National 5 Chemistry
Unit 1.4a pH

		Lesson	Traffic Light		
			Red	Amber	Green
53	The pH scale is a continuous range of numbers: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 ← Acidic solutions → neutral ← Alkaline solutions → • the pH scale runs from 0 to 14 • it is possible to get pH values below 0 and above 14		☹	😐	☺
55 56	Water is neutral as it dissociates according to the equation: $H_2O_{(l)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$ • dissociation produces equal concentrations of hydrogen H^+ ions & hydroxide OH^- ions. • At any time, only a few water molecules are dissociated into free ions. • The symbol $\rightleftharpoons$ indicates that a reaction is reversible and occurs in both directions.		☹	😐	☺
54 57 58	The acidity, alkalinity and neutral nature of a solution depends on H^+ and OH^- ions. • a <u>neutral</u> solution has equal concentrations of $H^+_{(aq)}$ and $OH^-_{(aq)}$ ions. • <u>acidic</u> solutions have a higher concentration of $H^+_{(aq)}$ ions than $OH^-_{(aq)}$ and have a pH below 7. • <u>alkaline</u> solutions have a higher concentration of $OH^-_{(aq)}$ ions than $H^+_{(aq)}$ ions and have a pH above 7.		☹	😐	☺
59 60	The pH of a acidic/alkaline solution heads towards pH=7 when diluted with water: • dilution of an acidic solution with water will decrease the concentration of $H^+_{(aq)}$ and the pH will increase towards 7. • dilution of an alkaline solution with water will decrease the concentration of $OH^-_{(aq)}$ and the pH will decrease towards 7.		☹	😐	☺
61	Soluble *non-metal* oxides dissolve in water forming acidic solutions e.g. CO_2, NO_2 and SO_2		☹	😐	☺
62	Soluble *metal* oxides dissolve in water to form alkaline solutions: metal oxide + water → metal hydroxide		☹	😐	☺
63	Metal oxides, metal hydroxides, metal carbonates & ammonia neutralise acids and are called bases. • only bases that dissolve in water form alkaline solutions • all bases neutralise acids and form water.		☹	😐	☺

National 5 Chemistry
Unit 1.4b Neutralisation Reactions

JAB chem

JAB chem

Lesson | Traffic Light: Red | Amber | Green

64

A neutralisation reaction is one in which a base reacts with an acid to form water.

- A salt is also formed in this reaction.

65a

Hydrogen ions in acids react with oxide ions in metal oxides to form water

acid + metal oxide ⟶ salt + water

65b

Hydrogen ions in acids react with hydroxide ions in alkalis to form water.

acid + metal hydroxide (alkali) ⟶ salt + water

65c

H^+ ions in acids react with carbonate ions in metal carbonates to form water and carbon dioxide.

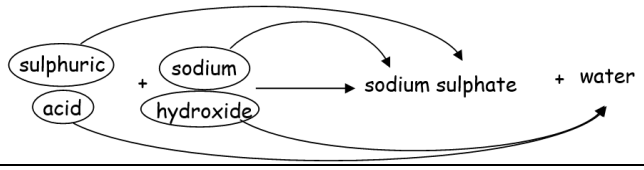
acid + metal carbonate ⟶ salt + water + carbon dioxide

66

Salts are formed in the reaction of acids with bases.

- *acids* supply the 2nd name of the salt:

Name of Acid	Hydrochloric acid	Sulphuric Acid	Nitric Acid
2nd Name of Salt	Chloride	Sulphate	Nitrate



67

Spectator ions can be identified and the equations can be rewritten omitting these ions:

sodium hydroxide + sulphuric acid → sodium sulphate + Water

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

Rewrite to include all ions separately

$2Na^+ + 2OH^- + 2H^+ + SO_4^{2-} \rightarrow 2Na^+ + SO_4^{2-} + 2H_2O$

Cancel out any spectator ions which appear on both sides

~~$2Na^+$~~ + $2OH^-$ + $2H^+$ + ~~SO_4^{2-}~~ → ~~$2Na^+$~~ + ~~SO_4^{2-}~~ + $2H_2O$

Re-write equation omitting spectator ions

$2OH^- + 2H^+ \rightarrow 2H_2O$

68

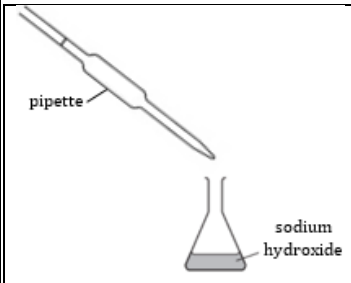
For neutralisation reactions, equations can be written omitting spectator ions:

For metal oxides	$2H^+_{(aq)} + O^{2-}_{(aq)} \longrightarrow H_2O_{(l)}$
for metal hydroxides	$H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$
for aqueous metal carbonates	$2H^+_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow H_2O_{(l)} + CO_{2(g)}$
for insoluble metal carbonates	$2H^+_{(aq)} + CO_3^{2-}{}_{(s)} \longrightarrow H_2O_{(l)} + CO_{2(g)}$

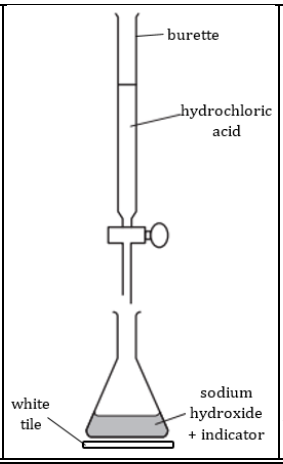
69

In an acid-base titration, the concentration of the acid or base is determined by accurately measuring the volumes used in the neutralisation reaction.

- an indicator can be added to show the end-point of the reaction.



Pipettes are used to transfer exact quantities of solutions. The line towards the top of the pipette shows where the solution should be taken up to using a pipette filler for safety.

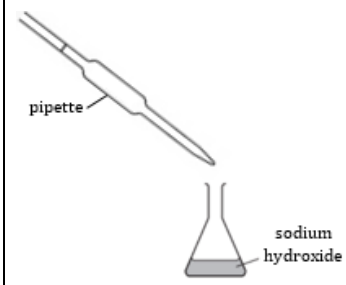
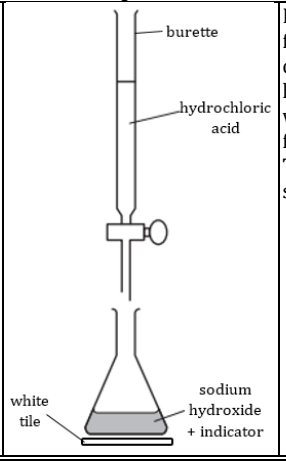
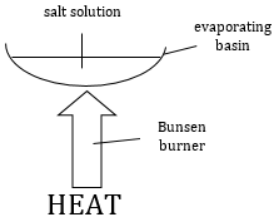
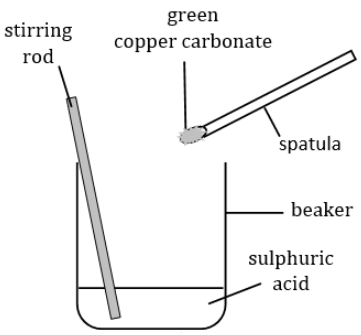
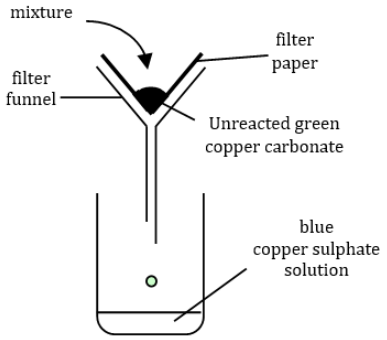
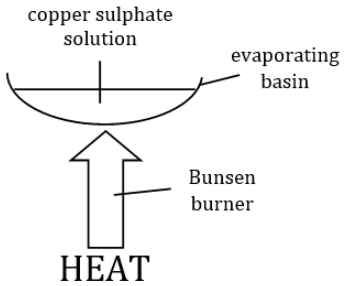


The burette is filled with hydrochloric acid of a known concentration and the volume of the hydrochloric acid in the burette is recorded (at the bottom of the meniscus). Hydrochloric acid is added from the burette into the flask until the colour in the flask changes. The final volume is recorded.

