

4: Acids, bases and salts – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
4	2016	November	32
5	2016	November	33
6	2016	March	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

4 Methyl orange and methyl red are both dyes which can be used as indicators.

(a) The actual value for the melting point of methyl red is 180°C .

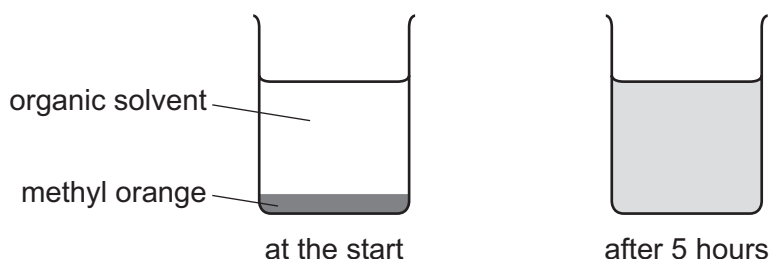
A chemist prepares a sample of methyl red and finds that it melts over the range 173°C to 177°C .

Suggest why the melting point of this sample was different from the actual value.

..... [1]

(b) A concentrated solution of methyl orange was placed at the bottom of a beaker containing an organic solvent.

After 5 hours, the orange colour had spread throughout the solvent.



Use the kinetic particle model of matter to explain this observation.

.....
.....
.....
..... [3]

(c) Methyl orange is used as an indicator.

What colour is methyl orange when placed in dilute sulfuric acid?

..... [1]

(d) Sulfuric acid can be used to prepare copper(II) sulfate from copper(II) oxide.

(i) Complete the general word equation for this reaction.

metal oxide + acid → +

[2]

(ii) Sulfuric acid is added to excess copper(II) oxide. The mixture is heated and the unreacted copper(II) oxide is removed.

Suggest how the unreacted copper(II) oxide is removed.

..... [1]

(iii) Put statements **A** to **E** about the preparation of pure dry crystals of copper(II) sulfate from copper(II) sulfate solution in the correct order.

- A** The crystals are filtered off.
- B** The heating is stopped when the point of crystallisation is reached.
- C** The mixture is left to form crystals.
- D** The crystals are dried with filter paper.
- E** The solution is heated gently.

correct order

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[2]

[Total: 10]

- 5 Lime (calcium oxide) is made by heating limestone (calcium carbonate).



- (a) (i) Is this reaction exothermic or endothermic?
Explain your answer.

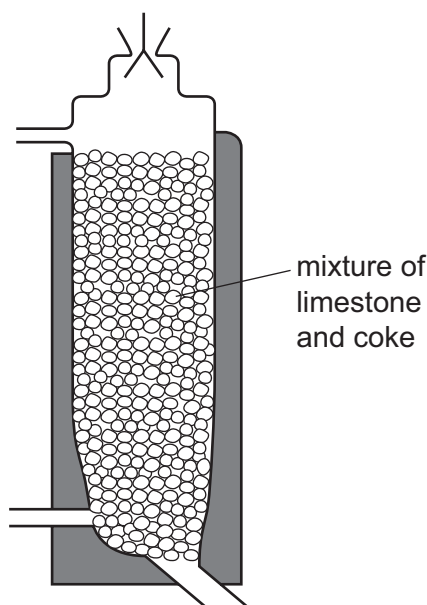
.....
..... [1]

- (ii) The reaction is reversible.

What information in the equation shows that this reaction is reversible?

..... [1]

- (b) The diagram shows a furnace for making lime.



- (i) On the diagram, write

- the letter **C** to show where the waste gases exit the furnace,
- the letter **L** to show where the lime is removed from the furnace.

[2]

- (ii) Suggest a reason for adding coke (carbon) to the furnace.

..... [1]

- (c) Explain why farmers use lime to treat acidic soils.

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

(d) Limestone is used to manufacture cement. The limestone is mixed with clay and heated to 1500 °C. It is then mixed with calcium sulfate and crushed.

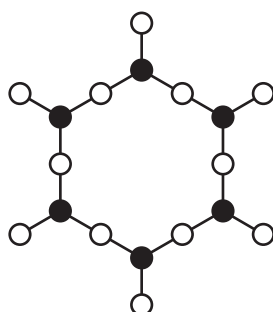
(i) Describe the test for sulfate ions.

test

result

[2]

(ii) Concrete is a mixture of cement, silicates and water. Part of the structure of a silicate is shown.



key

● = silicon atom

○ = oxygen atom

Deduce the formula for this silicate.

..... [1]

- (e) Concrete contains small amounts of calcium oxide.
This can react with rainwater to form calcium hydroxide.

- (i) Calcium hydroxide is strongly alkaline.

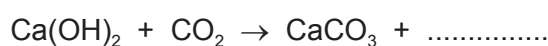
What is the most likely pH of a strongly alkaline solution?
Draw a ring around the correct answer.

pH 2 pH 6 pH 7 pH 12

[1]

- (ii) The calcium hydroxide on the surface of a piece of concrete reacts with carbon dioxide in the air.

Complete the chemical equation for this reaction.



[1]

- (iii) Limewater is an aqueous solution of calcium hydroxide. A teacher left an open beaker of limewater in the laboratory.
After a week, the solution in the beaker was pH 7 and a white precipitate was observed.

Use the information in (e)(i) and (e)(ii) to help you explain these observations.

.....

.....

.....

.....

.....

.....

