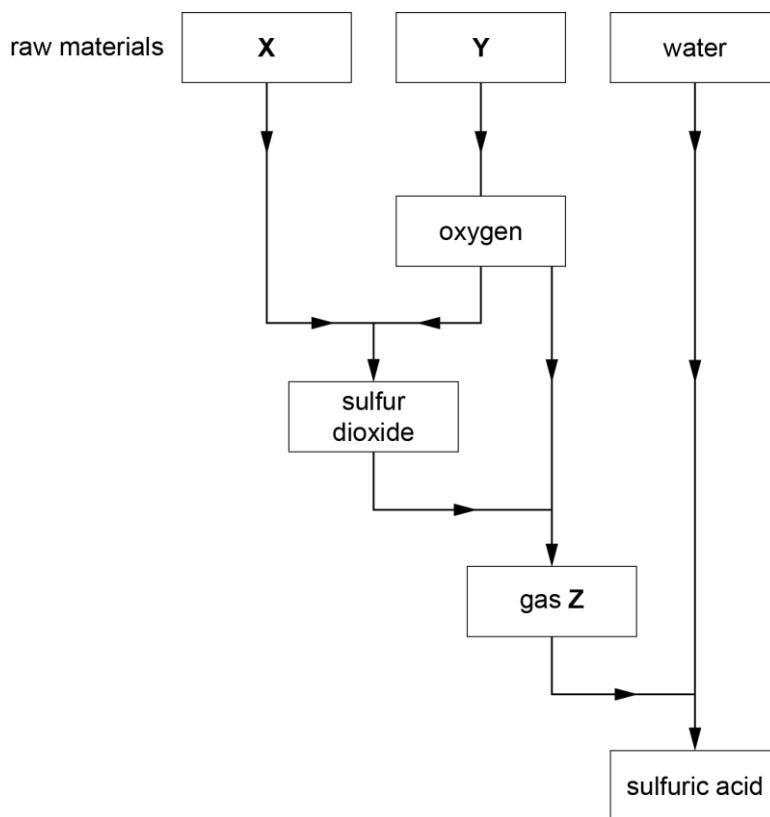


6 Sulfuric acid is made in the Contact Process.

Look at the flow chart. It shows all the stages in the Contact Process.



- (a) The three raw materials used in the Contact Process are at the top of the chart. Water is shown.

Write down the **names** of the other two raw materials (X and Y) and suggest why water is a good raw material.

.....

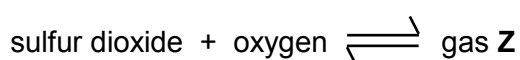
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..... [3]

- (b) Sulfur dioxide and oxygen react to give gas Z.



What is the name of gas Z?

..... [1]

[Total: 4]

7 This question is about acid-base titrations.

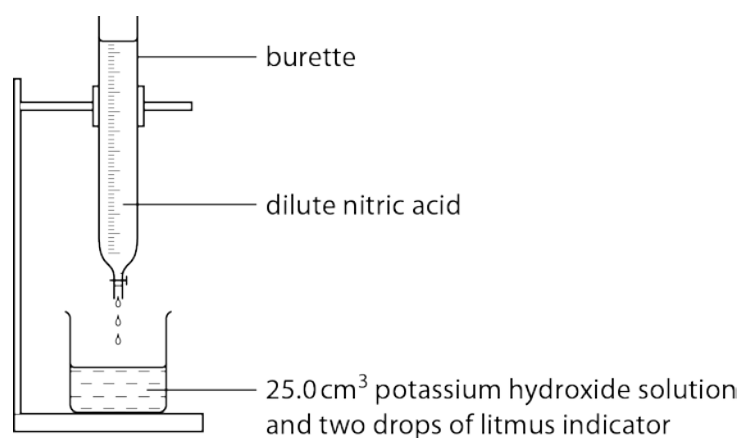
Issy decides to find out the volume of dilute nitric acid needed to neutralise 25.0 cm^3 of an alkali. She uses 0.100 mol/dm^3 potassium hydroxide solution.

(a) Issy measures 25.0 cm^3 of potassium hydroxide solution.

Write down the name of a piece of apparatus she can use.

.....[1]

(b) Look at the apparatus Issy uses to do her titrations.



She adds dilute nitric acid slowly until the end point is reached.

Describe what Issy sees when the end point of the titration has been reached.

.....
.....
..... [2]

- (c) She repeats the experiment two more times.

Look at Issy's results table.

titration number	1	2	3
final burette reading in cm^3	29.7	27.0	34.8
initial burette reading in cm^3	8.5	6.9	24.9
volume of acid used (titre) in cm^3	21.2		

- (i) Calculate the **mean** titre for titration numbers 2 and 3.

Give your answer to **one** decimal place.

.....