- The first titration is done in a way to work out the rough volume where the colour change takes place.
- Subsequent titrations involve the initial transfer of most of the volume from the rough titration is added initially then hydrochloric acid is added drop by drop until the colour changes
- The titration is repeated until at least two results are obtained within 0.2cm³ of each other (concordant)

The average volume is taken and then used to work out the number of moles of hydrochloric acid from the average volume and the already known concentration

70	Given a balanced equation for the reaction occurring in any titration: • the concentration of one reactant can be calculated given the concentration of the other reactant and the volumes of both solutions e.g. A 50·0 cm^3 sample of contaminated water containing chromate ions was titrated and found to require 27·4 cm^3 of 0·0200 mol l^{-1} iron(II) sulphate solution to reach the end-point. Calculate the chromate ion concentration, in mol l^{-1}, present in the sample of water. no of mol Fe^{2+} = volume x concentration = 0.0274 x 0.02 = $5.48x10^{-4}$ mol $3Fe^{2+} + CrO_4^{2-} + 8H^+ \longrightarrow 3Fe^{3+} + Cr^{3+} + 4H_2O$ 3mol $5.48x10^{-4}$mol; 1mol $1.83x10^{-4}$mol **c**oncentration = $\frac{\textbf{n}\text{o of mol}}{\textbf{v}\text{olume}} = \frac{1.83x10^{-4}\text{ mol}}{0.05\text{ litres}} = 3.65x10^{-3}\text{ mol l}^{-1}$		☹	😐	☺

		Lesson	Traffic Light		
	National 5 Chemistry **Unit 1.4c Preparation of Salts by Neutralisation**		Red	Amber	Green
74	Titration can be used to produce a soluble salt. Once the volumes of acid and alkali have been noted, the reaction can be repeated without the indicator to produce an uncontaminated salt solution. The solution can then be evaporated to dryness.  A pipette and pipette filler is used to transfer an exact quantity of sodium hydroxide to a conical flask.  Hydrochloric acid is transferred from a burette to the conical flask until the exact moment where the colour of the indicator changes. Have recorded both the starting and final volumes of hydrochloric acid, the titration can be repeated exactly without indicator to obtain a pure sample of the salt solution formed. The salt solution can then be evaporated to obtained a pure sample of the salt being produced. 		☹	😐	☺
75 76	Insoluble metal carbonates and insoluble metal oxides can be used to produce soluble salts. • excess base is added to the appropriate acid, the mixture is filtered and the filtrate evaporated to dryness. 1. <u>Neutralisation</u>  ○ Insoluble metal carbonate (or metal oxide) is used to neutralise the acid. ○ When all acid has been neutralised, some excess carbonate or oxide will lie on the bottom of the beaker 2. <u>Filtration</u>  ○ Excess metal carbonate (or metal oxide) is removed from the solution by filtration ○ The *residue* in the filter paper is unreacted metal carbonate (or metal oxide) ○ The filtrate in beaker is the solution of salt you are making 3. <u>Evaporation</u>  ○ The salt solution can be returned to the solid salt by evaporating the water		☹	😐	☺

Nat5
Traffic Lights

Past Paper Question Bank
Unit 1.4a pH

JABchem

Outcome	Original Specimen Paper	New Specimen Paper	Nat5 2014	Nat5 2015	Nat5 2016	Nat5 2017	Nat5 2018	Nat5 2019								
53		L6b					L13b									
55 56							L10a(ii)									
54 57 58	mc7 L3a	mc7 L4a	mc5	L4b	L5d		mc8									
59 60							mc9	mc11								
61				mc10	mc8	L11a										
62			mc6	mc10												
63				mc11		mc5		mc12								
64																
65a				L4c												
65b			L7c(i)													
65c	L4a(ii)	L5a(ii)					L1a									
66							L10d	L2c L11b								
67		mc24	mc8	mc18		mc6		mc25								
68																
69																
70			L13b	L15b												
74																
75 76							mc25	L11c								
Marking Scheme	Back of Paper	Back of Paper	SQA Nat5 2014 Msch	SQA Nat5 2015 Msch	SQA Nat5 2016 Msch	SQA Nat5 2017 Msch	SQA Nat5 2018 Msch	SQA Nat5 2019 Msch								

Nat5	Answer	% Correct	Reasoning
2014 5	C	75	☒A All aqueous solutions contain both hydrogen and hydroxide solutions ☒B All aqueous solutions contain both hydrogen and hydroxide solutions ☑C Acids contain more hydrogen ions than hydroxide ions ☒D Alkalis contain more hydroxide ions than hydrogen ions
2014 6	A	59	☑A calcium oxide is a soluble metal oxide which dissolves to form an alkali ☒B nickel oxide is a non-soluble metal oxide so has no effect on pH ☒C nitrogen dioxide is a soluble non-metal oxide and dissolves to form an acid ☒D sulphur dioxide is a soluble non-metal oxide and dissolves to form an acid
2014 8	A	88	Spectator ions appear chemically unchanged on both sides of a chemical equation: K^+ appears on both sides of equation $H^+_{(aq)} + NO_3^-{}_{(aq)} + K^+_{(aq)} + OH^-_{(aq)} \rightarrow K^+_{(aq)} + NO_3^-{}_{(aq)} + H_2O_{(l)}$ NO_3^- appears on both sides of equation
2015 10	B	59	☒A carbon dioxide is a non-metal oxide and forms an acid when added to water ☑B copper (II) oxide is insoluble in water and does not change the pH of water ☒C sodium oxide is a metal oxide and forms an alkali when added to water ☒D sulphur dioxide is a non-metal oxide and forms an acid when added to water
2015 11	B	46	☒A hydrochloric acid + sodium carbonate ⟶ sodium chloride + water + carbon dioxide ☑B sodium chloride does not react with acids as it is a salt not a base ☒C hydrochloric acid + sodium hydroxide ⟶ sodium chloride + water ☒D hydrochloric acid + sodium oxide ⟶ sodium chloride + water
2015 18	A	38	Spectator ions appear chemically unchanged on both sides of a chemical equation: Na^+ appears on both sides of equation $2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)} + Ba^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow BaSO_{4(s)} + 2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)}$ SO_4^{2-} appears on both sides of equation
2016 8	C	63	☒A tin is metal, tin oxide is insoluble ∴ no effect on pH ☒B zinc is a metal, zinc oxide is insoluble ∴no effect on pH ☑C sulphur is a non-metal, sulphur dioxide is a soluble non-metal oxide ∴pH<7 (acid) ☒D sodium is a metal, sodium oxide is a soluble metal oxide ∴pH >7 (alkali)
2017 5	A	58	A base is a chemical which neutralises an acid to form water e.g. metal hydroxides (alkalis), metal oxides and metal carbonates are bases
2017 6	B	72	Spectator ions appear chemically unchanged on both sides of a chemical equation: K^+ appears on both sides of equation $Ag^+_{(aq)} + NO_3^-{}_{(aq)} + K^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)} + K^+_{(aq)} + NO_3^-{}_{(aq)}$ NO_3^- appears on both sides of equation
2018 8	B	-	☒A An alkaline solution contains more OH^- ions than H^+ ions (still contains some H^+) ☑B An alkaline solution contains more OH^- ions than H^+ ions ☒C An acidic solution contains more H^+ ions than OH^- ions ☒D A neutral solution contains equal numbers of H^+ ions and OH^- ions

