

Answer **all** the questions.

1. DNA is a condensation polymer made from monomers called nucleotides.

How many different nucleotides are used to make DNA molecules?

- A 2
- B 3
- C 4
- D 5

Your answer

[1]

2. Ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$, is a fertiliser.

Ammonium sulfate can be manufactured from ammonia and sulfuric acid.

Sulfuric acid is manufactured in a series of steps.

Step 1:

Sulfur is burnt in oxygen to produce sulfur dioxide.

Step 2, The Contact Process:

Sulfur dioxide is reacted with oxygen to produce sulfur trioxide. This takes place in the presence of vanadium(V) oxide at a pressure of 2 atmospheres and at about 450°C .

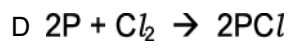
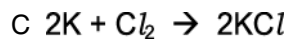
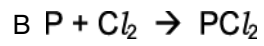
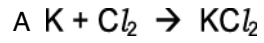
Step 3:

Sulfur trioxide is reacted with water to produce sulfuric acid.

Write balanced symbol equations for each stage of this process.

[4]

3. Which of these shows the balanced symbol equation for the reaction between potassium and chlorine to make potassium chloride?

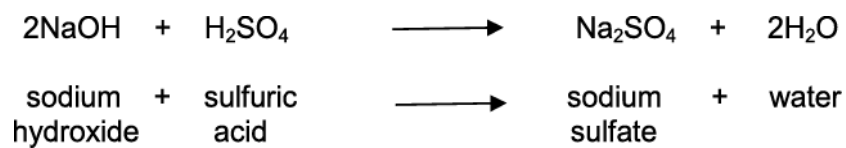


Your answer

[1]

4. Look at the equation.

It shows the reaction between sodium hydroxide and dilute sulfuric acid.



Calculate the mass of sodium hydroxide needed to make 30.0 g of sodium sulfate.

Give your answer to three significant figures.

Mass of sodium hydroxide = ----- g

[3]

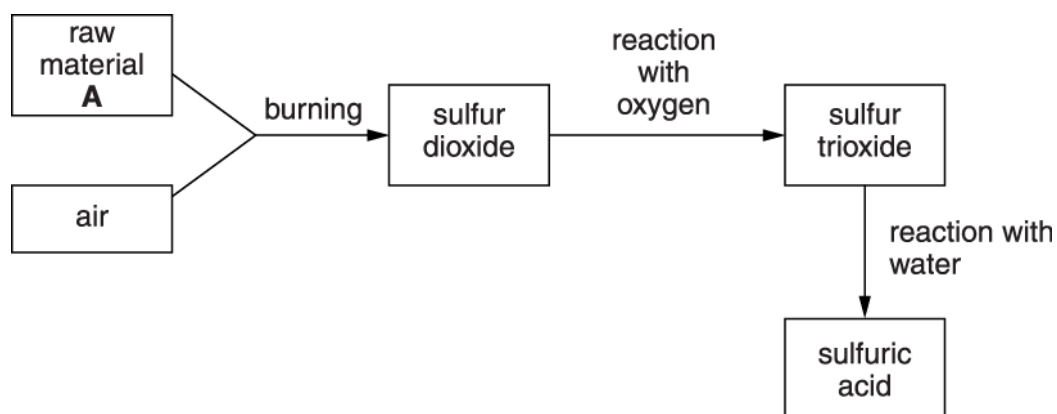
5. Zinc nitrate can be made by reacting zinc oxide with nitric acid, HNO_3 .

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

----- [2]

6. This question is about the Contact Process used for the manufacture of sulfuric acid.

Look at the flow chart for the process.



In the process, sulfur dioxide, SO_2 , reacts with oxygen, O_2 , to make sulfur trioxide, SO_3 .

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

----- [2]

7. Zinc reacts with hydrochloric acid.

Hydrogen gas and zinc chloride are made.

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

----- [1]

8.

(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.

