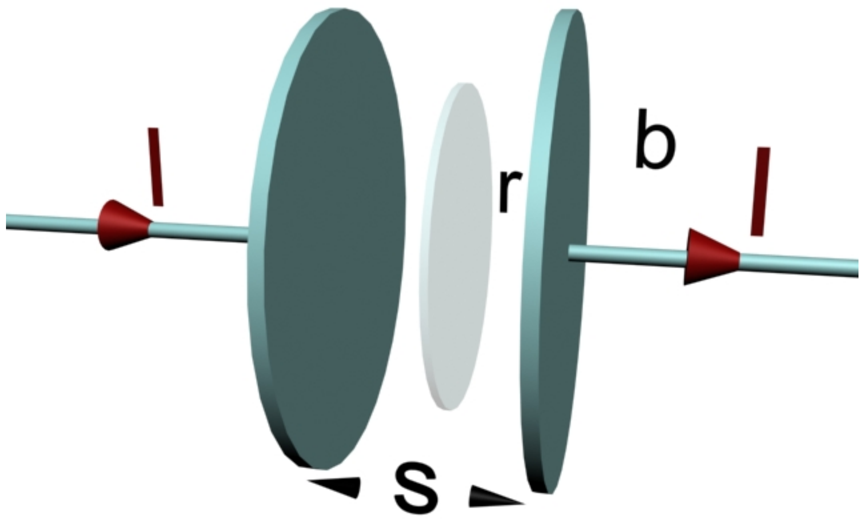
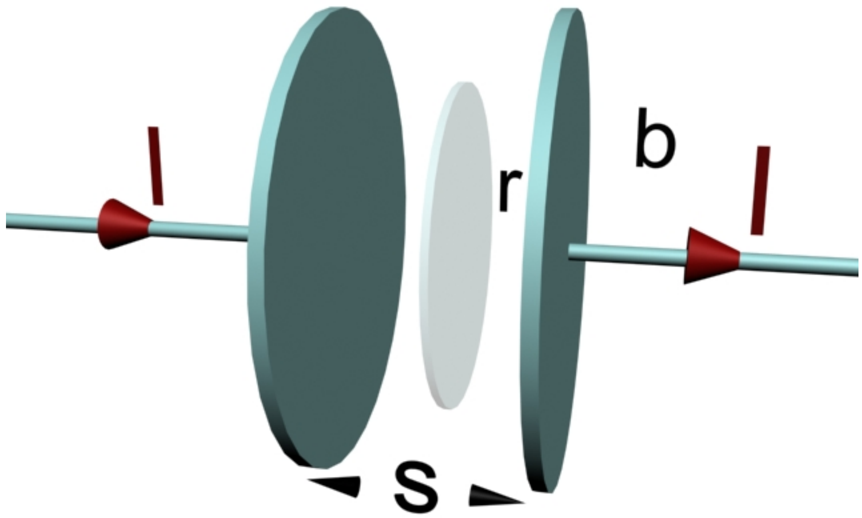