2018 9	C	-	☒A Diluting acids with water increases pH until it reaches pH=7 ☒B Diluting acids with water increases pH until it reaches pH=7 ☑C Diluting acids with water decreases the H^+ ion concentration as water is added ☒D Diluting acids with water decreases the H^+ ion concentration as water is added
2018 25	D	-	☒A Filtration (Step Z) must occur before evaporation (Step X) ☒B Neutralisaton Step Y must be first step ☒C Neutralisaton Step Y must be first step ☑D Order: Neutralisation (Y) followed by Filtration (Z) followed by Evaporation (X)
2019 11	D	-	☒A The pH of an alkaline solution will decrease to pH=7 on dilution ☒B The pH of an alkaline solution will decrease to pH=7 on dilution ☒C The concentration of OH^- ions decreases on dilution ☑D The concentration of OH^- ions decreases on dilution
2019 12	A	-	☑A sodium oxide is a metal oxide (a type of base) and neutralises an acid to form water ☒B calcium chloride does not react with acids and is not a base ☒C potassium nitrate does not react with acids and is not a base ☒D ammonium sulphate does not react with acids and is not a base
2019 25	B	-	$AgNO_3(aq) + NaBr(aq) \rightarrow NaNO_3(aq) + AgBr(s)$ Split solutions into ions $Ag(aq) + NO_3^-(aq) + Na^+(aq) + Br^-(aq) \rightarrow Na^+(aq) + NO_3^-(aq) + AgBr(s)$ Indentify Spectator Ions and cancel out Spectator Ions $Ag(aq) + \cancel{NO_3^-(aq)} + \cancel{Na^+(aq)} + Br^-(aq) \rightarrow \cancel{Na^+(aq)} + \cancel{NO_3^-(aq)} + AgBr(s)$ Re-write equation without spectator ions $Ag(aq) + Br^-(aq) \rightarrow AgBr(s)$

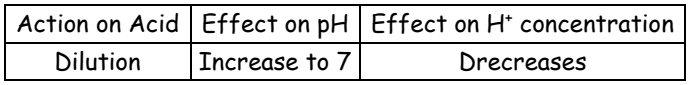
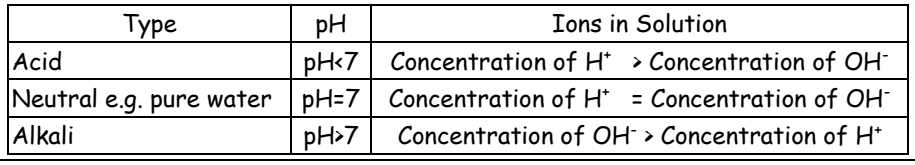
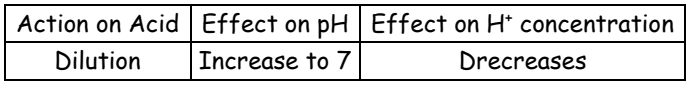
<table>
<tr><th>Nat5</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>2014
7c(i)</td><td>Neutralisation</td><td>Neutralisation: Acid + Alkali ⟶ Salt + Water</td></tr>
<tr><td>2015
4b</td><td>hydrogen
hydroxide</td><td>
<table>
<tr><td>Acids</td><td>Hydrogen ion concentration greater than hydroxide ion concentration</td></tr>
<tr><td>Neutral</td><td>Hydrogen ion concentration equal to hydroxide ion concentration</td></tr>
<tr><td>Alkali</td><td>Hydrogen ion concentration less than hydroxide ion concentration</td></tr>
</table>
</td></tr>
<tr><td>2015
4c</td><td>Answer to include:</td><td>1st Mark: Calcium oxide as a base or forms an alkali when dissolved in water (must mention when dissolved in water)
2nd Mark: Calcium oxide in water neutralises sulphur dioxide (must mention the word neutralise)</td></tr>
<tr><td>2016
5d</td><td>hydrogen
hydroxide</td><td>Nanorods are grown in a dilute solution of auric acid:
<table>
<tr><th>Solution Type</th><th>Description</th></tr>
<tr><td>Acidic Solution</td><td>Number of H^+ ions > Number of OH^- ions</td></tr>
<tr><td>Neutral Solution</td><td>Number of H^+ ions = Number of OH^- ions</td></tr>
<tr><td>Alkaline Solution</td><td>Number of OH^- ions > Number of H^+ ions</td></tr>
</table>
</td></tr>
<tr><td>2017
11a</td><td>Answer to include:</td><td>Non-metal oxides like SO_2 dissolve in water to form acids.
As acid is formed the pH number will decrease below 7</td></tr>
<tr><td>2018
1a</td><td>Carbon dioxide</td><td>hydrochloric acid + calcium carbonate ⟶ calcium chloride + water + carbon dioxide
ACID + METAL CARBONATE ⟶ SALT + WATER + CARBON DIOXIDE</td></tr>
<tr><td>2018
10a(i)</td><td>$N_2 + 3H_2 \rightleftharpoons 2NH_3$</td><td></td></tr>
<tr><td>2018
10d</td><td>ammonium nitrate</td><td>ammonia + water ⟶ ammonium hydroxide
ammonium hydroxide + nitric acid ⟶ ammonium nitrate + water</td></tr>
<tr><td>2018
13b</td><td>As halogen atom goes down group 7 the acidity decreases.</td><td>
<table>
<tr><td colspan="4">Any correct statement linking acidity to the position of the halogen</td></tr>
<tr><td>The acidity (of the carboxylic acids) decreases going down the group</td><td>As you go (up) from iodine to fluorine the acidity increases</td><td>The one at the top (of the group) has the highest acidity</td><td>The one that has the lowest acidity is at the bottom (of the group)</td></tr>
</table>
</td></tr>
<tr><td>2019
2c</td><td>calcium oxalate</td><td>Acids react with bases to form salts.
Oxalic acid reacts with calcium ions to form the salt calcium oxalate</td></tr>
<tr><td>2019
11b</td><td>propanoic acid</td><td>acid + metal carbonate → salt + water + carbon dioxide
propanoic acid + calcium carbonate → calcium propanoate + water + carbon dioxide</td></tr>
<tr><td>2019
11c</td><td>One answer from:</td><td>
<table>
<tr><td>no more solid reacts/ until it no longer reacts</td><td>solid remains/is left (at bottom of the beaker)</td><td>a gas is no longer produced no more fizzing/bubbling</td></tr>
<tr><td>calcium carbonate left (at the bottom)</td><td>no more calcium carbonate reacts</td><td>neutral/neutralised with a description of testing pH.</td></tr>
</table>
</td></tr>
</table>

Nat5
Traffic Lights

Past Paper Question Bank
Unit 1.4a pH

JABchem

Outcome	Int2 2000	Int2 2001	Int2 2002	Int2 2003	Int2 2004	Int2 2005	Int2 2006	Int2 2007	Int2 2008	Int2 2009	Int2 2010	Int2 2011	Int2 2012	Int2 2013	Int2 2014	Int2 2015
53								L9b			L10a			L13a(i)		
55 56	mc19					L13b(ii)				mc24	mc17				mc20	
54 57 58		mc19	mc20			mc27 L13b(i)	mc23	mc20	mc21		mc19			mc18		L15a
59 60			mc17			mc19		mc19				mc22		mc20		
61	mc18				mc23			mc18		mc21			10c	mc23		mc24
62					mc23			mc18	mc22	mc21		mc21	mc21		mc22	mc24
63			mc21		mc24		mc24				mc22			mc22		mc25
64											mc23					
65a		mc20			L8a			L3b(i)								
65b			L7b			L14b										
65c	L11c			mc28		L2a(ii)		mc22	L12a	mc22 L13c		mc24	L11b		mc23	mc26
66								L15a	L13b						L11a	L14a(i)
67		L12a(i)	L9a	mc21	L6a	mc24	L11b(i) L11b(ii)	mc25		L15a	mc26	mc25	L13b(i) L13b(ii)	L2d		
68													mc22			
69																
70	L16	L12b	L8d	L8c	L16b	mc22				L12c(ii)	L13b	L11c(iii)				L15b(iii)
74																
75 76	L15a L15b			L9a L9b L9c						L13a L13b						
Marking Scheme	Not Published	Not Published	Not Published	SQA Int2 2003 MSch	SQA Int2 2004 MSch	SQA Int2 2005 MSch	SQA Int2 2006 MSch	SQA Int2 2007 MSch	SQA Int2 2008 MSch	SQA Int2 2009 MSch	SQA Int2 2010 MSch	SQA Int2 2011 MSch	SQA Int2 2012 MSch	SQA Int2 2013 MSch	SQA Int2 2014 MSch	SQA Int2 2015 MSch

