Answer **all** the questions.

1. Ammonium sulfate is a salt.

It is manufactured using the reaction between the alkali ammonia and sulfuric acid.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

What type of reaction is this?

[1]

2. Hardeep does some experiments with acids and alkalis.

He measures the pH of a sample of acid and a sample of alkali.

He adds magnesium metal to a sample of the acid and to a sample of the alkali.

What results should Hardeep expect?

	Results for acid experiments	**Results for alkali experiments**
A	pH below 7 no reaction with magnesium	pH above 7 magnesium fizzes
B	pH below 7 magnesium fizzes	pH above 7 no reaction with magnesium
C	pH above 7 magnesium fizzes	pH above 7 no reaction with magnesium
D	pH above 7 no reaction with magnesium	pH below 7 magnesium fizzes

Your answer ☐

[1]

3. Magnesium burns in oxygen to make magnesium oxide.

The reaction involves both oxidation and reduction.

$$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$$

magnesium + oxygen ⟶ magnesium oxide

Complete the sentence.

During this reaction, the oxidising agent is _____ and the

reducing agent is _____.

[1]

4(a). Zinc nitrate can be made by reacting zinc oxide with nitric acid, HNO_3.

Paul suggests this method for preparing zinc nitrate.

1. Measure 50cm^3 of dilute nitric acid into a beaker.
2. Add one spatulaful of zinc oxide.
3. Heat the mixture until crystals of zinc nitrate are made.

Paul's method will not make a pure dry sample of zinc nitrate.

What improvements should Paul make to the method to make sure that:

- the reaction is complete
- the zinc nitrate can be separated from the nitric acid and the zinc oxide?

Explain your answer.

---

[4]

(b). Describe why this reaction is a neutralisation reaction.

---

[2]

5. 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]

6. A student investigates some acids.

She has a solution of hydrochloric acid of concentration 0.01 mol/dm^3.

This solution has a pH of 2.

She increases the concentration of hydrochloric acid from 0.01 mol/dm^3 to 0.1 mol/dm^3.

What is the pH of this new solution?

A 0
B 1
C 3
D 12

Your answer ☐

[1]

7. Ammonium sulfate is a salt.

It is made using the reaction between the alkali ammonia and sulfuric acid.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

(i) Describe how a sample of solid ammonium sulfate is prepared in a laboratory.

Explain why this method is not suitable to be used industrially.

---

[4]

(ii) Predict the maximum mass of ammonium sulfate that can be made from 51 tonnes of ammonia.

Maximum mass = _____ tonnes **[2]**

8. Magnesium oxide reacts with water to make an alkaline solution.

Describe how you would measure the pH of the magnesium hydroxide solution.

A pH meter is **not** available.

---

[3]

9. Colin investigates displacement reactions.

He adds some iron powder to copper(II) sulfate solution, $CuSO_4$.

A displacement reaction happens.

Look at the ionic equation for this reaction.

$$Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$$

This displacement reaction is a **redox** reaction.

Write the **word** equation and the **balanced symbol** equation for the reaction between iron andcopper(II) sulfate.

Explain why this displacement reaction involves both oxidation and reduction.

The quality of written communication will be assessed in your answer to this question.

[6]

10. Orange squash is a concentrated solution.

It has to be diluted with water to make sure that the taste is not too strong.

Some medicines and baby milk both need to be diluted before they are used.

Explain why some medicines and baby milk both need to be diluted.

---

[2]

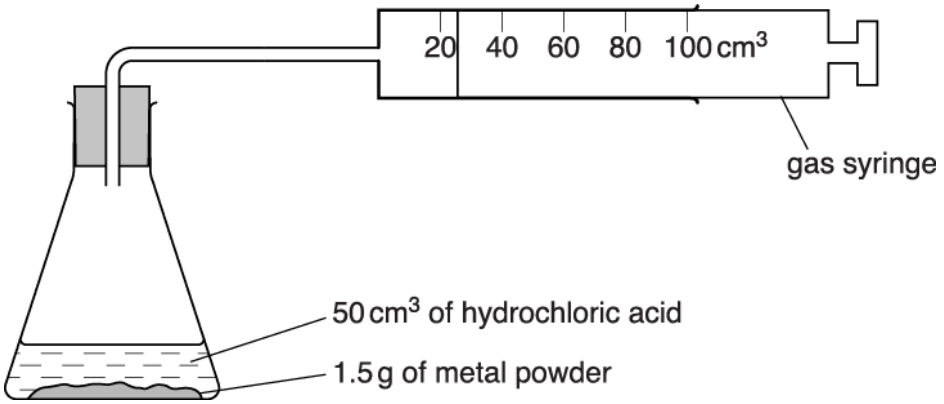
11. Zinc reacts with hydrochloric acid.

