

Natural Sciences Grade 9 2024
Marks: 35 converted to 20

Practical Task / Investigation
Worksheet

Acids, bases and the use of an indicator

PART 1

Aim:

To determine the colour of an indicator in an acid, a base and a neutral substance.

Materials:

Universal indicator or red cabbage water (see instructions for preparation below)
pH scale and colours for universal indicator or red cabbage water (Table 1)
Bicarbonate of soda (Baking soda, NaHCO_3 or sodium hydrogen carbonate)
Vinegar (Ethanoic acid)
Water (Distilled water if possible)
Test tubes, glass containers or transparent plastic cups
Test tube rack
Droppers
Plastic teaspoon

How to prepare red cabbage indicator:

Chop up a few (2 to 3) red cabbage leaves.

Cover the leaves with boiling water and boil for a few minutes.

Let the mixture cool down.

Instead of boiling the mixture, liquidise the leaves and water with an electric food processor.

Strain the mixture to remove the solid pieces from the indicator (red cabbage water).

How to prepare the bicarbonate of soda solution:

Dissolve 2 teaspoons of bicarbonate of soda in 100 ml (20 teaspoons) of water.

Stir until all the solid has dissolved.

Table 1: Colour scale and pH for universal indicator and red cabbage water

pH	Colour of universal indicator	Colour of red cabbage water
0	Dark red	Red
1	Red	
2	Red	Light pink
3	Orange red	
4	Orange	Dark pink
5	Orange yellow	
6	Greenish yellow	Purple
7	Green	
8	Greenish blue	Blue
9	Blue	
10	Navy blue	Blue green/Cyan
11	Purple	
12	Dark purple	Green
13	Violet	
14	Violet	Yellow

Method:

1. Put 3 test tubes in a test tube rack and number them **1, 2** and **3**.
2. Pour 5 to 10 ml of vinegar in test tube **1**.
3. Pour 5 to 10 ml of (distilled) water in test tube **2**.
4. Pour 5 to 10 ml of the bicarbonate of soda solution in test tube **3**.
5. Add a few drops of universal indicator or red cabbage water to each test tube.
6. Observe the colour of each solution.
7. Determine the pH of each solution. Use Table 1.
8. Decide whether the solution in each of test tubes **1, 2** and **3** is an acid, a base or neutral.
9. Keep the solutions to use as a reference in **Part 2** of the investigation.

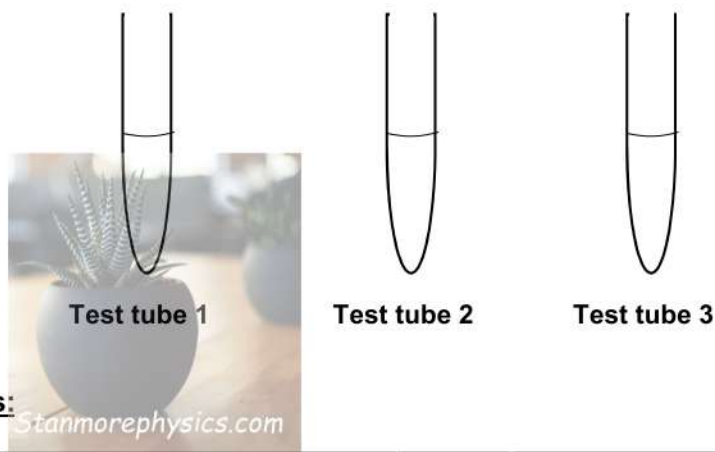


Table of results:

Test tube	Colour	pH	Acid, base or neutral
1 (Vinegar)			
2 (Water)			
3 (Bicarbonate of soda)			

Conclusion:

1. Which substance is neutral? _____ (1)
2. What is the pH of a neutral substance? _____ (1)
3. Which substance is an acid? _____ (1)
4. The pH of an acid is (below / above) seven. (1)
5. Which substance is a base? _____ (1)
6. The pH of a base is (below / above) seven. (1)
7. What is the function of an indicator?

_____ (2)

PART 2

Aim:

To investigate how the pH changes when vinegar is treated with a solution of bicarbonate of soda.

Investigative question:

How will the pH change when vinegar is treated with a solution of bicarbonate of soda?

Hypothesis:

(2)

Method:

1. Pour a small amount (5 ml or 1 teaspoon) of vinegar in a test tube or glass jar.
2. Add a few drops of universal indicator or red cabbage water to the vinegar.
3. Record the colour and the pH of the vinegar, using **Table 1**.
4. Use a medicine dropper or propette to transfer 10 drops of the original bicarbonate of soda solution, prepared in **Part 1**, to the vinegar-indicator mixture.
5. Stir the solution gently or swirl the test tube.
6. Record the colour and the pH of the solution.
7. Add another 10 drops of bicarbonate of soda and record the colour and pH.
8. Repeat steps 4 to 6 until the pH of the solution is well above 7.

