

HOMework BOOKLET

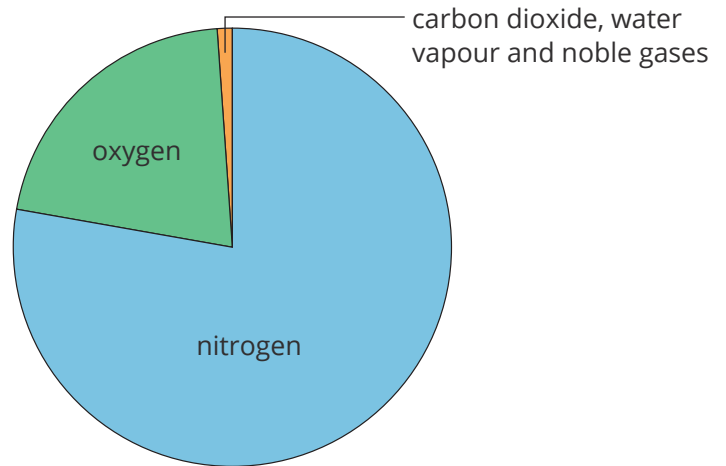
C9 & C10 Foundation

Evolution of the Earth's Atmosphere

Homework 1

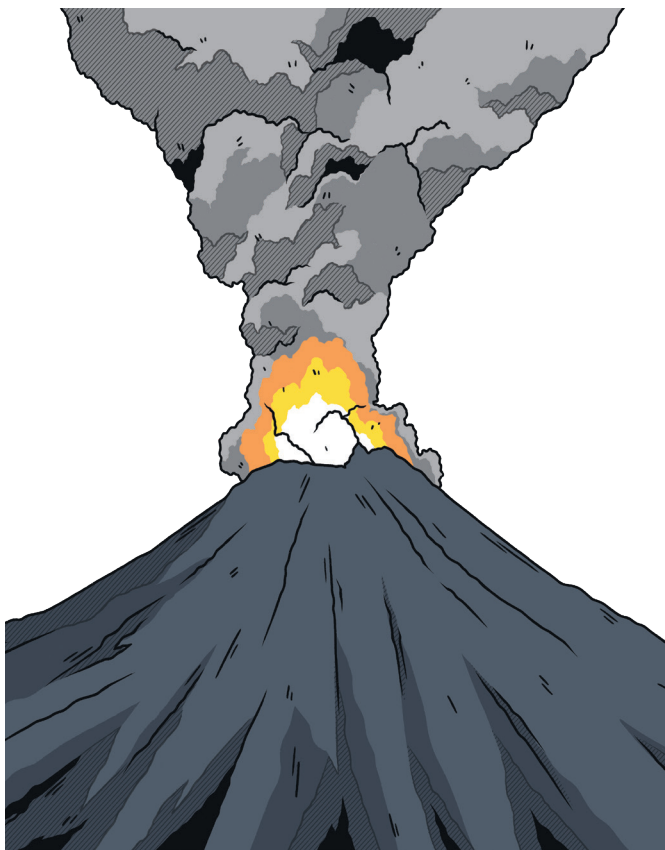
Read the text below and then answer the questions on the accompanying sheet.

For the last 200 million years, the proportions of different gases in the Earth's atmosphere have remained relatively stable. Today's atmosphere is around four-fifths nitrogen, about one-fifth oxygen and small proportions of other gases, including carbon dioxide, water vapour and noble gases.



The Early Atmosphere

The composition of the atmosphere has not always been the same. The Earth formed 4.6 billion years ago, so we have limited evidence about the early atmosphere. Scientists have studied gas bubbles trapped in ancient rocks on Earth and also the atmosphere on other planets and moons. Using this limited data, they have developed theories about what they think the atmosphere was like. There are several theories about how the atmosphere was formed and these have changed and developed over time based on new evidence.



One theory suggests that for the first billion years, Earth had no oceans and was covered in volcanoes. The intense volcanic activity released lots of carbon dioxide that made up most of the early atmosphere, along with nitrogen and possibly some methane and ammonia. At this point, the atmosphere may have been like the atmospheres of Mars and Venus today, with little or no oxygen.