Hydrogen gas and zinc chloride are made.

Fatimah and Sam investigate the reaction between acid and metals.

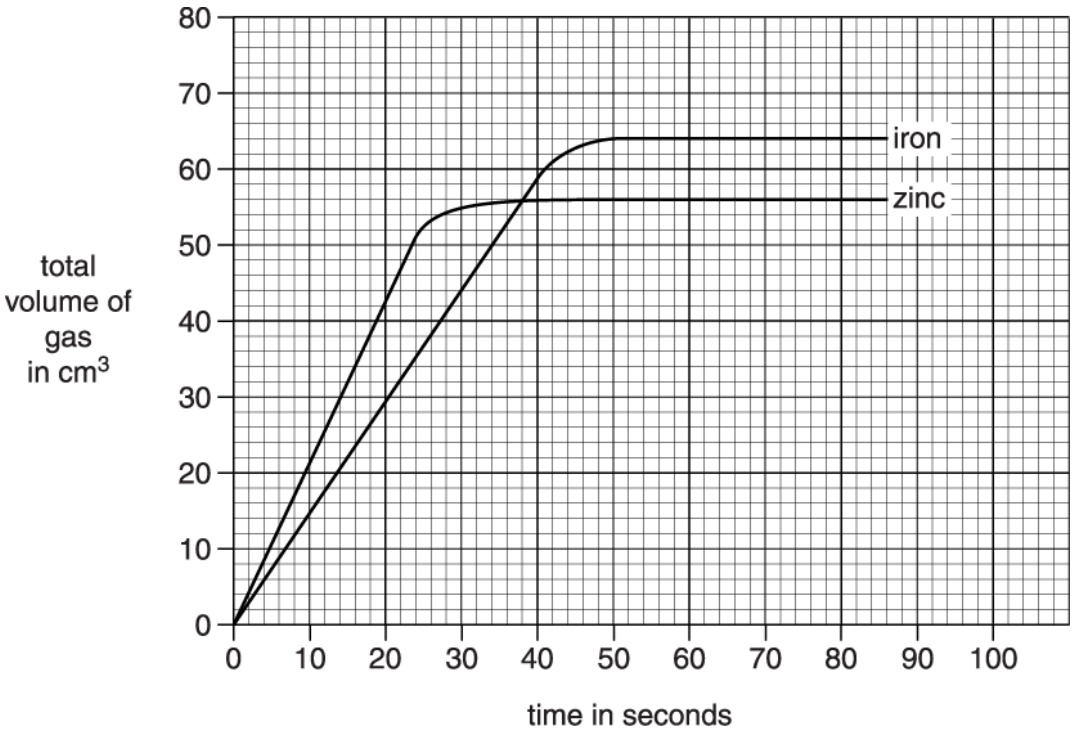
They react dilute hydrochloric acid with zinc powder and then with iron powder.

Look at the apparatus they use.



Every 10 seconds they measure the volume of gas in the gas syringe.

Look at the graph of the results.



(i) The graph for the reaction of **zinc** is different from the graph for **iron**.

Write about **two** differences in these graphs.

---**[2]**

(ii) Iron powder reacts faster than a lump of iron of the same mass.

Explain why.

---**[1]**

(iii) Fatimah and Sam want to make the reaction between iron powder and dilute hydrochloric acid **faster**.

They do not want to change the mass of the iron powder or the volume of acid.

Write about **three** ways they can make the reaction faster.

