



Question 1 (11 marks)

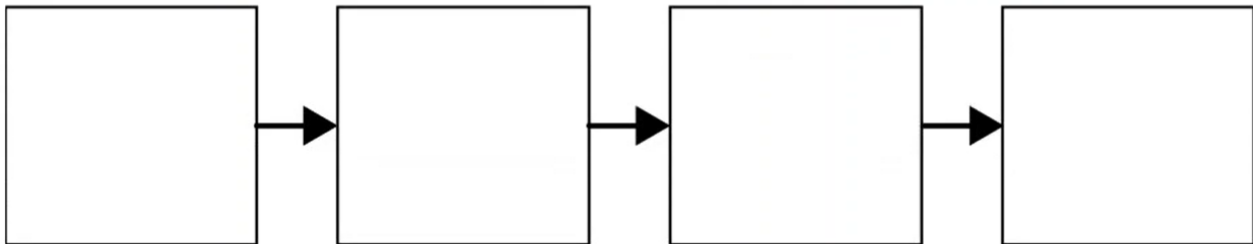
A biome contains plants and animals living in a major habitat. A biome can be made up of multiple ecosystems.



Question 1a (2 marks)

The images below show different organisms in a biome. **Organize** the organisms to create a food chain.

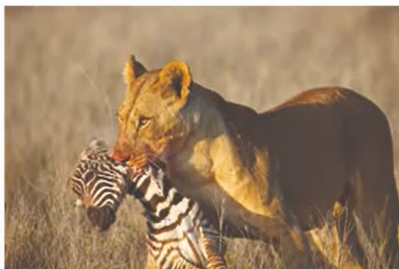
Draggable items:





Question 1b (3 marks)

Select the type of interaction occurring between the organisms below.



- Transpiration
- Predation
- Parasitism
- Respiration
- Competition



Question 1c (2 marks)

The surface of the Earth is covered with a wide diversity of ecosystems. State the meaning of the term *ecosystem*.

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Question 1d (4 marks)

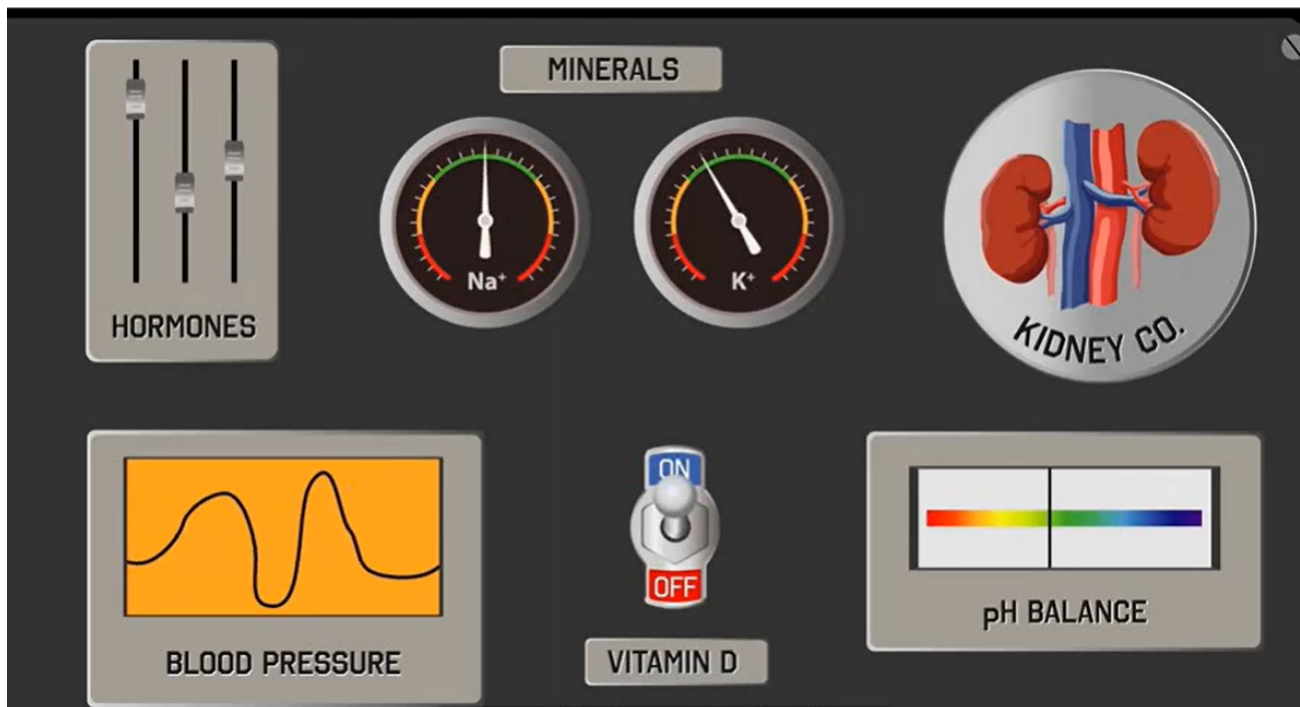
Using scientific terminology, **explain** the process of natural selection.

