

Chemistry of the environment

30 questions: 15 multiple choice, 15 structured.

1 **Core** Water

[1]

Anhydrous copper(II) sulfate is used to test for the presence of water.

What is the colour change when water is added to anhydrous copper(II) sulfate?

- A blue to white
- B white to blue
- C blue to pink
- D pink to blue

2 **Core** Air quality and climate

[1]

Which row gives the approximate composition of clean, dry air?

	nitrogen / %	oxygen / %	noble gases and carbon dioxide / %
A	21	78	1
B	68	31	1
C	78	1	21
D	78	21	1

3 **Core** Water

[1]

Which row correctly matches a stage in the treatment of the domestic water supply with its purpose?

	stage	purpose
A	treatment with carbon	kills microbes
B	chlorination	removes tastes and odours
C	filtration	removes solids
D	sedimentation	kills microbes

4**Core**

Fertilisers

[1]

A farmer wants to add a single compound to the soil that supplies both nitrogen and potassium to the crops.

Which compound should the farmer use?

- A ammonium sulfate
 - B calcium phosphate
 - C potassium nitrate
 - D sodium nitrate
-

5**Core**

Air quality and climate

[1]

Carbon dioxide and carbon monoxide can both be produced when carbon-containing fuels burn.

Which row shows the type of combustion that produces each gas?

	carbon dioxide	carbon monoxide
A	complete combustion	incomplete combustion
B	incomplete combustion	complete combustion
C	complete combustion	complete combustion
D	incomplete combustion	incomplete combustion

A student holds a cold metal pan above the flame of a camping stove. A few drops of a colourless liquid form on the outside of the pan. The student thinks the liquid is water.

- (a) Describe how anhydrous cobalt(II) chloride can be used to show that the liquid contains water. Give the colour change you would see. [2]

- (b) Describe how the student could use the boiling point of the liquid to find out whether it is pure water. [2]

- (c) The student collects a larger sample of the liquid. It melts at -1.5°C . Deduce whether the liquid is pure water. Give a reason for your answer. [2]

7

Core

Air quality and climate

[5]

Methane and carbon dioxide are both air pollutants.

(a) State two sources of methane in the air.

[2]

(b) State the adverse effect of higher levels of carbon dioxide and methane in the atmosphere.

[2]

(c) State the name of the process in green plants that removes carbon dioxide from the air.

[1]

Carbon dioxide and methane are greenhouse gases. Energy from the Sun passes through the atmosphere and reaches the surface of the Earth. Some of this energy is reflected.

- (a) State the type of energy that is emitted by the warm surface of the Earth. [1]

- (b) Describe how carbon dioxide and methane in the atmosphere cause global warming. In your answer, refer to the absorption and emission of energy. [4]

Topical Hub
topical-hub.pages.dev

A river flows past farmland and then through a town. A sample of the river water is found to contain these substances:

- dissolved oxygen
- nitrates
- plastics
- sewage

(a) Identify the substance in the list that is beneficial. State why it is beneficial. [2]

(b) State the source of the nitrates in the river water. [1]

(c) Explain why sewage in river water is harmful to humans. [2]

(d) State one effect of plastics in the river. [1]

Oxides of nitrogen, such as nitrogen monoxide, NO, are formed in car engines. Catalytic converters are fitted to car exhausts to remove them.

- (a) Explain how oxides of nitrogen are formed in car engines. [2]

- (b) In a catalytic converter, carbon monoxide reacts with nitrogen monoxide.
Write a balanced equation for this reaction. [2]

- (c) Explain how fitting catalytic converters to cars helps to reduce acid rain. [2]

11

Core

Water

[1]

The melting point and boiling point of four samples of colourless liquid were measured at atmospheric pressure.

Which sample is pure water?

sample	melting point / °C	boiling point / °C
A	-3	101
B	0	102
C	-1	100
D	0	100

12

Core

Air quality and climate

[1]

Which strategy reduces climate change by removing carbon dioxide from the atmosphere?

