

The Characteristic Properties of Acids and Bases

Question Paper

Level	O Level
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	The Chemistry and Uses of Acids, Bases And Salts
Sub-Topic	The characteristic Properties of Acids and Bases
Booklet	Question Paper

Time Allowed: 56 minutes

Score: /47

Percentage: /100

1 Which oxide is amphoteric?

- A** Al_2O_3 **B** CO_2 **C** Na_2O **D** SO_2

2 The pH of an aqueous solution of hydrochloric acid is 2.

What will be the pH of the acid after the addition of 10 g of sodium chloride?

- A** 1 **B** 2 **C** 7 **D** 9

3 Which row correctly describes the oxides?

	Al_2O_3	K_2O	MgO	SO_2
A	basic	acidic	acidic	amphoteric
B	acidic	basic	amphoteric	acidic
C	amphoteric	basic	amphoteric	acidic
D	amphoteric	basic	basic	acidic

4 Which pair of substances reacts to form a salt and water only?

- A** aqueous sodium chloride and aqueous silver nitrate
B aqueous sodium hydroxide and dilute ethanoic acid
C aqueous sodium carbonate and dilute sulfuric acid
D zinc and dilute hydrochloric acid

5 Which reaction does **not** involve neutralisation?

- A** $H_2SO_4(aq) + 2NH_3(aq) \rightarrow (NH_4)_2SO_4(aq)$
B $H_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2HCl(aq)$
C $H_2SO_4(aq) + CuO(s) \rightarrow CuSO_4(aq) + H_2O(l)$
D $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

6 Which solution containing one mole per dm^3 of the compound would have the lowest pH?

- A ethanoic acid
- B hydrochloric acid
- C sodium chloride
- D sodium hydrogencarbonate

7 Which statement about oxides is correct?

- A A basic oxide is an oxide of a non-metal.
- B Acidic oxides contain ionic bonds.
- C An amphoteric oxide contains a metal.
- D Basic oxides are always gases.

8 Which statement about amphoteric oxides is **not** correct?

- A They dissolve in water.
- B They are formed only by metals.
- C They react with aqueous sodium hydroxide to give salts.
- D They react with aqueous acids to give salts.

9 The sentence describes two metals and their oxides.

Metal X could be copper because its oxide is1..... and metal Y could be2..... because its oxide is amphoteric.

Which words correctly complete gaps 1 and 2?

	1	2
A	acidic	aluminium
B	basic	aluminium
C	acidic	magnesium
D	basic	magnesium

10 When the product of a reaction between two gases is added to water, a solution of pH7 is formed.

Which could be these gases?

- A hydrogen and chlorine
- B hydrogen and nitrogen
- C hydrogen and oxygen
- D oxygen and carbon monoxide

11 A sample of air was bubbled into water. The pH of the water slowly changed from 7 to 6.

Which gas in the sample caused this change?

- A carbon dioxide
- B carbon monoxide
- C nitrogen
- D oxygen

12 Which reaction occurring in the blast furnace is an acid base reaction?

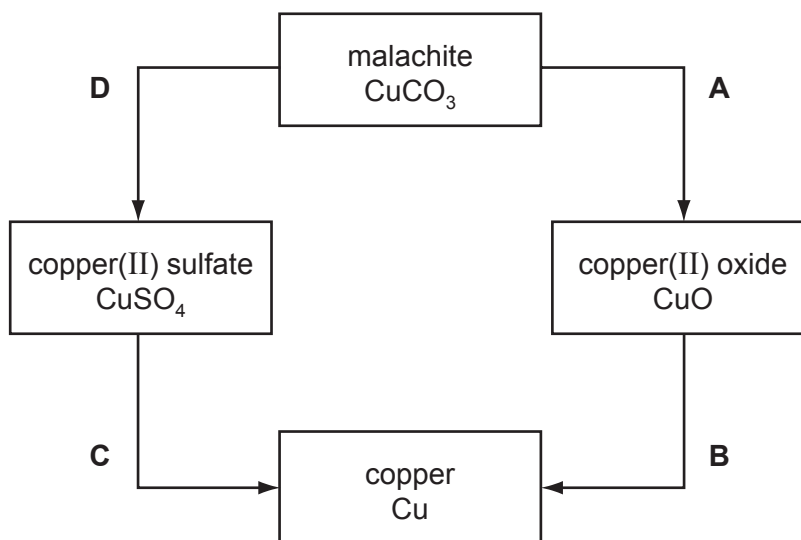
- A $C + CO_2 \rightarrow 2CO$
- B $C + O_2 \rightarrow CO_2$
- C $CaO + SiO_2 \rightarrow CaSiO_3$
- D $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

