

1.28 Since we are estimating, a cup of water is 8 oz., or $\frac{1}{4}$ quart (32 oz.). A quart is about a liter, so a cup is therefore about $\frac{1}{4}$ liter or 250 mL. Since a mL of water weighs one gram, a cup of water weighs about 250 g. So, to bring the water to boil, one must raise the water temperature from room temperature (20°C) to 100°C , or a change of 80°C . Since it takes one calorie to raise one g of water one $^{\circ}\text{C}$, it would take $(250\text{ g}) \cdot (80^{\circ}\text{C}) \cdot (1\text{ cal} / \text{g} \cdot ^{\circ}\text{C}) = 20,000\text{ cal}$ or $(20,000\text{ cal}) \cdot (4.2\text{ J/cal}) = 84,000\text{ J}$ to bring the water to a boil. If the microwave is doing work on the water at a rate of 600 J/s, the time it takes to come to a boil is $84000\text{ J} / 600\text{ J/s} = 140\text{ s}$, or about 2 min, 20 s. Seems about right in my experience.