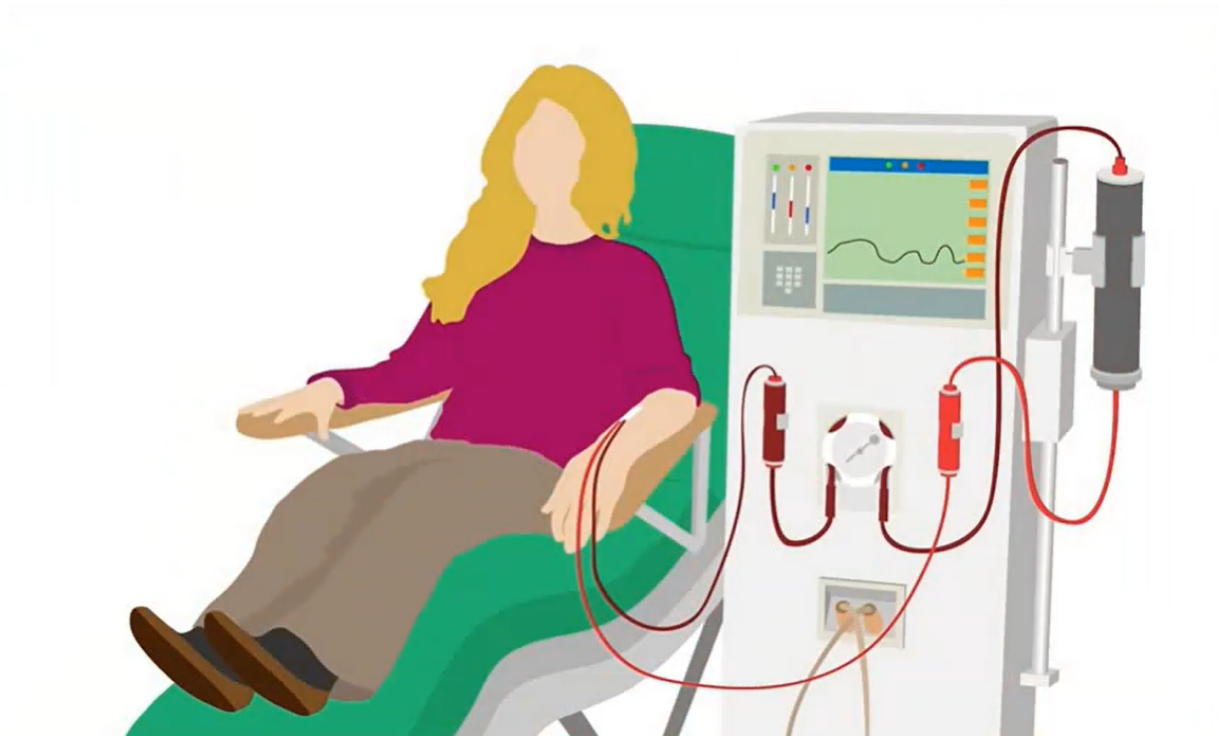
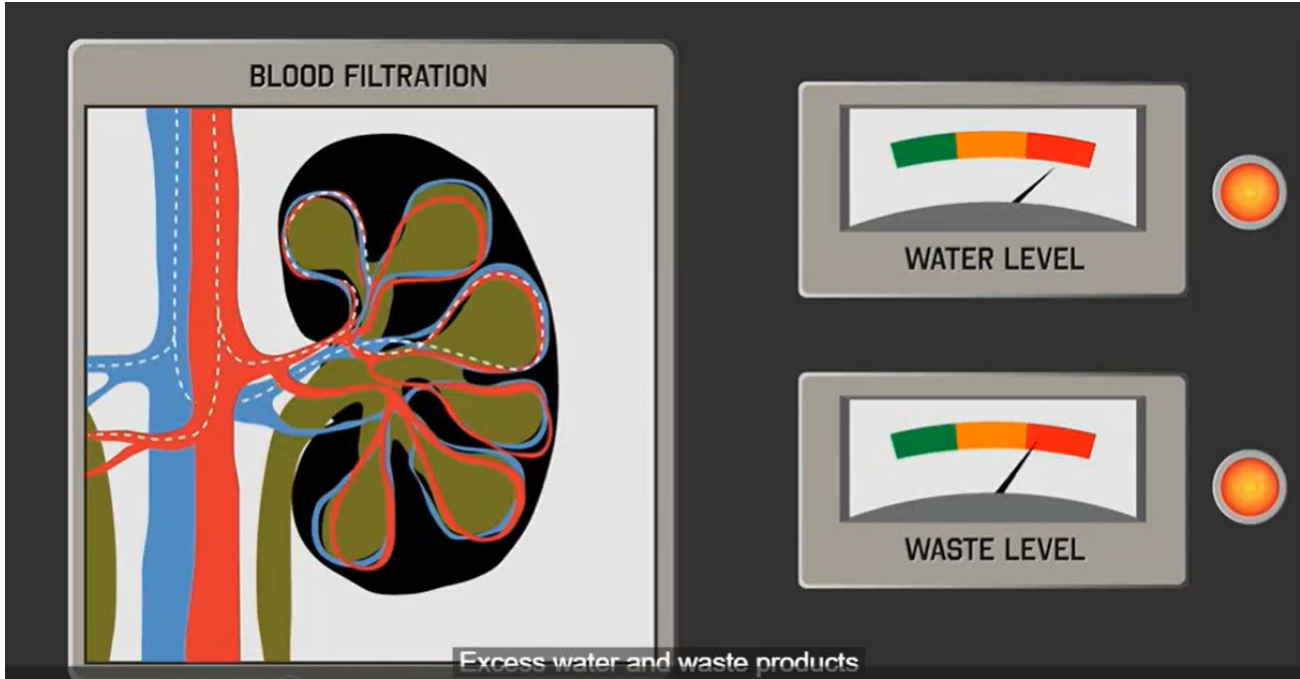
B *I* ← → U x_2 x^2 $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ Styles

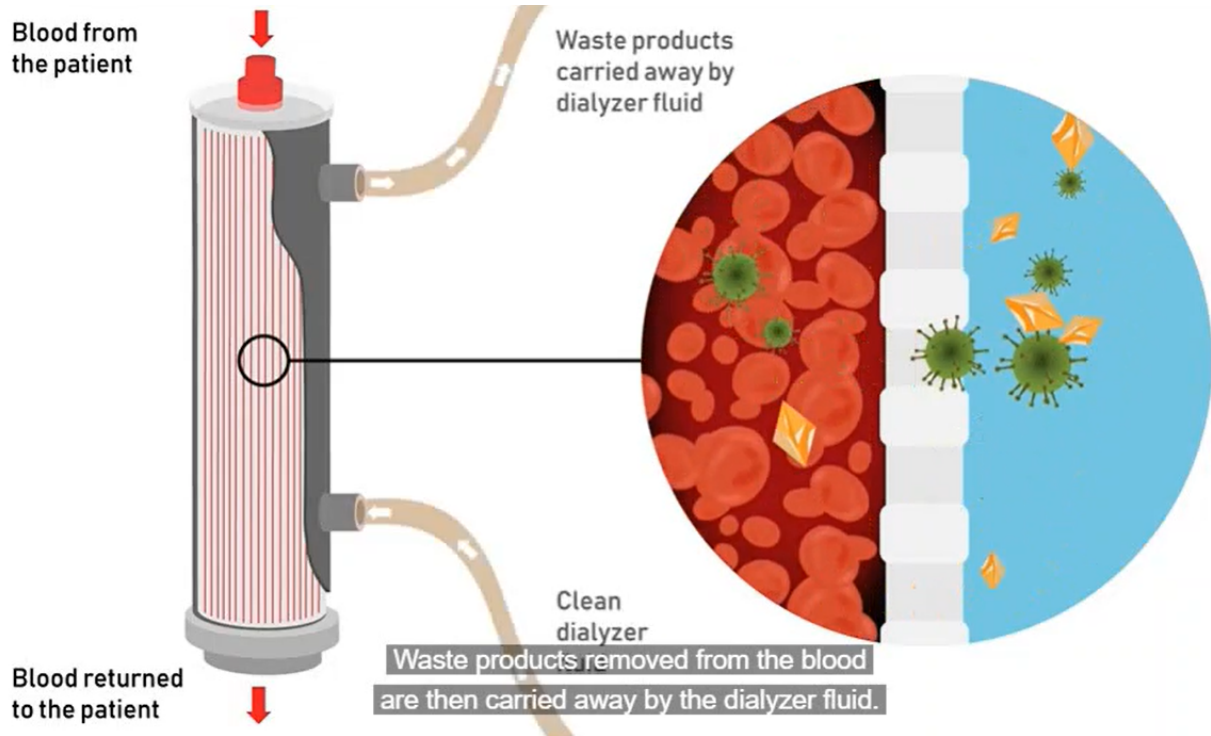


Question 2 (11 marks)

The human body depends on transport processes to maintain homeostasis. The video below demonstrates how these transport processes are used to treat medical conditions.