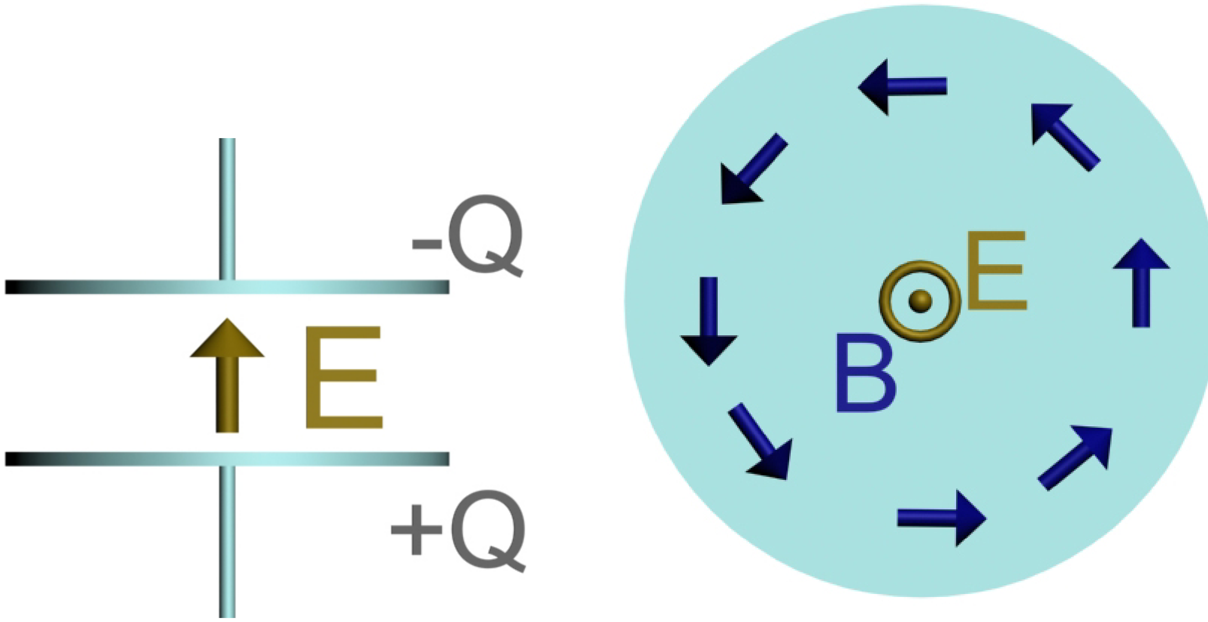
Consider the above circular capacitor, and the Amperian loop (radius *r*) in the plane midway between the plates. When the capacitor is charging, the line integral of the magnetic field around the Amperian loop is

1. Zero: No current crosses the surface spanning the Amperian loop
2. Zero: The magnetic field is perpendicular to the Amperian Loop
3. Non-zero: An electric current flows between the capacitor plates
4. Non-zero: There is time changing electric flux on the surface spanning the Amperian Loop



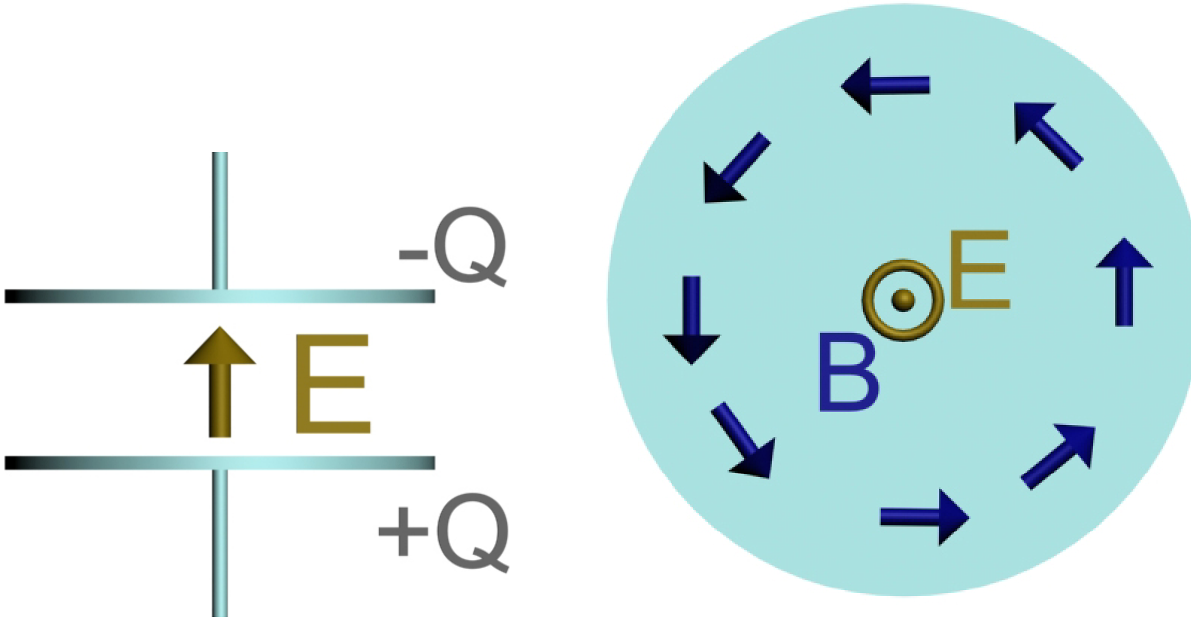
$$\oint_{C} \vec{\mathbf{B}} \cdot d\vec{\mathbf{s}} = \mu_0 I + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$$