13 What is a property of the hydroxide, OH^- , ion?

- A It combines with hydrogen to form water.
- B It is present in water.
- C It readily breaks down into hydrogen ions and oxide ions.
- D It travels to the cathode in electrolysis of an aqueous solution.

14 The diagram shows some reactions of copper compounds.

Which change is made by adding an acid?



15 Which calcium compound does **not** increase the pH of acidic soils?

- A calcium carbonate
- B calcium hydroxide
- C calcium oxide
- D calcium sulfate

16 An excess of calcium hydroxide is added to an acidic soil.

What happens to the pH of the soil?

	change in pH	final pH
A	decrease	5
B	decrease	7
C	increase	7
D	increase	10

17 Which substances react together to give hydrogen?

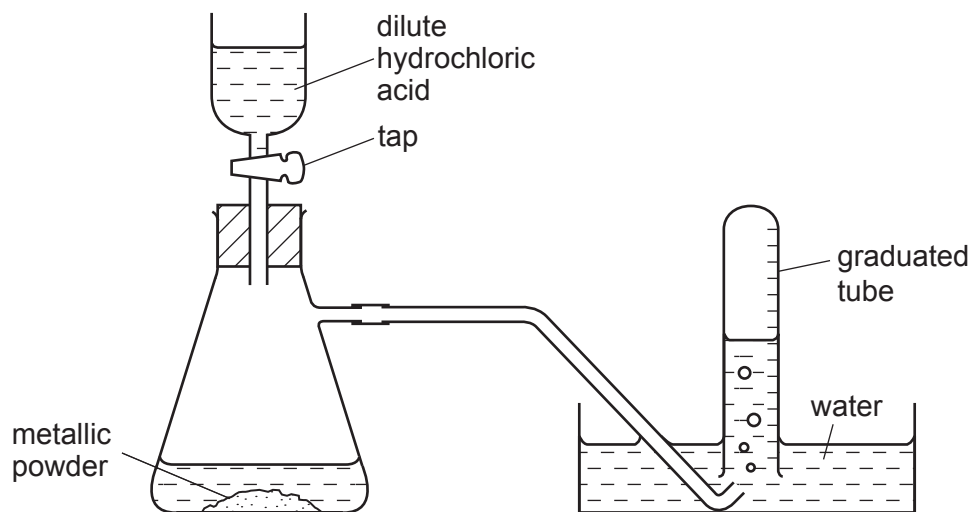
- A** calcium oxide and water
- B** copper and dilute sulfuric acid
- C** copper and steam
- D** magnesium and steam

18 An alloy of copper and zinc is added to an excess of dilute hydrochloric acid.

Which observations are correct?

	residue	filtrate
A	grey	blue solution
B	none	blue solution
C	none	colourless solution
D	red-brown	colourless solution

- 19 The diagram shows apparatus for measuring the volume of hydrogen given off when an excess of dilute hydrochloric acid is added to powdered metal. The volume of gas is measured at room temperature and pressure.



