

## 3: Air and water – Topic questions

## Paper 3

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

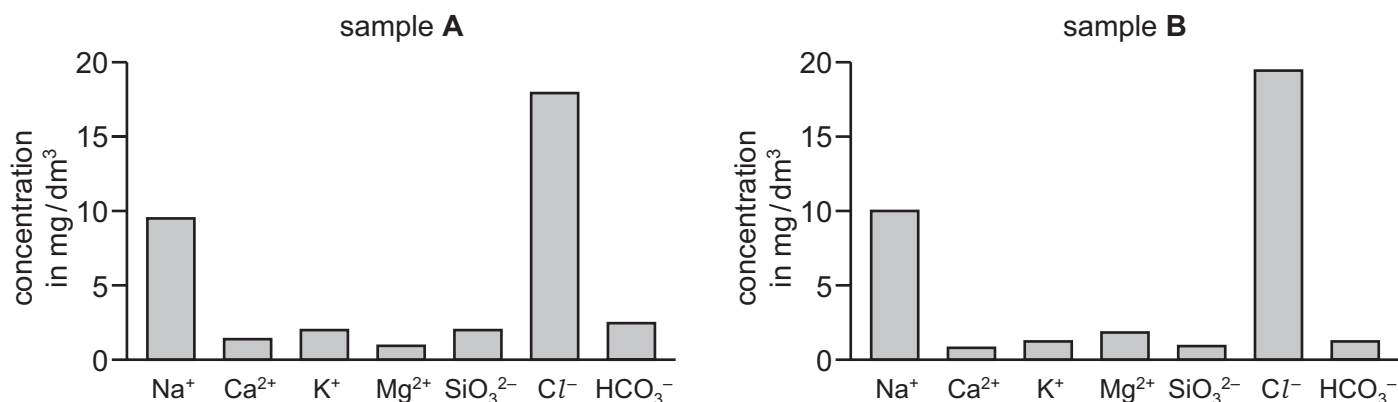
Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
2	2016	November	31
2	2016	November	33
8	2016	June	33

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](http://www.cambridgeinternational.org/support)

- 2 The bar charts compare the concentrations of the main ions in two samples of seawater, sample **A** and sample **B**.



(a) Use the information in the bar charts to answer the following questions.

- (i) Describe **two** differences in the composition of the seawater in sample **A** and sample **B**.

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

- (ii) Which positive ion has the lowest concentration in sample **A**?

..... [1]

- (iii) Calculate the mass of sodium ions in 200 cm<sup>3</sup> of sample **B**.  
 Show all your working. [1 dm<sup>3</sup> = 1000 cm<sup>3</sup>]

mass = ..... mg [2]

(b) Describe a test for sodium ions.

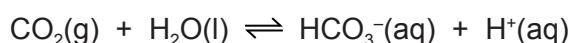
test .....  
 result ..... [2]

- (c) River water contains small particles of clay. When these particles are viewed under a microscope they show a random, jumpy motion even when the water is still.

What name is given to this type of movement?

..... [1]

- (d) Carbon dioxide dissolves in water to form a mixture which contains hydrogencarbonate ions and hydrogen ions.



- (i) What is the meaning of the symbol  $\rightleftharpoons$ ?

..... [1]

- (ii) The solution formed is slightly acidic.

Describe how you would use Universal Indicator paper to determine the pH of this solution.

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

- (iii) Carbon dioxide is a greenhouse gas which causes climate change.

Explain how carbon dioxide contributes to climate change.

..... [1]

- (iv) State the name of **one** other greenhouse gas and give **one** source of this gas.

gas .....

source ..... [2]

[Total: 14]

- 2 A scientist analysed the substances present in a 1 dm<sup>3</sup> sample of river water in an agricultural area. The table shows the mass of each ion dissolved in the 1 dm<sup>3</sup> sample.

name of ion	formula of ion	mass/g
calcium	Ca <sup>2+</sup>	1.2
chloride	Cl <sup>-</sup>	0.1
hydrogencarbonate	HCO <sub>3</sub> <sup>-</sup>	1.0
magnesium	Mg <sup>2+</sup>	0.5
nitrate	NO <sub>3</sub> <sup>-</sup>	1.0
sodium	Na <sup>+</sup>	
	SO <sub>4</sub> <sup>2-</sup>	0.5
phosphate	PO <sub>4</sub> <sup>3-</sup>	1.2
	Total	6.0

- (a) (i) Which negative ion has the highest concentration, in g/dm<sup>3</sup>, in this sample of water?

..... [1]

- (ii) Give the name of the ion with the formula SO<sub>4</sub><sup>2-</sup>.

..... [1]

- (iii) Calculate the mass of sodium ions in 1 dm<sup>3</sup> of this river water.

..... [1]

- (b) Describe a test for nitrate ions.

test .....

.....

result .....

[3]

- (c) The sample of river water also contains insoluble materials such as clay and the remains of dead animals and plants.

(i) What method could be used to separate insoluble materials from river water?

..... [1]

(ii) Some of the remains of dead animals and plants contain food materials.

Which **two** of the following substances are constituents of food?

Tick **two** boxes.

alkane

☐

carbohydrate

☐

graphite

☐

protein

☐

[1]

(iii) Particles of clay suspended in river water show Brownian motion.

Describe the movement of these particles.

..... [1]

(d) Most of the nitrate ions in river water come from fertilisers.

(i) Explain why farmers use fertilisers.

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

(ii) Ammonium nitrate is a fertiliser.