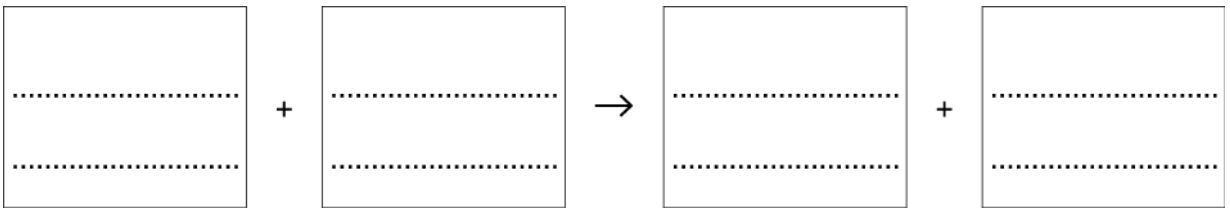
---**[3]**

12. Fertilisers are made by reacting an acid with an alkali.

This is a neutralisation reaction.

(i) Potassium hydroxide reacts with nitric acid.

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



[2]

(ii) One way to find out the pH of a solution of fertiliser is by using a pH meter.

Write about one **other** way to find the pH.

---**[2]**

13(a). Hydrochloric acid, HC*l*, reacts with calcium carbonate, $CaCO_3$.

Calcium chloride, $CaCl_2$, carbon dioxide and water are made.

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

[2]

(b). An acid reacts with a base to make a salt and water.

acid + base → salt + water

Look at the table. It shows some acids, bases and the salts made from them.

Acid	**Base**	**Salt**
sulfuric acid	copper oxide	copper sulfate
nitric acid	sodium carbonate	_____
_____	zinc oxide	zinc chloride
sulfuric acid	_____	magnesium sulfate

Complete the table.

[3]

14.

(i) Iron rusts in damp air.

Rust is hydrated iron(III) oxide.

Write the **word** equation for the rusting of iron.

[1]

(ii) The rusting of iron is an **oxidation** reaction.

Explain why.

[1]

15(a). A bottle contains a solution.

The label has fallen off the bottle.

Sophia wants to find out the pH of the solution in the bottle.

Describe how she can do this.

---

[2]

(b). An acid reacts with a base to make a salt and water.

acid + base → salt + water

Look at the table. It shows some acids, bases and the salts made from them.

Acid	**Base**	**Salt**
sulfuric acid	copper oxide	copper sulfate
nitric acid	sodium carbonate	_____
_____	zinc oxide	zinc chloride
sulfuric acid	_____	magnesium sulfate

Complete the table.

[3]

16. This question is about acids.

Nitric acid is a strong acid and propanoic acid is a weak acid.

David investigates the reaction of both of these acids with calcium carbonate.

Both acids react with calcium carbonate to make a gas.

What is the name of this gas?

Choose from

carbon dioxide

carbon monoxide

hydrogen

nitrogen

propane

answer _____ **[1]**

17. Hydrochloric acid is a **strong** acid.

Ethanoic acid is a **weak** acid.

Both acids contain hydrogen ions, H^+.

Explain why hydrochloric acid is a strong acid and ethanoic acid is a weak acid.

---

[2]

18. Iron rusts in the presence of oxygen and water.

Look at the equations for two reactions that happen during rusting.

$$Fe - 2e^- \rightarrow Fe^{2+}$$

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$$

Which reaction is oxidation and which is reduction?

Explain your answer.

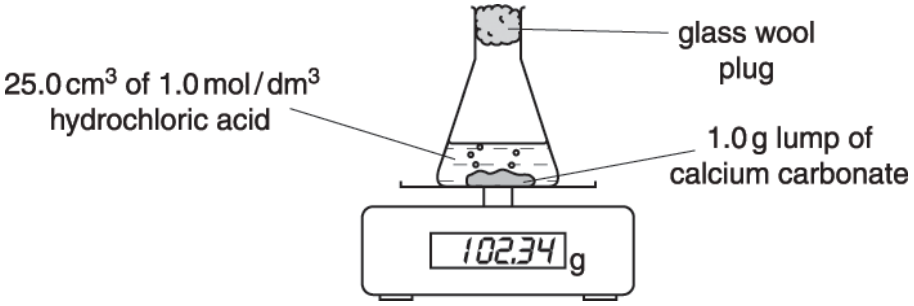
---

[2]

19. Debbie places a 1.0 g lump of calcium carbonate into a flask.

She adds 25.0 cm^3 of 1.0 mol / dm^3 hydrochloric acid to the flask.