Water vapour released from the volcanoes condensed as the Earth gradually cooled down and fell as rain. This rain settled in hollows of the crust to form the oceans. Carbon dioxide dissolved in the water to form soluble carbonate compounds which reduced the carbon dioxide in the atmosphere. These carbonate compounds precipitated as sediments which eventually formed sedimentary rocks.

Oxygen in the Atmosphere

Around 3.4 billion years ago, the simple gases in the atmosphere and oceans formed the compounds needed for life to start. Initially, simple organisms used the breakdown of these chemicals as a source of energy.

Around 2.7 billion years ago, bacteria and algae evolved. Algae used energy from the sun for photosynthesis, which can be represented by the equation:

carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen

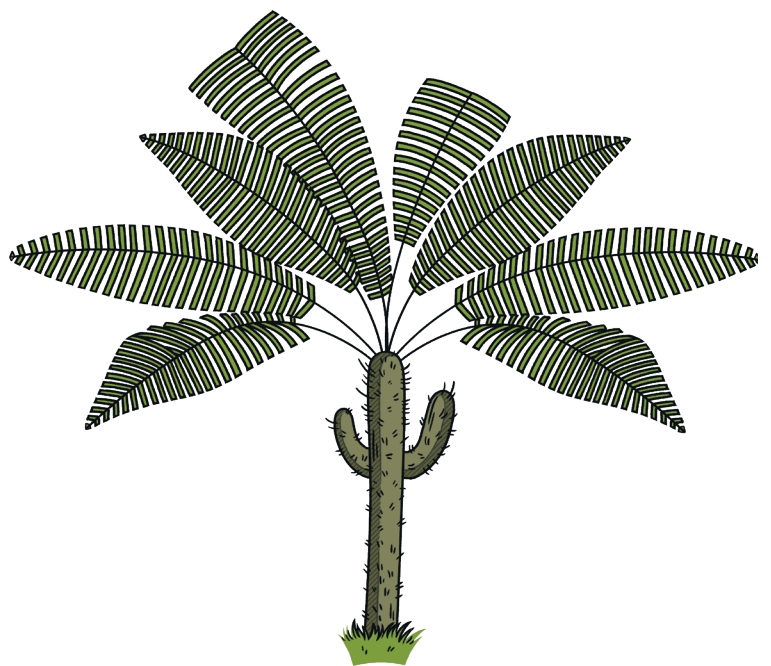


The oxygen gas produced as a waste product meant that oxygen was released into the atmosphere. Over the next billion years, plants evolved and the percentage of oxygen in the atmosphere increased steadily until there was enough to support animal life. Animals cannot make their own food in the way that plants and algae can, so rely on the plants for both food and oxygen to respire.

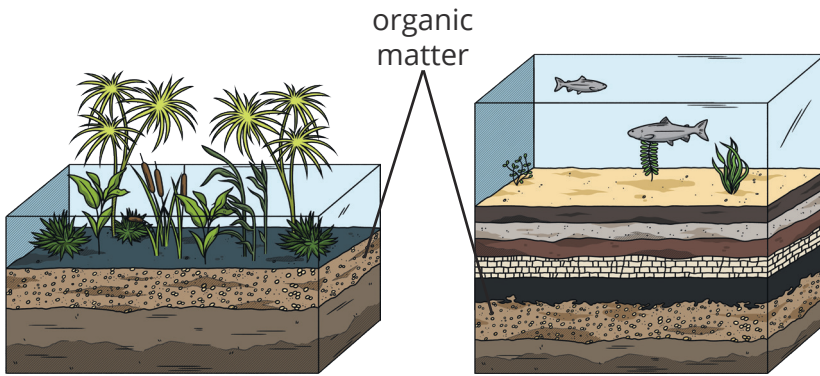
Decrease of Carbon Dioxide

Photosynthesis removes carbon dioxide from the atmosphere and locks it in the plants as they use it to make new plant material as they grow. As more algae and plants evolved, the percentage of carbon dioxide in the atmosphere decreased.

When animals eat plants, this carbon can be transferred to the animal tissues. Over millions of years, the shells and skeletons of animals with locked in carbon became covered with layers of sediment. The pressure from these layers formed sedimentary rocks such as limestone (CaCO_3). The carbon dioxide from the atmosphere became locked in these rocks within the Earth's crust.