The kidneys produce urine by removing excess water and toxins from the blood stream. They also produce hormones, regulate mineral levels and blood pressure, make vitamin D, and maintain the body's pH balance.

The kidneys filter all of the body's blood about 300 times each day. If the kidneys become diseased or fail it is a serious health problem. Excess water and waste products from the body's metabolism can no longer be filtered out of the blood to prevent toxins from building up.

When this happens toxins must be regularly removed from the blood by dialysis. Dialysis is a medical procedure carried out regularly to filter the patient's blood of toxins, excess water, and salts. This procedure takes up to six hours and is repeated up to three times a week.

Dialysis machines used for this procedure contain a dialysis filter called a dialyzer. The dialyzer functions as a healthy kidney. Within the dialyzer there are thousands of thin fibres with pores to help remove the metabolic waste and excess water from passing blood.

Waste products removed from the blood are then carried away by the dialyzer fluid. The cleaning process continues in the dialyzer as blood is pumped through it by the dialysis machine.



Question 2a (1 mark)

State the meaning of the term *homeostasis*.

B *I* ← → U x_2 x^2 $\frac{1}{2}$ $\frac{3}{4}$ Ω Σ Styles



Question 2b (1 mark)

Kidneys function to remove excess water and salts from the blood stream. Dialysis is the process that serves the same function if the kidneys stop functioning properly. The process of dialysis depends on the processes of diffusion and osmosis.

State the part of the cell that regulates the processes of diffusion and osmosis.

B *I* ← → U x_2 x^2 $\frac{1}{2}$ $\frac{3}{4}$ Ω Σ Styles



Question 2c (5 marks)

Explain the processes of diffusion and osmosis.

B *I* ← → U x_2 x^2 $\frac{1}{2}$ $\frac{3}{4}$ Ω Σ Styles



Question 2d (2 marks)

In dialysis, the dialysis fluid is continuously removed. **Suggest** a reason for removing the dialysis fluid and **predict** what would happen if it is not removed.

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Question 2e (2 marks)

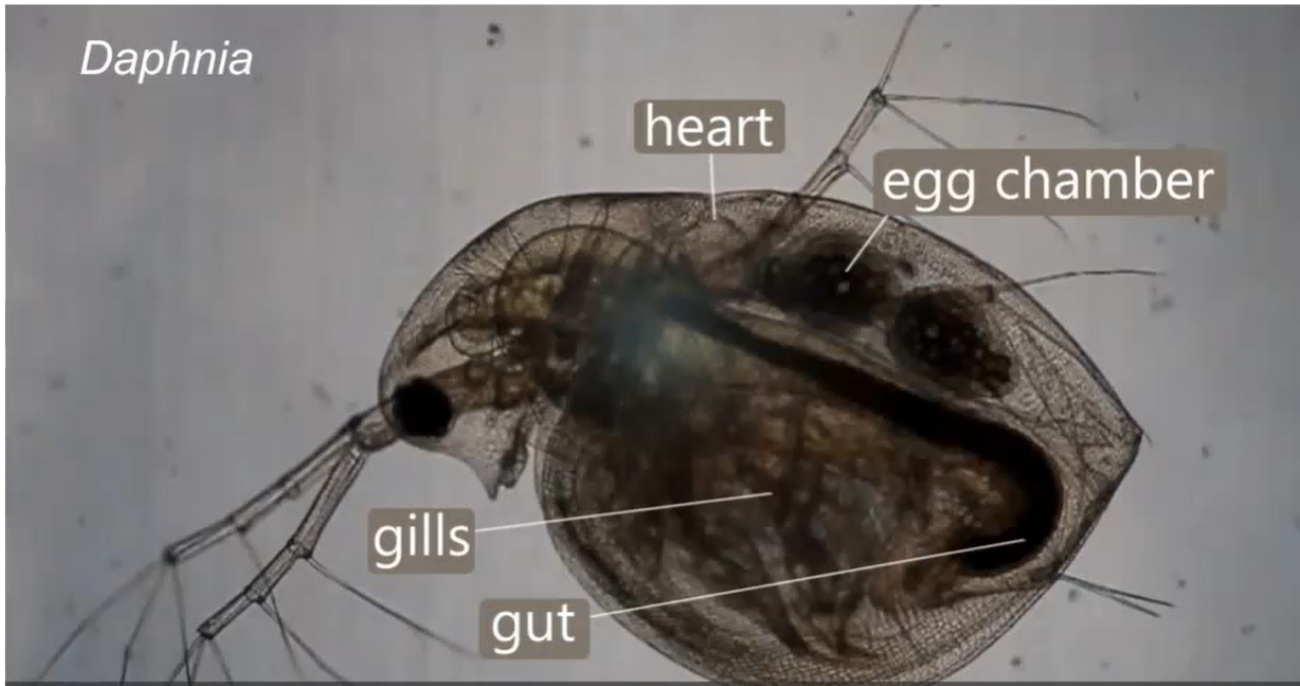
In the dialyzer, the blood passes through many fine tubes rather than one large tube. **Justify** why many fine tubes are used.

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Question 3 (13 marks)

Daphnia are small invertebrates that live in water. *Daphnia* are interesting to use for investigations into heart rate because they are transparent, so you can see their heart beating. Some of the information collected from studying *Daphnia* can model how certain factors might influence human heart rate.



Question 3a (2 marks)

List two characteristics of living organisms.



Characteristic 1

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Styles

Characteristic 2

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Question 3b (1 mark)

Elodea is a plant found in the same habitat as *Daphnia*. **Identify** one feature of *Elodea* cells that would make them different to cells found in *Daphnia*.

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Question 3c (2 marks)

Sugar can affect heart rate in humans. **Suggest** a hypothesis for what would happen to the heart rate of a *Daphnia* if it were provided with different amounts of sugar in its water. Your answer should include a scientific explanation.

