1. Which of these is the best explanation of what is meant by a strong acid?

A There is a large amount of acid and a small amount of water.
B There is a small amount of acid and a large amount of water.
C The acid is completely ionised in solution in water.
D The acid is partially ionised in solution in water.

Your answer ☐

[1]

2. Explain why the reaction between magnesium and copper sulfate solution is also a reduction/oxidation reaction.

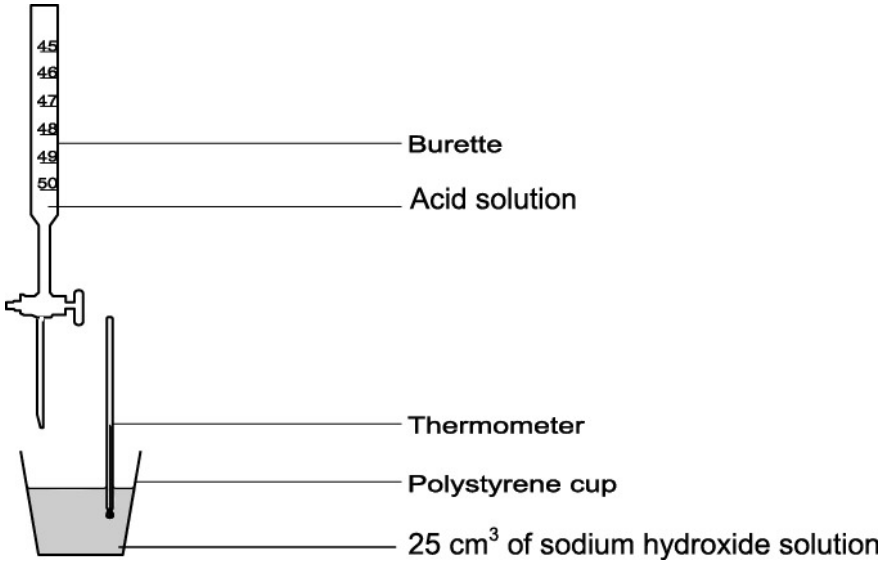
Use ideas about electrons in your answer.

---

[3]

3. A scientist investigates an acid solution.

Look at the diagram of the apparatus the scientist uses.



(i) The scientist adds universal indicator to the sodium hydroxide solution.

What colour is the universal indicator in the sodium hydroxide solution?

---

[1]

(ii) Universal indicator is a mixed indicator.

Name a single indicator.

---

[1]

4. This question is about chemical changes.

Four substances, **A**, **B**, **C** and **D** are added to four different test tubes of acid.

Look at the table. It shows the results of the experiments.

Substance	Observations	Temperature at start in °C	Temperature at end in °C
A	stays a white solid	19	19
B	colourless gas given off	23	18
C	solution stays colourless	19	24
D	stays a grey solid	18	18

Two of the substances react with acid to produce a **chemical change**.

Which two?

_____ and _____

Explain your answer.

---

[3]

5. David wants to make some potassium sulfate solution.

He decides to neutralise an acid with potassium hydroxide.

(i) Which **acid** should he use?

---

[1]

(ii) David wants to check that a solution of potassium sulfate is neutral.

Write about how he could do this.

---

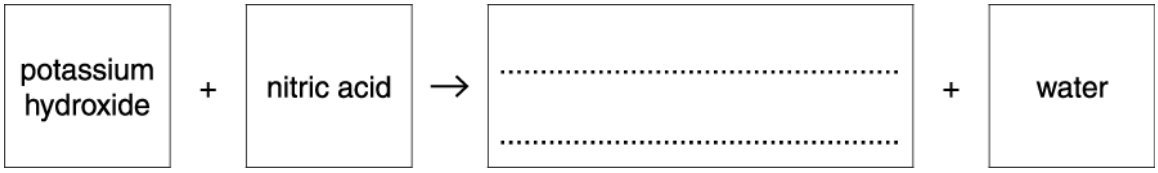
[2]

6(a). Alfie is a scientist. He investigates neutralisation.

He adds dilute nitric acid to potassium hydroxide solution.

He uses an indicator called **litmus** to tell when the solution is neutral.

Complete the word equation for the reaction



[1]

(b). Complete the table to show the colour of litmus in acidic and alkaline solutions.

