1 Four different solutions, W, X, Y and Z, are tested with universal indicator.

solution	W	X	Y	Z
colour with universal indicator	green	red	purple	orange

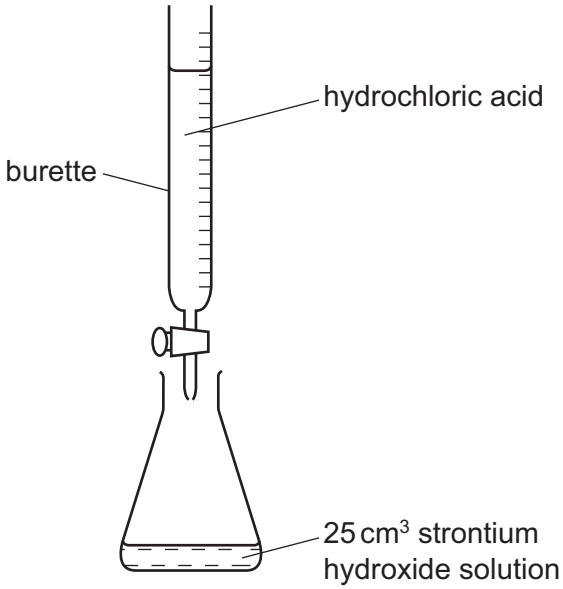
Which solutions are acidic?

A W and Z **B** X and Z **C** X only **D** Y only

[1]

[Total: 1]

2 The solution formed at the end of the reaction between strontium and water is alkaline. It is a solution of strontium hydroxide.
The teacher titrated this solution with hydrochloric acid using the apparatus shown below.



A few drops of litmus solution was added to the flask.

Explain why litmus is added to the flask and describe what happens to the litmus as the titration proceeds.

.....

.....

..... [2]

[Total: 2]

3 Magnesium chloride is a salt.
Magnesium sulfate is also a salt.

Give the name of two **compounds** which react together to form magnesium sulfate.

..... and .....

[2]

[Total: 2]

4 A solution of sodium bromide in water is neutral.

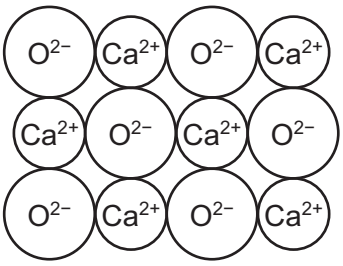
Which **one** of the following pH values is neutral?
Put a ring around the correct answer.

pH 0 pH 6 pH 7 pH 10 pH 14 [1]

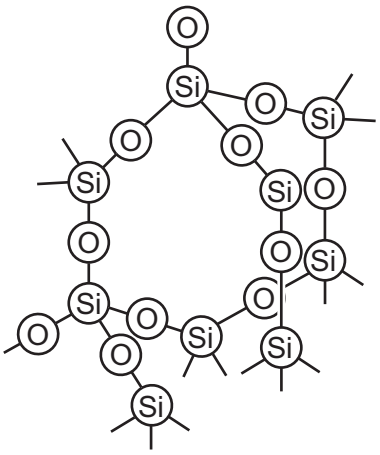
[Total: 1]

5 The structures of six compounds containing oxygen are shown below.

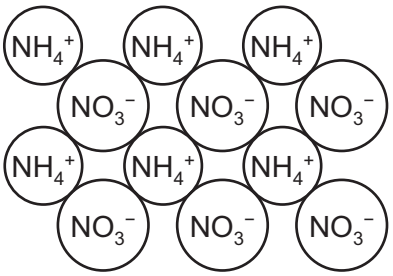
A



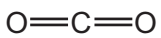
B



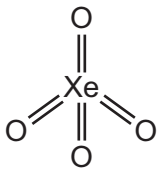
C



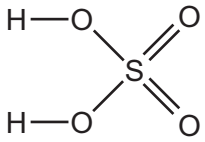
D



E



F



Complete the symbol equation for the reaction of compound **A** with hydrochloric acid.

$$CaO + ...HCl \rightarrow CaCl_2 + ...$$ [2]