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.....

mean titre = cm^3 [2]

- (ii) Issy repeats the titration experiment with three more acids.

Look at the results.

acid	mean titre in cm^3
A	24.2
B	18.7
C	22.0

Which is the most concentrated acid?

Choose from **nitric acid**, acid **A**, acid **B** or acid **C**.

Explain your answer.

.....

..... [1]

[Total: 6]

8 Silicon dioxide and sodium ferrate have been discovered on the planet Mars.

(a) Silicon dioxide, SiO_2 , has a molar mass of 60 g/mol.

Calculate the molar mass of sodium ferrate, Na_2FeO_4 .

The relative atomic mass of O is 16, of Na is 23, of Si is 28 and of Fe is 56.

.....

molar mass = g/mol [1]

(b) Compound X has been discovered on the planet Mars.

Compound X has the empirical formula CH.

Which formula could be the formula of compound X?

CH_4	C_2H_6
C_4H_4	C_4H_8
C_6H_{12}	$\text{C}_{10}\text{H}_{22}$

answer [1]

[Total: 2]

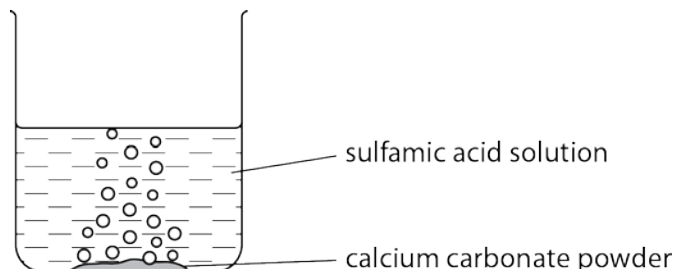
9 Sulfamic acid is a **weak** acid.

It reacts with calcium carbonate as shown in the equation.



Hayley investigates 1.0 mol/dm³ sulfamic acid solution and 1.0 mol/dm³ nitric acid.

Look at the diagram.



Hayley adds 1.0 g of calcium carbonate powder to 100 cm³ of the sulfamic acid solution.

There is a lot of fizzing but after a minute the reaction stops.

Hayley repeats the experiment using a **strong** acid. This time she uses 100 cm³ of the nitric acid.

Describe and explain, using the particle model, one **similarity** and one **difference** between the reactions of the two acids with calcium carbonate.

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

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[6]
[Total: 6]

Question	Expected answers	Marks	Additional guidance
3 (c) 	<p>Level 3 Well-reasoned conclusion about Lucy's parents' concern. Applies knowledge of factors that affect growth to show how a broad range of interacting factors could have led to Lucy growing less than average. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>Level 2 Simple conclusion about Lucy's parents. Applies knowledge of factors that affect growth to show how at least two factors could have led to Lucy growing less than average. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>Level 1 Recalls some factors that affect growth. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>relevant points include:</p> <ul style="list-style-type: none"> • yes because she is below the line and therefore underweight • no because she is only being compared to an average, there is time for her to grow and catch up, it is not necessarily bad to be below average <p>factors include:</p> <ul style="list-style-type: none"> • genes inherited from parents / quality of diet / amount of exercise / levels of hormones / health / disease <p>applications include:</p> <ul style="list-style-type: none"> • genes: Lucy's parents are shorter / lighter than average so Lucy will inherit genes which make her shorter / lighter • diet: in Lucy's diet a possible lack of proteins needed for growth / calcium needed for teeth and bones / not having balanced diet could limit growth / eating too little / AW • exercise: lack of regular exercise by Lucy could mean she does not develop strong bones / strong muscles • hormones: lack of hormones during infancy / puberty to stimulate growth • health / disease: Lucy could suffer from poor health / (specific) diseases which can limit growth • idea that could be a combination of factors that influence growth
	Total	9	


Question		Expected answers	Marks	Additional guidance
4	(a)	because blood is always needed / otherwise blood will run out (1) blood is needed for transfusions / used in operations / used for injured people (1)	2	allow people with blood loss / people who need blood e.g. haemophilia (1)
	(b)	blood group O (1) rhesus negative (1)	2	
	(c)	stop (blood) clotting (1) so blood keeps flowing / leech can keep feeding (1)	2	
Total			6	

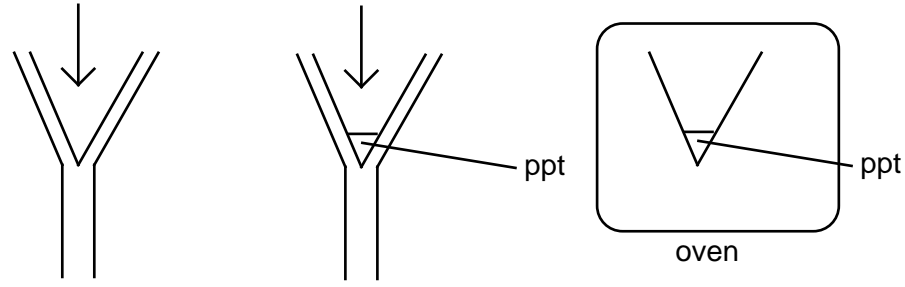
Question		Expected answers	Marks	Additional guidance
5	(a)	41.6 (1)	1	unit not needed answer on answer line takes precedence
	(b)	2000 (1)	1	unit not needed
Total			2	