She puts the flask on top of an electronic balance.



This apparatus can be used to find the mass of carbon dioxide made during the reaction.

Debbie repeats the experiment.

This time she uses 25.0 cm^3 of 1.0 mol / dm^3 **ethanoic acid** instead of hydrochloric acid.

The reaction is much slower because ethanoic acid is a weak acid.

Explain why weak acids react **more slowly** than strong acids.

---

[1]

20(a). Chlorine reacts with sodium bromide solution.

Look at the **ionic** equation for this reaction.

$$Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$$

Explain why chlorine is **reduced** in this reaction.

---

[1]

(b). Chlorine also reacts with potassium iodide solution, KI.

Iodine and potassium chloride are made.

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

[2]

21(a). Hydrochloric acid is a strong acid.

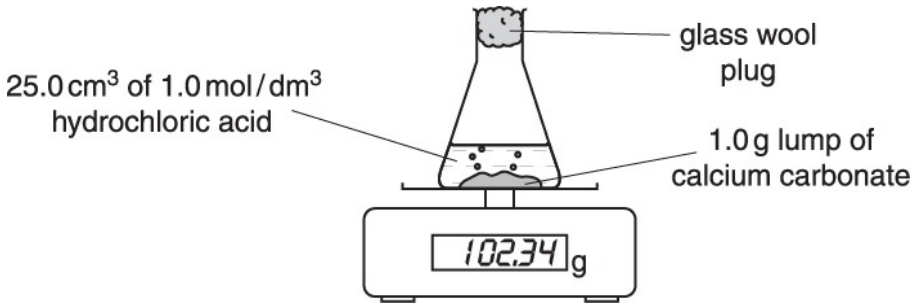
Hydrochloric acid reacts with calcium carbonate.

calcium carbonate + hydrochloric acid → calcium chloride + carbon dioxide + water

Debbie places a 1.0 g lump of calcium carbonate into a flask.

She adds 25.0 cm^3 of 1.0 mol / dm^3 hydrochloric acid to the flask.

Debbie puts the flask on top of an electronic balance.



What happens to the reading on the balance during the reaction?

Explain your answer.

---

[2]

(b). Debbie repeats the experiment.

This time she uses 25.0 cm^3 of 1.0 mol / dm^3 **ethanoic acid** instead of hydrochloric acid.

Her results are different this time.

How are the results different?

Explain your answer.

---

[2]

22(a). During the electrolysis of sodium bromide solution, bromide ions make bromine molecules.

Complete the equation for this reaction.

..... Br^- – .....e^- → Br_2

[1]

(b). Explain why this reaction is an example of **oxidation**.

---

[1]

23. Hilary investigates the reaction between magnesium and hydrochloric acid.

Magnesium chloride and hydrogen are made.

Write down the **word** equation for this reaction.

---

[1]

24. During the electrolysis of sodium chloride solution, the chloride ions are turned into chlorine molecules.

(i) Complete the equation for this reaction.

$$\_\_\_\_\_ Cl^- \_\_\_\_\_ e^- \rightarrow Cl_2$$

[1]

(ii) Is this reaction **oxidation** or **reduction**?

Explain how you can tell from the equation.

---

[1]

25. Aluminium, A?, reacts with sulfuric acid, H_2SO_4.

Aluminium sulfate, $A?_2(SO_4)_3$, and hydrogen, H_2, are made.

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

---

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			Neutralisation (1)	1	
			Total	**1**	
2			B	1	
			Total	**1**	
3			The oxidising agent is **oxygen** and the reducing agent is **magnesium** (1)	1	
			Total	**1**	
4	a		**Any four from:** idea that an excess of zinc oxide must be added (1) so reaction is complete / all nitric acid is reacted (1) filter off excess zinc oxide (1) evaporate off some of the water (1) allow to crystallise (1)	4	
	b		reaction between nitric acid (HNO_3), an acid and zinc oxide (ZnO), a base (1) to make zinc nitrate ($Zn(NO_3)_2$, a salt and water (only) (1)	2	Only award marks if reactions and products are named in the answer **ALLOW** the use of just chemical formulae
			Total	**6**	
5			C	1	
			Total	**1**	
6			B	1	
			Total	**1**	
7		i	Titrate ammonia against sulfuric acid to obtain volumes needed for complete neutralisation (1) Add these volumes without the use of indicator (1) Slow evaporation of reaction mixture / heat reaction mixture over a steam bath (1) Burette and other chemical apparatus not suitable for using large quantities / very difficult to use a steam bath in the large scale (1)	4	**ALLOW** heat neutral mixture with carbon or charcoal and then filter off carbon **ALLOW** Slow evaporation of filtrate / heat filtrate over a steam bath if method involving carbon is used