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Question 3d (4 marks)

Identify the variables in this investigation.

Independent variable

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Question 3e (2 marks)

State how many different amounts of sugar should be given to the *Daphnia* to study changes in heart rate and **justify** your answer.

B *I* ← → x₂ x² ☰ ☷ Ω Σ Styles ↕



Question 3f (2 marks)

State how many trials should be repeated for each amount of sugar and **justify** your answer.

B *I* ← → x₂ x² ☰ ☷ Ω Σ Styles ↕

Question 4 (16 marks)

A student planned the method below to study the effect of temperature on heart rate.

Method	
Step 1: Take a small piece of cotton and place it in the middle of a small Petri dish.	Step 6: Use a stopwatch to time 20 seconds.
Step 2: Select a <i>Daphnia</i> and use a pipette to transfer it onto the cotton.	Step 7: Record the number of heartbeats in the data table.
Step 3: Measure the temperature of the pond water in the beaker.	Step 8: Repeat steps 4-7 with pond water at 10°C, 15°C and 25°C. Allow the <i>Daphnia</i> some time to acclimatize and then count the heartbeat for 20 seconds. Use a new <i>Daphnia</i> for each trial.
Step 4: Add pond water from the beaker to the Petri dish until the <i>Daphnia</i> is just covered by the water.	

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Step 4: Add pond water from the beaker to the Petri dish until the <i>Daphnia</i> is just covered by the water.	
Step 5: Place the Petri dish on the stage of a microscope and observe the <i>Daphnia</i> under low power.	



Question 4a (3 marks)

Students counted the heartbeats of a *Daphnia* for 20 seconds. **Calculate** the *Daphnia*'s heart rate in beats per minute (bpm). You should show your working in the box below and add your answer to the table.

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x₂), Superscript (x²), Bulleted List, Numbered List, Omega (Ω), Sigma (Σ), Styles dropdown, and a document icon.

Temperature / °C	10	15	25
Heartbeats in 20 s	47	83	96
Heart rate / bpm			



Question 4b (4 marks)

Suggest two weaknesses of the investigation and **justify** your answers.



Weakness 1

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x₂), Superscript (x²), Bulleted List, Numbered List, Omega (Ω), Sigma (Σ), Styles dropdown, and a document icon.

Weakness 2

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x₂), Superscript (x²), Bulleted List, Numbered List, Omega (Ω), Sigma (Σ), Styles dropdown, and a document icon.



Question 4c (1 mark)

Suggest a different independent variable to extend this investigation.

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Question 4d (2 marks)

At the start of the investigation, the student predicted that the *Daphnia*'s heart rate would increase as temperature increased.

Discuss the prediction using scientific reasoning.

B **I** x_2 x^2 Ω Σ Styles



Question 4e (2 marks)

Based on the data presented in the table in part (a), **outline** whether or not the prediction was valid. Consider the method and the reliability of the data.

B **I** x_2 x^2 Ω Σ Styles



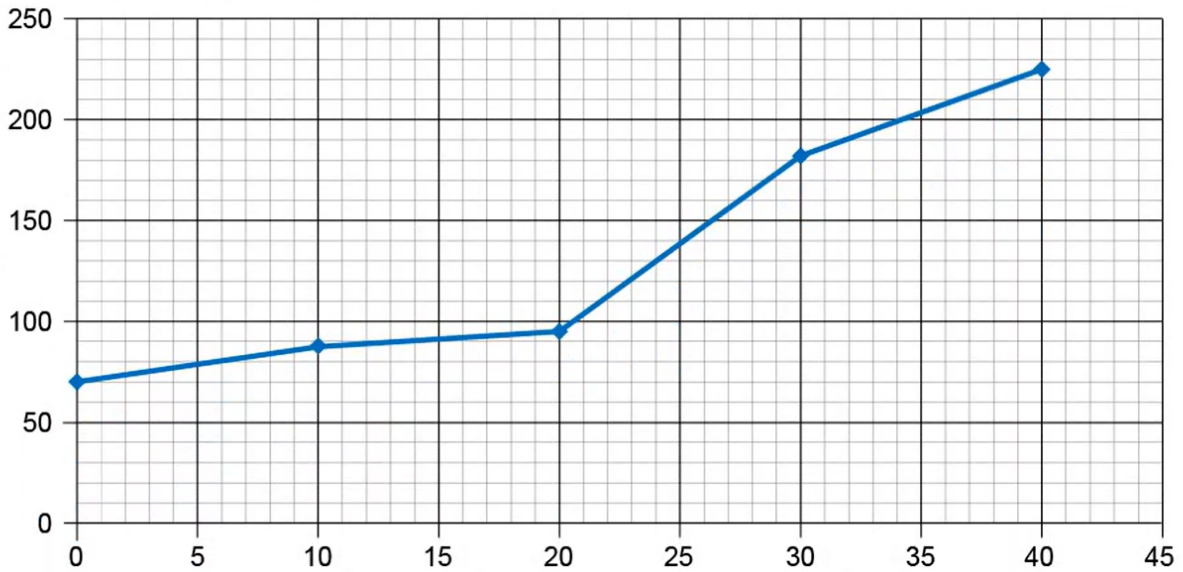
Question 4f (2 marks)

The students were working with a school in another part of the world and wanted to compare this data to their own results. The student's raw data and transformed data are presented below with a graph of their results.

Raw data

Temperature / °C	Heart rate / bpm			
	Daphnia A	Daphnia B	Daphnia C	Average
0	75	71	65	70
10				
20				
30	178	180	190	183
40	221	228	224	224

Effect of temperature on *Daphnia* heart rate



The graph is incomplete. Label the x and y axis.



Question 4g (2 marks)

The table of transformed data is incomplete. Use information from the graph to **determine** the missing data. You should add these values to the transformed data table below.

Transformed data

Temperature / °C	Average heart rate / bpm
0	70
10	
20	
30	183
40	224



Question 5 (17 marks)

Caffeine is a stimulant which is found in coffee and cola drinks. The health and fitness club in a school wants to ban caffeinated drinks. They want to collect some scientific evidence to support their argument.

Design an investigation to study the influence of caffeine on human heart rate. You are provided with a range of solutions of different caffeine concentration (0 – 0.5 gdm⁻³ caffeine concentration) to model the effect of caffeinated drinks. In your answer you should include:

- the independent variable, dependent variable and two control variables
- a testable hypothesis
- details of how to manipulate, measure or monitor all of the variables
- details of the method to collect sufficient data
- ethical considerations.