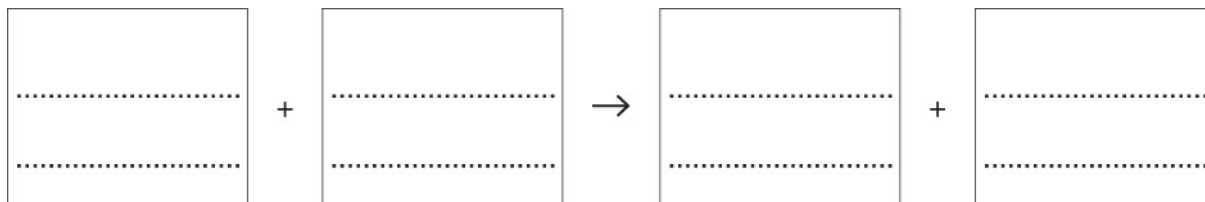
----- [1]

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

This is a neutralisation reaction.

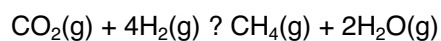
Potassium hydroxide reacts with nitric acid.

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



[2]

10. Methane is a fuel that can be made by the reaction between carbon dioxide and hydrogen.

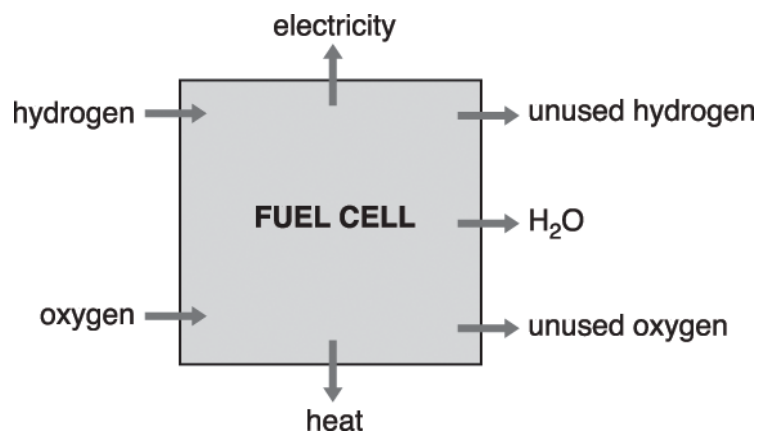


What is the meaning of (g) in the equation?

----- [1]

11. Fuel cells are used to make electricity.

Look at the diagram. It shows what happens in a fuel cell.



In this fuel cell, hydrogen, H₂, reacts with oxygen, O₂.

Water, H₂O, is made.

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

----- [2]

12. CFCs have now been replaced by HFCs.

The formula of one HFC is $C_2H_2F_4$.

(i) Write down the names of the three **elements** in $C_2H_2F_4$.

----- [1]

(ii) Write down the **total number of atoms** in one molecule of $C_2H_2F_4$.

answer -----

[1]

13. Copper hydroxide decomposes when heated. Copper oxide and water are made.

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

----- [1]

14. Glucose reacts to make carbon dioxide and ethanol.

Look at the formulas.

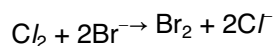
Substance	Formula
glucose	$C_6H_{12}O_6$
carbon dioxide	CO_2
ethanol	C_2H_5OH

Write down the **balanced symbol** equation for this reaction.

----- [2]

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

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



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]

16. Bromine reacts with sodium. Sodium bromide is made.

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

----- [1]

17. Hilary investigates the reaction between magnesium, Mg, and hydrochloric acid, HCl.

Magnesium chloride, MgCl_2 , and hydrogen, H_2 , are made.

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

----- [2]

18. The LPG fraction of crude oil contains propane gas, C₃H₈.

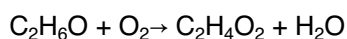
Write a **balanced symbol** equation for the **incomplete** combustion of propane in oxygen, O₂.

