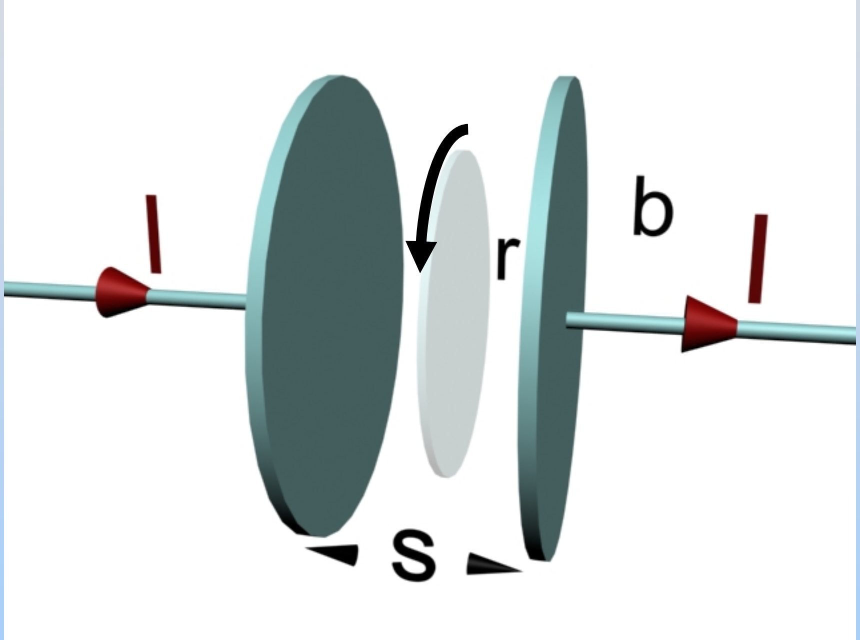
Answer: 2. The integral of B as shown is positive

Here the displacement current is the same direction as the current regardless of whether we are charging or discharging, so the B field is in the direction in which we are integrating



$$\oint_C \vec{\mathbf{B}} \cdot d\vec{\mathbf{s}} = \mu_0 I + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$$

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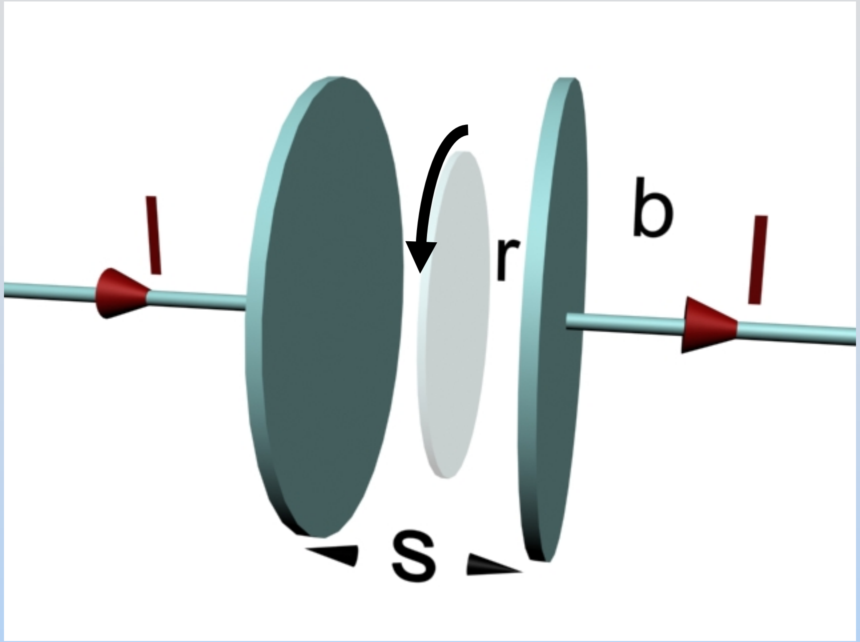
If instead of integrating around the pictured Amperian loop we were to integrate around an Amperian loop of the same radius as the plates (b) then the integral would be



1. the same.
2. larger.
3. smaller.
4. I don't know.

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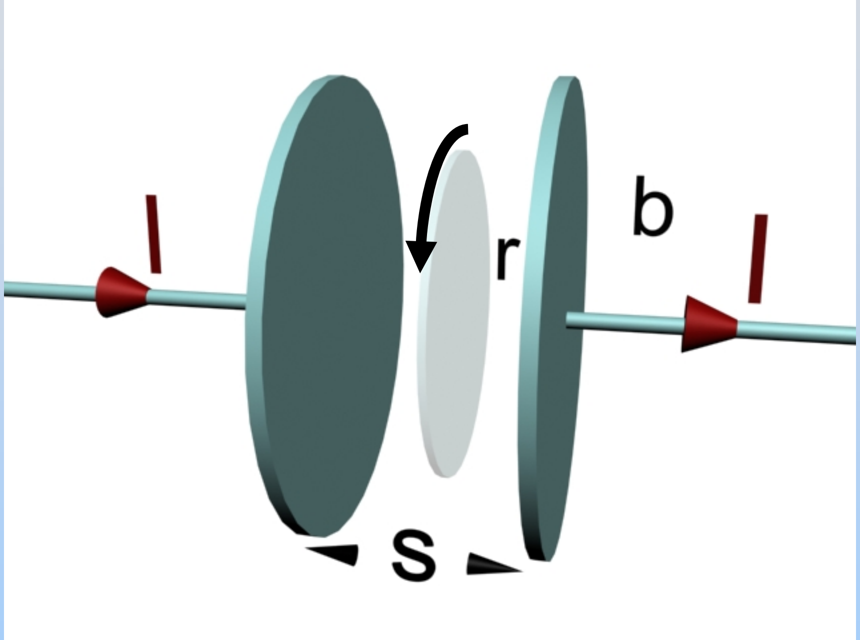
Answer: 2. The integral is larger for larger r

As we increase the radius of our Amperian loop we enclose more flux (up until we enclose all of it) and hence the magnitude of the integral will increase.



