Questions are for both separate science and combined science students unless indicated in the question

Q1.

This question is about acids and their reactions.

Acids can be either weak or strong.

(a) What is meant by 'a **weak** acid'? **(HT only)**

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_____

_____

_____

(2)

(b) Explain what happens to the pH of an acid as the acid is diluted with water.

_____

_____

_____

_____

(2)

(c) A student does a titration to find the volume of acid needed to neutralise an alkali.

The student fills a burette with the acid.

Give **three** more steps the student must do before adding the acid to the alkali from the burette. **(chemistry only)**

You should name any equipment used.

1 _____

_____

2 _____

_____

3 _____

_____

(3)

(d) The student titrated a solution containing 0.0045 moles of sodium hydroxide with 0.15 mol/dm^3 hydrochloric acid.

The equation for the reaction is:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Calculate the volume of hydrochloric acid in cm^3 needed in the titration. **(chemistry only) (HT only)**

_____

_____

_____

Volume of acid = _____ cm^3

(2)

(e) A calcium atom is larger than a magnesium atom.

Explain why calcium reacts more vigorously than magnesium with hydrochloric acid of the same concentration.

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(3)

(Total 12 marks)

Q2.

This question is about acids and alkalis.

(a) Ethanoic acid is a weak acid.

What is meant by 'weak acid'? **(HT only)**

Answer in terms of ionisation.

_____

_____

(1)

(b) The concentration of an acid can be measured in mol/dm^3.

Which combination of changes **increases** the concentration of an acid? **(chemistry only) (HT only)**

Tick (✓) **one** box.

The mass of acid dissolved is halved and the volume of the solution is halved.	☐
The mass of acid dissolved is halved and the volume of the solution is doubled.	☐
The mass of acid dissolved is doubled and the volume of the solution is halved.	☐
The mass of acid dissolved is doubled and the volume of the solution is doubled.	☐

(1)

(c) The concentration of an acid can be determined by titration.

An indicator is added to an alkali in a flask.

Name an indicator that can be used in this titration.

Give the colour change of the indicator when acid from a burette is added to the alkali in the flask. **(chemistry only)**

Name of indicator _____

Colour change from _____ to _____

(2)

(d) Sodium carbonate dissolves in water to produce an alkaline solution.

Give the formula of the ion that makes a solution alkaline.

_____

(1)

(e) A student does a titration using sodium carbonate solution and nitric acid.

The equation for the reaction is:

$$Na_2CO_3 + 2\ HNO_3 \rightarrow 2\ NaNO_3 + CO_2 + H_2O$$

25.0 cm^3 of 0.124 mol/dm^3 sodium carbonate solution is neutralised by 23.6 cm^3 of nitric acid.

Calculate the concentration of the nitric acid. **(chemistry only) (HT only)**

Give your answer to 3 significant figures.

You should calculate:
- the number of moles of sodium carbonate in 25.0 cm^3 of the solution
- the number of moles of nitric acid in 23.6 cm^3 of the nitric acid
- the concentration of the nitric acid in mol/dm^3.

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Concentration (3 significant figures) = _____ mol/dm^3

(5)

When hydrochloric acid dissolves in water, hydrogen ions (H^+) and chloride ions (Cl^-) are produced.

(f) A solution of hydrochloric acid with pH 4.5 has a concentration of H^+ ions of 3.16×10^{-5} mol/dm^3.

What is the concentration of H^+ ions in a solution of hydrochloric acid with pH 2.5? **(HT only)**

_____

_____

Concentration of H^+ ions = _____ mol/dm^3

(1)

(g) Which element has atoms that have the same electronic structure as the chloride ion?

Use the periodic table.

_____

(1)

(Total 12 marks)

Q3.

This question is about acids and alkalis.

(a) Explain why the pH of an acid depends on: **(chemistry only) (HT only)**

- the strength of the acid
- the concentration of the acid.

(4)

(b) A student titrated 25.00 cm^3 of hydrochloric acid with 0.100 mol/dm^3 barium hydroxide solution.

The table below shows the results.

Titration number	1	2	3	4	5
Volume of barium hydroxide solution used in cm^3	23.90	23.45	23.55	23.55	23.45

The student calculated the volume of barium hydroxide solution to be used in the titration calculation as 23.50 cm^3.

Explain why the student used a volume of 23.50 cm^3 of barium hydroxide solution in the titration calculation. **(chemistry only)**

(2)

(c) 25.00 cm^3 of the hydrochloric acid reacted with 23.50 cm^3 of the 0.100 mol/dm^3 barium hydroxide solution.

The equation for the reaction is:

$$2\ HCl(aq) + Ba(OH)_2(aq) \rightarrow BaCl_2(aq) + 2\ H_2O(l)$$

Calculate the concentration of the hydrochloric acid in mol/dm^3. **(chemistry only) (HT only)**

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Concentration of the hydrochloric acid = _____ mol/dm^3

(4)

Another student titrated sulfuric acid with barium hydroxide solution.

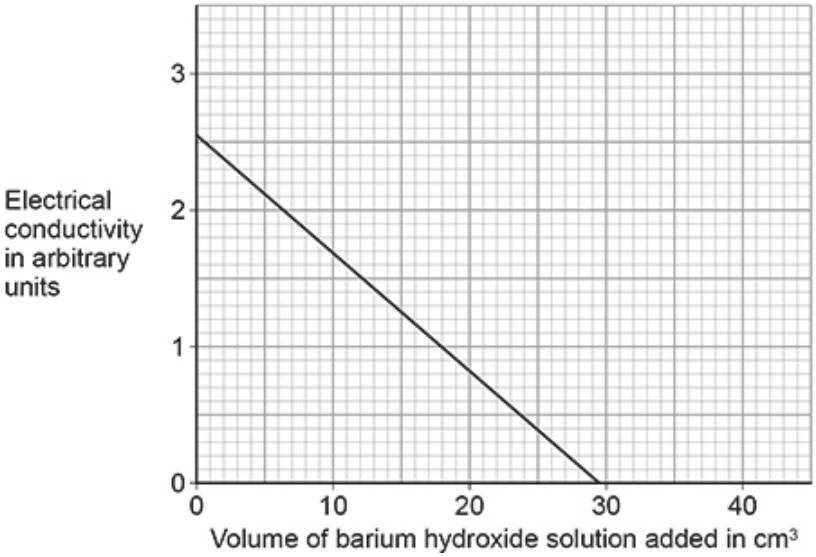
The equation for the reaction is:

$$H_2SO_4(aq) + Ba(OH)_2(aq) \rightarrow BaSO_4(s) + 2\ H_2O(l)$$

The student measured the electrical conductivity of the mixture during the titration.

The better a conductor, the higher the electrical conductivity value.

The figure below shows the results.



(d) Explain why the electrical conductivity of the mixture was zero when the sulfuric acid had just been neutralised.

Use the equation for the reaction.

Refer to ions in your answer.

_____

_____

_____

_____

_____

_____

(3)

(e) The student then added a further 10 cm^3 of barium hydroxide solution.

The electrical conductivity of the mixture increased.

Give **one** reason why.

_____

_____

(1)

(Total 14 marks)