..... [3]

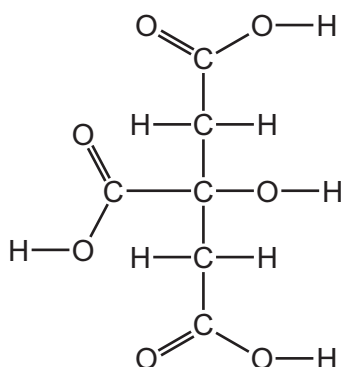
[Total: 15]

6 Citric acid is found in lemon juice. Citric acid shows typical acidic properties.

(a) Describe how you could determine the pH of a solution of lemon juice using Universal Indicator.

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

(b) The structure of citric acid is shown below.



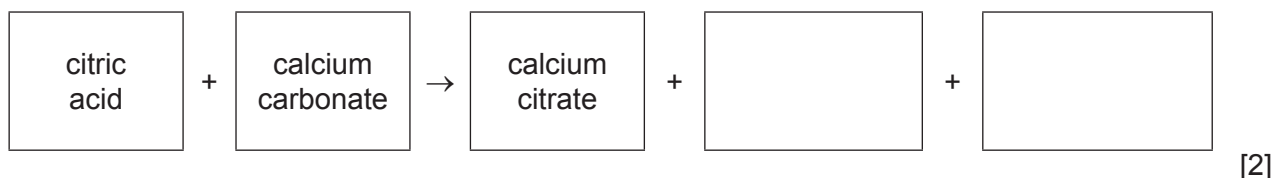
(i) On the diagram, draw a ring around a carboxylic acid functional group. [1]

(ii) State the name of **one** other carboxylic acid.

..... [1]

(c) Calcium citrate can be prepared by neutralising aqueous citric acid with excess calcium carbonate.

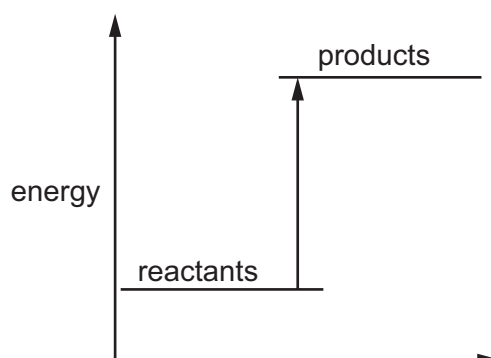
(i) Complete the word equation for this reaction.



(ii) Suggest how you could separate the excess calcium carbonate from the rest of the solution.

..... [1]

- (d) The energy level diagram for the reaction of citric acid with sodium hydrogen carbonate is shown below.



Is this reaction exothermic or endothermic?
Give a reason for your answer.

.....
..... [1]

- (e) Both citric acid and ethanol can be manufactured by fermentation.

- (i) Complete the chemical equation for the fermentation of glucose to form ethanol.



- (ii) State **two** conditions needed for fermentation.

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

- (iii) Complete the table below and calculate the relative molecular mass of glucose.

type of atom	number of atoms	relative atomic mass	
carbon	6	12	$6 \times 12 = 72$
hydrogen			
oxygen			

relative molecular mass = [2]

[Total: 14]

Question	Answer	Marks
4 (a)	The sample is impure	1
4 (b)	any 3 from: <ul style="list-style-type: none"> • diffusion • particles move / motion of particles • (movement is) random / in any direction / in all directions • particles spread out / particles mix • particles move from high to low concentration 	3
4 (c)	red	1
4 (d) (i)	(metal) salt water	1 1
4 (d) (ii)	filtration / filter	1
4 (d) (iii)	E, B, C, A, D	2
		Total: 10

Continues on next page ...

Question	Answer	Marks
5 (a) (i)	<u>endothermic</u> because heating is needed	1
5 (a) (ii)	Arrow(s) pointing in both directions / \rightleftharpoons	1
5 (b) (i)	C in or just outside the tube at the top left	1
	L in or just outside the tube at the bottom right	1
5 (b) (ii)	to produce a high temperature / for heat(ing)	1
5 (c)	any 2 from: <ul style="list-style-type: none"> plants / crops do not grow well if the soil is too acidic increases the pH of the soil / makes the soil less acidic neutralises the acid 	2
5 (d) (i)	<i>test:</i> (aqueous) barium chloride / (aqueous) barium nitrate	1
	<i>result:</i> white precipitate / white solid	1
5 (d) (ii)	SiO_2 / Si_6O_{12}	1
5 (e) (i)	pH 12	1
5 (e) (ii)	H_2O	1
5 (e) (iii)	any 3 from: <ul style="list-style-type: none"> (limewater absorbs) carbon dioxide (carbon dioxide) from the air carbon dioxide dissolves in limewater carbon dioxide (solution) is slightly acidic / carbon dioxide is an acidic oxide idea that carbon dioxide reacts with / neutralises calcium hydroxide / neutralises limewater / neutralises the solution pH (of limewater / solution) falls / pH goes down calcium carbonate is formed 	3
Total: 15		

Continues on next page ...

Question	Answer	Marks
6 (a)	add universal indicator to the lemon juice / solution; match colour with colour chart;	2
6 (b) (i)	ring around one or more COOH groups;	1
6 (b) (ii)	ethanoic (acid) / any other correctly named carboxylic acid;	1
6 (c) (i)	carbon dioxide; water;	2
6 (c) (ii)	filtration;	1
6 (d)	endothermic <u>and</u> energy if products higher than energy of reactants;	1
6 (e) (i)	2(C ₂ H ₅ OH) 2(CO ₂)	2
6 (e) (ii)	any two from: <ul style="list-style-type: none"> • yeast / zymase • temperature between 5 °C and 40 °C / room temperature • anaerobic / no oxygen / no air • pH ~ 7 	2
6 (e) (iii)	180; one row correct = [1], e.g. 12 × 1 = 12 or 6 × 16 = 96	2
		Total: 14