rms Current and emf

PROBLEM

A generator with a maximum output emf of 205 V is connected to a 115 Ω resistor. Calculate the rms potential difference. Find the rms current through the resistor. Find the maximum ac current in the circuit.
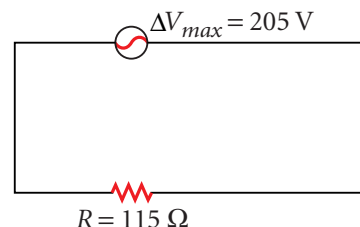
SOLUTION

1. DEFINE **Given:** $\Delta V_{max} = 205$ V $\quad R = 115\ \Omega$

Unknown: $\Delta V_{rms} = ?$ $\quad I_{rms} = ?$ $\quad I_{max} = ?$

Diagram:

$\Delta V_{max} = 205$ V

$R = 115\ \Omega$

2. PLAN **Choose an equation or situation:** Use the equation for the rms potential difference to find ΔV_{rms}.

$$\Delta V_{rms} = 0.707\ \Delta V_{max}$$

Rearrange the definition for resistance to calculate I_{rms}.

$$I_{rms} = \frac{\Delta V_{rms}}{R}$$

Use the equation for rms current to find I_{max}.

$$I_{rms} = 0.707\ I_{max}$$

TIP *Because emf is measured in volts, maximum emf is frequently abbreviated as ΔV_{max}, and rms emf can be abbreviated as ΔV_{rms}.*

Rearrange the equation to isolate the unknown:
Rearrange the equation relating rms current to maximum current so that maximum current is calculated.

$$I_{max} = \frac{I_{rms}}{0.707}$$

3. CALCULATE **Substitute the values into the equation and solve:**

$$\Delta V_{rms} = (0.707)(205\ \text{V}) = 145\ \text{V}$$
$$I_{rms} = \frac{145\ \text{V}}{115\ \Omega} = 1.26\ \text{A}$$
$$I_{max} = \frac{1.26\ \text{A}}{0.707} = 1.78\ \text{A}$$

$\Delta V_{rms} = 145$ V
$I_{rms} = 1.26$ A
$I_{max} = 1.78$ A

4. EVALUATE The rms values for the emf and current are a little more than two-thirds the maximum values, as expected.