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Question 6 (7 marks)

After conducting their investigation, a student did some further research into caffeine in energy drinks. They studied the energy drink shown below:



Nutrition facts

Serving size 100 cm³
Servings per container 1

Amount per serving
Calories 60 Calories from fat 0

		% Daily value*
Total fat	0 g	0 %
Sodium	0 mg	0 %
Total carbohydrate	15 g	5 %
Sugar	15 g	
Caffeine	50 mg	
Vitamin A		25 %
Vitamin C		250 %
Vitamin E		100 %
Vitamin B12		125 %
Riboflavin		50 %

* Percent daily values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

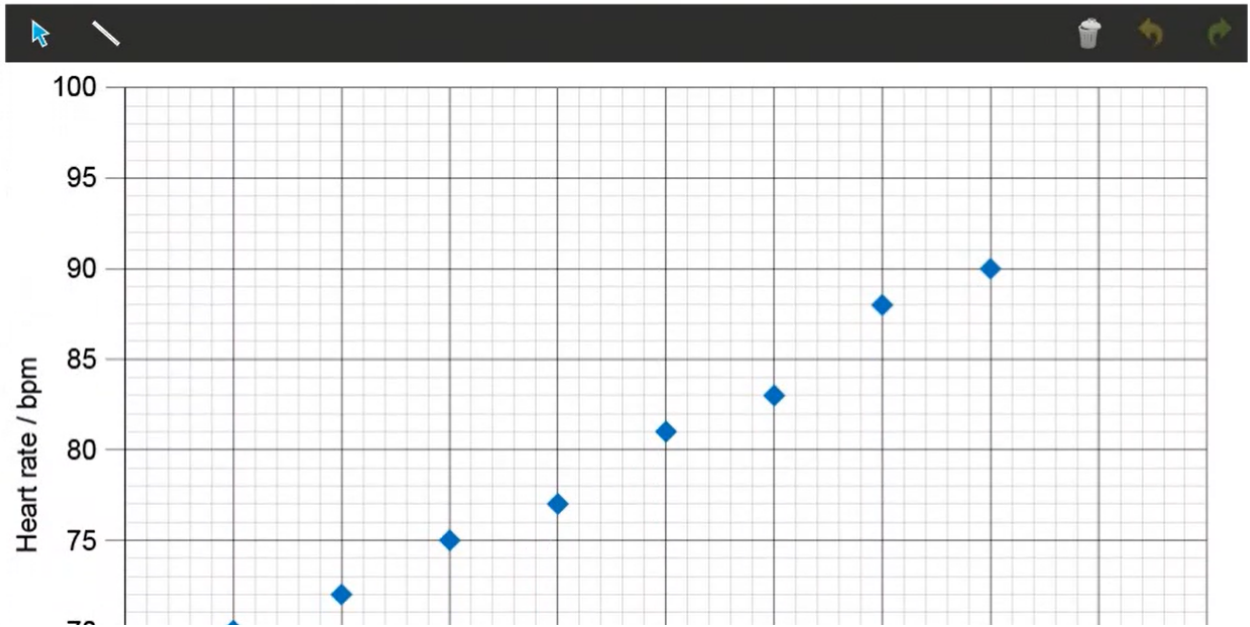


Caffeine	50 mg	
Vitamin A		25 %
Vitamin C		250 %
Vitamin E		100 %
Vitamin B12		125 %
Riboflavin		50 %

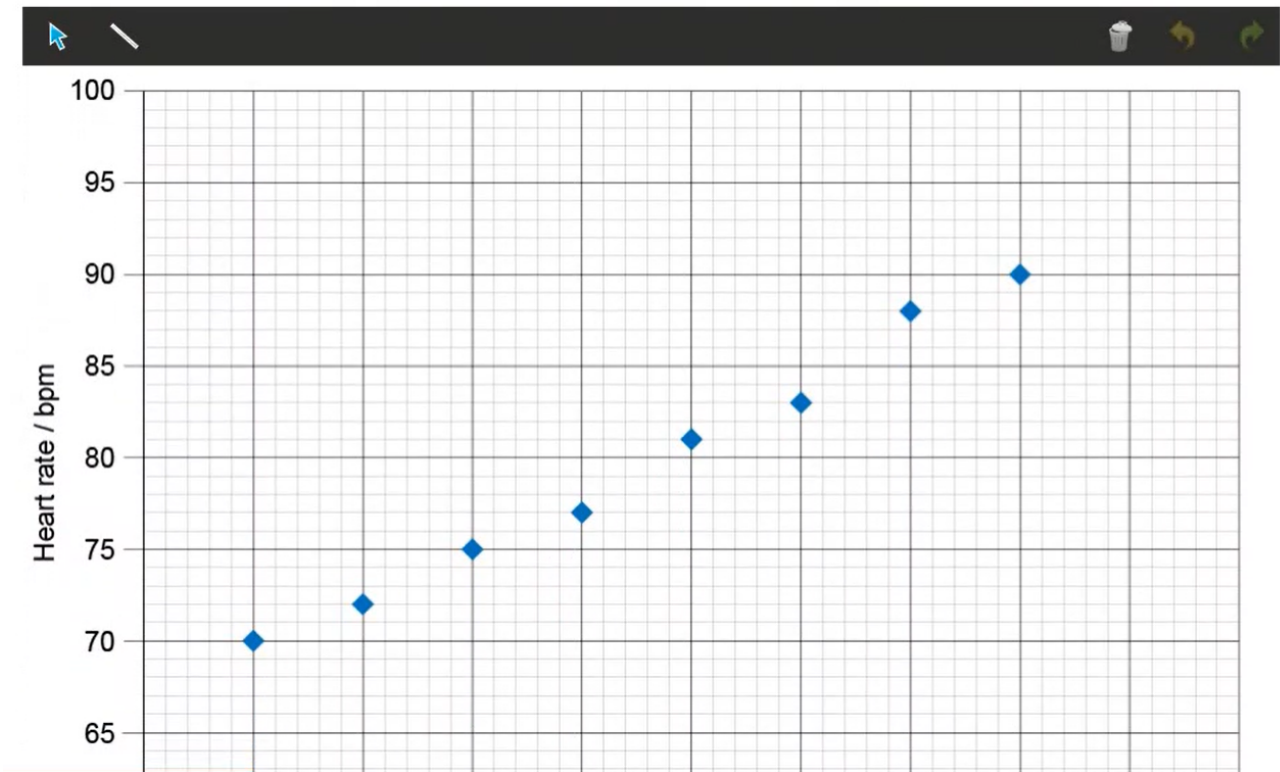
* Percent daily values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