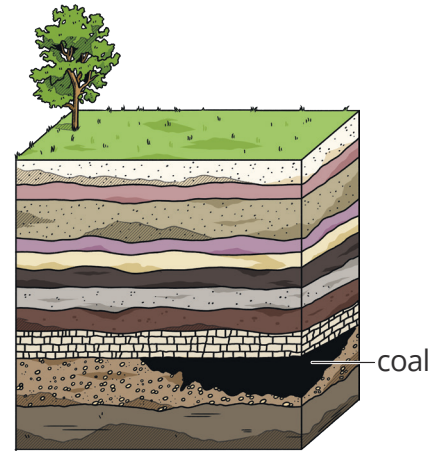


Carbon dioxide levels in the atmosphere were also decreased by the formation of fossil fuels. Coal, oil and natural gas formed in different conditions, but all involved a lack of oxygen, pressure from layers of sediments and heat from the Earth's crust.

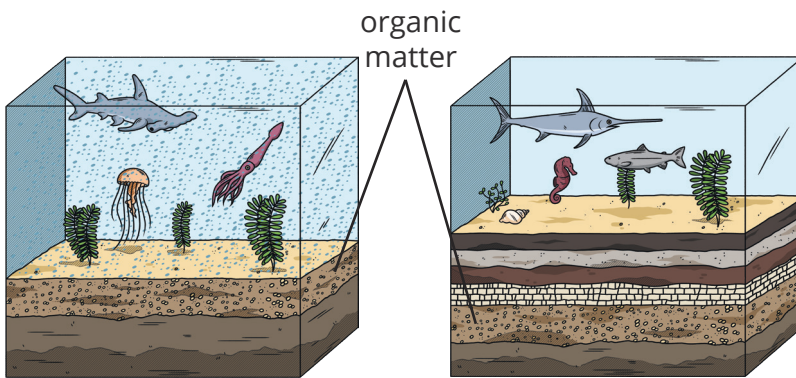


Coal was formed from trees and ferns which were buried in swamps.

Layers of sediment built up on top of the dead organic matter and a lack of oxygen prevented oxidation from occurring.

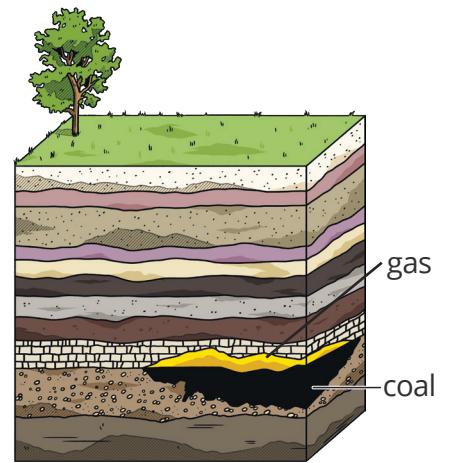


Pressure from the layers of sediment and heat from the Earth's crust turned the remains into coal over millions of years.



Crude oil and natural gas were formed from simple plants and animals living in oceans and lakes.

Layers of sediment built up on top of the dead organic matter and a lack of oxygen prevented oxidation from occurring.



Pressure from the layers of sediment and heat from the Earth's crust turned the remains into crude oil and natural gas over at least a million years.

Carbon is locked in the fossil fuels and is released back into the atmosphere when they are burnt.



Evolution of the Earth's Atmosphere

Homework 1

Read the comprehension sheet and then answer the questions below.

1. What percentage of the Earth's atmosphere today is made up of:

nitrogen? _____

oxygen? _____

2. Which other gases are found in today's atmosphere?

3. The Earth formed 4600 million years ago.

What percentage of the Earth's age has the atmosphere been its current composition?

Give your answer to 3 significant figures.