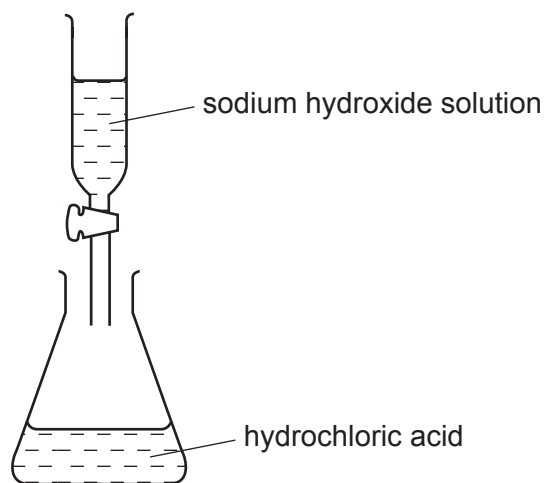
The experiment is carried out three times, using the same mass of powder each time but with different powders:

- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume?

	greatest volume of H ₂	least volume of H ₂
A	magnesium	zinc
B	magnesium	the mixture
C	zinc	magnesium
D	zinc	the mixture

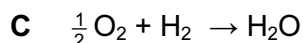
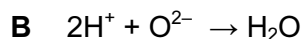
- 20 Sodium hydroxide solution was added to dilute hydrochloric acid. The pH of the solution in the flask was measured at intervals until no further change of pH took place.



What would be the pH change in this reaction?

- A decrease to 1
 - B decrease to 7
 - C increase to 7
 - D increase to 12
- 21 Which mixture would react with dilute sulfuric acid to form two **different** gases?
- A copper and magnesium carbonate
 - B copper(II) carbonate and magnesium
 - C copper(II) carbonate and magnesium oxide
 - D copper(II) oxide and magnesium
- 22 Which compound in a 1 mol/dm^3 solution has the lowest pH value?
- A ethanoic acid
 - B hydrogen chloride
 - C sodium chloride
 - D sodium hydroxide

23 Which equation represents the reaction between hydrochloric acid and sodium hydroxide?



24 The following statements about dilute sulphuric acid are all correct.

- 1 A white precipitate is formed when aqueous barium chloride is added.
- 2 The solution turns anhydrous copper(II) sulphate from white to blue.
- 3 Addition of Universal Indicator shows that the solution has a pH value of less than 7.0.
- 4 The solution reacts with copper(II) oxide, forming a blue solution.

Which two statements confirm the acidic nature of the solution?

- A** 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

25 Which element will burn in oxygen to form an acidic oxide?

- A** calcium
B carbon
C iron
D magnesium

26 Different solids were added to separate portions of warm dilute sulphuric acid.

For which solid is the observation correct?

	solid	observation
A	ammonium sulphate	alkaline gas produced
B	copper	gas evolved ignited with a pop
C	magnesium oxide	solid dissolved with no effervescence
D	zinc carbonate	gas evolved relights glowing splint

- 27 One mole of compound **X** gives three moles of ions in aqueous solution. **X** reacts with ammonium carbonate to give an acidic gas.

What is compound **X**?

- A** calcium hydroxide
 - B** ethanoic acid
 - C** sodium hydroxide
 - D** sulphuric acid
- 28 Why is ethanoic acid described as a weak acid?
- A** It is only slightly ionised in water.
 - B** It is a poor conductor of electricity.
 - C** It is an organic acid.
 - D** It reacts only with very reactive metals.
- 29 Which pair of substances produce a precipitate when their aqueous solutions are mixed?
- A** barium nitrate, silver nitrate
 - B** sodium chloride, barium nitrate
 - C** sodium nitrate, barium chloride
 - D** sodium sulphate, barium chloride

- 30 Sodium, aluminium and sulphur are in the same period of the Periodic Table.

Which trend in types of oxide occurs across this period?

	left	—————>	right
A	acidic	amphoteric	basic
B	amphoteric	basic	acidic
C	basic	acidic	amphoteric
D	basic	amphoteric	acidic

