**INVESTIGATING HARD AND SOFT WATER**

**Skills: AI/MM**

**AIM:** To \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**APPARATUS and MATERIALS:**

* Soap solution
* Detergent
* 5 test tubes
* 1 rubber bung
* Droppers
* Measuring cylinder
* Tap water
* Distilled water
* Permanently Hard water (1g MgSO4 in 100ml water)
* Temporary hard water (solution of CaHCO3)
* Sodium carbonate solution
* Stopclock
* ruler

**DIAGRAM:** *Draw a diagram showing the set up of apparatus.*

**TITLE:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**INSTRUCTIONS:**

1. Label 4 test tubes – A, B, C and D. Set up each tube as follows

A – Distilled water

B – Tap water

C – Permanently hard water

D – Temporary hard water

1. Measure out 5ml of each type of water and place in the appropriate tube. Add 1 drop of soap solution and shake for 1 minute.
2. Check for lather (bubbles must cover water for 1 minute after shaking)
3. If no more lather forms, add 1 more drop of soap and continue shaking and checking for lather, Keep adding soap until a permanent lather forms.
4. Record for each type of water, the number of drops of soap needed to form lather and whether any signs of scum (Calcium soap) formed.
5. Discard each solution and rinse the test tubes thoroughly.
6. Measure and place 5ml of each type of water into the same test tubes.
7. Then add 2ml of sodium carbonate solution to each test tube followed by 1ml of soap solution.
8. Record the appearance of the solutions and the height of the lather formed in each tube.

*Rewrite your method into past tense in the space below or on a separate page.*

**METHOD**:

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**RESULTS:**

Draw a table in the space provided to collect your results.

**Table 1 showing** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| **Water sample used** | **Number of drops of soap needed** | **Any signs of scum? (Calcium soap)** |
|
| **A – distilled water** |  |  |
| **B – tap water** |  |  |
| **C – permanent hard water** |  |  |
| **D – temporary hard water** |  |  |
|  |  |  |

**Table 2 showing**:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| **Tube + contents** | **Height of lather (cm)** | **Appearance of test tube.** |
| **A – distilled water**  **And sodium carbonate solution.** |  |  |
| **B – tap water**  **And sodium carbonate solution.** |  |  |
| **C – permanent hard water**  **And sodium carbonate solution.** |  |  |
| **D – temporary hard water**  **And sodium carbonate solution.** |  |  |

**DISCUSSION:** *Write your responses in full sentences on a separate page –* ***use paragraphs.***

1. Decide which sample contains the hardest water and state why. (Hint – the one that needs most soap solution and forms a scum).
2. Which water sample was soft water? (Hint – the one that lathers easiest)
3. What happened to each sample of water when sodium carbonate was added?
4. What are the problems of hard water for a hospital?
5. How can water be softened? (Explain the 3 ways – boiling, adding chemicals and distillation).
6. Why is distilled water used in school laboratories and car batteries?

**CONCLUSION:** *State what you found out in this experiment? Remember your aim (manipulated and responding variables)!*

**MARKSCHEME - ANALYSIS AND INTERPRETATION (AI)**

|  |  |
| --- | --- |
| **Criteria (AI)** | **Marks** |
| 1. Identifying the hard water with reason | 1 |
| 1. Identifying the soft water with reason | 1 |
| 1. Stating the sodium carbonate removes the hardness from the temporary hard water | 1 |
| 1. Problems of hard water in a hospital – scum and more water has to be used to form a lather. | 2 |
| 1. Ways water can be softened | 3 |
| 1. Uses of distilled water – reasons | 1 |
| 1. Conclusion | 1 |
| **TOTAL** | **10** |

**MARKSCHEME – MANIPULATION AND MEASUREMENT (MM)**

|  |  |
| --- | --- |
| **Criteria (MM)** - Using the measuring cylinder/ droppers - | **Marks** |
| Cylinder on flat surface | 2 |
| Readings taken at eye level | 2 |
| All liquid poured out completely from cylinder | 2 |
| Cylinder is cleaned and washed between uses and at end of lab | 2 |
| Using the dropper to add soap properly | 2 |
| **TOTAL** | **10** |