[Total: 2]

6 Ammonia is a soluble base.

Which **one** of the following pH values could be the pH of aqueous ammonia?
Draw a circle around the correct answer.

pH 1 pH 5 pH 7 pH 10

[1]

[Total: 1]

7 Which **one** of the following pH values could be the pH of dilute hydrochloric acid?
Draw a circle around the correct answer.

pH 1 pH 7 pH 9 pH 13

[1]

[Total: 1]

8 The names of seven gases are given.

ammonia
ethene
helium
hydrogen
hydrogen chloride
methane
nitrogen

State which gas forms an acidic solution in water.

..... [1]

[Total: 1]

9 State the name of the salt with the formula $NaNO_3$.

..... [1]

[Total: 1]

10 Which **one** of the following pH values is acidic?
Put a circle around the correct answer.

pH 4 pH 7 pH 9 pH 13

[1]

[Total: 1]

11 Apple juice is slightly acidic.

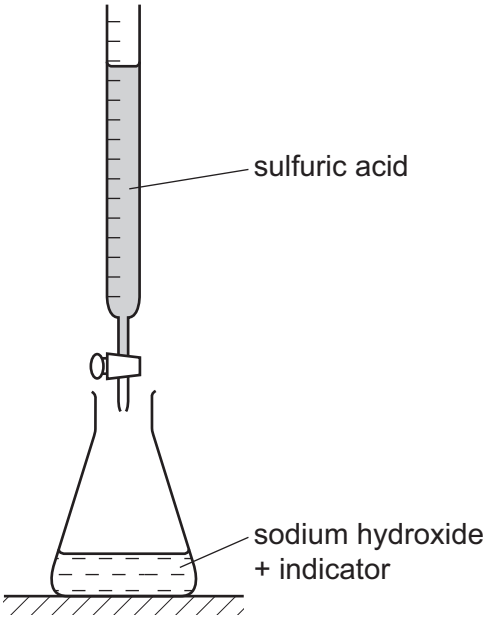
Which **one** of the following pH values is slightly acidic?
Put a ring around the correct answer.

pH 1 **pH 5** **pH 7** **pH 9** **pH 14**

[1]

[Total: 1]

12 Sulfur trioxide reacts with water to form sulfuric acid.
A student used the apparatus shown below to determine the concentration of a solution of sodium hydroxide.

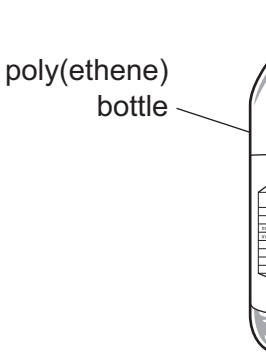


How would the student know when the sulfuric acid had neutralised the sodium hydroxide?

..... [1]

[Total: 1]

13 The diagram shows a bottle of mineral water. The concentration of the ions present in the water is shown on the label. The pH of the water is also shown.



ions present	concentration in mg / 1000 cm^3
chloride, Cl^-	0.71
X, F^-	0.31
magnesium, Mg^{2+}	0.02
manganese, Mn^{2+}	0.01
Y, NO_3^-	0.70
potassium, K^+	0.44
sodium, Na^+	1.22
pH = 6.6	

Which **one** of the following phrases best describes the pH of this mineral water?
Tick **one** box.

neutral ☐

strongly acidic ☐

strongly alkaline ☐

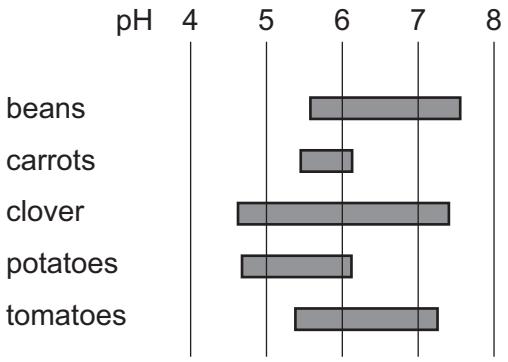
weakly acidic ☐

weakly alkaline ☐

[1]

[Total: 1]

14 The diagram shows the best pH ranges for growing different plants.



(a) Which **two** plants grow best in acidic conditions **only**?

