Testing for Water Hardness

Background Info:
Hard water has a lot of minerals (Calcium and Magnesium mainly) dissolved in it. Hard water does not mix well with soaps. Because of this, you can test for the hardness of water by looking at the amount of bubbles produced when you mix water and soap.

Aim:
To test various solutions of water for hardness and see how effective different filtering materials are at removing the minerals that cause the hardness.

Materials:
- 6 Vials w/caps
- Test tube rack
- Measuring cylinder
- Eye Dropper
- Dish soap
- Ruler
- Plastic cup
- Funnel
- Beaker
- Filter paper
- Carbon
- Ion Exchange Resin

Water:
- Calcium chloride solution
- Deionized water
- Tap water

Be sure to do the following:
1) Read the steps before doing anything
2) Ask for help or clarification if you don’t understand.
3) Check each step after you complete it.
Procedure:

Part I: Testing for Hardness

___ 1) Measure out 5ml of one of the solutions and pour it into a vial.

___ 2) Add a drop of soap to the vial. Put the cap on and shake vigorously (strongly) for 10 seconds.

___ 3) Take a ruler and measure the height of the bubble from the top of the liquid. Record this in the table 1.

___ 4) Repeat steps 1-3 for the other solutions. Be sure to record your results.

___ 5) Rank each solution from hardest (#1) to softest #3).

___ 6) Clean your test tubes thoroughly.

Results:

Table 1: Hardness for Different Solutions

<table>
<thead>
<tr>
<th>Solution</th>
<th>Bubble Height (cm)</th>
<th>Hardness Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deionized Water</td>
<td></td>
<td></td>
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<tr>
<td>Water w/CaCl₂</td>
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</tbody>
</table>

Conclusion:
Which solution had the most hardness? What evidence supports this?

______________________________________________________________________
Part II: **Testing Methods to Soften Hard Water.**

Method I:

**Filtering using Filter paper:**

6) Look over your results and choose the solution that had the most hardness (#1). This will be the one you will filter.

7) Measure and pour 10 ml of this solution into a beaker.

8) Put a piece of filter paper in the funnel. Put the funnel into a plastic cup.

9) Pour the solution into the filter and collect it in the cup.

10) Perform steps 1-3 on the solution. Record your results in Table 2.

**Filtering using charcoal (Carbon):**

10) Repeat steps 7-10, but add 2 scoops of activated charcoal to the beaker and swirl together for 1 minute.

**Filtering using Ion exchange Resin:**

12) Repeat steps 7-10, but add 2 scoops of the ion exchange resin to the beaker and swirl together for 1 minute.

13) Calculate the change in bubble height for each filter material.

Record in Table 2

\[
\text{change in height} = \text{solutions bubble height} - \text{solutions bubble height after filtering}
\]
14) Get the change in heights results from 3 different groups, for each filtering technique, and calculate the average for all four. Record this in table 2.

\[ \text{Average} = \frac{\text{change in height} + \text{change in height} + \text{change in height} + \text{change in height}}{4} \]

15) Look over your results to see which filtering material worked best at removing the ions from the water.

Results:

Table 2: Filtration Results:

<table>
<thead>
<tr>
<th>Filter Material</th>
<th>Bubble Height (cm)</th>
<th>Change in Height (cm)</th>
<th>Average Change in Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Paper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Paper &amp; Carbon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Paper &amp; Ion Exchange Resin</td>
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<td></td>
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</tbody>
</table>

Conclusions/Questions:

Did either the carbon or the resin go through the filter? Why or why not?
Which filtration material worked best at softening the water? How do you know (evidence)?

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__________________________________________________________________________

Why do you think this material was the most effective (How did it remove the minerals)?

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__________________________________________________________________________

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How did your results for the change in bubble height compare with the average? Why is it better to use the average?

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