Only carbon monoxide, CO, and water are made.

[2]

19. Ethanoic acid, C₂H₄O₂, can be made by several different processes.

Ethanol can be oxidised using oxygen.



Mike knows that 46 tonnes of ethanol should make 60 tonnes of ethanoic acid.

A factory uses 4.6 tonnes of ethanol.

Predict the mass of ethanoic acid that should be made.

predicted mass of ethanoic acid = ----- tonnes

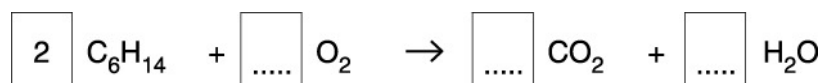
[1]

20. Hexane is one of the hydrocarbons found in petrol.

Hexane completely burns in excess air.

Look at the symbol equation for this reaction.

Balance the equation by putting numbers in the boxes.



[2]

21. Sam makes some copper.

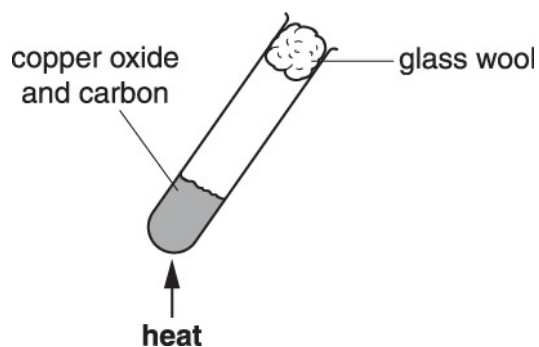
(i) Sam heats copper oxide, CuO , with carbon, C .

Copper, Cu , and carbon dioxide, CO_2 , are made.

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

[2]

(ii) Look at the diagram. It shows the apparatus he uses.



Sam measures the mass of the test tube and its contents before and after heating.

The mass of the test tube and its contents **decreases**.

Suggest why.

[1]

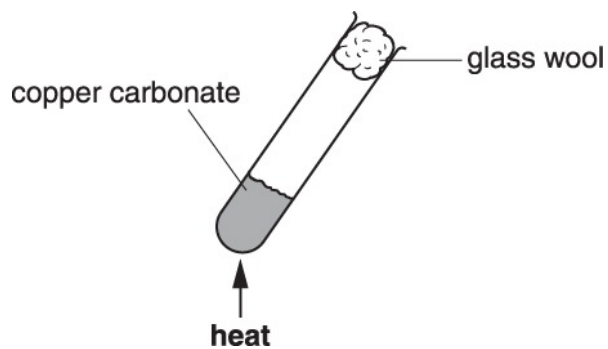
22(a). John and Sue investigate the decomposition of copper carbonate.

Copper carbonate, CuCO_3 , breaks down into copper oxide, CuO , and carbon dioxide, CO_2 .

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

----- [1]

(b). Look at the diagram. It shows the apparatus they use.



They measure the contents of the test tube before and after heating.

Look at their results.

	Mass in g
mass of contents before heating	12.40
mass of contents after heating	8.00

(i) Calculate the mass of **carbon dioxide** made.

answer ----- g

[1]

(ii) John and Sue repeat the experiment.

This time they use **24.80 g** of copper carbonate.

Calculate the mass of **carbon dioxide** they make this time.

answer ----- g

[1]

23. Bornite is a mineral extracted from the Earth.

Bornite has the chemical formula Cu_5FeS_4 .

How many different **elements** are in Cu_5FeS_4 ?

----- [1]

24(a). Some power stations burn coal.

Coal often contains **sulfur** as an impurity.

The sulfur reacts with oxygen to make sulfur dioxide.

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

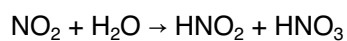
----- [1]

(b). Nitrogen dioxide is also made in a power station.

To stop the nitrogen dioxide going into the atmosphere it is reacted with water.