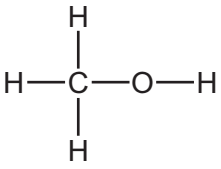
..... and ..... [1]

(b) Which pH shown in the diagram above represents a neutral pH?

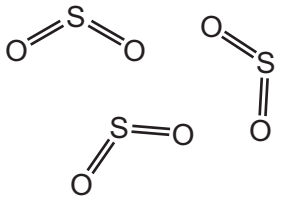
..... [1]

[Total: 2]

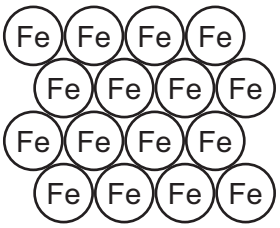
15 The diagrams show part of the structures of five substances, **A**, **B**, **C**, **D** and **E**.



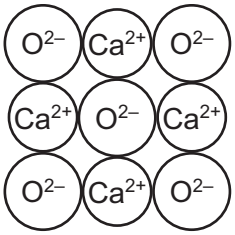
A



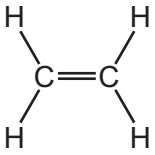
B



C



D



E

State which **one** of these structures, **A**, **B**, **C**, **D** or **E** reacts with an acid to form a salt and water.

..... [1]

[Total: 1]

16 Aqueous sodium hydroxide is a base.

Describe the reaction of aqueous sodium hydroxide with:

a named acid .....

.....

.....

ammonium salts .....

.....

.....

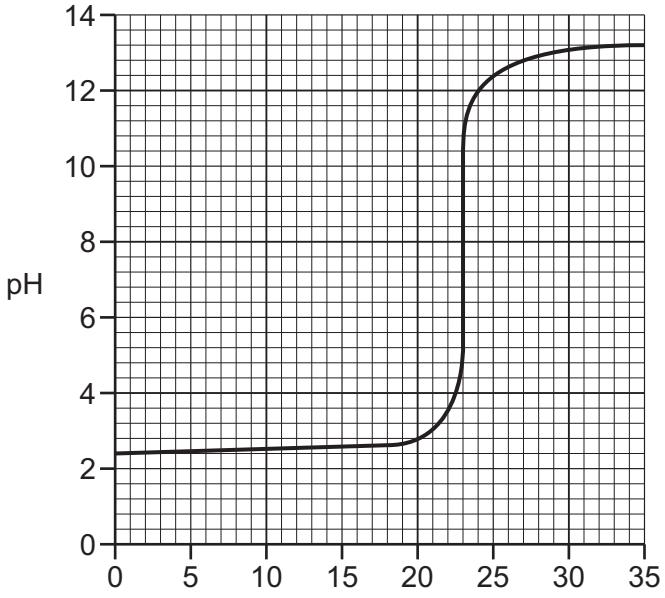
a named indicator .....

.....

..... [5]

[Total: 5]

17 The graph shows how the pH of a dilute acid in a conical flask changes as aqueous sodium hydroxide is added to it.



(a) Describe how the pH changes as the aqueous sodium hydroxide is added.

.....

.....

..... [2]

(b) What is the pH of the dilute acid before the aqueous sodium hydroxide is added?

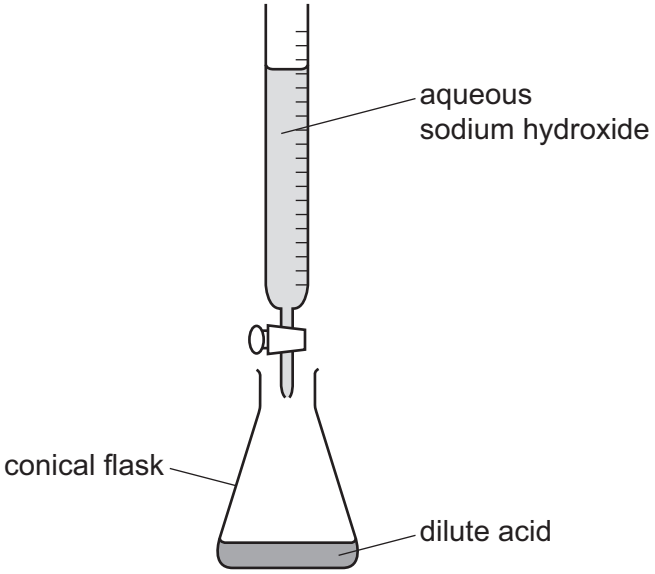
..... [1]