- A fitting catalytic converters to cars
- B planting trees
- C using low-sulfur fuels
- D flue gas desulfurisation with calcium oxide

13

Supplement

Air quality and climate

[1]

Which is the balanced symbol equation for photosynthesis?

- A $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 3\text{O}_2$
- B $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$
- C $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- D $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$

14**Core**

Fertilisers

[1]

A farmer mixes two compounds to make an NPK fertiliser.

Which pair of compounds provides all three of the elements nitrogen, phosphorus and potassium?

- A ammonium nitrate and potassium chloride
 - B ammonium phosphate and potassium chloride
 - C ammonium sulfate and potassium nitrate
 - D calcium phosphate and ammonium nitrate
-

15**Core**

Water

[1]

Why is distilled water used rather than tap water in practical chemistry?

- A Distilled water contains fewer chemical impurities.
- B Distilled water has been treated with chlorine to kill microbes.
- C Distilled water contains more dissolved oxygen.
- D Distilled water contains essential minerals.

Topical Hub
topical-hub.pages.dev

A water company takes water from a river that flows through farmland. The company treats the water to make it safe to drink. The treatment includes:

- sedimentation and filtration
- treatment with carbon
- chlorination

(a) State the purpose of sedimentation and filtration. [1]

(b) State why the water is treated with carbon. [1]

(c) Explain why chlorine is added to the water. [2]

(d) The river water contains nitrates from fertilisers.
Suggest why sedimentation and filtration do not remove the nitrates. [1]

Green plants make their own food by photosynthesis.

- (a) Complete the word equation for photosynthesis.

carbon dioxide + → + oxygen

[2]

- (b) State the name of the green substance in leaves that is needed for photosynthesis.

[1]

- (c) State the source of the energy used in photosynthesis.

[1]

- (d) A pond contains many green water plants.

Predict how the concentration of dissolved oxygen in the pond water changes during a sunny day. Explain your answer.

[2]

A power station burns coal that contains sulfur compounds.

- (a) State the name of the gas, formed from the sulfur compounds, that causes acid rain. [1]

- (b) The waste gases from the power station are passed through calcium oxide before they are released into the air.

State the name of this process and explain how it reduces acid rain. [3]

- (c) Suggest one other change the power station could make to reduce the amount of this gas it releases. [1]

- (d) The table shows the mass of this gas released by the power station each year and the average pH of the rain in a nearby town.

year	mass of gas released / tonnes	average pH of rain
2000	14 000	4.2
2010	6500	4.9
2020	1800	5.4

Describe how the pH of the rain changed as the mass of gas released decreased. Suggest a reason for this change. [2]

Topical Hub
topical-hub.pages.dev

The table shows the percentage by mass of nitrogen, phosphorus and potassium in three fertilisers, E, F and G.

fertiliser	nitrogen / %	phosphorus / %	potassium / %
E	34	0	0
F	15	6	12
G	0	0	50

- (a) State two types of compound that are used as fertilisers to provide nitrogen. [2]

- (b) Identify which fertiliser, E, F or G, is an NPK fertiliser. Give a reason for your answer. [2]

- (c) Calculate the mass of nitrogen in a 25 kg bag of fertiliser E. [2]

- (d) State why farmers add NPK fertilisers to soil. [1]

A student passes 100 cm^3 of clean, dry air backwards and forwards over heated copper until the volume of gas stops changing. The copper removes all of the oxygen from the air and reacts with nothing else. The final volume is measured at the original temperature and pressure.

