

4.1 Water, pollution and management trade-offs

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS eutrophication • pollutant load

Objective

Water, pollution and management trade-offs. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

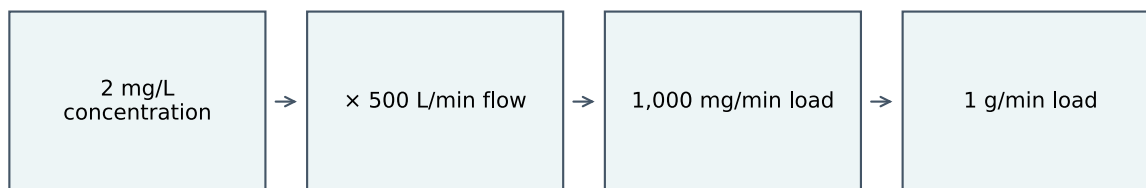
1 Key knowledge and worked examples

■ What would explain this observation?

- A downstream sample has less dissolved oxygen after a nutrient input. The explanation must connect biological processes with the water-system evidence.
 - Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.
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■ Build the model

- **Eutrophication** can begin with nutrient enrichment, followed by greater producer growth and increased decomposition after organisms die. Decomposer respiration can lower dissolved oxygen. Water availability depends on quantity, quality and access.
- eutrophication: Nutrient enrichment with ecological consequences; **pollutant load**
: Mass of pollutant transferred per time.



■ Choose evidence that can test it

- Distinguish concentration from total pollutant load. Dilution can reduce concentration without removing the pollutant mass. A management plan should consider upstream causes, users and effects on other parts of the catchment.
- Collect approved water-quality observations at matched sites and times. Use calibrated instruments and consistent sampling depth. Avoid contact with contaminated water and do not infer potability from clarity.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: concentration is 2 mg per litre and flow is 500 litres per minute. Load = concentration $\times$ flow = $2 \times 500 = 1,000$ mg per minute = 1 g per minute. A lower concentration during high flow can still produce a high total load.

Example:

Concentration is 3 mg/L and flow 200 L/min. Find load in mg/min. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Clear water is not necessarily safe water. Nutrient enrichment does not directly use up oxygen; the pathway includes biological activity and decomposition.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Clear water is always safe to drink. This claim is false: Clear water is not necessarily safe water. Nutrient enrichment does not directly use up oxygen; the pathway includes biological activity and decomposition.

Key:

Water, pollution and management trade-offs: Distinguish concentration from total pollutant load. Dilution can reduce concentration without removing the pollutant mass. A management plan should consider upstream causes, users and effects on other parts of the catchment.

2 Practice

2.1 Which can occur after dilution without pollutant removal? Choose one answer.

- **A** Concentration decreases but pollutant mass remains
 - **B** All pollutant disappears
 - **C** The water becomes automatically safe [1]
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2.2 Concentration is 3 mg/L and flow 200 L/min. Find load in mg/min. Show the relation, substitution and units. [2]

2.3 Decide whether this claim is true and justify: Clear water is always safe to drink. [2]

2.4 Nutrient enrichment with ecological consequences: write the technical term. [1]

3 Exam-style questions

3.1 Fictional river A has 4 mg/L at 100 L/min; B has 2 mg/L at 300 L/min. Compare concentration and load. Why need dilution not reduce transported mass? [4]

Solutions

2.1 A Distinguish concentration from total pollutant load. Dilution can reduce concentration without removing the pollutant mass. A management plan should consider upstream causes, users and effects on other parts of the catchment.

2.2 $\text{load} = 3\text{mg/L} \times 200\text{L/min} = 600\text{mg/min}$.

2.3 False. Clear water is not necessarily safe water. Nutrient enrichment does not directly use up oxygen; the pathway includes biological activity and decomposition.

2.4 eutrophication. eutrophication means Nutrient enrichment with ecological consequences.

3.1 Loads 400 and 600 mg/min. B has lower concentration but greater load. Added water can dilute without removing pollutant; varying flow, concentration and sampling matter.