6.4 Stratospheric ozone

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS ozone layer • ultraviolet radiation • CFCs • catalyst • ozone hole • Montreal Protocol

Objective

Build the skills to answer exam questions on **stratospheric ozone** : how the ozone layer protects life, how **ozone-depleting substances** destroy it, and the **Montreal Protocol** .

You must be able to:

- explain how the ozone layer absorbs UV radiation
- explain how CFCs and other ozone-depleting substances destroy ozone
- describe the effects of increased UV on people and ecosystems
- evaluate the Montreal Protocol and its lessons for other problems

1 Key knowledge and worked examples

■ Stratospheric ozone

Ozone (O_3) in the stratosphere absorbs most harmful **ultraviolet** (UV) radiation. UV splits O_2 into oxygen atoms, which join O_2 to make O_3; UV also splits O_3. In a natural balance, ozone is made and broken down at the same rate.

Ozone-depleting substances (ODS): chlorofluorocarbons (**CFCs**) from old fridges, aerosol sprays and foams; halons (fire extinguishers); methyl bromide (pesticide). In the stratosphere, UV breaks them up and releases **chlorine** or **bromine** atoms. One chlorine atom can destroy many thousands of ozone molecules, because it is not used up (it acts as a **catalyst**).

Ozone hole: over Antarctica in spring (September–October). In the very cold winter, polar stratospheric clouds form; on their surfaces chlorine is turned into forms that sunlight in spring quickly breaks into ozone-destroying atoms.

Effects of more UV-B: skin cancer, cataracts (eye damage), weaker immune system; damage to crops and to **phytoplankton**, the base of ocean food chains.

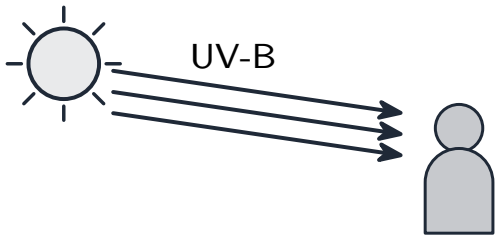
Montreal Protocol (1987): phased out CFCs and most other ODS; signed by every UN member state. Ozone is recovering and should return to 1980 levels over Antarctica around 2066. Some replacements (HFCs) are strong greenhouse gases, so the

Kigali Amendment (2016) phases them down too.

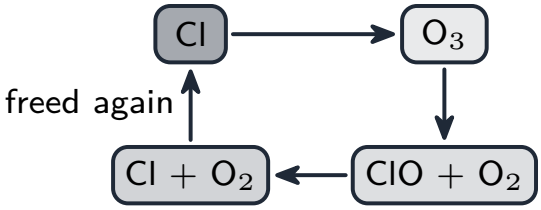
Answer shapes: link each step: CFC → UV releases chlorine → chlorine breaks ozone → more UV reaches the surface → named harm.

2 Practice

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



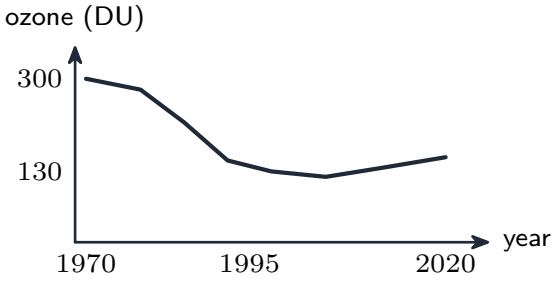
2.2 Explain how CFCs destroy ozone in the stratosphere. [3]



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3 Exam-style questions

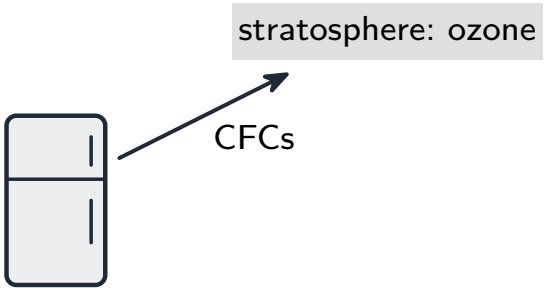
3.1 The graph shows the mean October ozone over Antarctica (approximate values).



(a) Describe the trend shown. [2]

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

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



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

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

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