(c) What volume of aqueous sodium hydroxide has been added when the pH reaches pH 7?

..... [1]

[Total: 4]

18 The concentration of a dilute acid can be found by reacting it with aqueous sodium hydroxide using the apparatus shown.



(a) What piece of apparatus should be used to add exactly 25.0 cm^3 of dilute acid to the conical flask?

..... [1]

(b) A few drops of litmus solution are added to the conical flask.

Explain why litmus solution is added to the conical flask.

.....

..... [1]

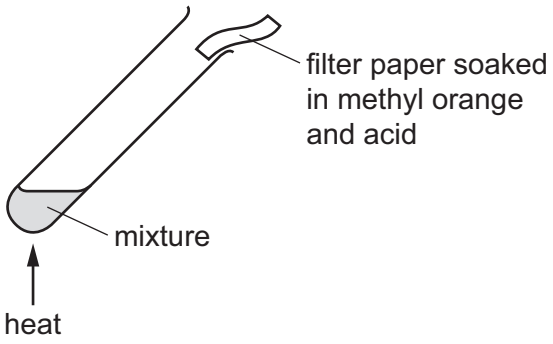
(c) Aqueous sodium hydroxide is then added to the dilute acid until it is in excess.

Describe the change in the colour of the litmus solution in the conical flask.

from .....to ..... [2]

[Total: 4]

19 A mixture of ammonium chloride and aqueous sodium hydroxide is heated as shown.



The filter paper changes colour from red to yellow.

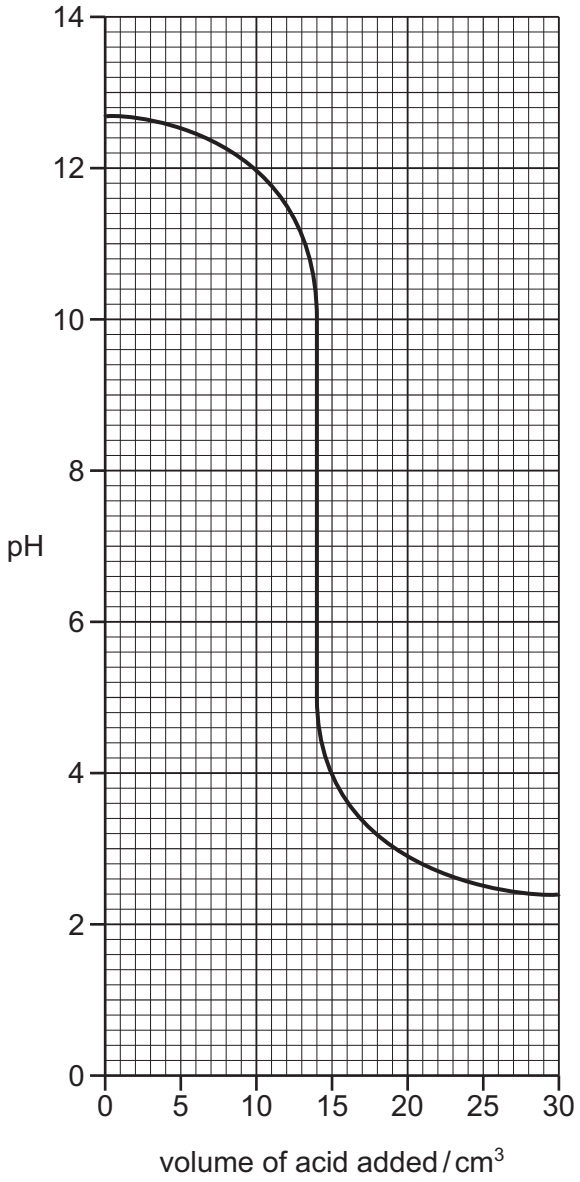
Explain why.

