1. You are provided with:

* Aqueous hydrochloric acid solution W9 in a burette.
* Solution W11 containing 6.3g of a dibasic acid H2X. 2H2O
* Solution W12 – aqueous sodium hydroxide.
* Phemolphlnalein indicator

You are required to:

* Standardize the sodium hydroxide solution W12
* Use the standardized solution W12 to determine the concentration of W9

Procedure:

1. Fill a burette with solution W11, pipette 25.0 cm3 of solution W12 into a conical flask. Titrate using phenolphthalein indicator. Record your result in Table I below.

Table I

|  |  |  |  |
| --- | --- | --- | --- |
| Run | 1st | 2nd | 3rd |
| Final burette reading (cm3) | 12.8 | 25.4 | 37.8 |
| Initial burette reading (cm3) | 0.0 | 12.8 | 25.4 |
| Volume of W11 used (cm3) | 12.8 | 12.6 | 12.4 |

1. Determine average volume of solution W11 used: (1 mk)

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1. Calculate the molarity of the dibasic acid, solution W11

(Relative formula mass of H2X.2H2O = 126) (1 mk)

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1. Determine the concentration of the sodium hydroxide solution W12 in moles per litre. (2 mks)

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1. Using a 100cm3 measuring cylinder measure 90cm3 of distilled water and place it into a 250cm3 beaker then add 10cm3 of solution W9 (w9 is supplied in a burette). Mix the solution well and label it W10.

Fill a burette with solution W10, pipette 25.0 cm3 of solution W12 into a conical flask. Titrate using phenolphthalein indicator. Record your results in table II below.

Table II

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| --- | --- | --- | --- |
| Run | 1st | 2nd | 3rd |
| Final burette reading (cm3) | 18.45 | 36.65 | 18.00 |
| Initial burette reading (cm3) | 0.00 | 18.45 | 0.00 |
| Volume of W10 used (cm3) | 18.45 | 18.20 | 18.00 |

1. Determine the average volume of solution W10 used. (1 mk)

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1. Calculate the concentration of the diluted hydrochloric acid solution W10 in moles per litre. (2 mks)

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1. Determine the concentration of the original hydrochloric acid solution W9 in mol per litre. (1 mk)

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………0.6906mol/l…………………………………………………………………………………………

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1. In this experiment, you require About 50cm3 of 2M sodium hydroxide solution N, About 25cm3 of dilute sulphuric acid solution W in a burette, Thermometer, 100 ml plastic beaker and stop watch

In this experiment you are expected to determine the molar heat of neutralization of sulphuric (VI) acid with 2M sodium hydroxide. Measure 20 cm3 of sulphuric (VI) acid, solution W and transfer into 100ml plastic beaker provided. Measure its temperature and record in the table below under 1st column. After every 15 seconds, run 5 cm3 of solution N from the burette into solution W in the plastic beaker, stir with the thermometer and record the final steady temperature. Continue to add 5cm3 of N to the same solution and record the final steady temperature until 40 cm3 of N has been added. (3 mks)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time in seconds | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 |
| Volume of H2SO4, W used (cm3) | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Volume of 2M NaOH (aq) N, added (cm3) | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| Highest temperature reached (0C) |  |  |  |  |  |  |  |  |  |

1. Plot a graph of highest temperature reached (vertical axis) against volume of 2M NaOH(ag) added.(3 mks)



1. From your graph determine the following:-
2. Change in temperature (∆T) (1 mk)

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1. Volume of 2M NaOH (aq) needed to neutralize completely 20cm3 of sulphuric (VI) acid. (1 mk)

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1. Determine the number of moles of sulphuric (VI) acid used given that the solution contains 1 mole per litre of the acid. (1 mk)

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1. Calculate the amount of heat evolved in the above reaction (take specific heat capacity of the solution to he 4.2J/gK and density of the solution to be 1 g/cm3)

(1 mk)

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1. Hence determine the molar heat of neutralization of sulphuric (VI) acid. (2 mks)

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**EACH STUDENT SHOULD BE PROVIDED WITH.**

Q.1. - About 90cm3 of 0.6906M solution W9. PREP 1000CM3

- About 60cm3 of solution W11. PREP 1000CM3

- Burette

- Pipette

- 250ml conical flask

- About 160cm3 of 0.05M solution W12. PREP 2000CM3

- phenolphthalein indicator

- A stand

- White tile

Q.2. - About 50cm3 of 2M sodium hydroxide solution N.

- About 50cm3 of 1M dilute sulphuric acid solution W in a burette.

- Thermometer.

- 100 ml measuring cylinder.

- 100 ml plastic beaker

- stop watch