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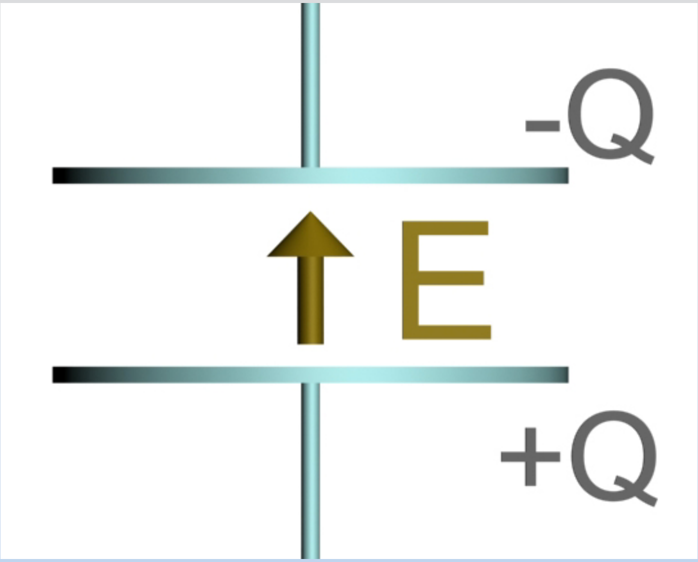
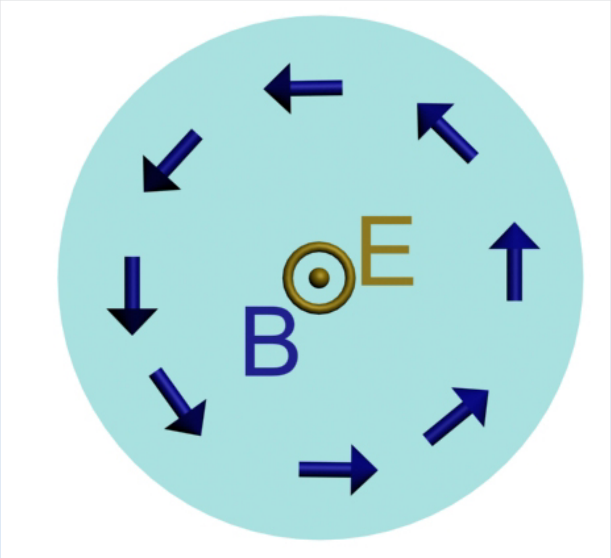


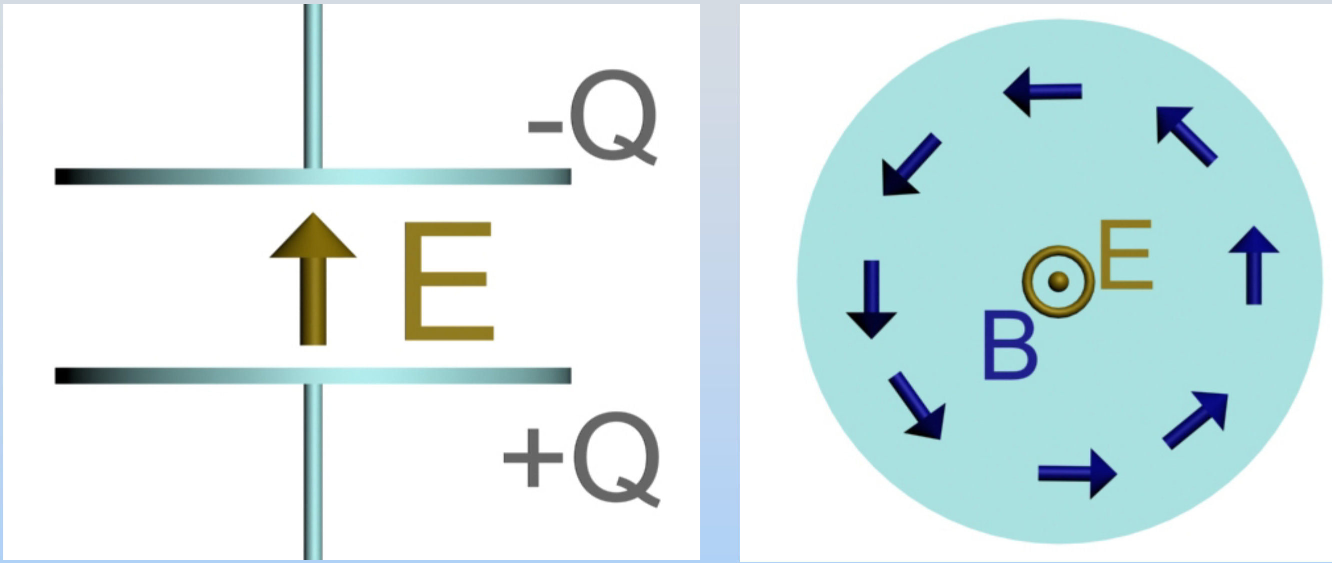


The figures above show a side and top view of a capacitor with charge *Q* and electric and magnetic fields E and B at time *t*. At this time the charge *Q* is:

1. Increasing in time
2. Constant in time.
3. Decreasing in time.
4. I don’t know

Concept Q. Answer: Capacitor

Answer: 1. The charge Q is increasing in time



The B field is counterclockwise, which means that the current (real & displacement) must be flowing out of the page = up. So positive charge is being carried to the bottom plate, and the total charge is increasing.