.....

..... [2]

[Total: 2]

20 The concentration of aqueous sodium hydroxide can be found by reacting it with an acid of known concentration.
The graph shows how the pH of aqueous sodium hydroxide in a conical flask changes as acid is added to it.



(a) Describe how the pH changes as the acid is added.

.....

.....

..... [2]

(b) What is the pH of the aqueous sodium hydroxide before the acid is added?

..... [1]

(c) What volume of acid has been added when the solution reaches neutral pH?

..... [1]

[Total: 4]

21 Potassium hydrogensulfate, $KHSO_4$, is an acid salt. It dissolves in water to produce an aqueous solution, **X**, containing K^+, H^+ and SO_4^{2-} ions.

Describe what you would see when the following experiments are done.

(a) Magnesium ribbon is added to an excess of solution **X**.

.....

..... [2]

(b) A flame test is done on solution **X**.

..... [1]

(c) An aqueous solution containing barium ions is added to solution **X**.

..... [1]

[Total: 4]

22 When sodium reacts with water, an alkaline solution is formed.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

(a) Use the information in the equation to explain why the solution formed is alkaline.

..... [1]

(b) Describe how you could use a named indicator solution to show that the solution is alkaline.

.....

..... [2]

[Total: 3]

23 Ethanoic acid, CH_3COOH, is a weak acid. It reacts with copper(II) carbonate to form the salt copper(II) ethanoate, $Cu(CH_3COO)_2$.

What is meant by the term *weak* when applied to acids?

..... [1]

[Total: 1]

24 Acids react with alkalis such as sodium hydroxide.

(a) What type of chemical reaction is this?

..... [1]

(b) Which **one** of the following pH values is the pH of an aqueous solution of sodium hydroxide? Draw a circle around the correct answer.

pH 2 pH 5 pH 7 pH 13 [1]

(c) A mixture of sodium hydroxide and ammonium sulfate is warmed gently.

State the name of the gas produced.

..... [1]

(d) The melting point of sodium hydroxide is 319 °C.
The boiling point of sodium hydroxide is 1390 °C.

Which **one** of the following statements about sodium hydroxide is correct?
Tick **one** box.

Pure sodium hydroxide melts over a range of temperatures.	☐
Impure sodium hydroxide has a sharp melting point.	☐
Pure sodium hydroxide boils between 319 °C and 1390 °C.	☐
Pure sodium hydroxide has a sharp boiling point.	☐

[1]

(e) Sodium hydroxide is used in the manufacture of some medicines.

Why is it important that the ingredients used in medicines are pure?

..... [1]

[Total: 5]

25 Acids have characteristic chemical properties.

Describe the reactions of hydrochloric acid with:

- calcium oxide
- magnesium
- a named indicator of your choice.

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 5]

26 Which statements are properties of an acid?

1 reacts with ammonium sulfate to form ammonia

2 turns red litmus blue

	1	2
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

[1]

[Total: 1]

27 The results of some tests on a colourless liquid X are shown.

- Boiling point = 102 °C
- Universal Indicator turns green

What is X?