Indicator	Colour in		
	Acidic solution	Neutral solution	Alkaline solution
Litmus	.....	purple	.....

[2]

7. Chris is a gardener.

He uses different compounds in his garden.

Look at the table. It shows information about some of these compounds

Compound	Formula	Solubility in water	Use
calcium hydroxide	$Ca(OH)_2$	slightly soluble	soil conditioner
glyphosate	$C_3H_8NO_5P$	highly soluble	weedkiller
ammonium phosphate	$(NH_4)_3PO_4$	highly soluble	fertiliser
sodium nitrate	$NaNO_3$	highly soluble	fertiliser

Which compound could Chris use to neutralise an acid soil?

Explain why.

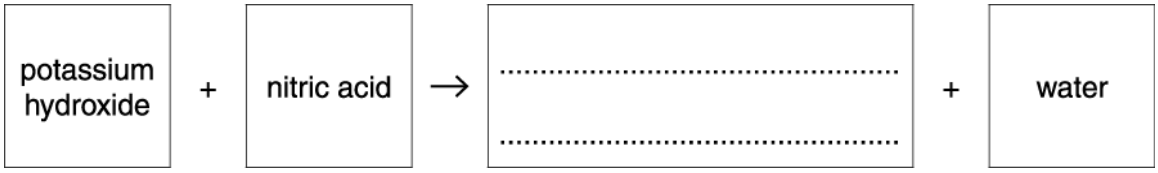
---

[2]

8(a). Alfie is a scientist. He investigates neutralisation.

He adds dilute nitric acid to potassium hydroxide solution.

Complete the word equation for the reaction.



[1]

(b). Alfie then reacts sulfuric acid, H_2SO_4, with sodium hydroxide solution, NaOH.

Sodium sulfate and water are made.

Write a **balanced symbol** equation for this reaction.

[2]

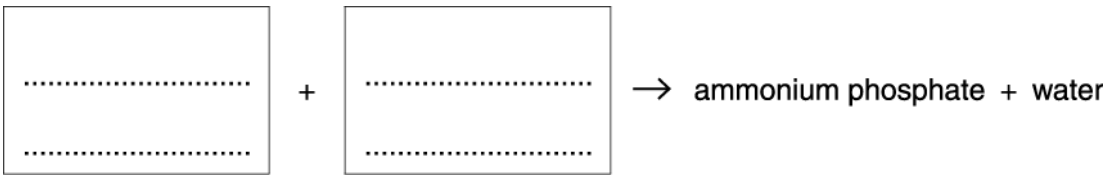
9. Ammonium phosphate is used as a fertiliser.

The formula for ammonium phosphate is

$(NH_4)_3PO_4$

Ammonium phosphate is made by **neutralisation**.

Complete the **word** equation with the chemicals needed to make ammonium phosphate.



[2]

10. Sarah is a farmer.

Look at the table.

It shows information about some of the chemicals Sarah uses while farming.

Chemical	Formula	Colour	State at room temperature	Solubility in water
Ammonia	NH_3	colourless	gas	soluble
Ammonium phosphate	$(NH_4)_3PO_4$	white	solid	soluble
Calcium carbonate	$CaCO_3$	white	solid	insoluble
Potassium sulfate	K_{2SO4}	white	solid	soluble

Sarah uses one of the **solid** chemicals to neutralise acid soils.

Which one?

---

[1]

11. Bromine will react with potassium iodide in a displacement reaction.

The ionic equation for this reaction is

$$Br_2 + 2I^- \rightarrow 2Br^- + I_2$$

The reaction involves both oxidation and reduction.

Explain why the reaction involves both oxidation and reduction.

---

[2]

12. Sarah neutralises dilute sulfuric acid with a base.

She uses sodium hydroxide solution as the base.

(i) Write the names of the **two** compounds made when dilute sulfuric acid is neutralised by sodium hydroxide solution.

_____ and _____ [2]

(ii) Dilute hydrochloric acid contains hydrogen ions.

Sodium hydroxide solution contains hydroxide ions, OH^-.

Construct the **ionic** equation to show the reaction of hydrogen ions with hydroxide ions.