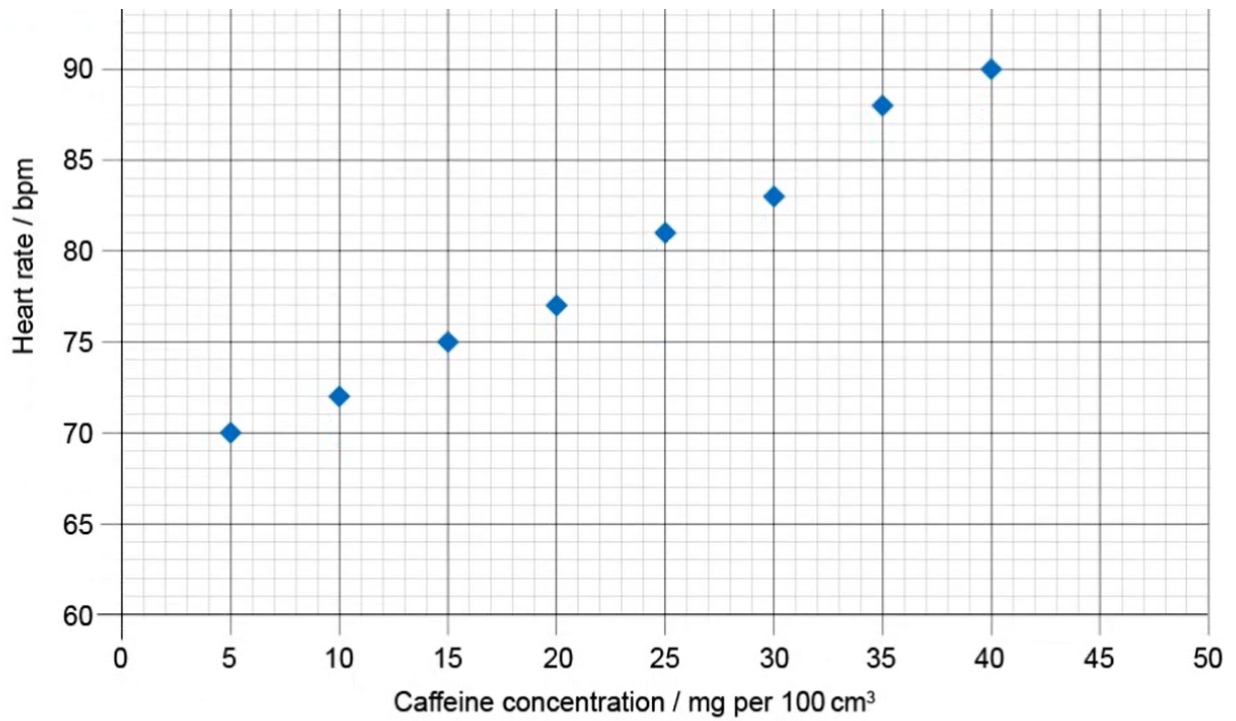
Question 6a (2 marks)

The graph below shows how caffeine concentration affects heart rate.



The graph below shows how caffeine concentration affects heart rate.





Add a line of best fit to the graph and use this to **predict** the heart rate after drinking 100 cm³ of JHIVD.

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Question 6b (3 marks)

The student wanted to test the prediction from part (a). After drinking JHIVD, he measured his heart rate at 112 bpm.

Calculate the percentage **increase** between the predicted heart rate and the measured value. You should give your answer to three significant figures.

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Question 6c (2 marks)

Using nutritional information from above, **suggest** why the actual heart rate was different to the predicted value.

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Question 7 (8 marks)

Humans have been interacting with and changing their environment for thousands of years. We have changed our environment to suit our needs, but these changes are causing the environment to respond in ways we have yet to fully understand.



Question 7a (2 marks)

Select the name of the processes that add CO₂ to the atmosphere and remove CO₂ from the atmosphere.

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Draggable items:

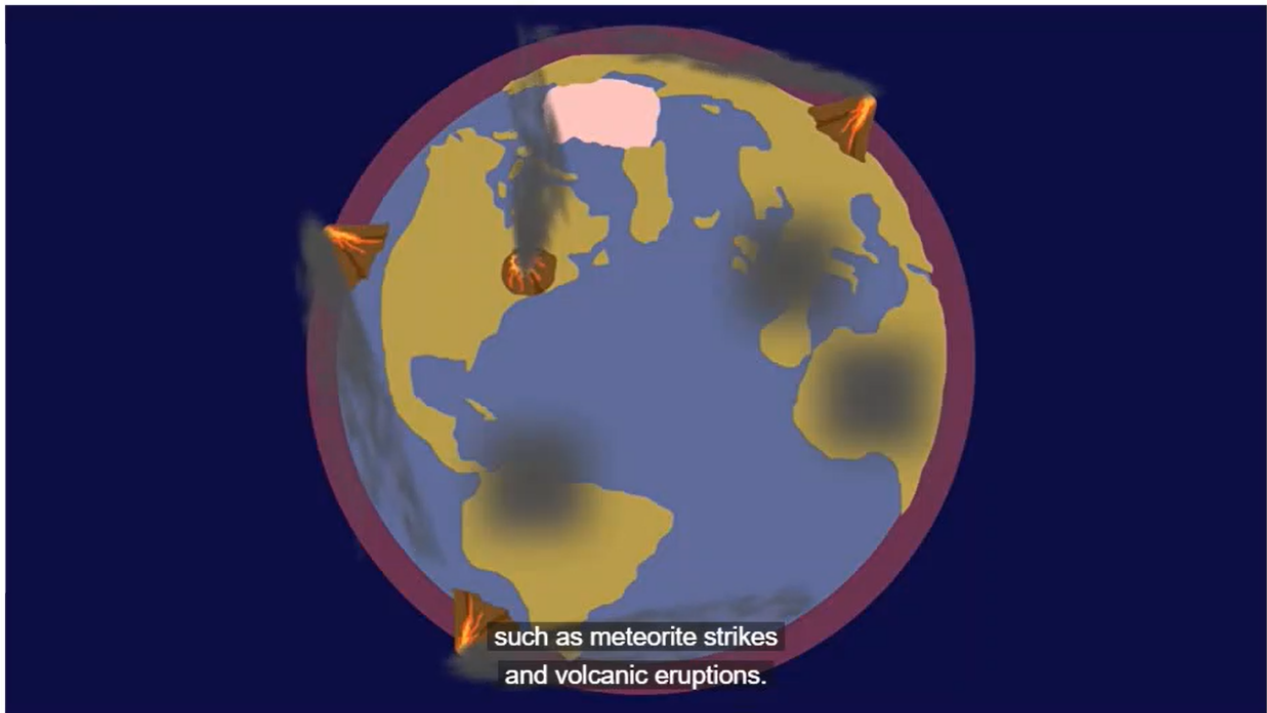
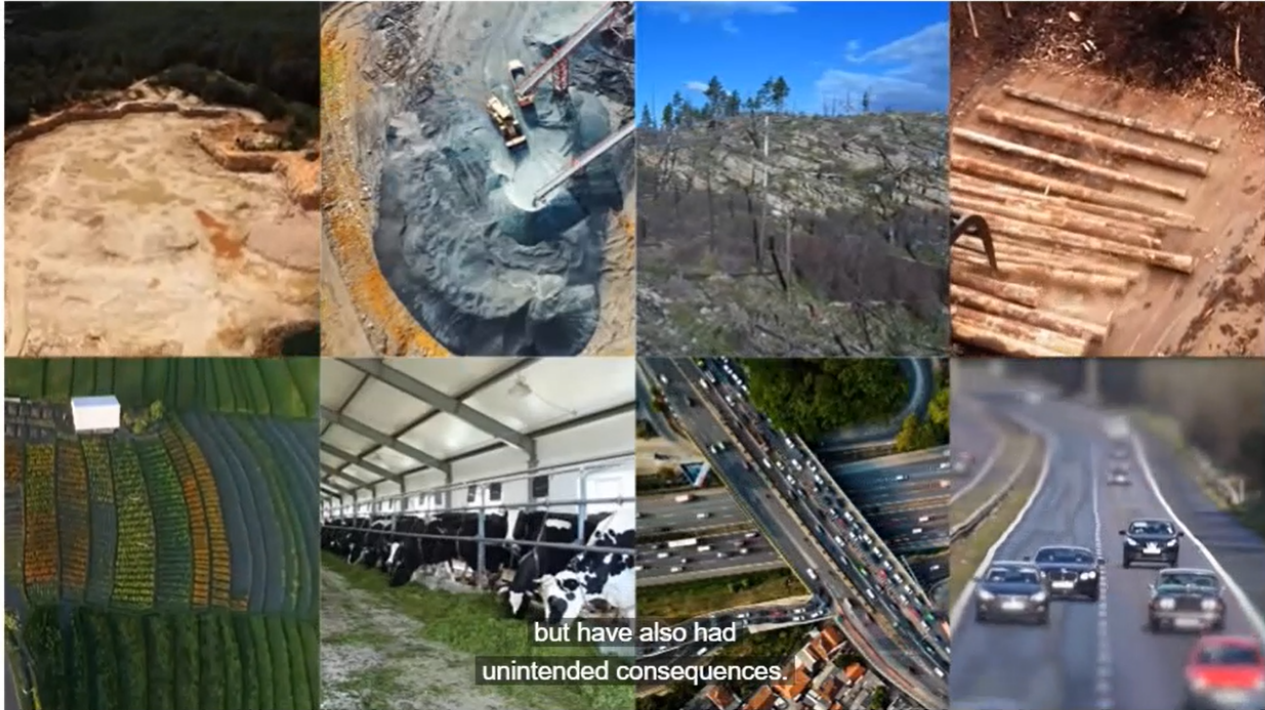
- respiration
- photosynthesis
- tropism
- evaporation
- transpiration

The process that adds CO₂ to the atmosphere

The process that removes CO₂ from the atmosphere



We have changed our environment to suit our needs



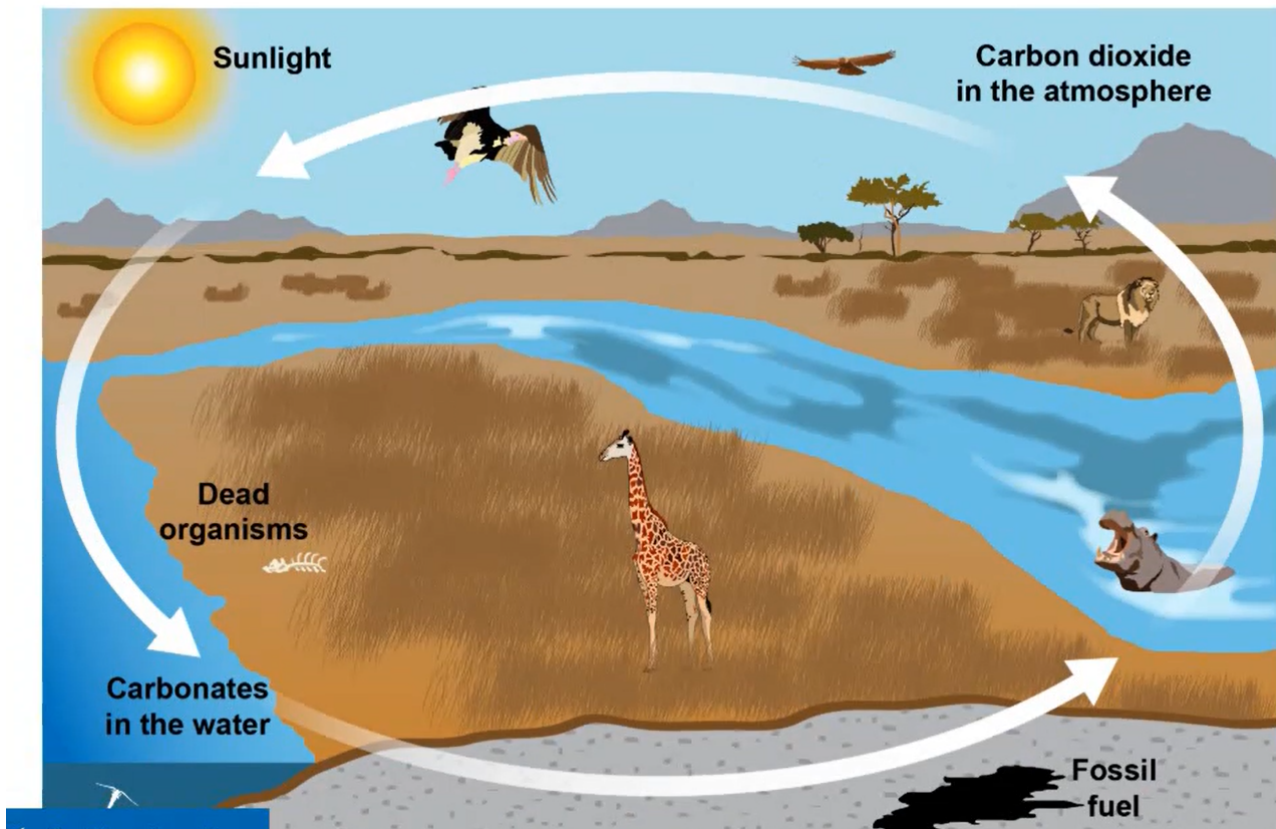
Humans have been interacting with and changing their environment for thousands of years.