- 31 Substance **X** conducts electricity when in the solid state. **X** reacts with hydrochloric acid.
- Which substance could **X** be?
- A copper(II) oxide
 - B silicon(IV) oxide
 - C sodium chloride
 - D zinc
- 32 Which of the following is a reaction of dilute sodium hydroxide?
- A It reacts with ammonium chloride to produce ammonia.
 - B It reacts with calcium carbonate to produce carbon dioxide.
 - C It reacts with copper(II) oxide to produce water.
 - D It reacts with Universal Indicator solution turning it red.
- 33 Which substance does **not** produce copper(II) sulphate when added to dilute sulphuric acid?
- A copper
 - B copper(II) carbonate
 - C copper(II) hydroxide
 - D copper(II) oxide
- 34 Which ionic equation represents the neutralisation of aqueous sodium hydroxide with dilute nitric acid?
- A $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
 - B $\text{Na}^+ + \text{NO}_3^- \rightarrow \text{NaNO}_3$
 - C $\text{Na}^+ + \text{HNO}_3 \rightarrow \text{NaNO}_3 + \text{H}^+$
 - D $\text{NaOH} + \text{H}^+ \rightarrow \text{Na}^+ + \text{H}_2\text{O}$

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- 35 The diagram shows the colours of the indicators, methyl orange and methyl red, at different pH values.

pH	2	3	4	5	6
colour of methyl orange	red		yellow		
colour of methyl red	red				yellow

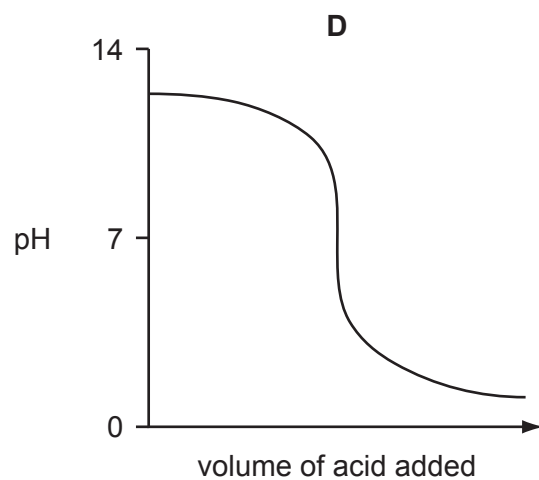
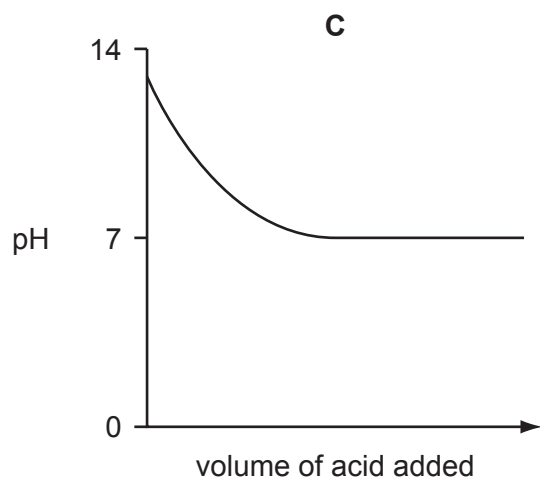
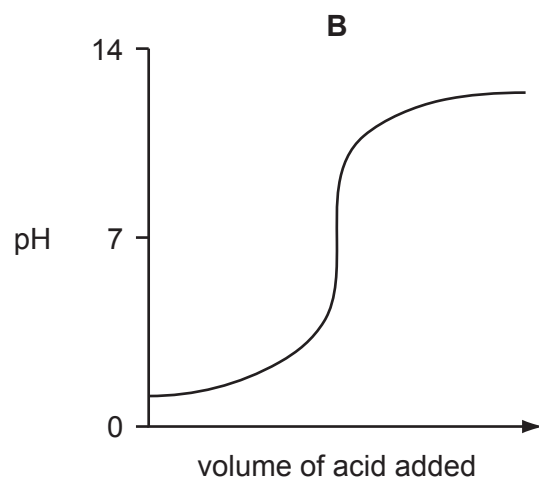
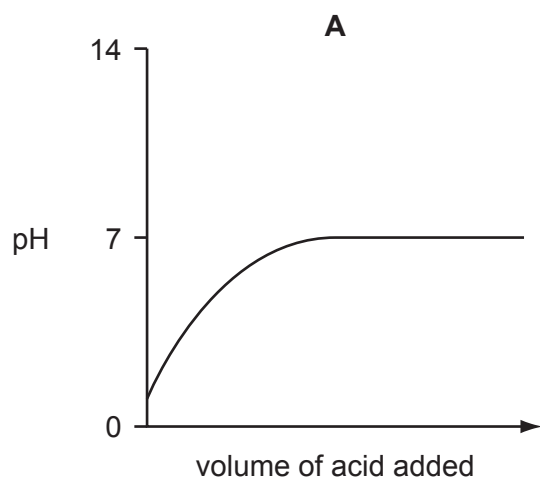
The table shows the pH of four solutions.

solution	W	X	Y	Z
pH	2	3	5	6

In which solutions will both indicators be yellow?