Answer: 4. When the capacitor is charging up, the line integral of the magnetic field around the Amperian loop is non-zero because there is a time changing electric flux on the flat disc that spans the Amperian Loop

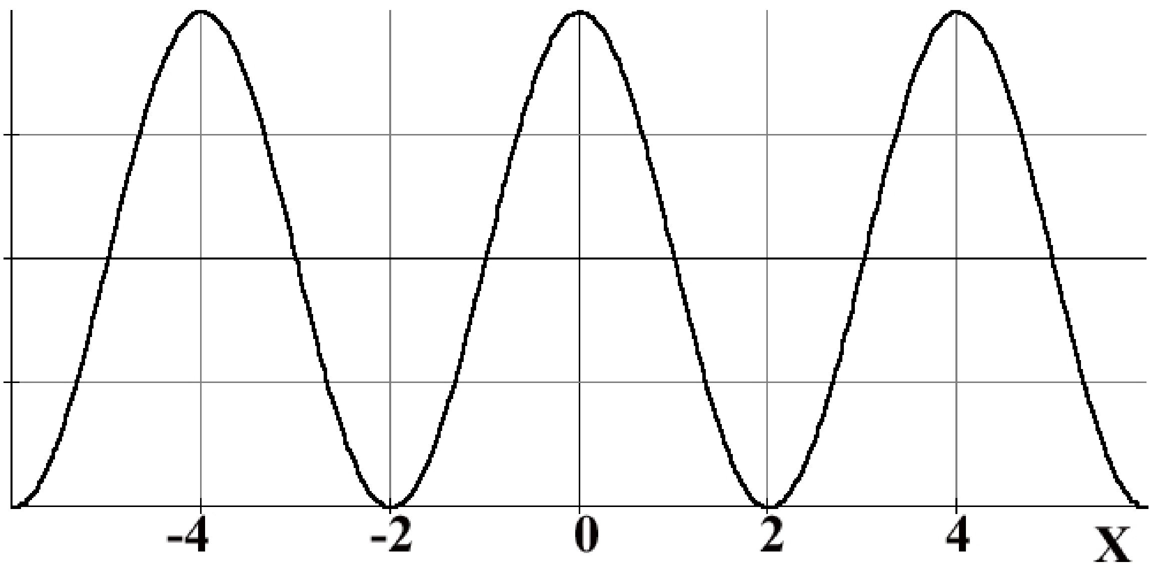


The plot above shows a side and a top view of a capacitor with charge *Q* with electric and magnetic fields E and B at time *t*. The charge *Q* is:

1. **Increasing in time**
2. **Constant in time.**
3. **Decreasing in time.**
4. **Don't have a clue.**