A ethanol

B hydrochloric acid

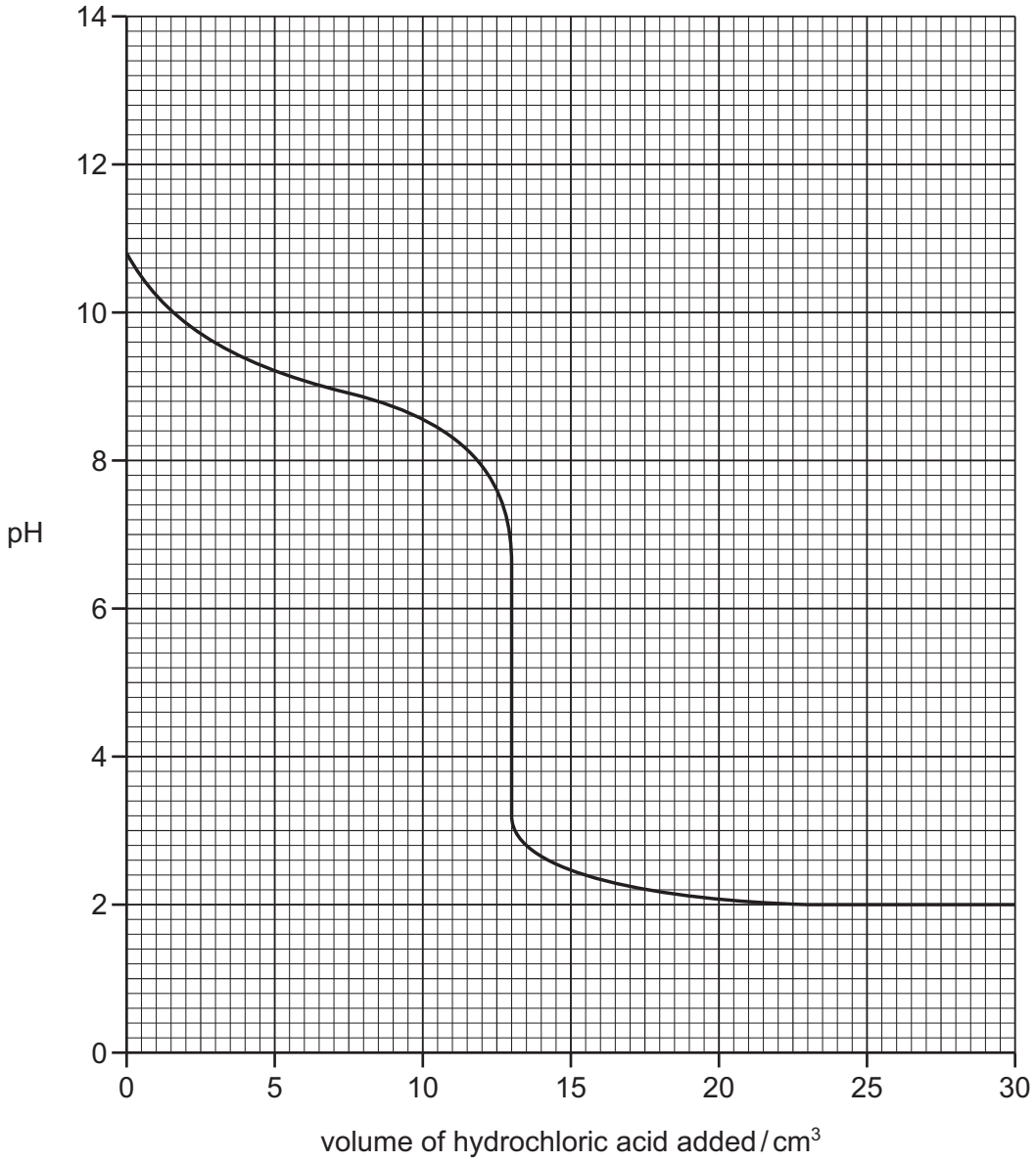
C pure water

D sodium chloride (salt) solution

[1]

[Total: 1]

28 The graph below shows how pH changes when aqueous ammonia is neutralised by hydrochloric acid.



(a) What is the pH of the aqueous ammonia at the start of the experiment?

..... [1]

(b) What volume of hydrochloric acid has been added when the pH is 10?

..... [1]

(c) What volume of hydrochloric acid has been added when the pH is changing most quickly?

..... [1]

[Total: 3]

29 Describe how acids react with metals and with metal oxides.

In your answer:
- refer to a particular metal and metal oxide,
- illustrate your answer with at least one word equation.

.....

.....

.....

.....