_____ [2]

13. Sarah tests dilute sulfuric acid.

She wants to find the pH of the acid.

She does **not** have a pH meter.

Describe how she can find the pH of dilute sulfuric acid.

---

[2]

14. Ethanoic acid is a **weak** acid.

What is the pH of ethanoic acid?

A 1

B 5

C 7

D 12

Your answer ☐ **[1]**

15.

Sodium hydroxide reacts with hydrochloric acid.

Sodium chloride and water are made.

Write a **word** equation for this reaction.

---

[1]

16(a) A student reacts an acid with a metal carbonate.

.

The student uses universal indicator in his experiment.

Why did the student use universal indicator?

---

[1]

(b). An acid has a pH of 3. The hydrogen ion concentration of the acid is 1×10^{-3} mol / dm^3.

A different acid has a pH of 1.

What is the hydrogen ion concentration of this acid?

Answer = ---------- (mol / dm^3) **[1]**

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			C	1	
			Total	**1**	
2			Mg loses electrons/Cu gains electrons (1) Mg is oxidised (1) Cu ions are reduced(1)	3	**ALLOW** oxidation is loss of electrons and reduction is gain of electrons (1)
			Total	**3**	
3		i	Blue/indigo/violet/purple (1)	1	
		ii	Litmus / phenolphthalein / methyl orange (1)	1	
			Total	**2**	
4			B **and** C (1) (because) a new substance is made in B / a gas is given off in B / there is a temperature change in B / fall in temperature in B (1) an energy change takes place in C / there is a temperature change in C / rise in temperature in C (1)	3	**both required for mark** explanation marks are dependent on correct identification of B and C **allow** ora e.g. A is not a chemical change as there is no new substance made or no temperature or energy change **AND** D is not a chemical change as there is no new substance made or no temperature or energy change **scores 2 marks** If B **and** C correctly identified (1), **allow** both have a temperature change (2) **Examiner's Comments** This question was about chemical changes. Most candidates correctly identified B and C, but a significant proportion failed to gain full marks for this question because their explanation lacked clarity.
			Total	**3**	
5		i	sulfuric acid / H2SO4 (1)	1	**allow** hydrogen sulfate

Question			Answer/Indicative content	Marks	Guidance
		ii	add universal indicator / pH paper (1) if colour goes green it is neutral / match colour with neutral colour (1)	2	**allow** add (red and blue) litmus (1) the litmus does not change colour (1) **allow** use a pH meter (1) and it should be pH 7 (1) **allow** check the pH see if it is 7 (1) **mark for colour change must link correctly to indicator used** **Examiner's Comments** Only about a fifth of candidates could identify the acid needed to make a sulfate. Few candidates knew how to test a solution to see if it was neutral.
			Total	3	
6	a		potassium nitrate (1)	1	**allow** potassium nitrate solution / potassium nitrate salt (1) **allow** KNO_3 (1) **Examiner's Comments** The word equation proved difficult with only a minority of candidates correctly giving the product as potassium nitrate.
	b		acidic - red (1) alkaline - blue (1)	2	**allow** pink **not** green **Examiner's Comments** About one third of candidates were able to give the correct colours for litmus in acid and alkaline solution, of the rest approximately half gave one of the colours correctly.
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
7			mark independently calcium hydroxide / $Ca(OH)_2$ (1) because it is an alkali or base (1)	2	 **ignore** it's a neutraliser / soil conditioner / it is soluble **Examiner's Comments** The majority of candidates identified calcium hydroxide but failed to give the correct reason. Most thought it was because calcium hydroxide was a soil conditioner not because it was an alkali. Few candidates identified calcium hydroxide as not containing any essential elements most candidates thought it was glycophosphate. Even less candidates understood that ammonium phosphate had more essential elements. Instead they thought it was due to there being more atoms or elements.
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
8	a		potassium nitrate (1)	1	**allow** potassium nitrate solution / potassium nitrate salt (1) **allow** KNO_3 (1) **Examiner's Comments** This question was answered correctly by the majority of candidates. The correct answer was potassium nitrate, however, salt and nitric oxide were also offered.
	b		2NaOH + H_2SO_4 ? Na2SO4 + 2H_2O formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae **but** **allow** one mark for balanced equation with minor errors of subscripts, superscripts, etc. e.g. 2NAOH + H_2SO_4 ? Na_2So_4 + 2H_2O **not** and or & for + **allow** = instead of ? **allow** correct multiples eg 4NaOH + 2H_2SO_4 ? 2Na_2SO_4 + 4H_2O **Examiner's Comments** Candidates could not recall the formula of sodium sulfate and as a result could not write a balanced equation. Many of the equations presented were not balanced and had unusual formulae for sodium sulfate e.g. NaS and NaSO4.
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
9			ammonia / ammonium hydroxide (1) phosphoric acid (1)	2	order unimportant **allow** NH_3 / NH_4OH (1) **allow** ammonium hydrogencarbonate or ammonium carbonate (1) **not** ammonium **not** ammonia hydroxide or ammonia carbonate or ammonia hydrogencarbonate **allow** H_3PO_4 (1) **not** phosphorus acid Examiner's Comments Few candidates scored both marks on this question. Ammonia was the most common correct answer. Weaker candidates confused this with the Haber process for ammonia production and gave nitrogen and hydrogen. Phosphorus was a common incorrect answer.
			Total	2	
10			calcium carbonate / $CaCO_3$ (1)	1	Examiner's Comments Although some candidates gave calcium carbonate, a significant proportion of candidates gave potassium sulfate instead.
			Total	1	