Nitrogen dioxide reacts with water to make two acids.

Copy out and **balance** the **symbol equation** for this reaction.



----- [1]

END OF QUESTION PAPER

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
1		C	1	
		Total	1	
2		$S + O_2 \rightarrow SO_2$ (1) $2SO_2 + O_2 \rightleftharpoons 2SO_3$ (1) $SO_3 + H_2O \rightarrow H_2SO_4$ (1)	4	One mark for each correct balanced equation One mark for reversible reaction sign
		Total	4	
3		C	1	
		Total	1	
4		16.9 (g) scores (3) but if answer incorrect then RFM of NaOH = 40.0 and RFM of Na ₂ SO ₄ = 142.1 (1) idea that 2 moles of NaOH react to produce 1 mole of Na ₂ SO ₄ (1)	3	ALLOW 16.89 (2) ALLOW ecf from incorrect RFMs
		Total	1	
5		$ZnO + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2O$ correct formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae ALLOW any correct multiple e.g. $2ZnO + 4HNO_3 \rightarrow 2Zn(NO_3)_2 + 2H_2O$ (2) ALLOW = or Δ or ⇌ for arrow DO NOT ALLOW 'and' or & for + ALLOW one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $ZnO + 2HNO^3 \square Zn(NO_3)_2 + H_2$
		Total	2	
6		$2SO_2 + O_2 \rightleftharpoons 2SO_3$ formulae (1)	2	allow any correct multiple e.g. $4SO_2 + 2O_2 \rightleftharpoons 4SO_3$ (2)

