4.4 Water pollution

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

KEY WORDS point source • non-point source • biochemical oxygen demand (BOD) • eutrophication • indicator species • dead zone

Objective

Build the skills to answer exam questions on **water pollution** : sources and types of pollutants, **biochemical oxygen demand** , **eutrophication** , **indicator species** and pollution management.

You must be able to:

- tell point-source from non-point-source pollution, and name the main pollutants
- explain biochemical oxygen demand and the use of indicator species and biotic indices
- explain eutrophication as positive feedback
- evaluate pollution management at the source, the release and the clean-up stages

1 Key knowledge and worked examples

Water pollution

source	meaning	example
point	one clear source	a factory pipe, a sewage outlet
non-point	many spread-out sources	fertilizer runoff from farmland, urban street runoff

Pollutants include organic matter (sewage), nutrients (nitrate, phosphate), toxic metals (mercury), pesticides, plastics, oil and heat.

Biochemical oxygen demand (BOD): the oxygen used by microorganisms to break down organic matter in a water sample over 5 days. High BOD = much organic pollution = less oxygen left for animals.

Indicator species show water quality by their presence or absence: stonefly larvae need clean, oxygen-rich water; bloodworms and sludge worms tolerate low oxygen. A **biotic index** combines the counts of such species into one score.

Eutrophication (positive feedback):

1. nitrate and phosphate enter a lake or the sea;
2. algae grow fast (an algal bloom) and shade plants below, which die;
3. dead algae and plants are decomposed by bacteria, which use up oxygen (BOD rises);
4. fish and invertebrates die, adding more dead matter: more decomposition, less oxygen;
5. a **dead zone** with almost no oxygen may form (e.g. the Gulf of Mexico every summer).

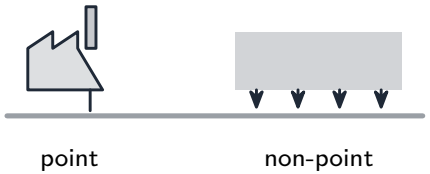
Management works at three levels:

level	example
change the human activity	use less fertilizer; phosphate-free detergents
control the release	buffer strips of vegetation; sewage treatment that removes nutrients
clean up and restore	dredge sediment; pump air into water; replant water plants

Answer shapes: in a sequence, write each step as cause → effect, and say where the oxygen goes.

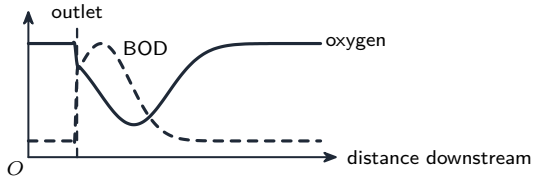
2 Practice

2.1 Distinguish between point-source and non-point-source pollution, with **one** example of each. [2]



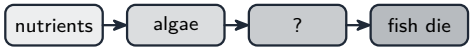
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2.2 The graph shows dissolved oxygen and BOD downstream of a sewage outlet. Explain the changes in oxygen. [3]



3 Exam-style questions

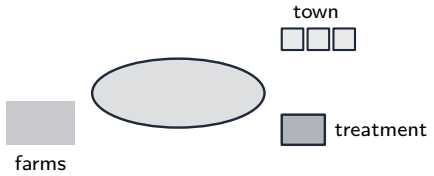
3.1 Fertilizer runs off farmland into a lake.



(a) Outline the process of eutrophication. [3]

(b) Explain why eutrophication is an example of positive feedback. [1]

3.2 A lake suffers from eutrophication caused by farm runoff and town sewage.



Evaluate strategies at **three** levels to manage the problem. [5]

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Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

point: from one identifiable place, e.g. a factory outlet pipe; non-point: from many spread-out places, e.g. fertilizer runoff from farmland

2.2

below the outlet, organic matter is decomposed by bacteria, so BOD is high; bacteria use up oxygen, so dissolved oxygen falls; further downstream the organic matter is used up and oxygen dissolves from the air, so oxygen recovers

3.1

(a) nitrate and phosphate cause rapid growth of algae; algae block light, so plants die; dead matter is decomposed by bacteria; bacteria use up oxygen, so fish and other animals die

(b) the dead animals add more organic matter, so decomposition and oxygen loss increase further

3.2

award up to [5]: change the activity: use less fertilizer, apply it at the right time, phosphate-free detergents: cheapest in the long term but needs farmer cooperation; control the release: buffer strips and sewage treatment that removes nutrients: effective but costly to build; clean-up: dredge nutrient-rich sediment, aerate water, remove algae: fast effect but expensive and only treats the symptoms; conclusion: prevention at the source is most sustainable, with clean-up for quick relief

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