Int2	Answer	% Correct	Reasoning
2000 18	D	32	☒A calcium oxide (metal oxide) dissolves in water to form an alkali ☒B carbon dioxide (non-metal oxide) dissolves in water to form an acid ☒C sulphur dioxide (non-metal oxide) dissolves in water to form an acid ☑D zinc oxide is insoluble in water so will not change the pH of water from pH=7
2000 19	D	42	☒A At equilibrium, the rate of the forward and reverse reactions are equal ☒B water has little dissociation into ions and the majority stays as molecules ☒C Concentration of water if much greater than hydrogen ions ☑D At equilibrium, concentration of reactants and products are constant
2001 19	C	69	☒A acids contain more H^+ ions than OH^- ions (some OH^- ions present) ☒B neutral solutions contain equal numbers of H^+ and OH^- ions ☑C acids contain more H^+ ions than OH^- ion ☒D acids contain more H^+ ions than OH^- ion
2001 20	C	24	☒A Condensation: small molecules join together with water removed at the join ☒B Dehydration: Water is removed from a molecule forming a C=C double bond ☑C Neutralisation: H^+ ions reacting to form water ☒D Precipitation: An insoluble solid is formed when two ions come together
2002 17	B	62	
2002 20	A	75	
2002 21	A	43	A base is a chemical which neutralises an acid: Alkalis (metal hydroxide) Metal Oxide Metal Carbonate
2003 21	A	76	$Pb^{2+} + 2NO_3^- + 2Na^+ + 2I^- \rightarrow Pb^{2+}(I^-)_2 + 2Na^+ + 2NO_3^-$ Cancel out any spectator ions which appear on both sides $Pb^{2+} + \cancel{2NO_3^-} + \cancel{2Na^+} + 2I^- \rightarrow Pb^{2+}(I^-)_2 + \cancel{2Na^+} + \cancel{2NO_3^-}$ Re-write equation omitting spectator ions $Pb^{2+} + 2I^- \rightarrow Pb^{2+}(I^-)_2$
2003 28	B	58	☒A calcium hydroxide + hydrochloric acid → calcium chloride + water ☑B calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide ☒C calcium oxide + hydrochloric acid → calcium chloride + water ☒D calcium + hydrochloric acid → calcium chloride + hydrogen (flammable!)
2004 23	B	74	☒A non-metal oxides e.g. carbon dioxide dissolve in water in form acids ☑B copper oxide is insoluble in water (p8 of data book) so pH is unchanged ☒C metal oxides e.g. sodium oxide dissolve in water in form alkali ☒D non-metal oxides e.g. sulphur dioxide dissolve in water in form acids
2004 24	A	59	Bases neutralise acids: acid + alkali (metal hydroxide) → salt + water acid + metal oxide → salt + water acid + metal carbonate → salt + water + carbon dioxide
2005 19	D	69	

Action on Acid	Effect on pH	Effect on H^+ concentration
Dilution	Increase to 7	Drecreases

Type	pH	Ions in Solution
Acid	pH<7	Concentration of H^+ > Concentration of OH^-
Neutral e.g. pure water	pH=7	Concentration of H^+ = Concentration of OH^-
Alkali	pH>7	Concentration of OH^- > Concentration of H^+

2005 22	D	28	no. of mol H_2SO_4 = volume x concentration = 0.02litres x 1 mol l^{-1} = 0.02mol $2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$ 2mol 1mol 0.04mol 0.02mol
2005 24	A	83	$Ba^{2+} + 2NO_3^- + 2Na^+ + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-} + 2Na^+ + 2NO_3^-$ Cancel out any spectator ions which appear on both sides $Ba^{2+} + \cancel{2NO_3^-} + \cancel{2Na^+} + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-} + \cancel{2Na^+} + \cancel{2NO_3^-}$ Re-write equation omitting spectator ions $Ba^{2+} + + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-}$
2005 27	C	78	<table><tr><td>Type</td><td>pH</td><td>Ions in Solution</td></tr><tr><td>Acid</td><td>pH<7</td><td>Concentration of H^+ > Concentration of OH^-</td></tr><tr><td>Neutral</td><td>pH=7</td><td>Concentration of H^+ = Concentration of OH^-</td></tr><tr><td>Alkali</td><td>pH>7</td><td>Concentration of OH^- > Concentration of H^+</td></tr></table>
2006 23	A	79	☑A Hydrogen H^+ ion concentration decreases as acid is diluted from pH=3 to pH=6 ☒B Hydroxide OH^- ion concentration does not decrease when water is added ☒C At pH=6, concentration of H^+ ions is greater the concentration of OH^- ions ☒D Hydrogen H^+ ion concentration decreases as acid is diluted from pH=3 to pH=6
2006 24	A	56	A base is a chemical which neutralises an acid: Alkalis (metal hydroxide) Metal Oxide Metal Carbonate
2007 18	B	76	☒A carbon dioxide (non-metal oxide) dissolves in water to make an acidic solution ☑B Copper oxide is insoluble in water (p8 of data booklet) ∴ pH unchanged ☒C Sodium oxide (metal oxide) dissolves in water to make an alkaline solution ☒D Sulphur Dioxide (non-metal oxide) dissolves in water to make an acidic solution
2007 19	D	77	☒A Rate of reaction decreases as concentration of H^+ decreases ☒B Concentration of H^+ ions decreases with dilution ☒C Electrical conductivity decreases with dilution as ion concentration decreases ☑D pH is below 7 and increases up to 7 as water is added
2007 20	A	85	<table><tr><td>Type</td><td>pH</td><td>Ions in Solution</td></tr><tr><td>Acid</td><td>pH<7</td><td>Concentration of H^+ > Concentration of OH^-</td></tr><tr><td>Neutral</td><td>pH=7</td><td>Concentration of H^+ = Concentration of OH^-</td></tr><tr><td>Alkali</td><td>pH>7</td><td>Concentration of OH^- > Concentration of H^+</td></tr></table>
2007 22	C	54	☒A Copper + hydrochloric acid → no reaction as copper not reactive enough ☒B copper oxide + hydrochloric acid → copper chloride + water ☑C copper carbonate + hydrochloric acid → copper chloride + water + carbon dioxide ☒D copper hydroxide + hydrochloric acid → copper chloride + water
2007 25	A	52	Sodium ions and chloride ions are both spectator ions as neither end up in the precipitate (new substance formed). As neither sodium ions and chloride ions are chemically changed, they are spectator ions.
2008 21	B	95	<table><tr><th>Solution Type</th><th>Description</th></tr><tr><td>Acidic Solution</td><td>Number of H^+ ions > Number of OH^- ions</td></tr><tr><td>Neutral Solution</td><td>Number of H^+ ions = Number of OH^- ions</td></tr><tr><td>Alkaline Solution</td><td>Number of OH^- ions > Number of H^+ ions</td></tr></table>
2008 22	C	84	☒A non-metal oxides like carbon dioxide dissolve to form acids ☒B copper (II) oxide is insoluble in water (p8 of data booklet) ☑C metal oxides like potassium oxide dissolve to form alkalis ☒D non-metal oxides like nitrogen dioxide dissolve to form acids