Ammonium nitrate reacts with calcium hydroxide.

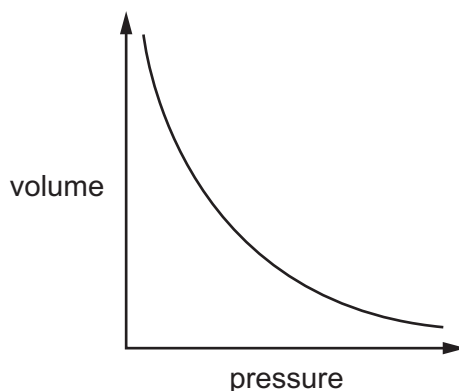
ammonium nitrate + calcium hydroxide → calcium nitrate + ammonia + water

Explain why adding calcium hydroxide to the soil at the same time as nitrate fertilisers results in loss of nitrogen from the soil.

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

[Total: 13]

- 8 The graph shows how increasing the pressure at constant temperature changes the volume of a fixed mass of carbon dioxide gas.



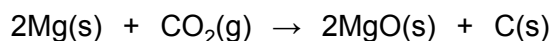
- (a) Describe how the volume of gas changes with pressure.

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

- (b) What happens to the average distance of the molecules from each other when the pressure is decreased?

..... [1]

- (c) Carbon dioxide can be reduced by magnesium.



- (i) Use the information in the equation to show that carbon dioxide gets reduced.

..... [1]

- (ii) Which one of these processes does **not** produce carbon dioxide?

Tick **one** box.

respiration

☐

reaction of an acid with a metal oxide

☐

reaction of an acid with a carbonate

☐

thermal decomposition of limestone

☐

[1]

- (iii) Give **two** problems caused by increasing the amount of carbon dioxide in the atmosphere.

.....

.....

..... [2]

[Total: 7]

Question	Answer	Marks
2 (a) (i)	any 2 from: <ul style="list-style-type: none"> <li>• more <math>\text{Na}^+</math> ions in sample <b>B ORA</b></li> <li>• more <math>\text{Cl}^-</math> ions in sample <b>B ORA</b></li> <li>• more <math>\text{Mg}^{2+}</math> ions in sample <b>B ORA</b></li> <li>• more <math>\text{HCO}_3^-</math> ions in sample <b>A ORA</b></li> <li>• more <math>\text{Ca}^{2+}</math> ions in sample <b>A ORA</b></li> <li>• more <math>\text{K}^+</math> ions in sample <b>A ORA</b></li> <li>• more <math>\text{SiO}_3^{2-}</math> ions in sample <b>A ORA</b></li> </ul>	2
2 (a) (ii)	$\text{Mg}^{2+}$	1
2 (a) (iii)	2 mg = [2]  $\frac{200}{1000} \times 10 = (10) = [1]$ <b>OR</b> $0.2 \times (10) = [1]$	2
2 (b)	<i>test:</i> flame test /description of flame test <i>result:</i> yellow (flame)	2
2 (c)	Brownian (motion)	1
2 (d) (i)	indicates a reversible reaction	1
2 (d) (ii)	dip (indicator) paper in solution / put (indicator paper) in solution compare the colour with the (colour) chart / different colours represent different pH values	1 1
2 (d) (iii)	absorbs heat / absorbs infra-red radiation / causes global warming	1
2 (d) (iv)	<i>gas:</i> methane <i>source:</i> gases from (digestion in) animals / swamps / decomposition of vegetation / rice paddy fields / fracking / melting of permafrost	1 1
		Total: 14

Continues on next page ...



Question	Answer	Marks
2 (a) (i)	phosphate / $\text{PO}_4^{3-}$	1
2 (a) (ii)	sulfate	1
2 (a) (iii)	0.5 (g)	1
2 (b)	<i>test:</i>	
	aluminium / magnesium / Devarda's alloy	1
	sodium hydroxide / strong alkali (and warm)	1
	<i>result:</i> gas given off turns (red) litmus blue	1
2 (c) (i)	filtration / filter	1
2 (c) (ii)	carbohydrate <b>AND</b> protein	1
2 (c) (iii)	random / zigzag / go anywhere / irregular	1
2 (d) (i)	any 2 from:	2
	<ul style="list-style-type: none"> <li>improve growth of plants</li> <li>increase protein (in plants)</li> <li>fertilisers add nitrogen / nitrates / phosphorus / phosphates / potassium</li> <li>to put back nitrogen / nitrates / phosphorus / phosphates / potassium <u>into the soil</u></li> </ul>	
2 (d) (ii)	ammonia is produced / formed	1
	(ammonia) is a gas	1
Total: 13		

Continues on next page ...

Question	Answer	Marks
8 (a)	volume decreases as pressure increases; reference to rate of change is more rapid at first / rate of change decreases / correct reference to curve;	<b>2</b> 1 1
8 (b)	(distance) increases;	<b>1</b>
8 (c) (i)	carbon dioxide loses oxygen;	<b>1</b>
8 (c) (ii)	“reaction of an acid with a metal oxide” box ticked;	<b>1</b>
8 (c) (iii)	any 2 from: <ul style="list-style-type: none"> <li>• climate change / more extreme weather;</li> <li>• desertification;</li> <li>• melting ice caps;</li> <li>• rise in sea levels / increased flooding of low-lying areas;</li> <li>• temperature of atmosphere / oceans increases;</li> <li>• habitat loss;</li> </ul>	<b>2</b>
Total: 7		