Mr Snewin and his degu, Gizmo, are doing some titrations. Unfortunately, Gizmo doesn’t know how to do the calculations, so he needs your help.

1. Use the information to determine the concentration of the hydrochloric acid.

* A 25 cm3 sample of hydrochloric acid is sucked into a pipette and transferred into a 250 cm3 volumetric flask. The solution is made up to the mark.
* 25 cm3 of the diluted acid is transferred into a conical flask using a pipette.
* A burette is used to neutralise the acid with 0.100 mol dm-3 sodium hydroxide.

Hydrochloric acid reacts with sodium hydroxide according to the equation:

HCl(aq) + NaOH(aq) 🡺 NaCl(aq) + H2O(l)

* 1. The average titre of the sodium hydroxide solution was 30.00 cm3. Calculate the number of moles in the average titre.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol (1)

* 1. Determine the number of moles in the diluted sample of hydrochloric acid, and hence the concentration of the diluted acid.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (2)

* 1. Calculate the concentration of the undiluted hydrochloric acid in mol dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (1)

* 1. Calculate the concentration of the hydrochloric acid in g dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g dm-3 (2)

1. Use the information to determine the concentration of the nitric acid.

* A 10 cm3 sample of nitric acid is sucked into a pipette and transferred into a 100 cm3 volumetric flask. The solution is made up to the mark.
* 25 cm3 of the diluted acid is transferred into a conical flask using a pipette.
* A burette is used to neutralise the acid with 0.150 mol dm-3 sodium hydroxide.

Nitric acid reacts with sodium hydroxide according to the equation:

HNO3 (aq) + NaOH(aq) 🡺 NaNO3 (aq) + H2O(l)

* 1. The average titre of the sodium hydroxide solution was 23.33 cm3. Calculate the number of moles in the average titre.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol (1)

* 1. Determine the number of moles in the diluted sample of nitric acid, and hence the concentration of the diluted acid.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (2)

* 1. Calculate the concentration of the undiluted nitric acid in mol dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (1)

* 1. Calculate the concentration of the nitric acid in g dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g dm-3 (2)

1. Use the information to determine the concentration of the sulfuric acid.

* A 25 cm3 sample of sulfuric acid is sucked into a pipette and transferred into a 500 cm3 volumetric flask. The solution is made up to the mark.
* 25 cm3 of the diluted acid is transferred into a conical flask using a pipette.
* A burette is used to neutralise the acid with 0.100 mol dm-3 sodium hydroxide.

Sulfuric acid reacts with sodium hydroxide according to the equation:

H2SO4 (aq) + 2NaOH(aq) 🡺 Na2SO4(aq) + 2H2O(l)

* 1. The average titre of the sodium hydroxide solution was 25.00 cm3. Calculate the number of moles in the average titre.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol (1)

* 1. Determine the number of moles in the diluted sample of sulfuric acid, and hence the concentration of the diluted acid.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (2)

* 1. Calculate the concentration of the undiluted sulfuric acid in mol dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (1)

* 1. Calculate the concentration of the sulfuric acid in g dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g dm-3 (2)

1. Use the information to determine the concentration of the hydrochloric acid.

* A 10 cm3 sample of hydrochloric acid is sucked into a pipette and transferred into a 500 cm3 volumetric flask. The solution is made up to the mark.
* 25 cm3 of the diluted acid is transferred into a conical flask using a pipette.
* A burette is used to neutralise the acid with 0.050 mol dm-3 potassium hydroxide.

Hydrochloric acid reacts with potassium hydroxide according to the equation:

HCl (aq) + KOH(aq) 🡺 KCl(aq) + H2O(l)

* 1. The average titre of the potassium hydroxide solution was 20.00 cm3. Calculate the number of moles in the average titre.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol (1)

* 1. Determine the number of moles in the diluted sample of hydrochloric acid, and hence the concentration of the diluted acid.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (2)

* 1. Calculate the concentration of the undiluted hydrochloric acid in mol dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol dm-3 (1)

* 1. Calculate the concentration of the hydrochloric acid in g dm-3.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g dm-3 (2)

*Questions*

1. *Explain* to Gizmo what the effect on the titre would be if:
   1. The pipette used to transfer the acid solution was filled to slightly above the mark. (2)

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* 1. The pipette used to transfer the acid solution was filled to slightly below the mark. (2)

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* 1. The volumetric flask was filled to slightly above the mark. (2)

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* 1. The volumetric flask was filled to slightly below the mark. (2)

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1. Gizmo doesn’t know how to work out percentage uncertainties. Calculate the percentage uncertainty of:
   1. A 100 cm3 volumetric flask with an uncertainty of 0.1 cm3. (1)

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* 1. A 250 cm3 volumetric flask with an uncertainty of 0.2 cm3. (1)

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* 1. A 500 cm3 volumetric flask with an uncertainty of 0.5 cm3. (1)

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1. Gizmo suggests washing out the pipette with water before filling it with acid solution. Explain why this is not a good idea. (2)

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1. Gizmo suggests washing out the burette with water before filling it with alkali solution. Explain why this is not a good idea either. (2)

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Total marks: 39