Exercise walk-through

6.4
Stratospheric ozone

International Baccalaureate · IB Diploma · Environmental Systems and Societies · HL

Composition and layers

Dry air

About 78% nitrogen, 21% oxygen and 0.9% argon.

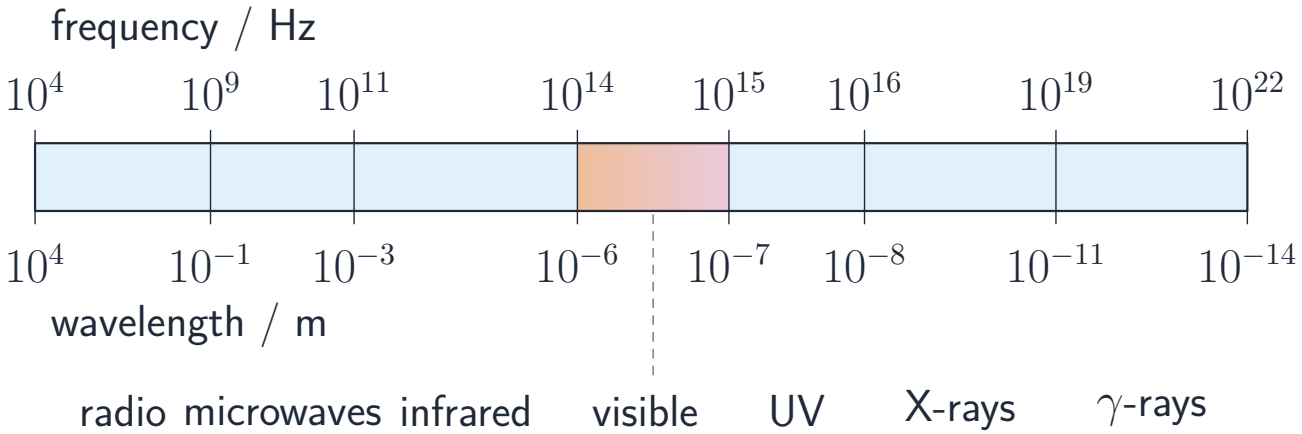
NOAA global 2024 CO_2: about 422.8 ppm; water vapour excluded from dry air.

Temperature profile

Troposphere: most weather; temperature usually falls upwards.

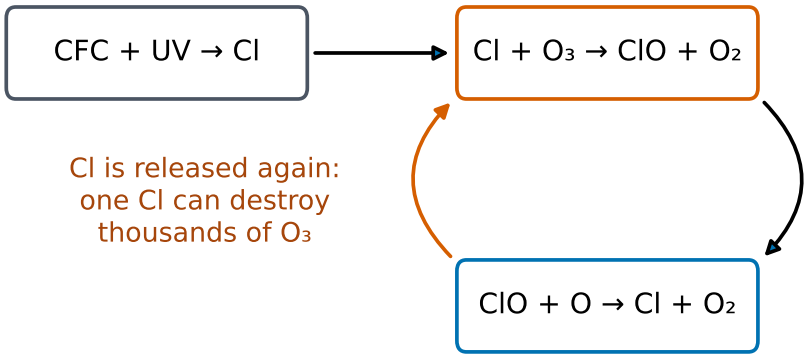
Stratosphere: **ozone** absorbs UV; temperature rises upwards.

The electromagnetic spectrum



UV-B and UV-C damage living cells; **ozone** absorbs them

How chlorine destroys ozone

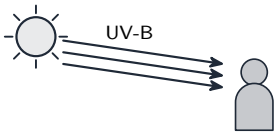


the Montreal Protocol phased out CFCs; the ozone layer is slowly recovering

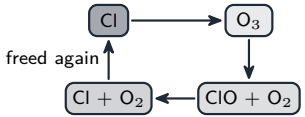
> One atom can destroy thousands of **ozone** molecules