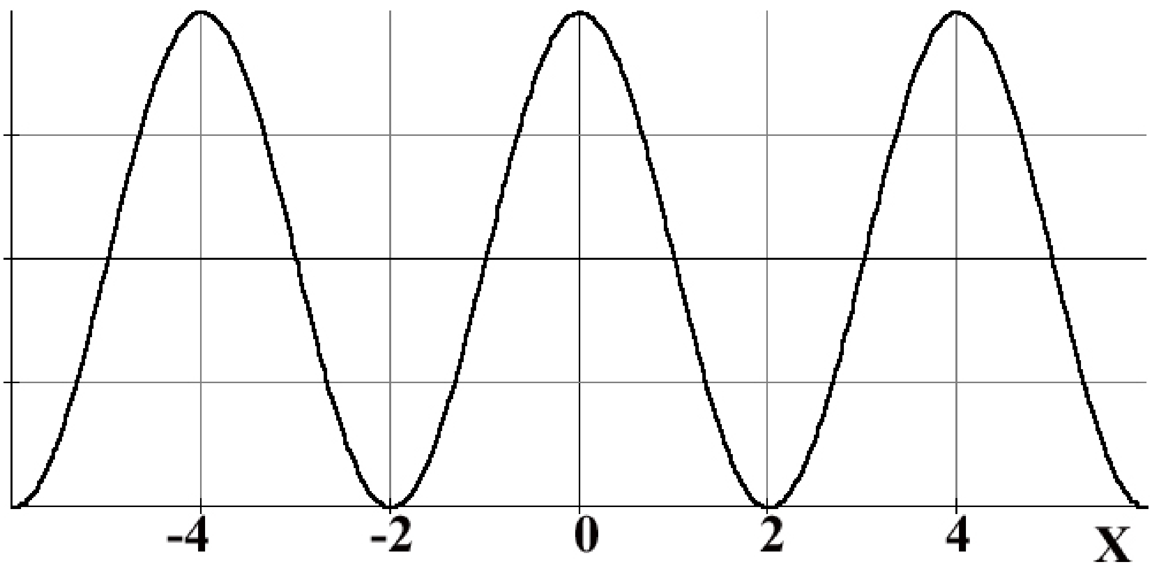


Answer: 1. The charge *Q* is increasing in time.
The B field is counterclockwise, which means that the current (real & displacement) must be flowing out of the page = up. So there is more charge being carried to the bottom plate.



The graph shows a plot of the function $y = \cos(k x)$. The value of k is

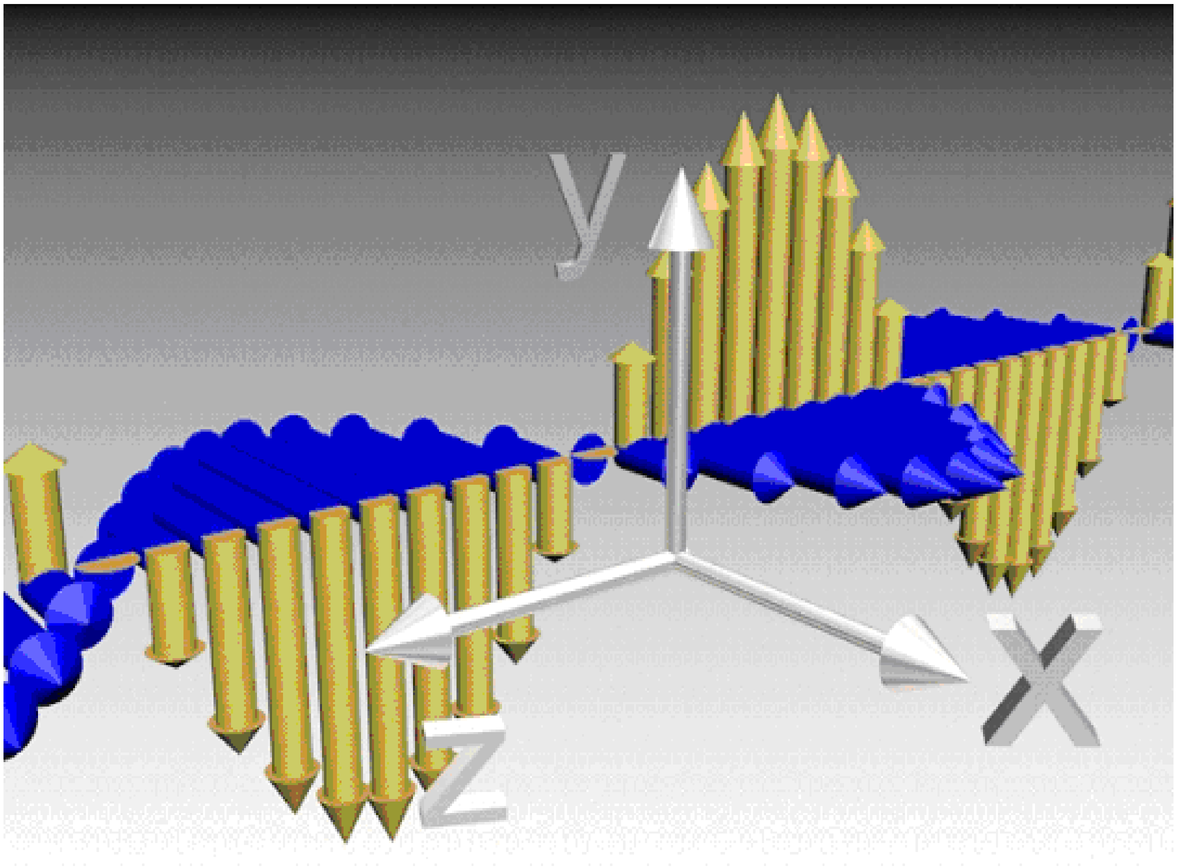
1. **1/2**
2. **1/4**
3. π
4. $\pi/2$
5. **Don't have a clue**