Question		Expected answers	Marks	Additional guidance
6	(a)	X is sulfur (1) Y is air (1) water is good because it is readily available / very cheap (1)	3	allow X is S allow one mark if X is air and Y is sulfur allow correct answers written on flow chart if answer lines are blank allow water is free
	(b)	sulfur trioxide (1)		1
Total			4	


Question		Expected answers	Marks	Additional guidance
7	(a)	pipette (1)	1	allow measuring cylinder
	(b)	indicator suddenly changes colour (1) from blue or purple in alkali to red or pink (1)	2	both colours needed
	(c)	(i) calculated titres for 2 and 3 as 21.1 and 19.9 (1) mean titre = 20.0 (1)	2	titres can be in text or in the table unit not needed but must be correct if quoted answer must be to one decimal place
		(ii) B because the least amount of acid is used to neutralise the alkali (1)	1	
Total			6	

Question		Expected answers	Marks	Additional guidance
8	(a)	166 (1)	1	ignore units
	(b)	C ₄ H ₄ (1)	1	
		Total	2	

Question	Expected answers	Marks	Additional guidance
9 	<p>Level 3 Applies understanding of weak and strong acids to describe in detail both a similarity and a difference which are explained in terms of hydrogen ions and collision theory. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>Level 2 Applies knowledge of weak and strong acids to describe that both acids make carbon dioxide and the nitric acid reaction is faster. Explanation that involves the use of collision theory although not in terms of hydrogen ions specifically. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>Level 1 Describes that both acids make a gas (if named the gas is carbon dioxide) and that the nitric acid reaction is faster. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>relevant points include:</p> <p><u>description</u></p> <ul style="list-style-type: none"> • both acids make carbon dioxide and water • same volume / amount of carbon dioxide made <p>• nitric acid has a faster reaction / ora</p> <ul style="list-style-type: none"> • reaction with nitric acid finishes before one minute <p><u>explanation</u></p> <ul style="list-style-type: none"> • both contain hydrogen ions which react with calcium carbonate to give carbon dioxide (and water) • same amount of acid / same volume and concentration of acid / same number of moles used in both cases so both make same volume or amount of carbon dioxide • with nitric acid more hydrogen ions in solution / greater concentration of hydrogen ions / hydrogen ions are more concentrated • with nitric acid more collisions (per second) between hydrogen ions and particles of calcium carbonate so faster reaction <p>allow ora for sulfamic acid but must specify which acid is being referred to</p>
	Total	6	

Question	Expected answers	Marks	Additional guidance
10 (a)	<p>add two solutions and filter (1)</p> <p>wash the residue with water (1)</p> <p>dry the residue in an oven / leave in air to evaporate (1)</p>	3	<p>ignore sieving filtering stage must be before the washing and drying stage</p> <p>washing stage must be before the drying stage</p> <p>drying stage must be the last stage allow let it dry in air ignore dry it / let it dry ignore heat it</p> <p>not use of a Bunsen burner to dry the residue</p> <p>allow marks from a diagram</p> <p>reaction mixture water</p> 

Question		Expected answers	Marks	Additional guidance
10	(b)	<p>masses do not support the principle of conservation of mass because the difference in mass is significant / more evidence is needed / AW (1)</p> <p>OR</p> <p>masses support the principle of conservation of mass because the total mass of reactants is very close to total mass of products / the difference is due to experimental error/spillage/loss of product during filtering (1)</p> <p>WITH use calculation for second mark</p> <p>evidence of calculation of mass of reactants = 6.6g and mass of products = 6.4g used to support conclusion / difference in masses = 0.2g (1)</p>	2	<p>to gain second mark numerical evidence must be used to support either conclusion</p>
		Total	5	