Question			Answer/Indicative content	Marks	Guidance
		ii	34 (g or tonnes) of ammonia makes 132 (g or tonnes) of ammonium sulfate / 17 (g or tonnes) of ammonia makes 66 (g or tonnes) of ammonium sulfate (1) So 51 tonnes makes 198 tonnes of ammonium sulfate (1)	2	**ALLOW** one mark for correct calculation of M_r for ammonia **AND** ammonium sulfate **IGNORE** units for the first marking point **ALLOW** one mark for 2 moles of ammonia makes 1 mole of ammonium sulfate
			Total	**6**	
8			add universal indicator solution / pH paper (1) identify colour produced (1) match to colour chart to determine pH (1)	3	
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
9			**Level 3** **Correct word and symbol equation AND** **explanation that reaction involves both oxidation and reduction.** Quality of communication does not impede communication of science at this level. (5 – 6 marks) **Level 2** **Correct word and symbol equation OR** **explanation that reaction involves both oxidation and reduction.** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Correct word equation OR** **Correct symbol equation OR** **Correct statement about OIL RIG OR** **explains why iron is oxidised OR** **explains why copper ions are reduced.** Quality of communication impedes communication of the science at this level. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A*** **Indicative scientific points at levels 3 must include:** • $Fe + CuSO_4$? $FeSO_4 + Cu$ • oxidation because Fe loses electrons – could be shown as a half equation • reduction because Cu^{2+} gains electrons – could be show as a half equation **Indicative scientific points for all levels could include:** • oxidation is loss of electrons (OIL) • reduction is gain of electrons (RIG) • electrons are transferred • iron + copper(II) sulfate ? copper + iron(II) sulfate **ignore** missing oxidation states in the names **do not allow** copper(II) instead of copper in RHS of equation **Use the L1, L2, L3 annotations in Scoris, do not use ticks** **Examiner's Comments** This six mark question was about oxidation and reduction in a displacement reaction. Candidates had to construct both a word and a symbol equation and to obtain level 3 explain why the reaction involved both oxidation and reduction. Many candidates could write the two equations but a common misconception was to refer to the element copper as copper(II) and use the oxidation numbers in the formulae writing 'Fe_2SO_4' and 'Cu_2SO_4'. The concept of OIL RIG was often well known but candidates had real difficulty applying this information Candidates needed to be precise when

Question			Answer/Indicative content	Marks	Guidance
					explaining the species oxidised and the one reduced. It was important that it was the iron losing electrons and the copper ions gaining electrons. The best answers made this clear by the use of the appropriate half-equations.
			Total	**6**	
10			**any two from:** medicines ? idea of avoiding overdose / avoiding harm (1) idea of getting correct concentration (1) baby milk – idea of (to get correct concentration) to avoid harming the baby (1)	2	 **ignore** can have too many chemicals or preservatives **ignore** progressively dilute heroin to wean addicts off the drug **allow** idea that doses are weaker or could be harmful if left undiluted (1) **Examiner's Comments** Good responses described the ideas of diluting medicines to avoid an overdose and diluting baby milk to avoid harming the baby.
			Total	**2**	