Answer: 4. $k = \pi /2$

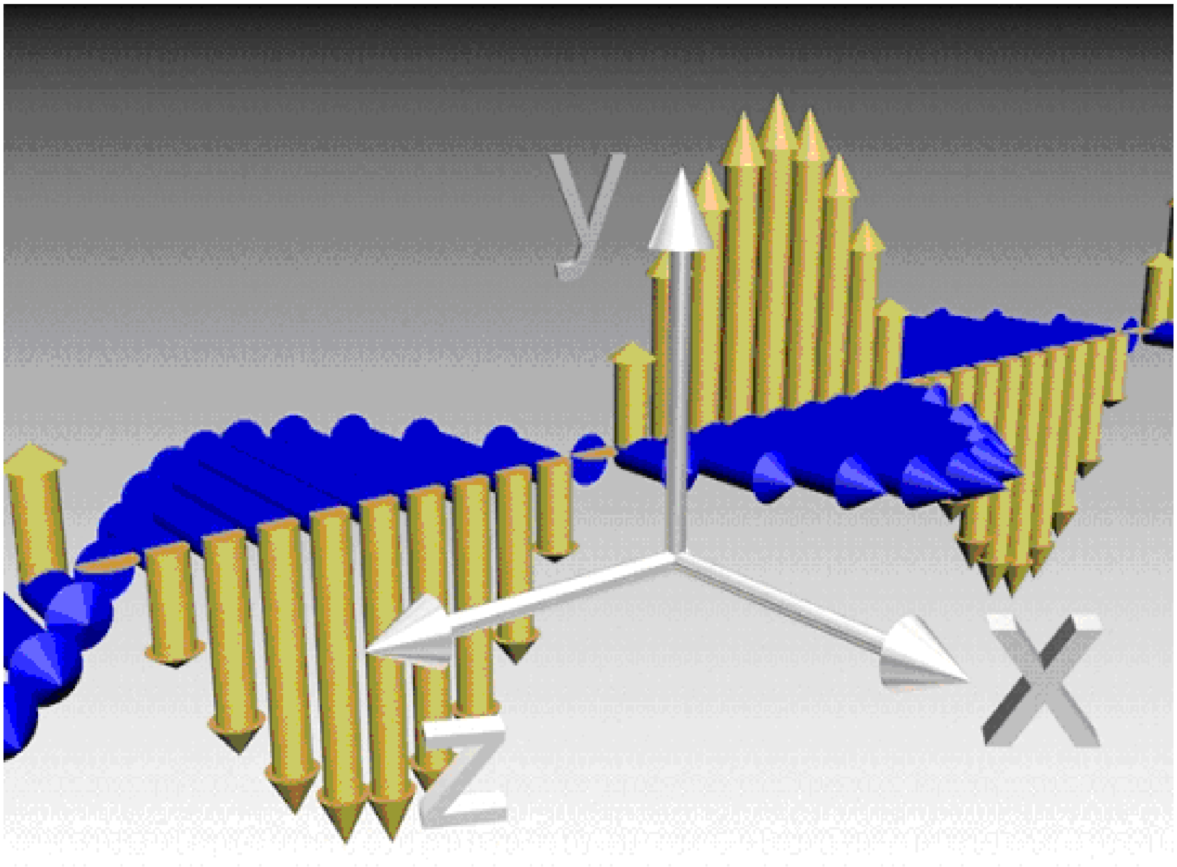
$\lambda = 4 \rightarrow k = 2\pi/\lambda = \pi/2$