_____ %

4. Why can scientists not be certain about the composition of the early atmosphere?

5. Why is it useful for scientists to study the atmospheres of other planets?



Chemistry of the Atmosphere

Multiple Choice Questions

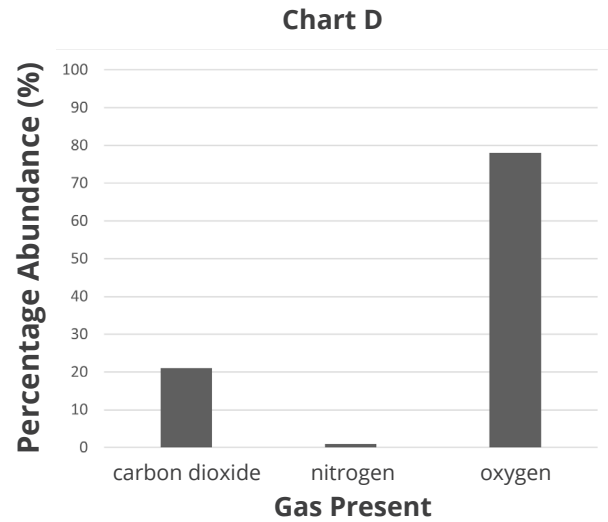
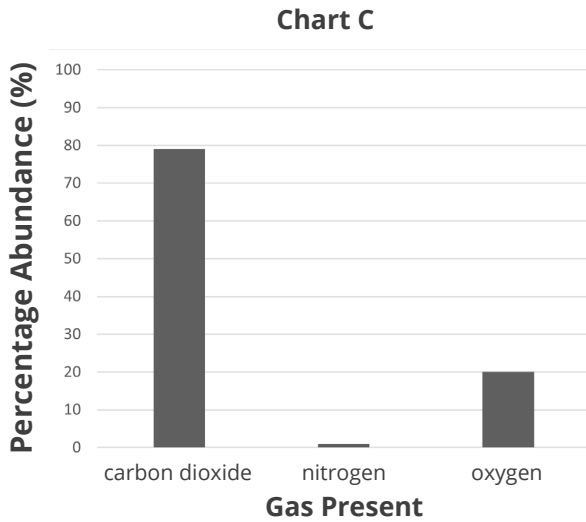
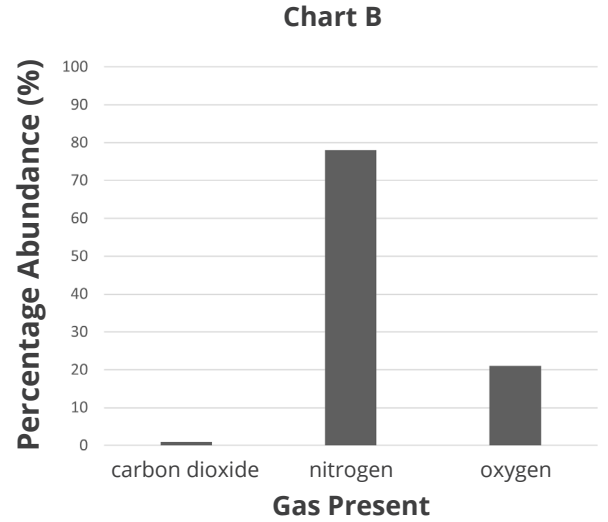
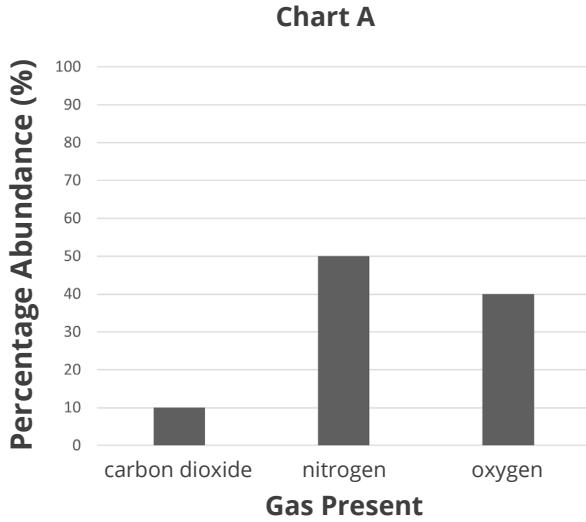
Homework 1

Set 4

You may use a periodic table to help you answer these questions.

Tick **one** box.