2009 21	D	81	☒A metal oxides e.g. calcium oxide dissolve in water to form alkalis ☒B non-metal oxides e.g. carbon dioxide dissolve in water to form acids ☒C non-metal oxides e.g. sulphur dioxide dissolve in water to form acids ☑D zinc oxide is insoluble in water (p8 of data booklet) so pH is unchanged
2009 22	B	86	<table><tr><td>Test</td><td>Test 1</td><td>Test 2</td></tr><tr><td>Result</td><td>Lime water turns milky</td><td>Blue-green flame colour</td></tr><tr><td>Conclusion</td><td>Compound X is a carbonate</td><td>Compound X contains copper ions</td></tr></table>
2009 24	D	46	☒A both forward and reverse reaction proceed at equal rates ☒B water is mainly molecules with few ions ☒C water is mainly molecules with few ions ☑D rate of forward reaction = rate of reverse reaction ∴ concentrations remain constant
2010 17	A	47	In a reversible reaction at equilibrium: Rate of forward reaction = Rate of reverse reaction Concentration of reactants and products are **constant** but not *equal*
2010 19	B	79	☒A acidic solutions have a small number of OH^- ions in them ☑B acidic solutions have concentration of H^+ ions > concentration of OH^- ions ☒C alkaline solutions have concentration of OH^- ions > concentration of H^+ ions ☒D neutral solutions have concentration of H^+ ions = concentration of OH^- ions
2010 22	D	58	<table><tr><td colspan="3">Base: Compound which neutralises an acid to form water</td></tr><tr><td>Alkalis (metal hydroxides)</td><td>Metal oxides</td><td>Metal carbonates</td></tr></table>
2010 23	A	88	☑A during neutralisation: pH of acid increases up to pH=7 ☒B during neutralisation: pH of acid increases up to pH=7 ☒C during neutralisation: pH of an alkali decreases down to pH=7 ☒D during neutralisation: pH of an alkali decreases down to pH=7
2010 26	A	84	$Pb^{2+} + 2NO_3^- + 2Na^+ + 2I^- \rightarrow Pb^{2+}(I^-)_2 + 2Na^+ + 2NO_3^-$ Cancel out any spectator ions which appear on both sides $Pb^{2+} + \cancel{2NO_3^-} + \cancel{2Na^+} + 2I^- \rightarrow Pb^{2+}(I^-)_2 + \cancel{2Na^+} + \cancel{2NO_3^-}$ Re-write equation omitting spectator ions $Pb^{2+} + 2I^- \rightarrow Pb^{2+}(I^-)_2$
2011 21	A	60	☑A Sodium oxide is a metal oxide ∴ dissolves in water to form an alkali (pH>7) ☒B Aluminium oxide is insoluble in water (p8 of data booklet) ☒C Sulphur dioxide is a non-metal oxide ∴dissolves in water to form an acid (pH<7) ☒D Silver oxide is insoluble in water (p8 of data booklet)
2011 22	B	74	☒A H^+ ion concentration decreases as acid is diluted with water ☑B H^+ ion concentration decreases and pH of acid increases to pH=7 when diluted. ☒C pH of acid will increase up to pH=7 when diluted with water ☒D pH of acid will increase up to pH=7 when diluted with water
2011 24	A	88	☑A calcium carbonate + hydrochloric acid ⟶ calcium chloride + water + carbon dioxide ☒B copper oxide + sulphuric acid ⟶ copper sulphate + water ☒C copper is not reactive enough to react with hydrochloric acid ☒D magnesium + sulphuric acid ⟶ magnesium sulphate + hydrogen
2011 25	D	90	$H^+ + NO_3^- + K^+ + OH^- \rightarrow K^+ + NO_3^- + H_2O$ Cancel out any spectator ions which appear on both sides $H^+ + \cancel{NO_3^-} + \cancel{K^+} + OH^- \rightarrow \cancel{K^+} + \cancel{NO_3^-} + H_2O$ Re-write equation omitting spectator ions $H^+ + OH^- \rightarrow H_2O$

2012 21	B	66	Soluble metal oxides dissolve in water to form alkalis but zinc oxide is insoluble. When added to water, zinc oxide would not change the pH of water (pH=7).
2012 22	B	61	Neutralisation reactions involve the reaction of H^+ ions and OH^- ions to form water.
2013 18	C	83	☒A all solutions contain hydrogen ions and hydroxide ions at all times ☒B neutral solutions contain equal numbers of hydrogen and hydroxide ions ☑C alkaline solutions contain more hydroxide ions than hydrogen ions ☒D acidic solutions contain more hydrogen ions than hydroxide ions
2013 20	A	78	☑A as pH rises from 3 to 6, concentration of H^+ ions decreases ☒B OH^- ions increase in number as pH rises from 3 to 6 ☒C at pH=6, concentration of H^+ ions is greater than concentration of OH^- ions ☒D as pH rises from 3 to 6, concentration of H^+ ions decreases
2013 22	A	59	Bases are compounds which neutralise acids and form water e.g. alkalis (metal hydroxides), metal oxides and metal carbonates
2013 23	D	40	☒A Argon is an insoluble Noble Gas and does not give react with acidic solutions ☒B Oxygen is an insoluble gas and does not give react with acidic solutions ☒C Ammonia dissolves in water to form an alkali ∴ would not react with an alkali ☑D Nitrogen dioxide forms an acidic solution and would react with alkali
2014 20	C	79	☒A All aqueous solutions contain both hydrogen and hydroxide solutions ☒B All aqueous solutions contain both hydrogen and hydroxide solutions ☑C Acids contain more hydrogen ions than hydroxide ions ☒D Alkalis contain more hydroxide ions than hydrogen ions
2014 22	A	68	☑A calcium oxide is a soluble metal oxide which dissolves to form an alkali ☒B nickel oxide is a non-soluble metal oxide so has no effect on pH ☒C nitrogen dioxide is a soluble non-metal oxide and dissolves to form an acid ☒D sulphur dioxide is a soluble non-metal oxide and dissolves to form an acid
2014 23	B	56	☒A no gas produced: magnesium hydroxide + hydrochloric acid → magnesium chloride + water ☑B CO_2 produced: magnesium carbonate + hydrochloric acid → magnesium chloride + water + CO_2 ☒C no gas produced: magnesium oxide + hydrochloric acid → magnesium chloride + water ☒D flammable gas produced: magnesium + hydrochloric acid → magnesium chloride + hydrogen
2015 24	B	83	☒A carbon dioxide is a non-metal oxide which dissolves in water to form an acid ☑B copper oxide is not soluble in water and would not change the pH of water ☒C sodium oxide is a metal oxide which dissolves in water to form an alkali ☒D sulphur dioxide is a non-metal oxide which dissolves in water to form an acid
2015 25	B	55	☒A sodium carbonate + hydrochloric acid ⟶ sodium chloride + water + carbon dioxide ☑B sodium chloride does not react with hydrochloric acid as it is not a base ☒C sodium hydroxide + hydrochloric acid ⟶ sodium chloride + water ☒D sodium oxide + hydrochloric acid ⟶ sodium chloride + water
2015 26	C	55	☒A copper metal does not react with dilute acid as copper is below hydrogen in ECS ☒B copper oxide + hydrochloric acid ⟶ copper chloride + water ☑C copper carbonate + hydrochloric acid ⟶ copper chloride + water + carbon dioxide ☒D copper hydroxide + hydrochloric acid ⟶ copper chloride + water

Int2	Answer	Reasoning
2000 11c	Neutralisation	Neutralisation: acid H^+ ions reacting to become water H_2O acid + alkali (metal hydroxide) ⟶ salt + water acid + metal oxide ⟶ salt + water acid + metal carbonate ⟶ salt + water + carbon dioxide
2000 15a	Neutralised when adding further solid it doesn't start fizzing again	$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$ <u>or</u> $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$ When the sulphuric acid runs out, $MgCO_3$ or Mg is in excess. To be sure no acid is left, a little extra solid is added to check there is no fizzing (which would indicate that acid is left)
2000 15b	Filter excess solid Evaporate solution to get crystals	Filtration: Filtering removes the excess solid added in the neutralisation Evaporation: Boiling the solution removes the water leaving crystals of $MgSO_4$
2000 16	0.18mol l^{-1}	**n**o. of mol acid = **v**olume x **c**oncentration = 0.0225 x 0.1 = 0.00225mol $2NaOH + H_2SO_4 \longrightarrow NaSO_4 + 2H_2O$ 2mol 1mol 0.00450mol 0.00225mol **c**oncentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.00450\text{ mol}}{0.025\text{ litres}} = 0.18\text{ mol l}^{-1}$
2001 12a(i)	$Ba^{2+}+SO_4^{2-}\rightarrow Ba^{2+}SO_4^{2-}$	$Ba^{2+} + 2Cl^- + 2Na^+ + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-} + 2Na^+ + 2Cl^-$ Cancel out any spectator ions which appear on both sides $Ba^{2+} + \cancel{2Cl^-} + \cancel{2Na^+} + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-} + \cancel{2Na^+} + \cancel{2Cl^-}$ Re-write equation omitting spectator ions $Ba^{2+} + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-}$
2001 12b	0.008mol l^{-1}	**n**o. of mol alkali = **v**olume x **c**oncentration = 0.020 x 0.1 = 0.002mol $2KOH + H_2SO_4 \longrightarrow NaSO_4 + 2H_2O$ 2mol 1mol 0.002mol 0.001mol **c**oncentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.001\text{ mol}}{0.0125\text{ litres}} = 0.08\text{ mol l}^{-1}$
2002 7b	Neutralisation	acid + alkali (metal hydroxide) ⟶ salt + water acid + metal oxide ⟶ salt + water acid + metal carbonate ⟶ salt + water + carbon dioxide
2002 8d	0.0448	**n**o. of mol acid = **v**olume x **c**oncentration = 0.0224 x 0.1 = 0.00224mol $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$ 1mol 2mol 0.00112mol 0.00224mol **c**oncentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.00112\text{ mol}}{0.025\text{ litres}} = 0.0448\text{ mol l}^{-1}$
2002 9a	$S_2O_3^{2-}+2H^+$ ↓ $S+SO_2+H_2O$	$(Na^+)_2S_2O_3^{2-} + 2H^+Cl^- \rightarrow 2Na^+Cl^- + S + SO_2 + H_2O$ Split up compounds into separate ions $2Na^+ + S_2O_3^{2-} + 2H^+ + 2Cl^- \rightarrow 2Na^+ + 2Cl^- + S + SO_2 + H_2O$ Cancel out any spectator ions which appear on both sides $\cancel{2Na^+} + S_2O_3^{2-} + 2H^+ + \cancel{2Cl^-} \rightarrow \cancel{2Na^+} + \cancel{2Cl^-} + S + SO_2 + H_2O$ Re-write equation omitting spectator ions $S_2O_3^{2-} + 2H^+ \rightarrow S + SO_2 + H_2O$