$y = \cos(\pi x /2)$ is 1 at –4, 0, 4, etc.



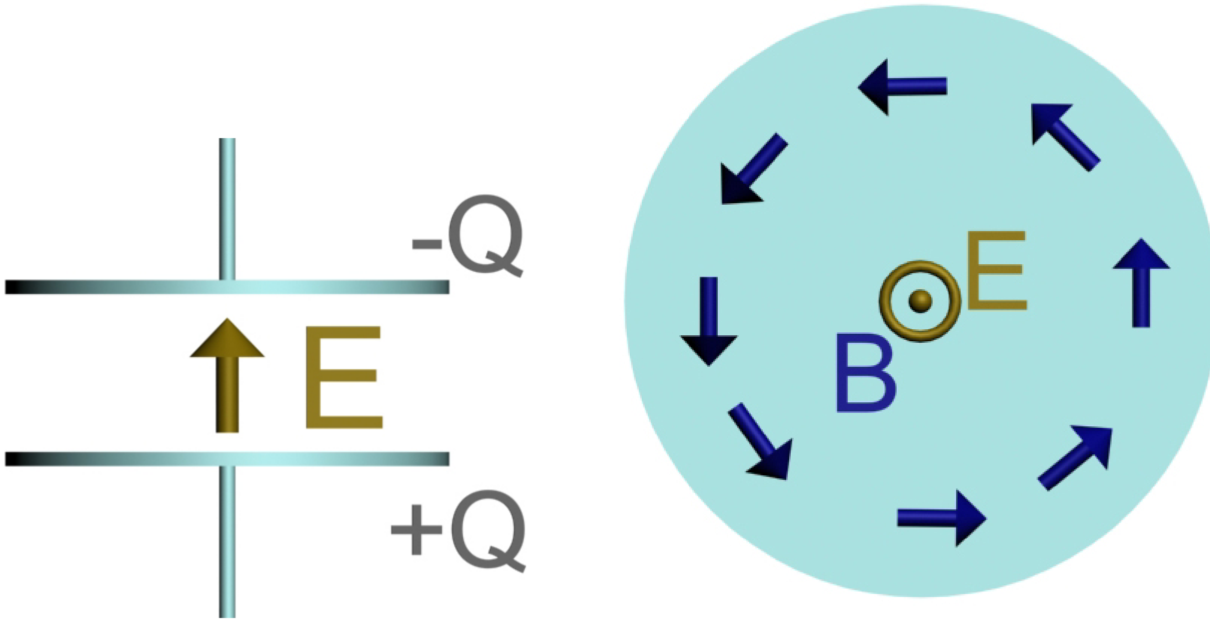
The graph shows the E (yellow) and B (blue) fields of a plane wave. This wave is propagating in the

1. **+x direction**
2. **–x direction**
3. **+z direction**
4. **–z direction**
5. **Don't have a clue**