1. Which chart shows the approximate composition of the present-day atmosphere?



- A. A
- B. B
- C. C
- D. D

2. Which gas was the most abundant in the early atmosphere of the Earth?

- A. carbon dioxide
- B. hydrogen
- C. nitrogen
- D. oxygen



3. What first produced the oxygen found in the present-day atmosphere of the Earth?
- A. algae and plants
 - B. animals
 - C. bacteria
 - D. volcanoes
4. Which of the following reduces the amount of carbon dioxide in the atmosphere?
- A. formation of fossil fuels
 - B. formation of sedimentary rock
 - C. photosynthesis
 - D. all the above
5. Water vapour, carbon dioxide and methane are examples of what?
- A. fossil fuels
 - B. greenhouse gases
 - C. hydrocarbons
 - D. toxins
6. Deforestation is linked to an increase in the atmospheric levels of which gas?
- A. carbon dioxide
 - B. methane
 - C. nitrogen
 - D. oxygen
7. Which statement is **not** true?
- A. climate change can affect the migration and hibernation of wildlife
 - B. climate change can affect the amount of food that it is possible to produce for people
 - C. climate change can lead to the loss of habitats
 - D. climate change only affects wildlife, not people



8. Which statement is **not** true?
- A. carbon capture can be used to reduce the carbon footprint of some industries
 - B. individuals, companies, industries and whole countries can all reduce their carbon footprint
 - C. most scientists and governments agree on how carbon footprints can be reduced
 - D. reducing carbon footprints can be an expensive and time-consuming process
9. Propanol, C_3H_7OH , is a fuel. What are the products of the complete combustion of propanol?
- A. carbon dioxide
 - B. carbon dioxide and water
 - C. carbon monoxide and water
 - D. carbon particulates
10. What problem is associated with oxides of nitrogen?
- A. acid rain
 - B. deforestation
 - C. global dimming
 - D. global warming



Chemistry of the Atmosphere

Multiple Choice Questions

Homework 2

Set 5

You may use a periodic table to help you answer these questions.

Tick **one** box.

- For how long have the proportions of gases in the present-day atmosphere of the Earth been approximately consistent?
 - 200 years
 - 2000 years
 - 2 000 000 years
 - 200 000 000 years
- Which gas was **not** present in the early atmosphere of the Earth?
 - carbon dioxide
 - nitrogen
 - oxygen
 - water vapour
- Which gas needed to be present in the atmosphere to enable animals to evolve?
 - carbon dioxide
 - nitrogen
 - oxygen
 - water vapour
- The percentage of which atmospheric gas has decreased because of photosynthesis?
 - carbon dioxide
 - nitrogen
 - oxygen
 - water vapour
- Which statement about greenhouse gases is correct?
 - greenhouse gases absorb all the radiation from the Sun
 - greenhouse gases absorb long wavelength (infrared) radiation from the surface of the Earth
 - greenhouse gases are all toxic
 - greenhouse gases are only produced by the combustion of fossil fuels



6. Which of these activities has **not** been linked to an increase in the atmospheric levels of greenhouse gases?
- A. cattle breeding
 - B. deforestation
 - C. disposal of waste in landfill sites
 - D. generation of electricity through nuclear power
7. What do most scientists believe is the major cause of global climate change?
- A. hunting of endangered species
 - B. increased frequency and severity of storms
 - C. overfishing of the oceans
 - D. rising average global temperature
8. Which mode of transport has the lowest greenhouse gas emissions?
- A. aeroplane
 - B. bus
 - C. car
 - D. walking
9. A student used a Bunsen burner to heat some water in a beaker. After the experiment, the student noticed a black residue on the bottom of the beaker. Which conclusion is correct?
- A. complete combustion of the gas from the Bunsen burner occurred
 - B. incomplete combustion of the gas from the Bunsen burner occurred
 - C. the beaker reacted with oxygen in the air when heated
 - D. the gas from the Bunsen burner was contaminated
10. Which pollutant is toxic due to it affecting the ability of red blood cells to carry oxygen?
- A. carbon monoxide
 - B. carbon particulates
 - C. oxides of nitrogen
 - D. sulfur dioxide



Chemistry of the Atmosphere Word Search

Each of the words in the grid below relates to the chemistry of the atmosphere. Work out the answer to each clue, then find the answers in the grid. They can be found horizontally, vertically and diagonally.