2003 **8c**	0.835	**n**o. of mol alkali = **v**olume x **c**oncentration = 0.0334 x 0.5 = 0.0167mol $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$ 1mol 1mol 0.0167mol 0.0167mol **c**oncentration = $\frac{\text{**n**o. of mol}}{\text{**v**olume}} = \frac{0.0167\text{mol}}{0.02\text{ litres}} = 0.835\text{ mol l}^{-1}$
2003 **9a**	Add solid until no more bubbles form	sulphuric acid + magnesium carbonate → magnesium sulphate + water + carbon dioxide sulphuric acid + magnesium → magnesium sulphate + hydrogen
2003 **9b**	To ensure all acid is neutralised	Solid is added and acid stirred until acid stops bubbling. Once enough solid has been added and the mixture doesn't start to bubble again, all the acid has been neutralised. The excess solid is removed by filtration and the salt solution is evaporated to make the new substance.
2003 **9c**	Step 2: filtration Step 3: evaporation	
2004 **6a**	$2H^+ + 2OH^- \rightarrow 2H_2O$ or $H^+ + OH^- \rightarrow H_2O$	$2NH_4^+ + 2OH^- + 2H^+ + SO_4^{2-} \rightarrow 2NH_4^+ + SO_4^{2-} + 2H_2O$ Cancel out any spectator ions which appear on both sides ~~$2NH_4^+$~~ + $2OH^-$ + $2H^+$ + ~~SO_4^{2-}~~ → ~~$2NH_4^+$~~ + ~~SO_4^{2-}~~ + $2H_2O$ Re-write equation omitting spectator ions $2OH^- + 2H^+ \rightarrow 2H_2O$
2004 **8a**	Neutralisation	acid + alkali (metal hydroxide) → salt + water acid + metal oxide → salt + water acid + metal carbonate → salt + water + carbon dioxide
2004 **16b**	0.123 mol l^{-1}	**n**o. of mol acid = **v**olume x **c**oncentration = 0.0246 x 0.1 = 0.00246mol $KOH + HNO_3 \longrightarrow KNO_3 + H_2O$ 1mol 1mol 0.00246mol 0.00246mol **c**oncentration = $\frac{\text{**n**o. of mol}}{\text{**v**olume}} = \frac{0.00246\text{mol}}{0.02\text{ litres}} = 0.123\text{ mol l}^{-1}$
2005 **2a**(ii)	Sodium chloride	ACID + Metal Carbonate → SALT + WATER + Carbon Dioxide hydrochloric acid + sodium carbonate → sodium chloride + water + carbon dioxide
2005 **13b**(i)	Ammonia dissolves to form alkaline OH^- ions	Ammonia dissolves in water to form the weak alkali ammonium hydroxide. Only a few molecules dissociate into ions.
2005 **13b**(ii)	Reaction is reversible	Some reactions are reversible where the forward reaction and reverse reactions both take place. Equilibrium is formed when the rate of the forward reaction equals the rate of the reverse reaction.
2005 **14b**	Neutralisation	ACID + ALKALI → SALT + WATER hydrochloric acid + magnesium hydroxide → magnesium chloride + water
2006 **11b**(i)	$Pb^{2+} + 2I^- \rightarrow Pb^{2+}(I^-)_2$	$Pb^{2+} + 2NO_3^- + 2K^+ + 2I^- \rightarrow Pb^{2+}(I^-)_2 + 2K^+ + 2NO_3^-$ Cancel out any spectator ions which appear on both sides Pb^{2+} + ~~$2NO_3^-$~~ + ~~$2K^+$~~ + $2I^-$ → $Pb^{2+}(I^-)_2$ + ~~$2K^+$~~ + ~~$2NO_3^-$~~ Re-write equation omitting spectator ions $Pb^{2+} + 2I^- \rightarrow Pb^{2+}(I^-)_2$

2006 11b(ii)	Spectator ions	Ions which appear on both sides of the equation are called spectator ions as they do not take part in the reaction.
2007 3b(i)	Neutralisation	ACID + METAL OXIDE → SALT + WATER hydrochloric acid + tin (IV) oxide → tin (IV) chloride + water
2007 9b	CO_2 dissolves to make an acid	Type of Oxide: Metal oxide — Dissolved in water: Alkaline solution — Examples: Sodium oxide, Potassium oxide, Calcium oxide Type of Oxide: Non-metal oxide — Dissolved in water: Acidic solution — Examples: Carbon dioxide, Sulphur Dioxide, Nitrogen dioxide
2007 15a	Sulphuric acid	Name of Acid: Hydrochloric acid, Sulphuric acid, Nitric acid 2nd Name of Salt: chloride, sulphate, nitrate
2008 12a	Carbon dioxide	Sodium hydrogencarbonate will react with acid to release carbon dioxide
2008 13b	Nitric acid	ACID + METAL CARBONATE → SALT + WATER + CARBON DIOXIDE nitric acid + strontium carbonate → strontium nitrate + water + carbon dioxide
2009 12c(ii)	0.25	no. of mol acid = volume x concentration = 0.1 x 1 = 0.1mol $2MnO_4^- + 5C_2H_2O_4 + 6H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$ 2mol 5mol 0.1mol 5mol x $^{0.1}/_{2}$ = 0.25mol
2009 13a	No more solid reacts with acid	The solid will continue to react with the acid, giving off a gas, until the acid is all reacted. The unreacted solid will lie on the bottom of the beaker as it is insoluble.
2009 13b	To ensure all the acid has reacted	It is important that no acid remains and is all reacted. Using an insoluble solid means that all the acid can be reacted and the excess solid removed by filtration.
2009 13c	$H_2SO_4 + MgCO_3$ ↓ $MgSO_4 + \mathbf{H_2O} + \mathbf{CO_2}$	acid + metal carbonate → salt + water + carbon dioxide sulphuric acid + magnesium carbonate → magnesium sulphate + water + carbon dioxide $H_2SO_4 + MgCO_3 \rightarrow MgSO_4 + H_2O + CO_2$
2009 15a	$OH^- + H^+ \rightarrow H_2O$	$2Na^+ + 2OH^- + 2H^+ + SO_4^{2-} \rightarrow 2Na^+ + SO_4^{2-} + 2H_2O$ Cancel out any spectator ions which appear on both sides ~~$2Na^+$~~ + $2OH^-$ + $2H^+$ + ~~SO_4^{2-}~~ → ~~$2Na^+$~~ + ~~SO_4^{2-}~~ + $2H_2O$ Re-write equation omitting spectator ions $2OH^- + 2H^+ \rightarrow 2H_2O$
2010 10a	pH value between 0-6	Acidic: pH<7 — Neutral: pH=7 — Alkaline: pH>7
2010 13b	0.08mol l^{-1}	no. of mol acid = volume x concentration = 0.020 x 0.1 = 0.002mol $2NaOH + H_2SO_4 \longrightarrow NaSO_4 + 2H_2O$ 2mol 1mol 0.004mol 0.002mol concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.004 \text{ mol}}{0.05 \text{ litres}} = 0.08 \text{ mol } l^{-1}$

