Methanal (hcho), sodium sulphite (na2so3) and sodium hydrogensulphite (nahso3) es...

Chemicals:

0. 3 M methanal about 100 cm3

solution B (containing 0. 20 M NaHSO3 and 0. 05 M Na2SO3) about 100 cm3

phenolphthalein indicator several dropping bottles shared

Apparatus:

Boiling tube x 6 100 cm3 beaker x 2

Glass rod x 1 250 cm3 beaker x 1

stop watch x 1 600 cm3 beaker x 1

10 cm3 measuring cylinder x 1 25cm3 measuring cylinder x 2

dropper x 3 white tile x 1

thermometer (-10? to 110?) x 1

Procedures:

A. Effect of Dilution

1. According to the following table, distilled water was measured using a clean 10. 0 cm3 measuring cylinder. each volume of water was poured into a clean and dry boiling tube.

Volume of water (cm3)

0

2. 5

5. 0

7. 5

10. 0

12. 5

15. 0

The experiment was started with 0 cm3 of water in the clean and dry boiling tube.

2. 5. 0 cm3 of 0. 3 M methanal was measured using another clean 10. 0 cm3 measuring cylinder and was poured into the first boiling tube.

3. 2 drops of phenolphthalein were added into the boiling tube.

4. 5. 0 cm3 of solution B was measured using another clean 10. 0 cm3 measuring cylinder and was poured it into the boiling tube.

5. The stop watch was started immediately.

6. The reaction mixture was quickly stirred with a clean and dry glass rod.

7. Any colour change was observed against a white tile.

8. The time for the pink colour to appear was recorded in Table 1.

9. The boiling tube was washed.

10. Steps 1-9 were repeated for the other sets of experiments mentioned in step 1.

11. A graph of volume of water added was plotted against time.

B. Effect of Concentration of Methanal

1. According to the table above, 0. 3 M methanal and deionized water was measured using clean 10. 0 cm3 measuring cylinders respectively.

Volume of 0. 3 M methanal (cm3)

5. 0

7. 5

10. 0

12. 5

15. 0

Volume of water (cm3)

15. 0

12. 5

10. 0

7. 5

5. 0

2. Each combination of methanal and water was poured into a clean and dry boiling tube.

3. The experiment was started with 5. 0 cm3 of methanal and 15. 0 cm3 of water in the clean and dry boiling tube.

4. 2 drops of phenolphthalein were added into the boiling tube.

5. 5. 0 cm3 of solution B was measured using another clean 10. 0 cm3 measuring cylinder and was poured into the boiling tube containing water and methanal.

6. The stop watch was started immediately.

7. the reaction mixture was stirred quickly.

8. Any colour change was observed against a white tile.

9. The time for the pink colour to appear was recorded in Table 2.

10. The boiling tube was washed.

11. Steps 1-10 were repeated for other combinations mentioned in step 1.

12. A graph with the volume of 0. 3 M methanal added was plotted against time.

C. Effect of Temperature

1. 400cm3 of hot water was poured into a 600 cm3 beaker

2. Keep the water bath at approximately 45?.

3. 10. 0 cm3 of 0. 3 M methanal and 20. 0 cm3 of distilled water was measured using clean 10. 0 cm3 measuring cylinders respectively and was poured into a clean and dry boiling tube.

4. 2 drops of phenolphthalein indicator were added into the boiling tube.

5. 10. 0 cm3 of solution X was measured using a clean and dry 10. 0 cm3 measuring cylinder and was poured into another clean and dry boiling tube.

6. The 2 boiling tubes were placed into the water bath for several minutes until the water, methanal and solution X in the boiling tubes were of the same temperature and were nearly equal to 45 ?.

7. The solution X was poured into the boiling tube containing methanal and water.

8. The stop watch was started immediately.

9. The reaction mixture was stirred quickly with a thermometer.

10. The time taken for the pink colour to appear was recorded in Table 3.

11. The highest temperature of the reaction mixture attained was also recorded in Table 3.

12. Steps 3-11 were repeated for each of the other temperatures listed below.

Approximate temperature (?)

30

35

40

45

13. A graph with the highest temperature of the reaction mixture attained was plotted against time.

Results:

Table 1

Volume of water (cm3)

0

2. 5

5. 0

7. 5

10. 0

12. 5

15. 0

Time (sec)

20. 41

30. 24

36. 19

42. 18

50. 39

60. 14

65. 54

Table 2

Volume of 0. 3 M methanal (cm3)

5. 0

7. 5

10. 0

12. 5

15. 0

Volume of water (cm3)

15. 0

12. 5

10. 0

7. 5

5. 0

Time (sec)

69. 81

29. 72

18. 43

13. 75

10. 48

Table 3

Approximate temperature of reaction mixture (?)

25

30

35

40

45

Highest temperature reached (?)

24

28

34

40

43

Time (sec)

34. 45

25. 40

18. 68

14. 10

10. 18

Graphs

Part A

A graph of volume of water added against time.

Part B

A graph with the volume of 0. 3 M methanal added was plotted against time

Part C

A graph with the highest temperature of the reaction mixture attained against time

Questions:

1. Based on the graph plotted in part A, state the effect of the amount of water on the rate of the reaction between methanal, sodium sulphite and sodium hydrogensulphite.

The larger the volume of water used, the longer the time for the appearance of pink colour, thus, the lower the rate of reaction between methanal, sodium sulphite and sodium hydrogensulphite.

There was a linear relationship (direct relationship) between the volume of water used and the rate of reaction between methanal, sodium sulphite and sodium hydrogensulphite.

2. Explain why the concentration of methanal in the reaction mixture increases when the volume of methanal added increases in part B.

When the volume of 0. 3 M methanal added increased and the volume of water used decreased, the total volume of the reaction mixture remained unchanged. As the number of mole of methanal molecules in the reaction

mixture increased while the volume of reaction mixture was constant, the number of mole of methanal molecules per one dm3 of solution increased. Hence, the concentration of methanal in the reaction mixture increased when the volume of methanal added increased

3. Based on the graph plotted in part B, state the effect of the concentration of methanal on the rate of reaction between methanal, sodium sulphite and sodium hydrogensulphite.

The larger the initial volume (higher concentration) of methanal in the reaction mixture, the shorter the time for the appearance of pink colour.

The concentration of methanal and the rate of reaction between methanal, sodium sulphite and sodium hydrogensulphite are inversely related (inversely proportional)to each other.

4. Based on the graph plotted in part C, state the effect of temperature on the rate of the reaction between methanal, sodium sulphite and sodium hydrogensulphite.

The higher temperature, the shorter the time for the appearance of pink colour

The time for the appearance of pink colour decreased with the highest temperature of the reaction mixture attained in an exponential manner.

Conclusion

According to the experiments, the rate of the chemical reaction between methanal (HCHO), sodium sulphite (Na2SO3) and sodium hydrogensulphite (NaHSO3) increases with the decrease in volume of water used or the increase in concentration of methanal or the increase in temperature.

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