..... [4]

[Total: 4]

30 Fertilisers usually contain compounds of nitrogen, phosphorus and potassium.

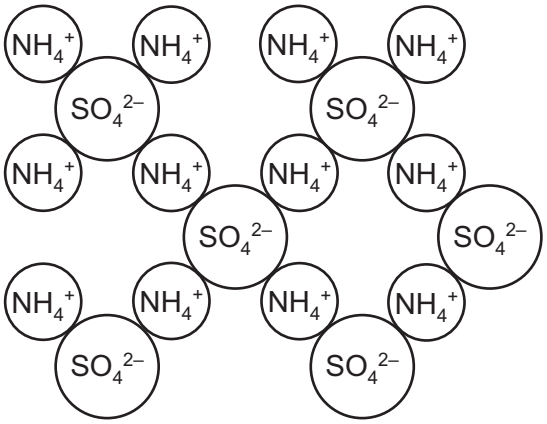
(a) Many fertilisers contain ammonium sulfate.
Ammonium sulfate is made by reacting aqueous ammonia with sulfuric acid.
What type of chemical reaction is this?

..... [1]

(b) Aqueous ammonia reacts with nitric acid to make another compound often found in fertilisers.
State the name of this compound.

..... [1]

(c) The structure of ammonium sulfate is shown below.



Deduce the simplest ratio of ammonium and sulfate ions in ammonium sulfate.

..... [1]

[Total: 3]

31 Explain why solutions of hydrochloric acid and ethanoic acid with the same concentration, in mol / dm^3, have a different pH.

.....

.....

..... [2]

[Total: 2]

32 Match the following pH values to the solutions given below.

1 3 7 10 13

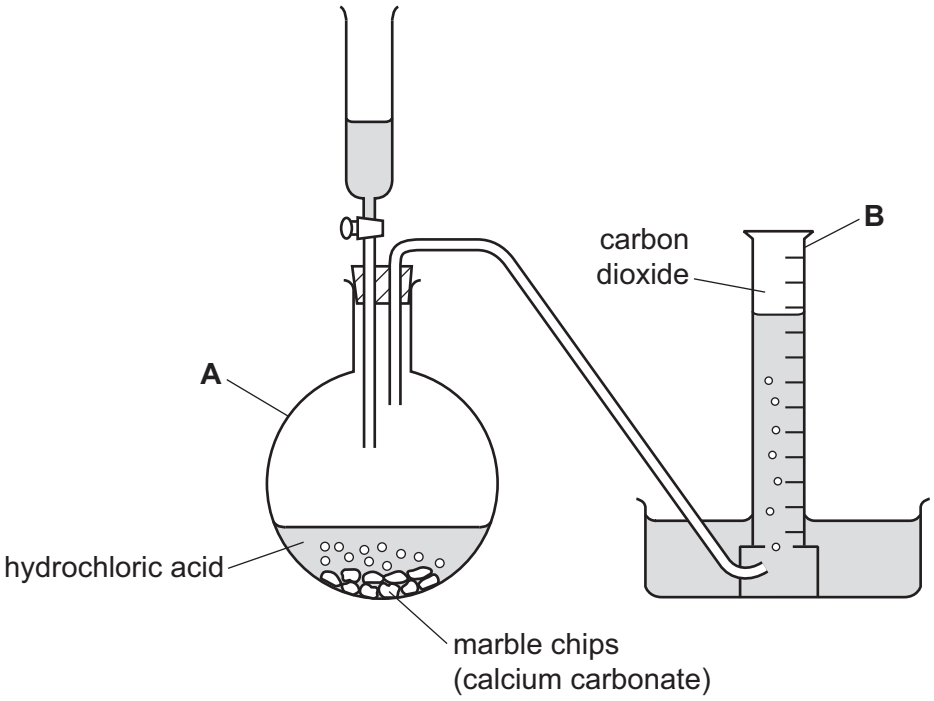
The solutions all have the same concentration.

solution	**pH**
aqueous ammonia, a weak base	.....
dilute hydrochloric acid, a strong acid	.....
aqueous sodium hydroxide, a strong base	.....
aqueous sodium chloride, a salt	.....
dilute ethanoic acid, a weak acid	.....

