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.

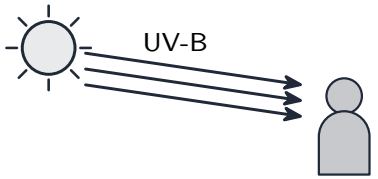
Effects of more UV-B: skin cancer, cataracts (eye damage), weaker immune system; damage to crops and to **phytoplankton**, the base of ocean food chains.

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.

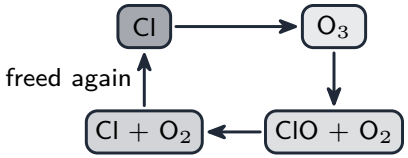
Answer shapes: link each step: CFC → UV releases chlorine → chlorine breaks ozone → more UV reaches the surface → named harm.

2 Practice

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



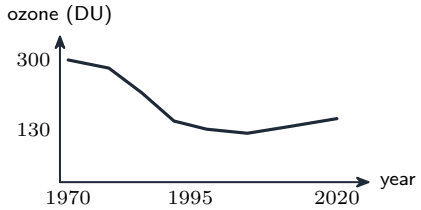
2.2 Explain how CFCs destroy ozone in the stratosphere. [3]



exercises.lol exercises.com.cn

3 Exam-style questions

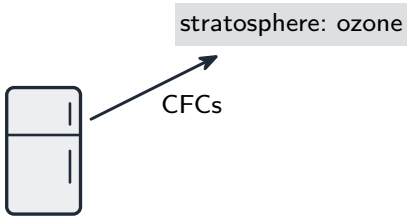
3.1 The graph shows the mean October ozone over Antarctica (approximate values).



(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]

exercises.lol exercises.com.cn