2011 11c(iii)	0.2	**n**o. of mol Br_2 = **v**olume x **c**oncentration = 0.016 x 0.5 = 0.008mol $C_{10}H_{16}$ + $2Br_2$ ⟶ $C_{10}H_{16}Br_4$ 1mol 2mol 0.004mol 0.008mol **c**oncentration = **n**o. of mol / **v**olume = 0.004mol / 0.020 litres = 0.2 mol l^{-1}
2012 10c	Lowers the pH	Carbon dioxide dissolves in water to form an acidic solution which would react with the alkali in the pH=8.2 and lower the pH.
2012 11b	calcium chloride	ACID + METAL CARBONATE ⟶ SALT + WATER + CARBON DIOXIDE hydrochloric acid + calcium carbonate ⟶ calcium chloride + water + carbon dioxide
2012 13b(i)	$Ba^{2+}+SO_4^{2-}\rightarrow Ba^{2+}SO_4^{2-}$	$Ba^{2+} + 2Cl^- + 2Na^+ + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-} + 2Na^+ + 2Cl^-$ Cancel out any spectator ions which appear on both sides $Ba^{2+} + \cancel{2Cl^-} + \cancel{2Na^+} + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-} + \cancel{2Na^+} + \cancel{2Cl^-}$ Re-write equation omitting spectator ions $Ba^{2+} + SO_4^{2-} \rightarrow Ba^{2+}SO_4^{2-}$
2012 13b(ii)	Spectator	Spectator ions are present in a reaction mixture but do not take part in a chemical reaction.
2013 2d	$2Na^+$ and $2Cl^-$	Spectator ions appear chemically unchanged on both sides of a chemical equation: $2Na^+$ appears on both sides of equation $2Na^+ + S_2O_3^{2-} + 2H^+ + 2Cl^- \rightarrow 2Na^+ + 2Cl^- + SO_2 + S + H_2O$ $2Cl^-$ appears on both sides of equation
2013 13a(i)	Any pH below 7	pH | pH below 7 | pH = 7 | pH above 7 Description | Acidic | Neutral | Alkaline
2014 11a	Sulphuric acid	ACID + METAL ⟶ SALT + HYDROGEN sulphuric acid + magnesium ⟶ magnesium sulphate + hydrogen H_2SO_4 + Mg ⟶ $MgSO_4$ + H_2
2015 14a(i)	Sulphuric acid	Acid + Metal ⟶ Salt + Hydrogen Sulphuric acid + Magnesium ⟶ magnesium sulphate + hydrogen
2015 15a	More hydrogen ions than hydroxide ions	**Acid** | concentration of H^+ ions | greater than | concentration of OH^- ions **Neutral** | concentration of H^+ ions | equal to | concentration of OH^- ions **Alkali** | concentration of H^+ ions | Less than | concentration of OH^- ions
2015 15b(iii)	0.0032	Iodine n = v x c = 0.016litres x 0.005mol l^{-1} = 0.00008mol $C_6H_8O_6$ + I_2 ⟶ $C_6H_6O_6$ + 2HI 1mol 1mol 0.00008mol 0.00008mol **c**oncentration = **n**o of mol / **v**olume = 0.00008 mol / 0.025 litres = 0.0032mol l^{-1}

Nat5
Traffic Lights

Past Paper Question Bank
Unit 1.4 pH & Neutralisation

Outcome	2000 Credit	2001 Credit	2002 Credit	2003 Credit	2004 Credit	2005 Credit	2006 Credit	2007 Credit	2008 Credit	2009 Credit	2010 Credit	2011 Credit	2012 Credit	2013 Credit		
53																
55 56																
54 57 58												14a				
59 60																
61							13c(ii)									
62																
63																
64						20a										
65a																
65b																
65c										13a				18c		
66		13b			12d			17b					13b(i)			
67			13a	15a					17b(i)		17a			14a		
68																
69					21a			20b(i) 20b(ii)				20c(i)				
70			19b		21b(iii)		18b				19b	20d		18b(ii)		
74							18c									
75 76						14a 14b										

SG Credit	Answer	Reasoning
2001C 13b	nitric acid	<table><tr><td>Acid</td><td>Hydrochloric</td><td>Sulphuric</td><td>Nitric</td></tr><tr><td>Salt Name ending</td><td>chloride</td><td>sulphate</td><td>nitrate</td></tr></table>
2002C 13a	$Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$	$Cu + 2Ag^+ + 2NO_3^- \rightarrow Cu^{2+} + 2Ag + 2NO_3^-$ Cancel out any spectator ions which appear on both sides $Cu + 2Ag^+ + \cancel{2NO_3^-} \rightarrow Cu^{2+} + 2Ag + \cancel{2NO_3^-}$ Re-write equation omitting spectator ions $Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$
2002C 19b	0.0804 mol/l	sodium hydroxide + ethanoic acid → sodium ethanoate + water 1mol 1mol 0.00201mol 0.00201mol **c**oncentration = $\frac{\textbf{n}\text{o. of mol}}{\textbf{v}\text{olume}} = \frac{0.00201\text{mol}}{0.025\text{litres}} = 0.0804\ \text{mol}\ l^{-1}$
2003C 15a	$6Cl^- + 6Na^+$	Spectator Ions appear on both sides of the arrow
2004C 12d	calcium chloride	metal carbonate + acid → salt + water + carbon dioxide calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide
2004C 21a	colour change in flask	Indicator in flask is designed to shown the end point of a chemical reaction accurately.
2004C 21b(iii)	0.00824 mol	$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ 1mol 2mol 0.00412 mol 0.00824mol
2005C 14a	to ensure all acid has reacted/neutralised	When enough copper carbonate has been added, there will be no acid left in the beaker. Excess copper carbonate will lie on the bottom and the acid will be completely neutralised.
2005C 14b	Step 4: Filter contents of beaker Step 5: Evaporate water	Step 4 Filtration: removes the unreacted/excess copper carbonate powder from the bottom of the beaker Step 5: Evaporation: turns the filtrate copper chloride solution into crystals of copper chloride
2005C 20a	$Al_2(SO_4)_3$	A salt is formed from the reaction of an acid with either a metal or a base. $2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$ Metal + Acid → Salt + Hydrogen
2006C 13c(ii)	red/orange/yellow	Acidic pH formed as CO_2 dissolves in water to make carbonic acid
2006C 18b	0.156	**n**o. of mol = **v**olume x **c**oncentration = $0.0156_{\text{litres}} \times 0.2\ \text{mol}\ l^{-1} = 0.00312\text{mol}$ $KOH + HCl \rightarrow H_2O + KCl$ 1mol 1mol 0.00312mol 0.00312mol **c**oncentration = $\frac{\textbf{n}\text{o. of mol}}{\textbf{v}\text{olume}} = \frac{0.00312\text{mol}}{0.02\text{litres}} = 0.156\ \text{mol}\ l^{-1}$
2006C 18c	evaporate water leaving solid KCl	Using evaporation basin and Bunsen burner would be quicker than natural evaporation