e u r n o e t e y q d a w e e u k p c g
s c a r b o n f o o t p r i n t r p a e
e f k u d t b e d m g o b o b b m c r m
d a v r q a s u m e r l k g a i l u b q
i p o m y j b p r t e l g n d j n z o o
m h l e f v t e o h e u c w h m k m n y
e o c s r m s e b a n t j h j z y x m b
n t a m h p n r z n h a g y h o j r o u
t o n g j a i r v e o n a q q x i r n h
a s o o j r t e x p u t k i w w u s o r
r y e x c t r v s s s y v o x o n b x w
y n s h r i o i w d e o d f p i k j i e
o t g w e c g e x p e l f a a j n k d m
u h z g c u e w g n f w v r f e f w e v
h e c z a l n e z c f r d p g r x e e b
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d i x r m t f q o t c o x b n b a i r j
c s o w c e y u a a t o v k w x w l n e
d m a y a s z w n a l g b h d w p y z r
y z c a r b o n d i o x i d e b d c o n



Clues

Homework 2

1. Microscopic particles suspended in the air that cause global dimming and health problems for humans.

2. Vents in the Earth's crust through which hot gases and molten rock are released. Emissions from these vents formed the Earth's early atmosphere.

3. An endothermic reaction which began to release oxygen into the atmosphere approximately 2.7 billion years ago.

4. The gas that makes up approximately 80% of today's atmosphere.

5. The evaluation of scientific research by other scientists working in the same field.

6. Precipitation that is acidic due to dissolved sulfur dioxide and oxides of nitrogen.

7. The retention of heat in the atmosphere due to certain gases absorbing energy transferred as long wavelength radiation from the Earth's surface.

8. A greenhouse gas that is produced by cattle and landfill sites.

9. The total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.

10. The gas released as a product of the complete combustion of fossil fuels.



11. The type of rock that is formed when layers of deposit are compressed over time. The formation of this type of rock led to a decrease in the amount of carbon dioxide in the atmosphere.

12. The gas that makes up approximately one-fifth of today's atmosphere.

13. A substance with undesirable effects that is introduced to the environment.

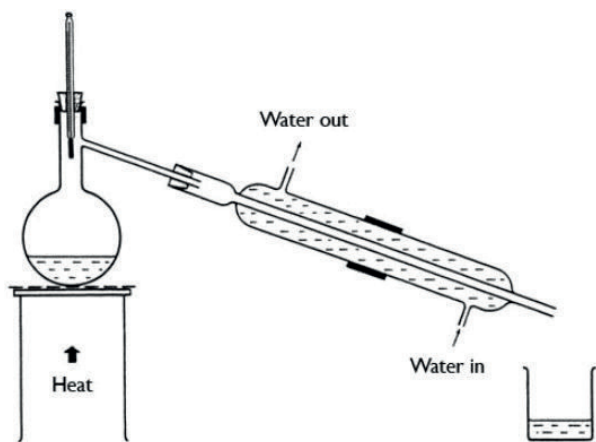
14. A toxic gas that is the product of incomplete combustion of fossil fuels.

15. A gas that was present in the early atmosphere and later condensed to form the oceans.

Water Purification

Questions

1. Distillation can be carried out using a piece of equipment called the Liebig condenser, as shown in the diagram below.



Compare this method of distillation with the method you used in your investigation. In your answer, remember to include:

- Any differences in the methods.
- Which method you prefer, and why.
- The advantages to the differences.
- An explanation of how distillation works.

2. Name two solutions that could be separated by distillation.

3. The pH of water can vary. How can the pH of water be tested? Give two methods.

Sewage Treatment Process

Number the cards below and reorganise them into the correct sequence to show the method for treating sewage.

The sediment is removed and treated by anaerobic digestion.

The sewage is screened to remove large bits, e.g. twigs, plastic bags and grit.

The sewage stands in a settlement tank to form a layer of sediment (heavier) and effluent (lighter).

Additional treatments can include addition of chemicals, UV radiation or using membranes.

The clean water is then released back into the environment.

The treated sediment produces methane (for energy) and digested waste (for fertiliser).

The effluent is removed and treated by biological aerobic digestion.



Using Resources Multiple Choice Questions

Set 1

Tick **one** box.