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
		balancing conditional on correct formulae (1)		<p>allow = or ? for arrow not 'and' or & for + allow one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ (1)</p> <p>Examiner's Comments</p> <p>Many candidates were able to write the correct balanced symbol equation for the reaction of sulfur dioxide with oxygen to make sulfur trioxide. 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 the product as SO_4.</p>
		Total	2	
7		zinc + (dilute) hydrochloric acid \rightarrow zinc chloride + hydrogen	1	<p>any order for reactants</p> <p>any order for products</p> <p>allow unbalanced symbol equation e.g. $\text{Zn} + \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$ allow mix of name and correct formula</p> <p>Examiner's Comments</p> <p>This question was about the reactions of zinc and iron with hydrochloric acid.</p> <p>Most candidates could write the word equation for the reaction between zinc and hydrochloric acid.</p>
		Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8		i	iron + water + oxygen ? hydrated iron(III) oxide (1)	1	<p>order of reactants is unimportant</p> <p>allow hydrated iron oxide not iron(III) oxide / iron oxide ignore incorrect oxidation state</p> <p>allow $\text{Fe} + \text{H}_2\text{O} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (1)</p> <p>allow mix of correct formulae and words</p> <p>Examiner's Comments</p> <p>This question focused on the corrosion of metals.</p> <p>The word equation in part (i) was completed well by most candidates, with most incorrect responses failing to include one of the reactants.</p>
		ii	involves reaction with oxygen / forms an oxide (1)	1	<p>allow addition of oxygen (1) allow (iron) loses electrons / (iron) loses an electron (1) allow oxidation number (of iron) increases (1)</p> <p>Examiner's Comments</p> <p>This question focused on the corrosion of metals.</p> <p>In part (ii) the most common correct response made reference to iron losing electrons. The mnemonic 'OILRIG' is well known.</p>
			Total	2	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
9		<p>potassium hydroxide + nitric (acid) → potassium nitrate + water</p> <p>one correct product, ie potassium nitrate / water (1)</p> <p>rest of word equation correct (1)</p>	2	<p>equation must be totally correct for 2 marks</p> <p>allow correct formulae or mix of names and formulae i.e. KOH + HNO₃ ? KNO₃ + H₂O</p> <p>allow hydrogen oxide</p> <p><u>Examiner's Comments</u></p> <p>This question was about fertilisers.</p> <p>Common misconception in this question were potassium nitroxide and nitrogen hydroxide as products of the reaction.</p>
		Total	2	
10		gas (1)	1	<p><u>Examiner's Comments</u></p> <p>Less than half of candidates understood that (g) is the state symbol for a gas. 'Grams' was a very common incorrect answer.</p>
		Total	1	
11		<p>2H₂ + O₂ ? 2H₂O</p> <p>correct formulae (1)</p> <p>balancing (1)</p> <p>balancing mark is conditional on correct formulae</p>	2	<p>allow any correct multiple e.g. 4H₂ + 2O₂ ? 4H₂O (2)</p> <p>allow = or ? for arrow</p> <p>not 'and' or & for +</p> <p>allow one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. 2h₂ + O² ? 2H₂O (1)</p> <p><u>?Examiner's Comments?</u></p> <p>Many candidates could write the balanced equation for the reaction of hydrogen and oxygen to make water.</p>
		Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12		i	carbon, hydrogen and fluorine (1)	1	<p>all three required allow any order ignore symbols not fluoride</p> <p>Examiner's Comments</p> <p>This question was well answered. Most candidates identified carbon, hydrogen and fluorine in part (i). Occasionally chlorine was incorrectly stated. Most identified 8 atoms in part (ii). Weaker candidates attempted to calculate the relative formula mass.</p>
		ii	8 (1)	1	
			Total	2	
13			copper hydroxide ? copper oxide + water (1)	1	<p>allow steam for water</p> <p>allow correct formulae and mix of formulae and names the equation does not need to be balanced $\text{Cu}(\text{OH})_2 ? \text{CuO} + \text{H}_2\text{O}$ (1)</p> <p>allow heat above arrow not copper hydroxide + heat ? copper oxide + water</p> <p>Examiner's Comments</p> <p>Better candidates correctly wrote this word equation. A significant number of candidates lost the mark as they included ' + heat' on the left hand side of the equation.</p>
			Total	1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
14		$C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$ formulae (1) balancing - dependent on correct formulae (1)	2	<p>allow C_2H_6O as formula for ethanol allow any correct multiple e.g. $2C_6H_{12}O_6 \rightarrow 4CO_2 + 4C_2H_5OH$ allow = or ? for arrow not 'and' or & for + allow one mark for correct balanced equation with minor errors of case, subscript or superscript e.g. $C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$</p> <p>Examiner's Comments</p> <p>The best candidates invariably scored 2 marks on this question. They gave a correctly balanced symbol equation. Weaker candidates either failed to score or gave the correct formulae with either no attempt at balancing or incorrect balancing and scored 1 mark.</p>
		Total	2	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
15	a	(chlorine molecule) gains electron(s) (1)	1	<p>Examiner's Comments</p> <p>The concept of Oil Rig was well understood so many candidates referred to chlorine gaining electrons.</p>