Question			Answer/Indicative content	Marks	Guidance
11			bromine is reduced since it gains electrons (1) iodide is oxidised since it loses electrons (1)	2	**allow** Br_2 / Br is reduced since it gains electrons **ignore** bromide / Br^- **allow** I^- is oxidised since it loses electrons **ignore** iodine / I / I_2 **ignore** potassium if no other mark scored then **allow** one mark for oxidation is loss of electrons / reduction is gain of electrons / if oxidation and reduction are not mentioned **allow** electrons are both lost and gained (1)
			Total	2	
12		i	sodium sulfate / sodium hydrogensulfate (1) water (1)	2	**allow** Na_2SO_4 / $NaHSO_4$ (1) **allow** H_2O (1)
		ii	$H^+ + OH^- \rightarrow H_2O$ (2) reactants correct (1) product correct (1)	2	**allow** OH_2 for water (1) **allow** $\rightleftharpoons$ instead of $\rightarrow$ **allow** any correct multiples
			Total	4	
13			use **universal** indicator (1) **match** colour with a pH / chart (1)	2	**allow** pH paper **ignore** pH meter / pH probe / pH scale **not** litmus paper / single phase indicator / incorrect reagents **allow** correct link between a colour and a pH value e.g. if green pH is 7 (1) **ignore** just 'look for colour' / just match colour **allow** this mark if no indicator is named **but do not** award this mark if the name of the indicator is incorrect
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
14			B ✓	1 (AO1.1)	ALLOW 5 Examiner's Comments Many candidates knew the answer was pH 5, but some selected pH 1. A number of candidates wrote the pH number in the box rather than A, B, C or D.
			Total	1	
15			Hydrochloric acid + sodium hydroxide → sodium chloride + water ✓	1 (AO2.1)	ALLOW = for → DO NOT ALLOW and, or, & for + ALLOW mix of correct formulae and words eg HCl + NaOH → NaCl + H2O equation does not need to be balanced Reactants can be in either order, products can be in either order Examiner's Comments Most candidates constructed a creditworthy equation but some could not copy the names of the chemicals from the stem of the question accurately. Some candidates used different chemicals to those shown in the questions. Some attempted a symbol equation but this rarely gained credit, even though it did not have to be balanced.
			Total	1	

Question			Answer/Indicative content	Marks	Guidance
16	a		To measure pH / to tell when the acid is neutralised ✓	1 (AO 1.2)	ALLOW to see if it is acid or alkaline Examiner's Comments Most candidates could give the purpose of using universal indicator to determine the pH of the reaction.
	b		1×10^{-1} / 0.1 (mol / dm^3) ✓	1 (AO 2.2)	Examiner's Comments Over half the candidates could calculate the concentration of hydrogen ions and give this value in standard form. Few candidates actually gave their working in the space provided. They were not asked to show workings but good practice would suggest this should be done for all calculations.
			Total	2	