1. What do humans use the Earth's resources for?

- A. food
- B. shelter
- C. warmth
- D. all of the above

2. Which of these is a renewable natural resource?

- A. copper
- B. crude oil
- C. natural gas
- D. timber

3. How is most potable water produced in the United Kingdom?

- A. desalination of salty water
- B. filtration and sterilisation of ground water
- C. treatment of waste water
- D. all of the above

4. Is potable water pure water?

- A. it cannot be known because it depends on where the water comes from
- B. it cannot be known because is not possible to test the purity of water
- C. no, because it contains small amounts of dissolved salts
- D. yes, because it comes from a natural source

5. Which of these is **not** a stage in the treatment of sewage?

- A. anaerobic digestion of sludge
- B. screening
- C. sedimentation
- D. sterilisation with chlorine



6. Why are life cycle assessments sometimes said to be subjective?
- A. because it is not possible to quantify every stage of a product's life cycle
 - B. because they can be selective in the information they present
 - C. because they can be misused to reach biased conclusions
 - D. all of the above

7. Which product can be widely reused?
- A. aluminium foil
 - B. glass milk bottles
 - C. paper carrier bags
 - D. polystyrene cups

Table 1 gives some information about paper bags and plastic bags.

Table 1

	Paper Bag	Plastic Bag
Raw Materials	wood	crude oil
Reusability	single-use	can be reused many times
Disposal	biodegradable and can be recycled	mostly landfill

8. Which type of bag in **Table 1** is made from a renewable resource?
- A. both paper bags and plastic bags
 - B. neither paper bags nor plastic bags
 - C. paper bags only
 - D. plastic bags only

9. What advantage of using paper bags is given in **Table 1**?
- A. a fossil fuel is used as the raw material
 - B. they can be reused many times
 - C. they contribute to deforestation
 - D. they naturally decompose

10. Which statement about recycling is not true?
- A. recycling an item is more energy-efficient than replacing it
 - B. recycling helps to reduce the environmental impact of mining and quarrying
 - C. recycling materials helps to preserve limited resources
 - D. the raw materials used to make an item can only be recycled once



Using Resources Multiple Choice Questions

Set 2

Tick **one** box.

1. Which statement about food, clothing, timber and fuels is correct?
 - A. they are always artificially made
 - B. they are always made from finite resources
 - C. they are always made from natural resources
 - D. they can be made from natural resources, supplemented by agriculture

2. What is a finite resource?
 - A. a limited resource that could run out
 - B. a resource that can be remade as quickly as it is being used
 - C. a resource that is made sustainably
 - D. a synthetic material

3. What is potable water?
 - A. all water is potable water
 - B. pure water
 - C. seawater
 - D. water which is safe to drink

4. Why is chlorine used in the production of potable water?
 - A. to kill microbes
 - B. to remove large debris
 - C. to remove salts
 - D. all of the above

5. What is the purpose of waste water treatment?
 - A. to make it safe to release the water back into the environment
 - B. to remove harmful chemicals from industrial processes
 - C. to remove organic waste and harmful microbes
 - D. all of the above



6. Which of these is **not** a stage of a life cycle assessment (LCA)?
- A. extraction of raw materials to make the product
 - B. disposal of the product
 - C. manufacturing of the product
 - D. the colour and style of the product
7. Which material is **not** widely recycled in the United Kingdom?
- A. cardboard
 - B. glass
 - C. fabric
 - D. metal

Table 1 shows information about the life cycle of two different milk bottles.

Table 1

	Glass Milk Bottle	Plastic Milk Bottle
Raw Materials	sand, soda ash, limestone	crude oil
Energy Required for Manufacturing (MJ/kg)	6.57	3.75
Lifespan	reusable	single-use

8. Calculate the number of times a glass milk bottle needs to be reused before it is more energy-efficient than a plastic milk bottle.
- A. 1
 - B. 2
 - C. 3
 - D. 4
9. How does reusing a glass bottle reduce its environmental impact? Use information from **Table 1**.
- A. it preserves natural resources
 - B. it reduces the volume of waste rock from quarrying
 - C. it requires less energy than recycling
 - D. all of the above



10. Which of the following statements is true? Use the information in **Table 1**.

- A. glass milk bottles cannot be used more than once
- B. glass milk bottles require twice as much energy to manufacture compared to plastic milk bottles
- C. plastic milk bottles are made using finite materials
- D. plastic milk bottles are made using renewable materials





Using Resources Multiple Choice Questions

Set 3 (HT Only)

Tick **one** box.

