

6.3 A stationary conducting loop with an internal resistance of $0.5\ \Omega$ is placed in a time-varying magnetic field. When the loop is closed, a current of 5 A flows through it. What will the current be if the loop is opened to create a small gap and a $4.5\ \Omega$ resistor is connected across its open ends?

Solution: V_{emf} is independent of the resistance which is in the loop. Therefore, when the loop is intact and the internal resistance is only $0.5\ \Omega$,

$$V_{\text{emf}} = 5\text{ A} \times 0.5\ \Omega = 2.5\text{ V}.$$

When the small gap is created, the total resistance in the loop is infinite and the current flow is zero. With a $4.5\ \Omega$ resistor in the gap,

$$I = V_{\text{emf}} / (4.5\ \Omega + 0.5\ \Omega) = 2.5\text{ V} / 5\ \Omega = 0.5\quad (\text{A}).$$