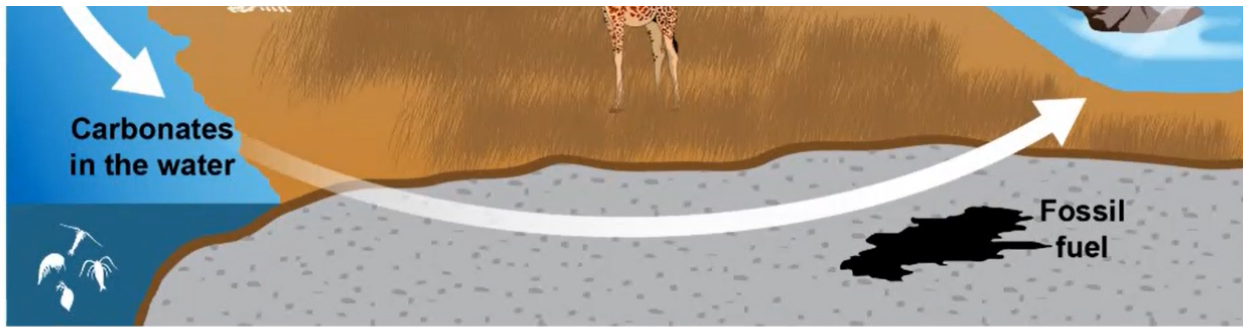
We have changed our environment to suit our needs, but these changes are causing the environment to respond in ways we have yet to fully understand. Activities such as mining the earth's resources, deforestation, intensive agriculture and mass transportation have allowed the human species to thrive on Earth.

These changes have made our lives easier but have also had unintended consequences. One of these consequences is an increase in the levels of carbon dioxide in the atmosphere. This has resulted in an increase in the earth's surface temperature, storms that are more intense and more frequent, and changes in rainfall patterns causing droughts and floods to occur more often and with a greater impact on our environment.

The human species, through its technological developments has created this massive change to the biosphere. Changes to the biosphere of this size have only been seen previously as a result of catastrophic natural events such as meteorite strikes and volcanic eruptions.

The diagram below shows the natural processes that form the carbon cycle.





©

The amount of carbon in the world is unchanging. The carbon cycle shows the flow of carbon from one compound to another. There have been many changes to the carbon cycle in the last 150 years.

State two human actions that have caused the imbalance in the carbon cycle and **outline** a consequence of each of these actions.

Question 7c (2 marks)

One of the consequences of increased carbon in the atmosphere is an increase in the temperature of the Earth's surface. **Outline** a biological consequence of an increase in the temperature of the Earth's surface.

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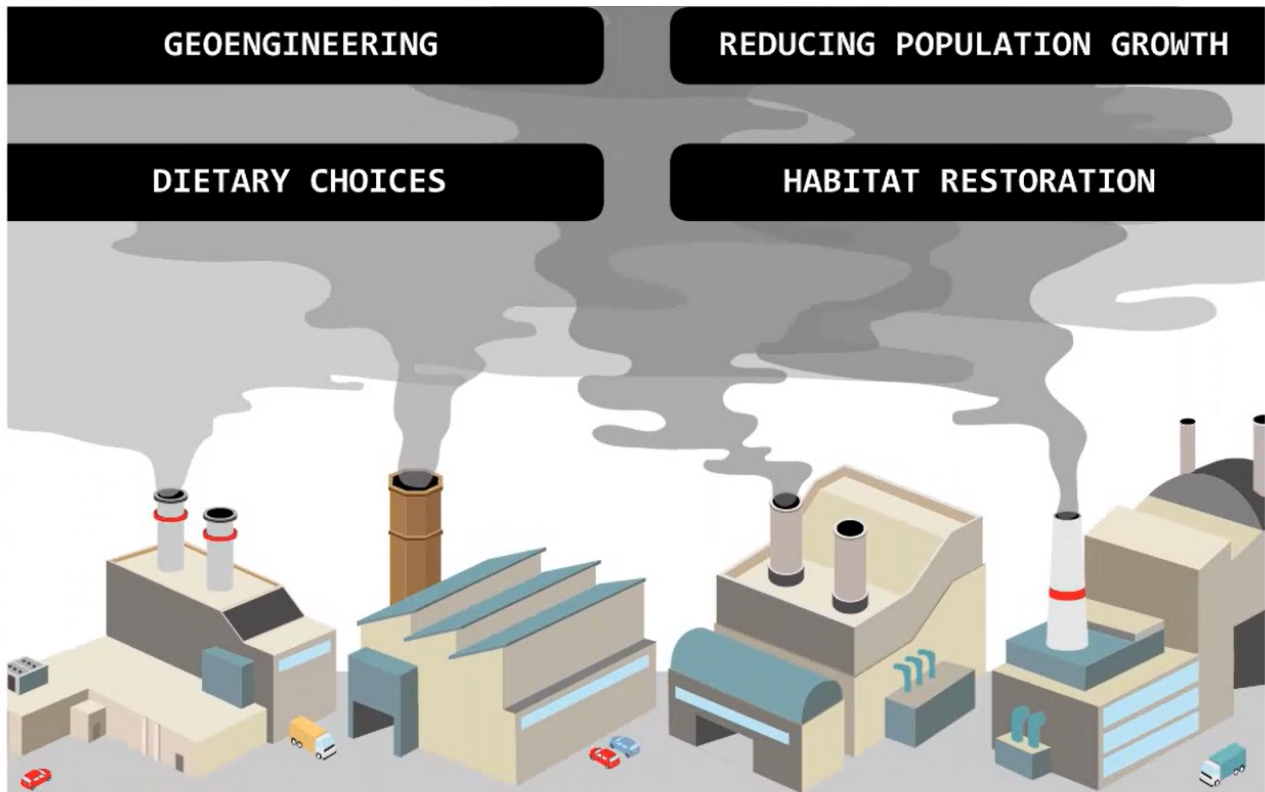


Question 8 (17 marks)

There have been many solutions suggested to reduce the cause of climate change. Four of the solutions are described in the interactive infographic below.

This media is interactive

Hover over the image to reveal the interactive areas.



Using information from the interactive infographic and your wider MYP studies, **discuss** and **evaluate** two possible solutions to reduce the impact of climate change. In your answer, you should include:

- a description of two actions humans can take to reduce the impact of global climate change
- an explanation of the science behind each human action
- advantages of your two chosen climate change solutions
- disadvantages of your two chosen climate change solutions
- a concluding appraisal giving your opinion of the single best climate change solution with justification.