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

36 Which graph shows the changes in pH as an excess of hydrochloric acid is added to aqueous sodium hydroxide?



37 Which statement does **not** describe a property of a weak acid in solution?

- A** It forms a salt with sodium hydroxide.
- B** It has a pH of between 8 and 9.
- C** It is only partly dissociated into ions.
- D** It reacts with sodium carbonate to give off carbon dioxide.

- 38 Which products are formed when dilute hydrochloric acid reacts with the substances shown in the table?

	substance	products
A	iron	iron(II) chloride + hydrogen only
B	iron(II) carbonate	iron(II) chloride + carbon dioxide gas only
C	iron(II) oxide	iron(II) chloride + oxygen gas only
D	iron(II) sulphate	iron(II) chloride + sulphur dioxide only

- 39 Which process does **not** result in the formation of **both** carbon dioxide and water?

- A** addition of a dilute acid to a carbonate
- B** burning ethanol
- C** burning methane
- D** heating crystals of hydrated sodium carbonate

- 40 The table gives information about three indicators.

indicator	colour change		pH at which colour change takes place
	low pH	high pH	
methyl orange	red	yellow	4.0
bromothymol blue	yellow	blue	6.5
phenolphthalein	colourless	pink	9.0

If equal volumes of these three indicators were mixed, which colour would be observed at pH 5?

- A** blue
- B** green
- C** orange
- D** yellow

41 The table gives information about three indicators.

indicator	colour at pH 1	pH at which colour changes	colour at pH 12
thymol blue	red	3	yellow
congo red	blue	5	red
phenolphthalein	colourless	10	red

Which colours would be obtained when each indicator was added separately to pure water?

	thymol blue	congo red	phenolphthalein
A	red	blue	red
B	yellow	blue	colourless
C	yellow	blue	red
D	yellow	red	colourless

42 From which reaction is a gas produced?

- A** adding calcium to water
- B** adding dilute hydrochloric acid to silver
- C** adding dilute sulphuric acid to copper
- D** electrolysis of aqueous copper(II) sulphate, using copper electrodes

43 The following equations represent reactions of dilute sulphuric acid.

Which reaction is not 'typical' of a dilute acid?

- A** $2\text{KOH}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{K}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
- B** $\text{CuO}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- C** $\text{Pb}(\text{NO}_3)_2(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{PbSO}_4(\text{s}) + 2\text{HNO}_3(\text{aq})$
- D** $\text{ZnCO}_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

44 A black powder is burned in air.

The gas produced dissolves in water to form solution **R**. The pH of **R** is close to 7.

The gas is readily absorbed in aqueous sodium hydroxide.

What type of substance is present in solution **R**?

- A** strong acid
- B** strong base
- C** weak acid
- D** weak base

45 Which reaction will **not** occur using cold, dilute sulphuric acid?

- A** formation of copper(II) sulphate from copper(II) oxide
- B** formation of copper(II) sulphate from copper
- C** formation of hydrogen from magnesium metal
- D** formation of carbon dioxide from sodium carbonate

46 The pH of an aqueous solution of hydrochloric acid is 2.

What will be the pH of the acid after the addition of 10 g of sodium chloride?

- A** 1
- B** 2
- C** 7
- D** 9

47 Aluminium sulphate is used in water treatment. Aqueous aluminium sulphate is acidic.

The table shows the results of tests on four different samples of treated water.

To which sample had an excess of aluminium sulphate been added?

sample	pH of sample	reaction with an excess of aqueous ammonia
A	3	white precipitate
B	3	no reaction
C	7	no reaction
D	11	white precipitate