Exercises 2.1·2.2

2.1 State **two** effects on human health of more UV-B radiation reaching the ground. [2]

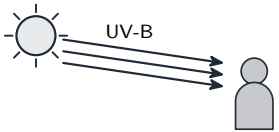


2.2 Explain how CFCs destroy ozone in the stratosphere. [3]



Exercises 2.1·2.2

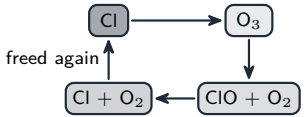
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2.1

any two: skin cancer; cataracts / eye damage; sunburn; weaker immune system

2.2 Explain how CFCs destroy ozone in the stratosphere. [3]



2.2

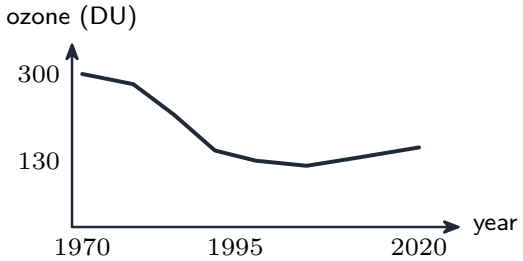
CFCs rise slowly into the stratosphere, where UV breaks them up and releases chlorine atoms; a chlorine atom reacts with ozone, forming oxygen; the chlorine is freed again, so one atom can destroy thousands of ozone molecules (catalyst)

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Exercise 3.1 (a)

3.1 The graph shows the mean October ozone over Antarctica (approximate values).

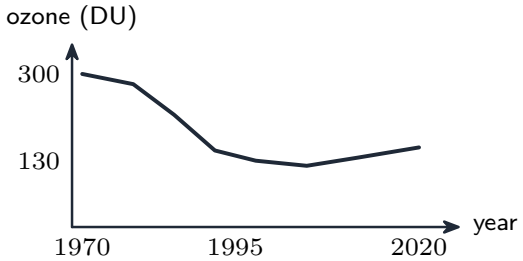
(a) Describe the trend shown. [2]



Exercise 3.1 (a)

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(a) ozone fell sharply from about 300 DU in 1970 to about 130 DU in the 1990s; since about 2000 it has stopped falling and is rising slowly

Exercise 3.1 (b)

3.1 The graph shows the mean October ozone over Antarctica (approximate values).

(b) Explain why the ozone hole forms over Antarctica in spring. [2]

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(b) the very cold winter forms polar stratospheric clouds, where chlorine is changed into active forms; when sunlight returns in spring, it releases chlorine atoms that destroy ozone quickly

Exercise 3.2 (a)

3.2 The Montreal Protocol is often called the most successful environmental agreement.

(a) Outline **two** reasons why the Montreal Protocol worked. [2]

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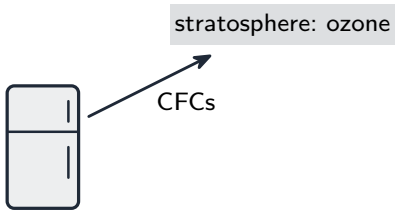
(a) Outline **two** reasons why the Montreal Protocol worked. [2]

(a) any two: replacement chemicals were available at low cost; only a few firms made CFCs; clear scientific evidence and visible ozone hole; a fund helped poorer countries switch; trade limits with non-members

Exercise 3.2 (b)

3.2 The Montreal Protocol is often called the most successful environmental agreement.

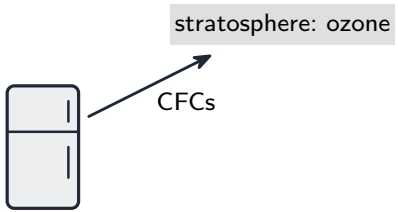
(b) Explain why the ozone layer will take many decades to recover. [3]



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(b) CFCs stay in the atmosphere for decades to a century; CFCs are still released from old fridges, foams and landfills; some illegal production continues, and chlorine keeps destroying ozone as a catalyst until it is removed

Exercise 3.3

3.3 Some people say climate change should be solved like ozone depletion.

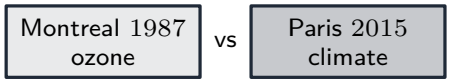
Discuss whether the success of the Montreal Protocol can be repeated for climate change. [5

Montreal 1987 ozone vs Paris 2015 climate

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Discuss whether the success of the Montreal Protocol can be repeated for climate change. [5]



3.3

award up to [5]: similarities: a global problem needing every country; strong science; help for poorer countries can work; differences: ODS came from a few products with cheap substitutes, but CO_2 comes from almost all energy use, transport, farming and industry; cutting CO_2 costs more and affects whole economies and jobs; Montreal had binding phase-out dates and trade limits; Paris targets are voluntary; conclusion: lessons on funding and review apply, but climate is much harder, with justification