Question			Answer/Indicative content	Marks	Guidance
11		i	zinc has a greater gradient / iron has a smaller gradient (1) less gas is made with zinc / more gas is made with iron (1)	2	**allow** reaction with zinc is faster / reaction with iron is slower / takes less time to react **Examiner's Comments** This question was about the reactions of zinc and iron with hydrochloric acid. Candidates in (i) had little difficulty interpreting the two graphs and could describe two differences focusing on the difference in the rate of reaction and the total volume of gas being made at the end of the reaction.
		ii	Powder has more surface area / more collisions (per second) / more exposed particles (1)	1	assume answers refer to powder unless lump is specified **allow** or a lump has less surface area / less collisions (per second) / less exposed particles **Examiner's Comments** This question was about the reactions of zinc and iron with hydrochloric acid. The idea that a powder has a larger surface area was well understood in (ii) and some candidates also referred to more collisions.
		iii	**any three from:** higher temperature / heat (1) greater concentration (1) add a catalyst (1) use a finer powder (1) shake or stir (1)	3	**ignore** increase pressure **Examiner's Comments** This question was about the reactions of zinc and iron with hydrochloric acid. In (iii) candidates often gave at least two ways of speeding up the reaction. The most common answers were adding a catalyst or having a higher temperature. Candidates sometimes explained the factor but there were no marks available in the mark scheme for explanations.
			Total	**6**	

Question			Answer/Indicative content	Marks	Guidance
12		i	potassium hydroxide + nitric acid → potassium nitrate + water one correct product: potassium nitrate / water (1) remainder of word equation correct(1)	2	equation must be totally correct for 2 marks **allow** correct formulae or mix of names and formulae i.e. $KOH + HNO_3$? $KNO_3 + H_2O$ **allow** hydrogen oxide **Examiner's Comments** This question was about fertilisers. Candidates found writing the word equation challenging and often could write the left hand side but could not name the correct products.
		ii	add a few drops of universal indicator to solution (1) check against colour chart / idea that colour indicates pH (1)	2	**allow** use pH paper / pH indicator **not** litmus **allow** specific reference to colour and pH e.g. green is pH 7 **allow** second marking point even if incorrect indicator is used **Examiner's Comments** This question was about fertilisers. The use of Universal Indicator was well known and candidates often appreciated the need to check against a colour chart. Some candidates described the use of litmus or methyl orange indicators rather than Universal Indicator.
			Total	**4**	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>13</td><td>a</td><td></td><td>$CaCO_3$ + 2HCl ? $CaCl_2$ + CO_2 + H_2O

formulae correct (1)
balancing (1)</td><td>2</td><td>balancing mark is dependent on correct formulae
but
allow one mark for balanced equation with minor errors of subscripts, superscripts, etc
eg
$CACO_3$ + 2HCl ? $CaCl^2$ + CO_2 + H2O

not and or & for +
allow = instead of ?
allow correct multiples eg
$2CaCO_3$ + 4HCl ? $2CaCl_2$ + $2CO_2$ + $2H_2O$

Examiner's Comments

Candidates were able to balance the symbol equation, given the formulae. They found balancing the ionic equation.</td></tr>
<tr><td></td><td>b</td><td></td><td><table><tr><th>acid</th><th>base</th><th>salt</th></tr><tr><td>sulfuric acid</td><td>copper oxide</td><td>copper sulfate</td></tr><tr><td>nitric acid</td><td>sodium carbonate</td><td>sodium nitrate (1)</td></tr><tr><td>hydrochloric acid (1)</td><td>zinc oxide</td><td>zinc chloride</td></tr><tr><td>sulfuric acid</td><td>magnesium oxide / magnesium hydroxide / magnesium carbonate (1)</td><td>magnesium sulfate</td></tr></table></td><td>3</td><td>allow correct formulae i.e.
$NaNO_3$ (1)

HCl (1)

MgO / $Mg(OH)_2$ / $MgCO_3$ (1)

Examiner's Comments

This question was about fertilisers.

Many candidates were awarded the marks for sodium nitrate and magnesium oxide (or carbonate). Hydrochloric acid was less well known, with chloric acid being a common response.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
14		i	iron + water + oxygen ? hydrated iron(III) oxide (1)	1	order of reactants is unimportant **allow** hydrated iron oxide **not** iron(III) oxide / iron oxide **ignore** incorrect oxidation state **allow** Fe + H_2O + O_2 ? $Fe_2O_3.xH_2O$ (1) **allow** mix of correct formulae and words **Examiner's Comments** This question focused on the corrosion of metals. The word equation in part (i) was completed well by most candidates, with most incorrect responses failing to include one of the reactants.
		ii	involves reaction with oxygen / forms an oxide (1)	1	**allow** addition of oxygen (1) **allow** (iron) loses electrons / (iron) loses an electron (1) **allow** oxidation number (of iron) increases (1) **Examiner's Comments** This question focused on the corrosion of metals. In part (ii) the most common correct response made reference to iron losing electrons. The mnemonic 'OILRIG' is well known.
			Total	**2**	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>15</td><td>a</td><td></td><td>add universal indicator (paper or solution) (1)

match colour to test card (1)</td><td>2</td><td>allow pH paper
allow use a pH meter (2)

