Simple AC Generator:

An electrical ac generator circuit consists of a conducting wire bent into a semi-circular shape (radius "r_o") and a resistor R as shown in the figure. A constant magnetic field "B" (perpendicular to and inward the paper along +x direction) is applied in the region. The conducting wire, bent like a semi-circular shape, is rotated by a hand crank with a constant angular velocity "ω" in the counterclockwise direction, as viewed from the crank end, and the angle "θ" is measured from the vertical position a_s shown. The area "A_o" of the segment of the circuit below the crank axis of rotation (i.e. the z-axis) is a constant. See figures below.

Assume that at t = 0, the angle "θ" is zero and the circuit appears as shown in the figure on the left.

a. Assuming that the angle θ = zero at t = 0, what is magnetic flux (Φ) linked to the circuit at t = 0? Express your answer in terms of the parameters "r_o", "B" and "A_o".

b. Assuming that the angle θ = zero at t = 0, what is magnetic flux (Φ) linked to the circuit at t = π/ω? Express your answer in terms of the parameters "r_o", "B" and "A_o".

c. What is the "emf" ([ε(t)] as a function of time) induced across the terminals (at the slip ring) of the conducting wire?

d. Between t=0 and t= π/ω, the area bounded by the circuit decreases. What is the direction of the induced current in the resistor during this time interval? Give reasons to substantiate your answer. What is the magnitude of this induced current?