2007C 17b	aluminium chloride	acid + alkali (metal hydroxide) → salt + water hydrochloric acid + aluminium hydroxide → aluminium chloride + water $3HCl + Al(OH)_3 \rightarrow AlCl_3 + 3H_2O$
2007C 20b(i)	0.1	$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ 1mol 2mol 0.1mol 0.2mol
2007C 20b(ii)	10g	1mol $CaCO_3$ = (1x40) + (1x12) + (3x12) = 40 + 12 + 48 = 100g **m**ass = **n**o. of mol x **gfm** = 0.1mol x 100g mol^{-1} = 10g
2008C 17b(i)	$2NO_3^-(aq)$	Spectator ions are ions which appear on both sides of the arrow chemically unchanged. They can be cancelled out of both sides.
2009C 13a	Neutralisation	acid + metal carbonate → salt + water + carbon dioxide hydrochloric acid + calcium carbonate → calcium chloride + water + carbon dioxide
2010C 17a	NO_3^- circled on both sides	$Fe(s) + 2Ag^+(aq) + 2NO_3^-(aq) \rightarrow Fe^{2+}(aq) + 2Ag(s) + 2NO_3^-(aq)$ Cancel out any spectator ions which appear on both sides $Fe(s) + 2Ag^+(aq) + \cancel{2NO_3^-(aq)} \rightarrow Fe^{2+}(aq) + 2Ag(s) + \cancel{2NO_3^-(aq)}$ Re-write equation omitting spectator ions $Fe(s) + 2Ag^+(aq) \rightarrow Fe^{2+}(aq) + 2Ag(s)$
2010C 19b	0.25mol/l	**n**o. of mol = **v**olume x **c**oncentration = 0.025litres x 0.1 mol l^{-1} = 0.0025mol $HCl + NaOH \rightarrow H_2O + NaCl$ 1mol 1mol 0.0025mol 0.0025mol $\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.0025\text{mol}}{0.01\text{litres}} = 0.25 \text{ mol } l^{-1}$
2011C 14a	higher	Solution / Acidic / Neutral / Alkaline H^+ concentration / H^+ greater than OH^- / H^+ equal to OH^- / H^+ less than OH^- OH^- concentration / OH^- less than H^+ / OH^- equal to H^+ / OH^- greater than H^+
2011C 20c(i)	Indicator	Indicator is added to change colour at the point of neutralisation
2011C 20d	0.001	$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ 1mol 2mol 0.001mol 0.002mol
2012C 13b(i)	$MgSO_4$	Metal + Acid → Salt + Hydrogen $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$
2013C 14a	SO_4^{2-}	$Zn(s) + Cu^{2+}(aq) + SO_4^{2-}(aq) \rightarrow Zn^{2+}(aq) + Cu(s) + SO_4^{2-}(aq)$ Cancel out any spectator ions which appear on both sides $Zn(s) + Cu^{2+}(aq) + \cancel{SO_4^{2-}(aq)} \rightarrow Zn^{2+}(aq) + Cu(s) + \cancel{SO_4^{2-}(aq)}$ Re-write equation omitting spectator ions $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$
2013C 18b(ii)	0.04	$\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.001 \text{ mol}}{0.025 \text{ litres}} = 0.04 \text{ mol } l^{-1}$
2013C 18c	sodium sulphate	acid + metal carbonate → salt + water + carbon dioxide sulphuric acid + sodium carbonate → sodium sulphate + water + carbon dioxide

Nat5
Traffic Lights

Past Paper Question Bank
Unit 1.4 pH & Neutralisation

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Outcome	2000 General	2001 General	2002 General	2003 General	2004 General	2005 General	2006 General	2007 General	2008 General	2009 General	2010 General	2011 General	2012 General	2013 General		
53	16a 16b		13c		12a		18a	11c	11b 21a			17b(i) 17b(ii)	13a(i) 13a(ii)			
55 56																
54 57 58				11b				11e					13b	16a		
59 60								11d				17c				
61		9a(i)											17c			
62		9a(ii)														
63																
64																
65a			16a	16b												
65b													20a(ii)			
65c	17a 17b															
66																
67																
68																
69																
70																
74																
75 76	17c		16b													

SG General	Answer	Reasoning
2000G 16a	answer to include:	Put pH paper into substance being tested. Match the colour on the pH paper against the pH chart colours and convert this colour into pH value.
2000G 16b	Fizz Alive	The lower the pH, the more acidic the solution is. Fizz Alive has lowest pH so is the most acidic and could cause tooth decay.
2000G 17a	neutralisation	acid + metal carbonate → salt + water + carbon dioxide
2000G 17b	carbon dioxide	sulphuric acid + zinc carbonate → zinc sulphate + water + carbon dioxide
2000G 17c	all acid is neutralised	Zinc carbonate is added to sulphuric acid and neutralises the acid. If excess zinc carbonate is added to the acid, all the acid will be neutralised. The excess zinc carbonate is insoluble in the soluble and can be removed by filtration.
2001G 9a(i)	pH below 7 pH above 7	Carbon is a non-metal and sodium is a metal. • Carbon Dioxide is a non-metal oxide and forms an acid when dissolved in water Sodium Oxide is a metal oxide and forms an alkali when dissolved in water
2001G 9a(ii)	Al_2O_3 is insoluble	Any substance which is insoluble in water cannot have a pH value
2002G 13c	pH less than 7	Sulphur dioxide dissolves in water to form an acid. Acidic: pH<7 | Neutral: pH=7 | Alkaline: pH>7
2002G 16a	neutralisation	acid + metal oxide → salt + water sulphuric acid + copper oxide → copper sulphate + water
2002G 16b	filtration	Excess copper oxide must be added to sulphuric acid to ensure all acid has been neutralised. As copper oxide is insoluble in water it can be removed from the solution by filtration.
2003G 11b	hydrogen or H^+	All acids contain more of the hydrogen ion (H^+ ion)
2003G 16b	neutralisation	ACID + METAL OXIDE → SALT + WATER hydrochloric acid + magnesium oxide → magnesium chloride + water
2004G 12a	bleach & detergent	acidic: pH<7 | neutral: pH=7 | alkaline: pH>7
2006G 18a	A	lowest pH ∴ most acidic ∴ most ions present ∴ highest current will flow
2007G 11c	½ mark: Add indicator/pH paper ½ mark: Check colour against chart	The colour achieve with universal indicator/pH paper should be matched against the colour chart and the closest match is the pH number of the solution.
2007G 11d	Increase	pH of acids is below 7. Dilution of acids with water makes pH increase to 7.
2007G 11e	Hydrogen ion or H^+ ion	Acids contain more of the hydrogen ion (H^+) Alkalis contain more of the hydroxide ion (OH^-)

<table>
<tr><td>2008G
11b</td><td>alkaline</td><td>
<table>
<tr><td>Type of solution</td><td>Acidic</td><td>Neutral</td><td>Alkaline</td></tr>
<tr><td>Universal Indicator</td><td>red</td><td>green</td><td>blue/purple</td></tr>
<tr><td>pH</td><td>pH less than 7</td><td>pH = 7</td><td>pH greater than 7</td></tr>
</table>
</td></tr>
<tr><td>2008G
21a</td><td>any pH below 7</td><td>Fizzy drinks have CO_2 dissolved in them
• CO_2 dissolved in water forms the weak acid carbonic acid
Acids have a pH below 7</td></tr>
<tr><td>2011G
17b(i)</td><td>answer to include:</td><td>Add pH paper or Universal Indicator
• match colour with pH chart
read matching pH number to colour</td></tr>
<tr><td>2011G
17b(ii)</td><td>Any pH below 7</td><td>pH must be below 7 but vinegar is a weak acid so pH is in 3-6 range</td></tr>
<tr><td>2011G
17c</td><td>increases</td><td>Lemon juice is an acid with a pH below 7. Diluting lemon juice with water will increase the pH until it reaches pH=7</td></tr>
<tr><td>2012G
13a(i)</td><td>A</td><td>
<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr>
<tr><td colspan="15">increasing acidity ◄ neutral ► increasing alkalinity</td></tr>
</table>
</td></tr>
<tr><td>2012G
13a(ii)</td><td>1-4mA</td><td>pH=6 ethanoic acid contains less ions than pH=5 ethanoic acid
∴ pH=6 Ethanoic acid will have a smaller current than pH=5 ethanoic acid</td></tr>
<tr><td>2012G
13b</td><td>Hydrogen or H^+</td><td>All acids contain Hydrogen H^+ ions. All alkalis contain the hydroxide OH^- ion.
Neutral solutions contain equal concentrations of H^+ ions and OH^- ions.</td></tr>
<tr><td>2012G
17c</td><td>Any pH 0→6</td><td>
<table>
<tr><td>Oxide Type</td><td>pH in water</td><td>Examples</td></tr>
<tr><td>Metal oxide</td><td>Metal oxides dissolve in water to form alkalis</td><td>K_2O, Na_2O</td></tr>
<tr><td>Non-metal oxide</td><td>Non-metal oxides dissolve in water for form acids</td><td>CO_2, NO_2, SO_2</td></tr>
</table>
</td></tr>
<tr><td>2012G
20a(ii)</td><td>water</td><td>potassium hydroxide + hydrochloric acid → potassium chloride + water
metal hydroxide (alkali) + acid → salt + water</td></tr>
<tr><td>2013
16a</td><td>Increases</td><td>Acids have a pH below 7.
Indigestion tablets neutralise acid and will increase pH up to 7</td></tr>
</table>