2nd mark is dependent on 1st being awarded
allow colour corresponds to a pH value (1)
allow correct colours in acid and / or alkali (1)
ignore to see what colour it goes

Examiner's Comments

A number of candidates quoted the use of litmus rather than universal indicator and failed to score. Only the best candidates scored both marks.</td></tr>
<tr><td></td><td>b</td><td></td><td><table><tr><th>acid</th><th>base</th><th>salt</th></tr><tr><td>sulfuric acid</td><td>copper oxide</td><td>copper sulfate</td></tr><tr><td>nitric acid</td><td>sodium carbonate</td><td>sodium nitrate (1)</td></tr><tr><td>hydrochloric acid (1)</td><td>zinc oxide</td><td>zinc chloride</td></tr><tr><td>sulfuric acid</td><td>magnesium oxide / magnesium hydroxide / magnesium carbonate (1)</td><td>magnesium sulfate</td></tr></table></td><td>3</td><td>allow correct formulae i.e.
$NaNO_3$ (1)

HCl (1)

MgO / $Mg(OH)_2$ / $MgCO_3$ (1)

Examiner's Comments

This question produced a spread of marks and differentiated well. Most candidates correctly deduced magnesium oxide as the base. The production of sodium nitrate was less well known and the hydrochloric acid least well known. ‘Chloric acid’ was a common misconception.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
16			carbon dioxide (1)	1	**allow** CO_2 (1) **allow** correct answer circled, underlined or ticked in list if answer line is blank **Examiner's Comments** The most common incorrect answer was ' carbon monoxide'. 'Nitrogen' and 'propane' also featured regularly.
			Total	**1**	
17			strong acid is fully ionised (in water) (1) weak acid is only partially ionised (1)	2	**allow** dissociated for ionised **Examiner's Comments** Some candidates gave good definitions based in comparing the degree of ionisation. Good answers stated that hydrochloric acid fully dissociated and ethanoic acid only partially dissociated. Marks were not awarded for candidates who only referred to the number of hydrogen ions present or to differences in pH.
			Total	**2**	
18			iron or top reaction loses **electrons** which is oxidation (1) oxygen or bottom reaction gains **electrons** which is reduction (1)	2	no mark for identifying which reaction is oxidation and which is reduction **allow** water gains electrons which is reduction **Examiner's Comments** Most candidates used the concept of Oil Rig and were able to identify that iron is oxidised and oxygen is reduced. Only a small proportion of candidates did not give a reason for their choice.
			Total	**2**	

Question			Answer/Indicative content	Marks	Guidance
19			**any one from:** fewer collisions (1) less crowded particles (1) fewer hydrogen ions / less concentrated H^+ (1)	1	**ignore** any extra qualification about collisions **but not** particles have more energy fewer ions / fewer particles is **not** sufficient **not** atoms or molecules as particles if particles are named **allow** weak acids do not fully ionise (but strong acids do) / weak acids do not completely dissociate (but strong acids do) / weak acids are less ionised **allow** ora if strong acid specifide **Examiner's Comments** Candidates often referred to ethanoic acid being only partially dissociated. Other candidates referred to the lower concentration of hydrogen ions or less collisions.
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
20	a		(chlorine molecule) gains electron(s) (1)	1	**Examiner's Comments** The concept of Oil Rig was well understood so many candidates referred to chlorine gaining electrons.
	b		$Cl_2 + 2KI \rightarrow 2KCl + I_2$ **OR** $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ correct formulae (1) correct balancing – dependent on correct formulae (1)	2	**ignore** state symbols **allow** = instead of ? **allow** any correct multiple including fractions **not** & or and instead of + **allow** one mark for correct equation with minor errors of subscript, superscript and case eg $cl2 + 2KI \rightarrow 2KCl + I^2$ **Examiner's Comments** Candidates found the balanced symbol equation very challenging. Many candidates were not able to recall the formula of potassium chloride or iodine. A typical error was to give the formula of iodine as I and of potassium chloride as KCl2. A small number of candidates gave the ionic equation for this reaction which was given full credit in the mark scheme.
			Total	**3**	