[5]

[Total: 5]

33 Carbon dioxide can be prepared in the laboratory using the apparatus shown below.



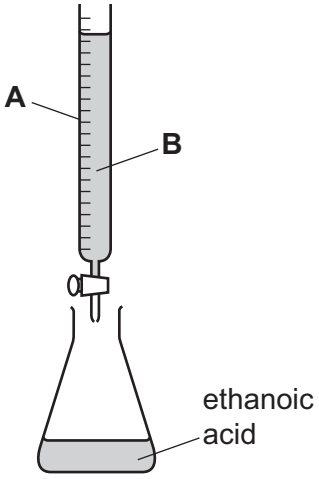
Complete the word equation for this reaction.

calcium carbonate + hydrochloric acid → ..... + carbon dioxide + ...

[2]

[Total: 2]

34 The concentration of ethanoic acid can be determined by titration using the apparatus shown below.



(a) State the name of the piece of glassware labelled **A**.

..... [1]

(b) Liquid **B** is an alkali.

Which **one** of the following compounds is also an alkali?
Put a ring around the correct answer.

calcium carbonate

calcium sulfate

sodium chloride

sodium hydroxide

[1]

(c) Describe how you would carry out this titration.

.....

.....

.....

..... [2]

[Total: 4]

35 Which reaction will result in a decrease in pH?

A adding calcium hydroxide to acid soil

B adding citric acid to sodium hydrogencarbonate solution

C adding sodium chloride to silver nitrate solution

D adding sodium hydroxide to hydrochloric acid

[1]

[Total: 1]

36 Ethanoic acid is a weak acid and hydrochloric acid is a strong acid.
Both ethanoic acid and hydrochloric acid dissociate in aqueous solution.

(a) Define the term *acid*.

..... [1]

(b) The chemical equation shows the changes which occur when the strong acid, hydrochloric acid, is added to water.

$$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$$

Complete the chemical equation to show the changes which occur when the weak acid, ethanoic acid, is added to water.

$CH_3COOH(aq)$ ..... [2]

[Total: 3]

37 Phosphine, PH_3, has a similar chemical structure to ammonia, NH_3.

Ammonia acts as a base when it reacts with sulfuric acid.

(a) What is meant by the term *base*?

..... [1]

(b) Write a chemical equation for the reaction between ammonia and sulfuric acid.

..... [2]

[Total: 3]

38 Titanium is extracted from an ore called rutile. Rutile is an impure form of titanium(IV) oxide, TiO_2.

Rutile is mixed with coke and heated in a furnace through which chlorine gas is passed. The product is gaseous titanium(IV) chloride, $TiCl_4$.

Titanium(IV) chloride, $TiCl_4$, is heated with an excess of magnesium, in an atmosphere of argon.

After titanium(IV) chloride is heated with magnesium, the unreacted magnesium is removed by adding an excess of dilute hydrochloric acid to the mixture.

The dilute hydrochloric acid also dissolves the magnesium chloride.
The dilute hydrochloric acid does **not** react with the titanium or dissolve it.

(a) Give **two** observations and write a chemical equation for the reaction that occurs when dilute hydrochloric acid reacts with magnesium.

1 .....

2 .....

chemical equation ..... [3]

(b) Name the process that is used to separate the titanium from the mixture after all the magnesium has been removed.

..... [1]

(c) Titanium does not react with the dilute hydrochloric acid or dissolve in it.

Suggest why titanium does **not** react with dilute hydrochloric acid.

..... [1]

[Total: 5]

39 Ethanoic acid, CH_3COOH, is a weak acid.

(a) What is meant by the term *acid*?

.....

..... [1]

(b) Why is ethanoic acid described as *weak*?

.....

..... [1]

[Total: 2]

40 How would you show that an aqueous solution of ethanoic acid, CH_3COOH, is an acid **without** using an indicator or measuring the pH?

State the reagent you would use and give the expected observations.
Write a chemical equation for the reaction that you describe.

reagent .....

expected observations .....

.....

chemical equation ..... [3]

[Total: 3]