# Year 11 Science: The Earth system, the carbon cycle and rising $CO_2$

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

## Practice

1. Name the sphere each of these belongs to: a glacier, a kauri tree, a coal seam.

2. Write the balanced equation for burning methane. How many $CO_2$ molecules does one methane molecule make?

3. $CO_2$ at Mauna Loa rises and falls a little every year, peaking around May. Explain why.

4. Explain how burning fossil fuels can harm pāua.

5. Discuss one way warming can feed back to make itself worse.

## Try it: $CO_2$ at Baring Head

**Baring Head, on the coast just east of the entrance to Wellington Harbour, has measured $CO_2$ in clean Southern Ocean air for more than 50 years. Its readings are below.**

| Baring Head reading | $CO_2$ (ppm) |
|---|---|
| Latest (published July 2026) | 424.7 |
| One year earlier | 423.3 |
| Ten years earlier | 401.1 |
| Pre-industrial level | 280 |

6. By how much did $CO_2$ at Baring Head rise over the ten years, and what is that per year?

7. By what percentage is the latest reading above the pre-industrial level?

8. Mauna Loa's yearly mean for 2025 was 427.35 ppm. Give one reason Baring Head reads a little lower.

## Fix the mistake

9. Correct this statement: "Global warming is caused by the hole in the ozone layer letting in more heat."

10. Correct this statement: "Ocean acidification means the sea has turned into an acid."

11. Correct this statement: "The greenhouse effect is harmful and should be stopped."

12. Correct this statement: "Burning fossil fuels creates new carbon."

## Answer key (for parents and tutors)

1. Name the sphere each of these belongs to: a glacier, a kauri tree, a coal seam.
   **Glacier: hydrosphere (water as ice); kauri: biosphere; coal seam: geosphere.**
2. Write the balanced equation for burning methane. How many $CO_2$ molecules does one methane molecule make?
   **$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$; one $CO_2$ molecule for each methane molecule, because there is one carbon atom in each.**
3. $CO_2$ at Mauna Loa rises and falls a little every year, peaking around May. Explain why.
   **Most land plants are in the Northern Hemisphere: in its spring and summer photosynthesis takes in more $CO_2$ than respiration and decay release, so $CO_2$ falls; in autumn and winter decay and respiration win, so it builds up again until May.**
4. Explain how burning fossil fuels can harm pāua.
   **Burning adds $CO_2$ to the air; some dissolves in seawater to form carbonic acid, releasing $H^+$ ions that lower the pH and react with carbonate ions, so pāua have less carbonate to build their calcium carbonate shells.**
5. Discuss one way warming can feed back to make itself worse.
   **For example: warmer seawater dissolves less $CO_2$, so more stays in the air and adds to warming; or melting snow and ice exposes darker ground and sea that absorb more sunlight and warm further. Either keeps going after it starts, so it makes cutting emissions early more important.**
6. By how much did $CO_2$ at Baring Head rise over the ten years, and what is that per year?
   **424.7 − 401.1 = 23.6 ppm in ten years, about 2.4 ppm a year.**
7. By what percentage is the latest reading above the pre-industrial level?
   **(424.7 − 280) ÷ 280 × 100 = 144.7 ÷ 280 × 100 ≈ 52% higher.**
8. Mauna Loa's yearly mean for 2025 was 427.35 ppm. Give one reason Baring Head reads a little lower.
   **Most fossil fuel is burned in the Northern Hemisphere, and air takes about a year to mix across the equator, so the Southern Hemisphere lags slightly behind.**
9. Correct this statement: "Global warming is caused by the hole in the ozone layer letting in more heat."
   **The ozone hole lets through more ultraviolet; warming comes from greenhouse gases absorbing and re-emitting infrared given off by the surface.**
10. Correct this statement: "Ocean acidification means the sea has turned into an acid."
    **Seawater is still alkaline at about pH 8; acidification means its pH is falling as dissolved $CO_2$ adds hydrogen ions.**
11. Correct this statement: "The greenhouse effect is harmful and should be stopped."
    **The natural greenhouse effect keeps the Earth warm enough for life; the problem is the enhanced effect from the extra gases people add.**
12. Correct this statement: "Burning fossil fuels creates new carbon."
    **Burning moves carbon that was locked in the geosphere for millions of years into the atmosphere; carbon atoms are never created or destroyed.**