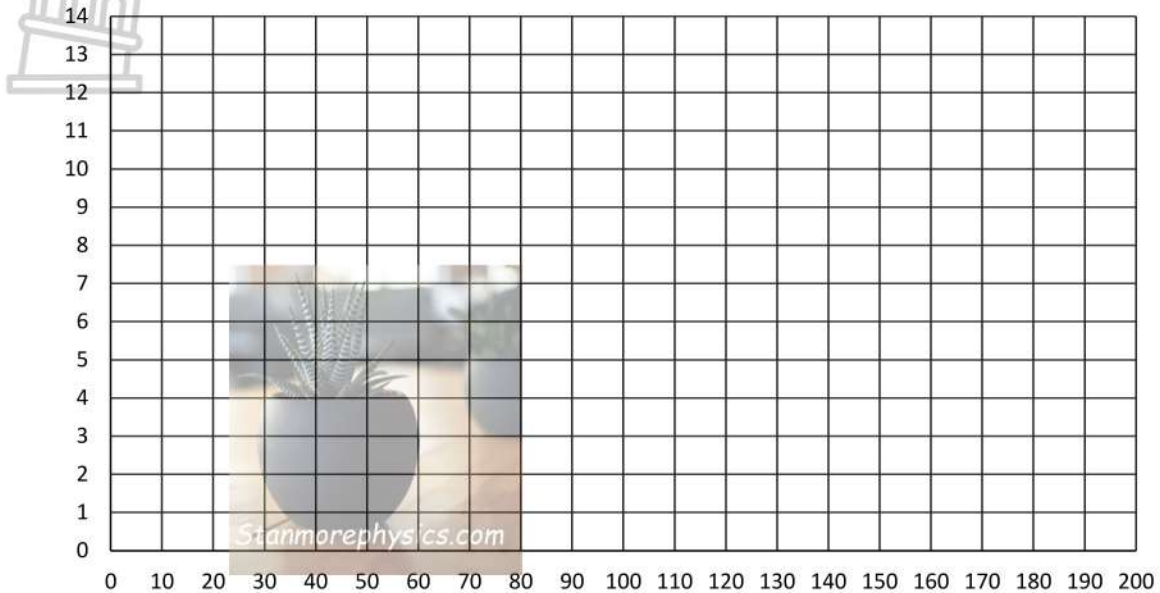
Table of results:

Total number of drops of bicarbonate of soda	Colour	pH
0		
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
130		
140		
150		
160		
170		
180		

(6)

Graph of the results:

Draw a graph of the results in the table. Use the graph paper given below. Provide the graph with a heading and label each axis clearly. (6)



Conclusion:

Were you able to confirm or reject your hypothesis? Use your experimental results to motivate your answer. (2)

Questions:


1. When the vinegar and bicarbonate of soda (NaHCO_3) react with each other, gas bubbles are observed. Which gas is liberated? (1)

2. Complete the general word equation for this reaction: (3)

Acid + metal carbonate \rightarrow _____ + _____ + _____

3. How many drops of bicarbonate of soda neutralised the vinegar in this investigation? (1)

4. Explain how you determined your answer in question 3. (2)

5. Identify the:  Stanmorephysics.com

- 5.1 Independent variable in this investigation. (1)

- 5.2 Dependent variable (1)

6. Bicarbonate of soda helps to calm the burning sensation after a bee sting. Explain how this is possible. (2)

TOTAL: 35

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Practical Task / Investigation
Memorandum

Acids, bases and the use of an indicator

PART 1

Table of results

(For universal indicator)

Test tube	Colour	pH	Acid, base or neutral
1 (Vinegar)	Red	Any value below 7	Acid
2 (Water)	Green	7	Neutral
3 (Bicarbonate of soda)	Blue/Purple	Any value above 7	Base

Conclusion:

1. (Distilled) water✓ (1)
2. 7✓ (1)
3. Vinegar✓ (1)
4. The pH of an acid is (below✓ / above) seven. (1)
5. Bicarbonate of soda✓ (1)
6. The pH of a base is (below / above✓) seven. (1)
7. An indicator is a substance, which indicates whether a solution is an acid, a base or neutral✓ through a colour change. ✓ (2)

PART 2

VERY IMPORTANT:

Teachers **MUST** do a test run or two themselves before the learners do this experiment. Results may vary a lot due to the different concentrations of the solutions.

