Exam Papers Practice

4.4 Water Pollution

Mark Schemes

Course	SL IB Environmental Systems & Societies (ESS)
Section	4. Water & Aquatic Food Production Systems & Societies
Topic	4.4 Water Pollution
Difficulty	Medium

To be used by all students preparing for
SL IB Environmental Systems & Societies (ESS)
Students of other boards may also find this useful

1a

i) The correct order is:

Stage of Eutrophication	Order
Algal bloom prevents sunlight from reaching aquatic plants. Water oxygen levels fall	4
Excessive nutrients from fertilisers run-off from the land into the water	1
Algae also show rapid growth	3
Death of organisms requiring dissolved oxygen in water	6
Decomposition rate increases. Aerobic respiration of decomposers reduces dissolved oxygen further	5
Aquatic plants flourish, growing rapidly	2

All numbers correct; [3 marks]
4–5 numbers correct; [2 marks]
2–3 numbers correct; [1 mark]

ii) Another consequence of sewage in the water is:

- Sewage contains pathogens / pathogenic bacteria; [1 mark]
- Which can cause disease; [1 mark]

1b

Indicative Content	Commentary
i) Raw sewage enters the river at point: • **A**; [1 mark]	The levels of mineral ions at **B** are still increasing to the maximum levels at **C**
ii) Because: Any **three** from the following:	This is the impact of the sewage entering the river at **A**

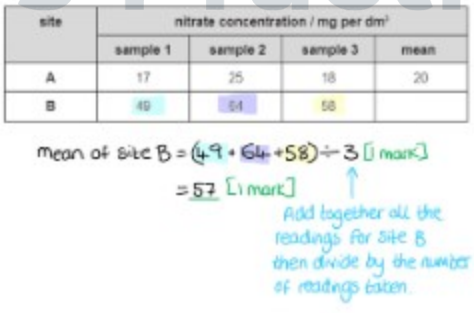
• The levels of mineral ions increased sharply after A and the dissolved oxygen levels decreased rapidly; [1 mark] • This occurs because of excessive biodegradation/breakdown of organic material (in sewage)...; [1 mark] • ...by microorganisms/bacteria/decomposers...; [1 mark] • ...involves/requires respiration (which depletes dissolved oxygen levels / leads to anoxic conditions in the water); [1 mark]	Mineral ion levels then start to lower between **C** and **D** as they are diluted and get increasingly lower further downstream The reverse is happening to the levels of oxygen showing the effects of eutrophication on the river closest to the source of the pollution

2a

Indicative Content	Commentary
The scientist's conclusion that the use of fertiliser in the field has affected the oxygen content of the river can be discussed as follows: Any **four** of the following: • Fertiliser leaches/washes into the river; [1 mark] • Fertiliser would cause algal/plant growth / algal bloom / eutrophication; [1 mark] • Dead algae are decomposed/broken down by bacteria/decomposers ; [1 mark] • (Bacterial) respiration would	For this kind of question, a bit of detective work is required to find the clues hidden among the introductory text at the start of the question For example, a mark can be awarded for acknowledging that the scientist took many readings and calculated a mean, but the word 'mean' is easy to miss if you only read through the question text once (or if you only skim-read it) The trick is to keep referring back to the introductory text and to pick out the small details that can assist your critical evaluation of the scientists'

reduce the level of (dissolved) oxygen (in the river water); [1 mark] • Means were calculated (by the scientist) / readings were repeated **SO** the experiment is reliable / valid; [1 mark] • Measurements were taken at the same time of year / in April (so are comparable/valid); [1 mark] • The direction of the river is past the farm; [1 mark] • The reduced oxygen level could be due to other factors / sources of fertiliser from other fields; [1 mark]	conclusion

2b

Indicative Content	Commentary
*i) The mean nitrate concentration for site **B** can be calculated as follows:* • (49 + 64 + 58) ÷ 3 **OR** 171 ÷ 3; [1 mark] • 57; [1 mark] *ii) These observations could be a result of the following factors:* Any **four** from the following: • Nitrates leaked/leached into the river (between the two sites); [1 mark]	

- Causing eutrophication; [1 mark]
- Algae block light to underwater plants / underwater plants cannot photosynthesise; [1 mark]
- (Dead plants / algae) broken down by microorganisms; [1 mark]
- Microorganisms respire; [1 mark]
- Causing oxygen depletion / less oxygen available for the fish; [1 mark]

3

Indicative Content
i) Biochemical oxygen demand (BOD) is: • The amount of oxygen/O_2 required for (full) decomposition/breakdown of the dead organic matter...; [1 mark] • ...in a given volume of water; [1 mark] *ii) It can be measured by:* • Measuring the original oxygen/O_2 concentration in a water sample of known volume; [1 mark] • Continuing to take oxygen/O_2 concentrations until it becomes constant/all organic matter is decomposed; [1 mark] • Subtracting final oxygen/O_2 concentration from initial concentration to calculate the quantity of oxygen/O_2 used; [1 mark]

4a

Indicative Content	Commentary
Eutrophication is: • The enrichment of any body of water with nutrients/fertilisers **OR** when excess nutrients/fertilisers run off / flow into a pond/lake/stream/river; [1 mark]	"Enrichment with **minerals**" would not gain a mark here Replacing the words nutrients/fertilisers with a specific example e.g. nitrates/phosphates would still gain a mark The specific word "enrichment" is not required for the mark but the idea of an **excess** of nutrients or contamination of the water with an **excessive load** of fertiliser(s) should be made clear

4b

Indicative Content	Commentary
Eutrophication is an example of positive feedback because: Any **three** from the following: • Positive feedback involves increasing/amplifying deviation(s) from the mean / equilibrium (state) **OR** positive feedback increases/amplifies/reinforces change (away from the average/norm); [1 mark] • Increased nutrients lead to increased organic matter / promote the growth of (aquatic)	You would not gain marks for simply describing or explaining the process of eutrophication Instead, your explanation should clearly **connect** the concepts of positive feedback and eutrophication You can still gain full marks for a response that does not include a definition of positive feedback but **develops** the **eutrophication example** to illustrate positive feedback (see the final marking point)

algae/plants; [1 mark]

- As this (excess) organic matter decays, this leads to increased nutrients **OR** further nutrients are released during decomposition of (excess) organic matter; [1 mark]
- This nutrient release accelerates the eutrophication process / amplifies eutrophication by fueling further algae growth **OR** overall, the cycle of increased nutrients and increased growth reinforces itself, exemplifying positive feedback; [1 mark]