Question			Answer/Indicative content	Marks	Guidance
21	a		reading decreases (1) (because) a gas is made / carbon dioxide is made (1)	2	**2nd mark is dependent on decreases not** the name of an incorrect gas **Examiner's Comments** Only better candidates realised that the mass would decrease as a gas was given off which could escape from the flask. Many candidates thought that the mass would increase as the gas would not escape. The ideas around conservation of mass are not well understood by a significant number of candidates.
	b		reaction is slower / reading on balance decreases more slowly (1) ethanoic acid is a weak acid / fewer collisions / fewer hydrogen ions (1)	2	**allow** idea that reaction takes longer (1) **allow** has not decreased as much (in the same time) (1) **ignore** a longer rate of reaction **allow** ethanoic acid is not as strong as hydrochloric acid (1) **Examiner's Comments** This question was poorly answered by all but the best candidates. Better candidates recognised that the reaction with ethanoic acid would be slower because ethanoic acid is a weak acid. Many thought that ethanoic acid would react faster as it would react more strongly. Others just said that the reaction would be different because the reactants are different.
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
22	a		**2**$Br^{?}$ - **2**$e^{?}$? Br_2(1)	1	**allow** any correct multiple, including fractions **not** any additional symbols, other than balancing **Examiner's Comments** Most candidates correctly balanced the equation.
	b		(oxidation because) electrons are lost (from $Br^{?}$) (1)	1	**allow** oxidation number of Br increases (1) **not** bromine (atoms) lose electrons **but allow** ions lose electrons (1) **Examiner's Comments** Most candidates explained that oxidation is loss of electrons. Candidates who did not gain credit either stated that electrons were gained, or suggested that the wrong species was losing electrons, e.g. bromine loses electrons.
			Total	**2**	
23			magnesium + hydrochloric acid ? magnesium chloride + hydrogen (1)	1	**allow** = for ? **not** and or & for + **allow** mix of correct formulae and words in an unbalanced equation eg Mg + HC*l* ? Mg$C\mathit{l}_2$ + H_2 **Examiner's Comments** Word equation was correctly written down by most candidates.
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
24		i	**2**C*l*$^-$? **2**e$^-$? Cl_2 (1)	1	**allow** any correct multiple, including fractions **Examiner's Comments** The majority of candidates correctly balanced the equation. The most common errors were balancing with the number '4' or completing the gaps with 'Na' and 'C*l*'.
		ii	oxidation because electrons are lost (1)	1	**allow** oxidation number of C*l* increases / oxidation number of C*l* goes from ?1 to 0 (1) **not** chlor**ine** loses electrons or chlor**ine** ions lose electrons **Examiner's Comments** Most candidates explained that the reaction was oxidation because electrons are lost. Candidates who failed to gain credit often suggested that the wrong species was losing electrons, e.g. chlorine, or chlorine ions, loses electrons.
			Total	**2**	

Question			Answer/Indicative content	Marks	Guidance
25			$2A? + 3H_2SO_4 \; ? \; A?_2(SO_4)_3 + 3H_2$ formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae **allow** any correct multiple e.g. $4A? + 6H_2SO_4 \; ? \; 2A?_2(SO_4)_3 + 6H_2$ **allow** = or ? for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with incorrect use of upper and lower case formulae e.g. $2A? + 3H_2SO_4 \; ? \; A?2(So_4)_3 + 3H_2$ **Examiner's Comments** This question required candidates to write a balanced symbol equation for the reaction of aluminium with sulfuric acid. One mark was awarded for the correct reactants and products and 1 mark for the correct balancing. The balancing mark was dependent on the correct formulae, but 1 mark was allowed for a balanced equation with a minor error in subscripts or formulae. When candidates did not gain marks it was often because they tried to balance the equation by writing Al_2 or H_23SO_4.
			Total	**2**	