	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	<p>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 $cl_2 + 2KI \rightarrow 2KCl + I^2$</p> <p>Examiner's Comments</p> <p>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.</p>
		Total	3	
16		sodium + bromine → sodium bromide (1)	1	<p>allow correct formulae i.e. $Na + Br_2 \rightarrow NaBr$ or mix of words and correct formulae If formulae used balancing is not necessary</p> <p>Examiner's Comments</p> <p>Most candidates could successfully write the word equation.</p>
		Total	1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
17		$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ formulae correct (1) balancing (1)	2	<p>allow any correct multiple, including fractions allow = / ? instead of ? not and / &</p> <p>balancing mark is dependent on the correct formula but allow 1 mark for a balanced equation with minor errors of case, subscripts, superscripts, etc $\text{Mg} + 2\text{HCL} \rightarrow \text{MgCl}_2 + \text{H}_2$</p> <p>Examiner's Comments</p> <p>Most candidates scored 2 marks for the correct balanced symbol equation. As before, 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 altering the formula for hydrochloric acid, i.e. H_2Cl_2.</p>
		Total	2	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
18		$C_3H_8 + 3\frac{1}{2}O_2 \rightarrow 3CO + 4H_2O$ formulae (1) balancing (1)	2	<p>allow any correct multiple, including fractions allow = / ? instead of ? not and / &</p> <p>balancing mark is dependent on the correct formula but allow 1 mark for a balanced equation with minor errors of case, subscripts, superscripts, etc eg $C_3H_8 + 3\frac{1}{2}O_2 \rightarrow 3CO + 4H_2O$</p> <p>Examiner's Comments</p> <p>This question required candidates to write a balanced symbol equation for the incomplete combustion of propane in oxygen. This was a challenging equation for candidates. 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 wrote an incorrect formula for carbon monoxide, e.g. CO_2, or failed to balance the oxygen atoms on the left hand side of the equation.</p>
		Total	2	
19		6 (1)	1	<p>unit not needed</p> <p>Examiner's Comments</p> <p>Candidates found this question more difficult than (a)(ii) because it involved the use of a ratio. Candidates rarely showed the working out used to get to the correct answer of 6.0 tonnes.</p>
		Total	1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
20		$2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$ right hand side correct (1) left hand side correct (1)	2	<p>Examiner's Comments</p> <p>Many candidates correctly balanced the equation. One mark was awarded for balancing the oxygen molecules and one mark for balancing the products. Where candidates scored only one mark it was usually for balancing the products.</p>
		Total	2	
21	i	$2CuO + C \rightarrow 2Cu + CO_2$ formulae correct (1) balancing (1)	2	<p>allow any correct multiple, including fractions allow = / ? instead of ? not and / & not '+ heat' in equation</p> <p>balancing mark is dependent on the correct formula but allow 1 mark for a balanced equation with minor errors of case, subscripts, superscripts, etc $2CuO + C \rightarrow 2CU + CO2$</p> <p>Examiner's Comments</p> <p>Was well answered.</p>
	ii	carbon dioxide given off (1)	1	<p>allow gas given off not the name of a wrong gas given off</p> <p>Examiner's Comments</p> <p>Was not well answered. An explanation of why the mass of the test tube and contents decreased was often attributed to evaporation. Change of state was another common answer.</p>
		Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
22	a		$\text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2$ (1)	1	<p>allow = for ? not and or & for + allow any correct multiples</p> <p>Examiner's Comments</p> <p>The balanced symbol equation was correctly written down by a number of candidates. A number reversed the equation and put copper carbonate as the product scoring no marks.</p>
	b	i	4.40 g (1)	1	<p>Examiner's Comments</p> <p>Was well answered.</p>
		ii	8.80 g (1)	1	<p>allow ecf from part (i) ie $2 \times$ answer (i)</p> <p>Examiner's Comments</p> <p>Required a deeper understanding of the figures and was found to be a difficult calculation.</p>
			Total	3	
23			3 / three (1)	1	<p>ignore Cu, Fe, S</p> <p>Examiner's Comments</p> <p>Many candidates could interpret the formula given and deduce that it contains three different elements. Some candidates gave answers that referred to the number of atoms in the formula instead.</p>
			Total	1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
24	a	sulfur + oxygen ? sulfur dioxide (1)	1	<p>allow $S + O_2 \rightarrow SO_2$ allow mix of formulae and names allow = in the equation not & or and instead of + not sulfur oxide but allow sulfur() oxide</p> <p>Examiner's Comments</p> <p>Most candidates could write the word equation. There were very few examples of answers where the candidate attempted a symbol equation.</p>
	b	$2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$	1	<p>allow in the question if answer line is blank</p> <p>ignore errors in case, subscript and superscript</p> <p>Examiner's Comments</p> <p>Candidates found this question very challenging. A significant proportion of the candidates changed the formulae given for example writing H_2O_2 rather than H_2O.</p>
		Total	2	