Question	Expected answers	Marks	Additional guidance
11 	<p>Level 3 Answer clearly describes forces involved in orbiting satellites. Answer gives a broad range of satellite uses and explains which orbits are suitable with detailed reference to a number of characteristics. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>Level 2 Answer gives a range of satellite uses with some description of the different types of orbit and at least one linking of characteristic included. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>Level 1 An incomplete answer that gives a use of satellites and recognises a difference between types of orbit. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>relevant points include:</p> <ul style="list-style-type: none"> • gravitational force needed to maintain orbit • lower speed at higher orbit and v.v. • orbits include geostationary/fixed position/equatorial and polar • lower orbits tend to be used for polar orbit satellites • higher orbits tend to be used for equatorial/geostationary orbit satellites <p>uses</p> <ul style="list-style-type: none"> • communications • weather forecasting • military/spying • research • GPS <p>links for characteristic of orbit to use</p> <ul style="list-style-type: none"> • polar orbits view different areas of the Earth, e.g. for spying • lower orbit increases the rate of image updating, e.g. for weather forecasting • lower orbit results in a higher period/speed which means the same point on Earth is covered more often/frequently, e.g. for GPS • geostationary orbits are in a fixed-position over the Earth, e.g. for TV satellite communications/weather forecasting • higher the orbit the greater the ground coverage, e.g. for TV or radio
	Total	6	




Question		Expected answers	Marks	Additional guidance
12	(a)	(relative speed decreases) because the cars were moving in the opposite direction / apart, but now they are moving in the same direction (1)	1	allow from 17 to 7 m/s or 12 m/s + 5 m/s (1)
	(b) (i)	300 (m) (2) but if answer is incorrect average speed (10 or $\{15 + 5\} \div 2$) or correct working (10 x 30) (1)	2	
	(ii)	car X overtakes car Y because $300+10 < 360$ / AW (2) OR car X overtakes car Y / distance travelled by car X is greater than the distance travelled by car Y / $300+10 / 360$ (1)	2	allow ecf from part (i) both evidence of calculation and explanation needed for 2 marks
Total			5	

Question		Expected answers	Marks	Additional guidance
13		<p>no (no mark)</p> <p>because the range increases as the angle increases to 40° but then the range decreases (1)</p> <p>because the optimum angle is 45° (1)</p> <p>then</p> <p>because increasing the angle increases the time the ball spends in the air but decreases the horizontal velocity (2)</p> <p>OR</p> <p>increasing angle increases the time the ball spends in the air / increasing angle decreases horizontal velocity (1)</p>	3	<p>allow max 1 mark for comments relating to fair testing or experimental method, e.g. he didn't kick the ball equally hard each time / he didn't do repeats and get an average</p> <p>linking the effect of increasing angle to time and horizontal velocity is worth 2 marks</p> <p>allow answers in terms of at high angles more energy being used to move the ball upwards than across (1)</p>
Total			3	

Question		Expected answers	Marks	Additional guidance
14	(a)	D and E (1)	1	any order
	(b)	light is <u>refracted</u> (1)	1	tick in fourth box
	(c)	light is reflected (internally and correct side of the normal) correctly with reflected angles equal to incident angle by inspection – margin of error +/- 2° (1)	1	any refracted light shown on diagram scores zero
Total			3	

Question		Expected answers	Marks	Additional guidance
15	(a)	light travels... (✓) light can bend... × EM longitudinal... ×	1	2 correct = (1) 1 correct = (0)
	(b)	idea of he hears loud and quiet areas / quiet or soft area followed by louder area followed by quiet or soft area (1) because of the overlap of waves from the two speakers (1)	2	allow different loudness (1) allow sound and no sound (1) allow higher level answers in terms of constructive and destructive interference (1)
	(c)	(scientists concluded) that light travels as waves (1) waves produce (an interference) pattern (1)	2	allow higher level answers in terms of constructive and destructive interference
	(d)	no (no mark) idea that signal B will be reduced in strength because of atmospheric effects and so will not pass through (1) idea that signal A will be reflected because it is below 30 MHz (1) idea that signal C (10 GHz) is in the band that can pass through the atmosphere so can be used (1)	3	for full credit answers must link signals with their behaviour in the atmosphere
Total			8	

Assessment Objectives (AO) Grid
(includes quality of written communication )

Question	AO1	AO2	AO3	Total
1(a)	1			1
1(b)	1			1
1(c)(i)		1		1
1(c)(ii)		1		1
1(c)(iii)		2		2
2(a)	2			2
2(b)		2		2
3(a)	1			1
3(b)(i)		1		1
3(b)(ii)		1		1
3(c) 	2	2	2	6
4(a)	2			2
4(b)	2			2
4(c)	1	1		2
5(a)		1		1
5(b)		1		1
6(a)	2	1		3
6(b)	1			1
7(a)	1			1
7(b)	2			2
7(c)(i)		2		2
7(c)(ii)		1		1
8(a)		1		1
8(b)		1		1
9 	3	3		6
10(a)	3			3
10(b)			2	2
11 	4	2		6
12(a)	1			1
12(b)(i)	1	1		2
12(b)(ii)		2		2
13	1		2	3
14(a)		1		1
14(b)	1			1
14(c)		1		1
15(a)	1			1
15(b)	2			2
15(c)	1	1		2
15(d)		2	1	3
Totals	36	32	7	75