1. What does sustainable development mean?
 - A. distributing resources evenly across the population
 - B. gradually increasing the number of natural resources used by each successive generation
 - C. using natural resources in a way that meets the current demand while ensuring that sufficient resources will be available for future generations
 - D. using natural resources to sustain the standard of living for the current population

2. Which of these is a finite resource?
 - A. cotton
 - B. coal
 - C. sugar cane
 - D. timber

3. What is used to sterilise ground water in the production of potable water in the United Kingdom?
 - A. chlorine
 - B. ozone
 - C. ultraviolet light
 - D. all of the above

4. How is potable water produced when there is no suitable source of ground water?
 - A. desalination of salty water
 - B. reverse osmosis of salty water
 - C. treatment of waste water
 - D. all of the above

5. Which stage of waste water treatment removes harmful microbes?
 - A. aerobic treatment
 - B. anaerobic digestion
 - C. screening
 - D. sedimentation



6. Which part of a product's life cycle assessment **cannot** be easily quantified?
- A. its energy requirements
 - B. its impact on wildlife
 - C. its waste production
 - D. its water consumption

Table 1 shows information relating to four different coffee cups.

Table 1

	Polystyrene Cup	Ceramic Cup	Plastic Cup	Paper Cup
Raw Materials	crude oil	clay	crude oil	wood
Energy Required for Manufacturing (MJ/kg)	0.20	14.0	6.30	0.50
Lifespan	single-use	reusable	reusable	single-use
Disposal	landfill	landfill	recyclable	recyclable

7. Which cup in **Table 1** is made from a sustainable resource?
- A. ceramic
 - B. paper
 - C. plastic
 - D. polystyrene
8. An office worker switches from using paper cups to a ceramic cup. After how many individual uses would the energy required to manufacture each be equal? Use information from **Table 1**.
- A. 7
 - B. 14
 - C. 28
 - D. 35
9. What is the name of the process which uses plants to absorb metal compounds from the ground?
- A. agriculture
 - B. bioleaching
 - C. phytomining
 - D. quarrying



10. Which statement about extracting metals is **not** correct?

- A. bioleaching and phytomining are modern ways of extracting increasingly scarce metal ores
- B. bioleaching and phytomining can extract metals from low-grade ores
- C. bioleaching and phytomining have a lesser environmental impact than traditional mining methods
- D. bioleaching and phytomining produce pure metals which do not require any further processing



Life Cycle Assessments

Number the cards below and reorganise them into the correct sequence to show each stage of a product's life cycle which is assessed for its environmental impact.

Manufacturing of the products and packaging.
Duration of use of the product.
Extraction of the raw materials.
Disposal of waste and by-products from the manufacturing process.
Processing of the raw materials.
Disposal of the product after use.
Pollution or environmental harm from use of the product.



Using Resources Crossword

Homework 4

Solve the clues to complete the crossword. Each of the answers to the clues relates to using the Earth's natural resources. The number of letters in each word has been given to help you.

The crossword puzzle grid consists of 12 numbered starting points for clues:

- 1: Down, 10 letters
- 2: Down, 3 letters
- 3: Down, 5 letters
- 4: Across, 5 letters
- 5: Across, 6 letters
- 6: Across, 10 letters
- 7: Across, 12 letters
- 8: Across, 8 letters
- 9: Down, 10 letters
- 10: Across, 8 letters
- 11: Across, 12 letters
- 12: Across, 10 letters



Across

4. A word to describe a limited resource that isn't replenished or replaced quickly enough to be considered renewable. (6)
5. The waste material that can be treated using a process of screening, sedimentation, anaerobic digestion of sludge, and aerobic biological treatment of effluent. (6)
6. The process used to remove undissolved solids from water. (10)
7. The name for water containing low levels of dissolved substances, that collects in the ground, lakes and rivers when it rains. (5,5)
8. The collection and processing of used materials to make new products. (9)
10. A word to describe substances made by chemical processes, i.e. not natural. (9)
11. A word relating to farming, including cultivating soil, growing crops and rearing livestock. Materials produced this way can be used to supplement natural resources to provide food, clothing and fuels. (11)
12. A word to describe a process that is able to be maintained at a certain level or rate, or continue over time. (11)

Down

1. Water that is safe to drink. It is not the same as pure water because it contains dissolved substances. (7,5)
2. A process that assesses the environmental impact of a product over the course of its life. (4,5,10)
3. The removal of microorganisms from water. This can be done by using chlorine, ozone or ultraviolet light. (13)
9. A process that removes salt from salty water or sea water. It can be done by distillation or by processes that use membranes such as reverse osmosis. (12)