Boiling Water at Low Temperature

Objective: At atmospheric pressure, water boils at 100 °C. Explore the connection between pressure and boiling point by changing the pressure.

Materials:

Syringe with a cap and a capacity of 10 or 20 ml
Hot plate or microwave oven
300 ml beaker
Thermometer
Water

Procedure:

1. Fill the beaker with 200 ml of water and heat it on a hot plate or in a microwave oven until the water temperature is 75-85 °C. Check with a thermometer to make sure the water does not reach its boiling point.

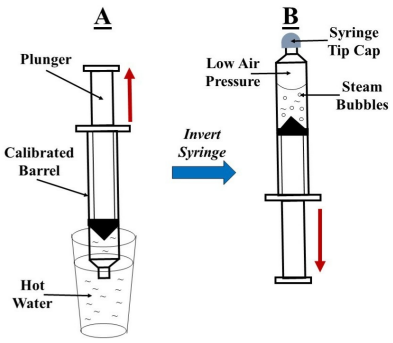
2. Remove the cap from the tip of the syringe.

3. Place the tip of the syringe in the warm water and pull the plunger out until you have 5 ml of water in the syringe. Invert the syringe and clear out any air bubbles.

5. Replace the cap TIGHTLY over the tip of the syringe.

6. Hold the syringe and pull the plunger slowly out to the 10 ml mark.

7. Observe and record changes you see in the water



Questions:

1. The syringe was not heated, but the water boiled. What happened to the air pressure above the liquid when the plunger of the syringe filled with warm water was pulled out?

   The pressure was: Higher_____ Lower_____ than the atmospheric pressure.

2. What does this tell you about the number of air molecules above the water in the syringe?

   _____

3 How did this cause the water to boil?

   _____

4. When you normally see water boiling in a pot, what is different about the conditions under which that happens compared with what you saw in the syringe?

   _____

5. If you want to boil a liquid with a boiling point of 200 °C, how can you save energy?

   _____

Answers to Questions:

1. The syringe was not heated, but the water boiled. What happened to the air pressure above the liquid when the plunger of the syringe filled with warm water was pulled out?

   The pressure was: higher_____ lower __X___ than the atmospheric pressure.

2. What does this tell you about the number of air molecules above the water in the syringe?

   There are fewer air molecules compared with the outside air.

3 How did this cause the water to boil?

   Because there is less air resistance, it takes less energy to make the water molecules vaporize, so the boiling point is lowered.

4. When you normally see water boiling in a pot, what is different about the conditions under which that happens compared with what you saw in the syringe?

   A pot of water must be constantly heated to make the water boil at atmospheric pressure.

5. If you want to boil a liquid with a boiling point of 200 ºC, how can you save energy?

   Reduce the pressure to lower the boiling point.