Hypothesis:

When vinegar is treated with bicarbonate of soda✓ the pH will increase.✓

OR

When vinegar is treated with bicarbonate of soda✓ the pH will decrease.✓ (2)

Table of results:

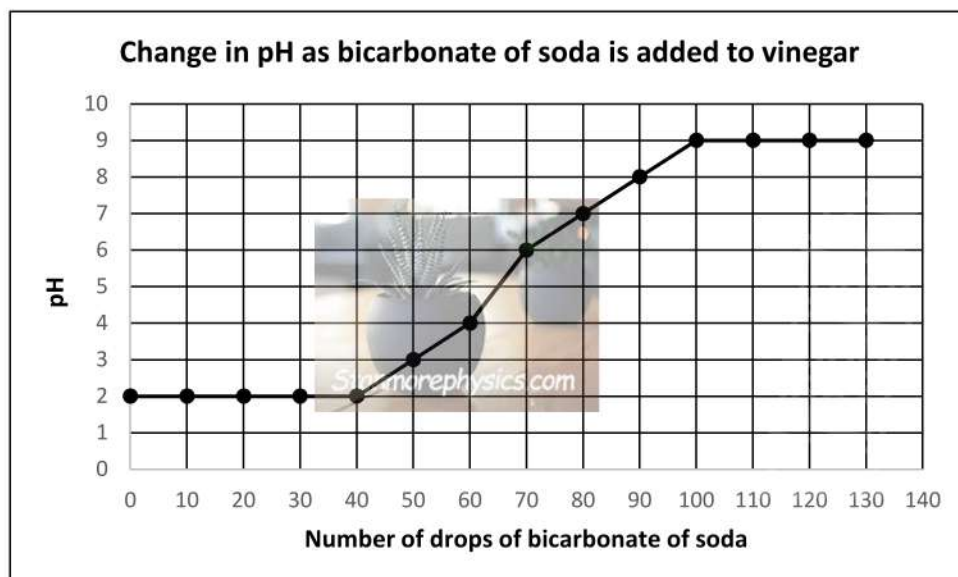
(For universal indicator)

Total number of drops of bicarbonate of soda	Colour	pH
0	Red	2
10	Red	2
20	Red	2
30	Red	2
40	Red	2
50	Orange red	3
60	Orange	4
70	Greenish yellow	6
80	Green	7
90	Greenish blue	8
100	Blue	9
110	Blue	9
120	Blue	9
130	Blue	9

Marking criteria for table of results	Marks
Colour and pH values below 7	✓✓
Colour and pH value at 7	✓✓
Colour and pH values above 7	✓✓

(6)

Graph of the results:





Marking criteria for graph	Marks
Heading	✓
Label on x-axis	✓
Label on y-axis	✓
Half of points plotted correctly	✓
Rest of points plotted correctly	✓
Line of best fit drawn through the points	✓

(6)

Conclusion:

NOTE: Whether the hypothesis has been confirmed or rejected, depends on the learner's hypothesis above.

Treating vinegar with bicarbonate of soda causes the pH to increase. ✓
The hypothesis has been confirmed/rejected. ✓

OR

When the number of drops of bicarbonate of soda increases, the pH of the mixture increases. ✓
The hypothesis has been confirmed/rejected. ✓



OR

When the volume of bicarbonate of soda (base) increases, the vinegar/mixture becomes less acidic and the pH increases. ✓
The hypothesis has been confirmed/rejected. ✓

(2)

Questions:

- Carbon dioxide OR CO_2 ✓ (1)
- Acid + metal carbonate \rightarrow Salt ✓ + H_2O ✓ + CO_2 ✓ (3)
- 80 drops ✓ (This answer depends on the graph of the learner.) (1)
- From the table of results:** After 80 drops of bicarbonate of soda have been added to the vinegar, the pH of the solution was 7, ✓ the solution was green, the colour of a neutral solution. ✓ (The number of drops depends on the results.)

OR

From the graph: A pH of 7 was reached after 80 drops ✓ of bicarbonate of soda have been added to the solution, indicating a neutral solution. ✓
(The number of drops depends on the results.)

(2)

- 5.1 Number of drops of NaHCO_3

OR

Volume/Amount of bicarbonate of soda ✓ (1)

- 5.2 pH ✓ (1)

6. Bicarbonate of soda, which is a base, neutralises✓ the acidic chemical✓ that is injected into the skin during a bee sting. (2)



TOTAL: 35