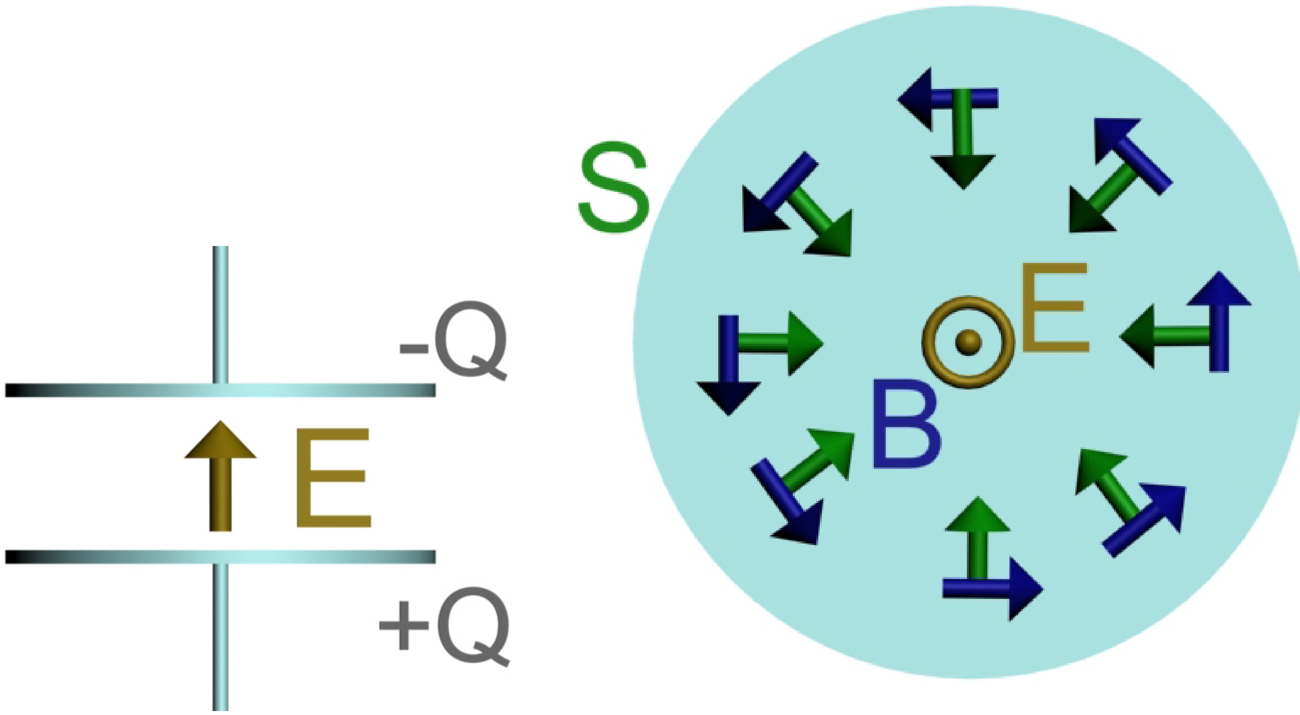
Answer: 4. –z direction.

We can see this because this is the direction of E x B (Yellow x Blue)



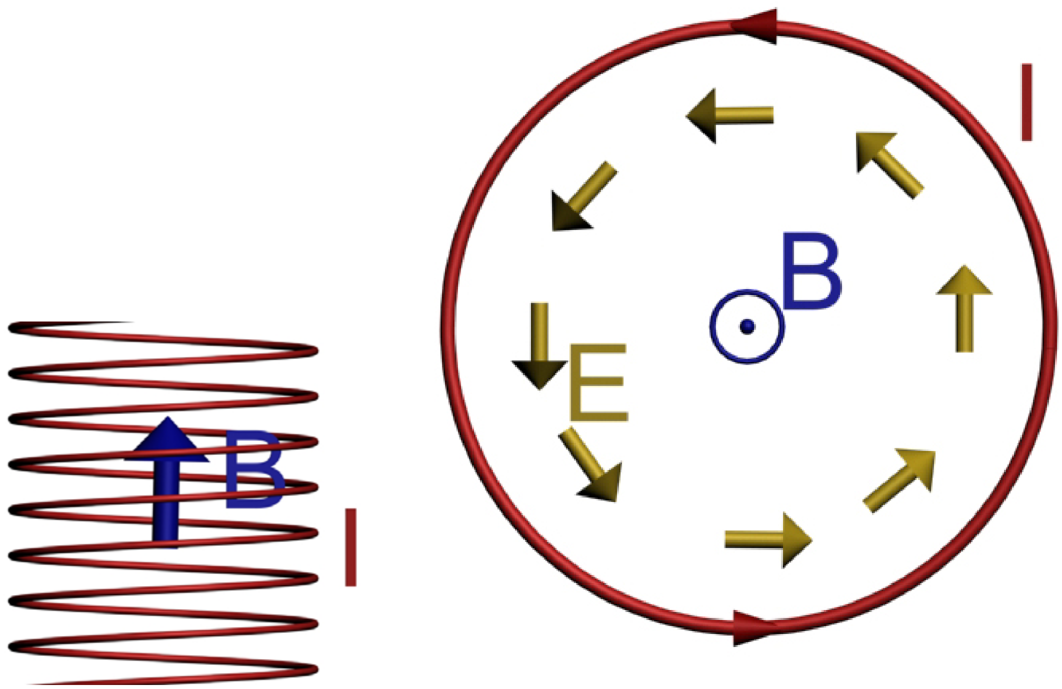
The plot above shows a side and a top view of a capacitor with charge *Q* with electric and magnetic fields E and B at time *t*. The charge *Q* is:

5. **Increasing in time**
6. **Constant in time.**
7. **Decreasing in time.**
8. **Don't have a clue.**



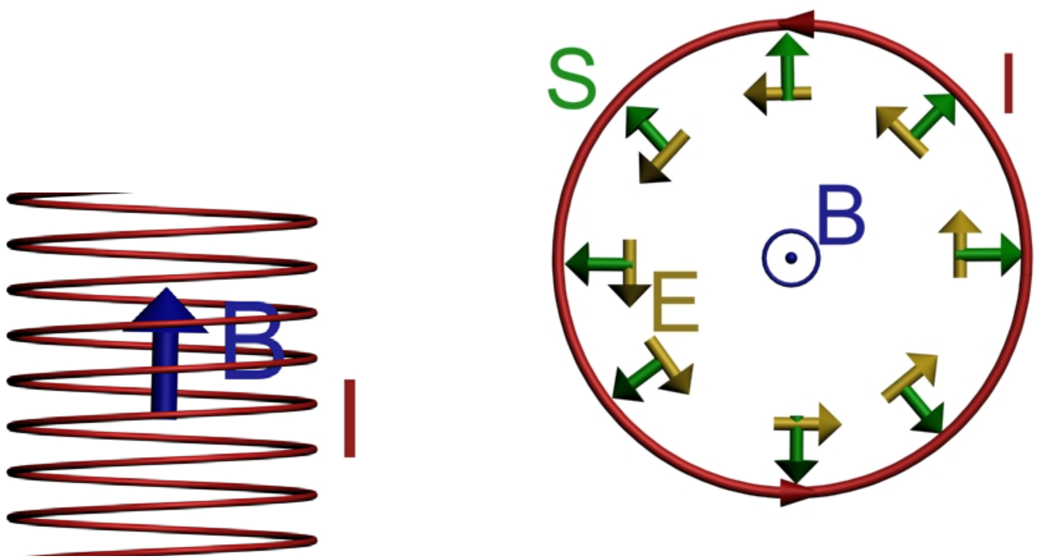
Answer: 1. The charge *Q* is increasing

The direction of the Poynting Flux S (=E x B) inside the capacitor is inward. Therefore electromagnetic energy is flowing inward, and the energy in the electric field inside is increasing. Thus Q must be increasing, since E is proportional to Q.



The plot above shows a side and a top view of a solenoid carrying current *I* with electric and magnetic fields E and B at time *t*. In the solenoid, the current I is:

1. **Increasing in time**
2. **Constant in time.**
3. **Decreasing in time.**
4. **Don't have a clue.**



Answer: 3. The current I is decreasing

The Poynting Flux S (= E x B) inside the solenoid is outward from the center of the solenoid. Therefore electromagnetic energy is flowing outward, and the energy in the magnetic field inside is decreasing. Thus I must be decreasing, since B is proportional to I.