- (a) Predict the final volume of gas. [1]

- (b) State the name of the gas that makes up most of the remaining gas. [1]

- (c) State the names of two other gases present in the remaining gas. [2]

- (d) The experiment is repeated using 250 cm^3 of clean, dry air.
Calculate the decrease in the volume of gas. [2]

21

Core

Water

[1]

Which row correctly shows whether each substance, when present in river water, is beneficial or potentially harmful?

	dissolved oxygen	nitrates	sewage
A	potentially harmful	beneficial	potentially harmful
B	beneficial	beneficial	potentially harmful
C	potentially harmful	potentially harmful	beneficial
D	beneficial	potentially harmful	potentially harmful

22

Core

Water

[1]

Which substance found in river water can come from both fertilisers and detergents?

- A nitrates
- B phosphates
- C harmful microbes
- D dissolved oxygen

23

Core

Water

[1]

River water is being treated to make it safe to drink. After sedimentation and filtration, the water is clear, but it still has an unpleasant smell and contains harmful microbes.

Which two further treatments are needed?

- A chlorination and filtration
- B treatment with carbon and sedimentation
- C treatment with carbon and chlorination
- D filtration and sedimentation

24**Supplement**

Air quality and climate

[1]

Which statement explains how methane in the atmosphere increases global warming?

- A Methane absorbs thermal energy emitted by the Earth's surface and emits some of it back towards the Earth.
 - B Methane reflects energy from the Sun back into space.
 - C Methane reacts with oxygen in the air and releases thermal energy.
 - D Methane allows more thermal energy to escape from the Earth into space.
-

25**Core**

Air quality and climate

[1]

Which air pollutant causes photochemical smog?

- A carbon monoxide
- B methane
- C sulfur dioxide
- D oxides of nitrogen

Topical Hub
topical-hub.pages.dev

A student evaporates 50 cm³ of tap water and 50 cm³ of distilled water to dryness in separate, clean evaporating basins. The table shows the results.

sample	mass of solid left in the basin / g
tap water	0.018
distilled water	0.000

- (a) Suggest what type of substance makes up the solid left by the tap water. [1]

- (b) Explain why distilled water, rather than tap water, is used in practical chemistry. [2]

- (c) The student adds a few drops of each water sample to separate portions of anhydrous copper(II) sulfate.

Predict what the student observes for both samples. Explain why this test cannot show which sample is purer. [2]

Scientists measure the concentration of dissolved oxygen at two sites on a river.

site	description	dissolved oxygen / mg per dm ³
P	upstream, before the river reaches any farmland	9.0
Q	beside fields that have been spread with fertiliser	4.5

- (a) Describe how the concentration of dissolved oxygen changes from site P to site Q. [1]

- (b) The water at site Q contains high concentrations of nitrates and phosphates.
Suggest where these substances come from and explain how they affect the fish in the river. [3]

- (c) Further downstream, water from a factory adds mercury compounds to the river. A spring that flows into the river adds calcium compounds.
Contrast the effects of these two types of metal compound on living things. [2]

A government wants to reduce climate change. It is considering three strategies:

- building more wind farms and solar farms
- reducing livestock farming
- using hydrogen instead of petrol as a fuel for vehicles

Hydrogen burns to form only water.

- (a) Explain how building more wind farms and solar farms reduces climate change. [2]

- (b) Explain how reducing livestock farming reduces climate change. [2]

- (c) Explain why using hydrogen instead of petrol as a fuel reduces climate change. [2]

The air quality at two places in a city is monitored. The table shows the results.

pollutant	beside a busy road	in a park
carbon monoxide / mg per m ³	3.2	0.4
particulates / µg per m ³	48	11

- (a) Suggest why the concentrations of carbon monoxide and particulates are higher beside the busy road.

[2]

- (b) State the adverse effect of carbon monoxide.

[1]

- (c) State two adverse effects of particulates.

[2]

Forests remove carbon dioxide from the atmosphere by photosynthesis.

- (a) Write the balanced symbol equation for photosynthesis.

[2]

- (b) Use your equation to deduce the number of molecules of oxygen made when 4 molecules of glucose are produced.

[1]

- (c) Large areas of forest are cut down and the trees are burned.

Explain how this increases global warming.

[3]
