

Exercise walk-through

2.6

Chemistry and the Environment

GAC Science

Method — Key knowledge: a treatment result needs a mass balance, a stated criterion and waste handling

Pollution involves substances or other agents causing harmful environmental effects; the amount, pathway and conditions matter. **Combustion** of carbon-containing fuels can release carbon dioxide. Carbon dioxide absorbs and emits thermal infrared radiation and contributes to the **greenhouse effect**. Acid deposition involves sulfur dioxide and nitrogen oxides reacting in the atmosphere to form acidic compounds; this is a different mechanism. Chemistry can also support treatment, but removal from water does not necessarily destroy a substance.

Method — Source A: text or task brief

Scientific background checked 2 October 2026: EPA explanation of acid-rain formation describes atmospheric reactions involving sulfur dioxide and nitrogen oxides. NASA radiation budget explains infrared absorption by greenhouse gases. These sources do not measure the fictional classroom treatment below.

Supplied fictional treatment record: a 10.0 L liquid sample contains a model substance at 12.0 mg/L before treatment and 3.0 mg/L after treatment. Assume volume stays 10.0 L and the only substance removed from the liquid is retained on the filter. For this written exercise, the declared target is at most 2.0 mg/L. This is an invented task target, not a real environmental or drinking-water standard. Students analyse the record; they do not handle or discharge chemicals.

Method — Source B: response or review record

Report draft: “The filter destroyed all the substance, leaving pure water. A seventy-five-percent reduction means the two-milligram-per-litre target is met. Filter waste can be ignored because it is no longer in the liquid. Reducing a model substance proves every environmental effect has disappeared. Carbon dioxide causes acid rain in exactly the same way as sulfur dioxide, so one chemical intervention solves both problems.”

Method — Worked example: follow the substance through the stated treatment boundary

Known: initial concentration 12.0 mg/L and volume 10.0 L. Why multiply?
Concentration is mass per volume.

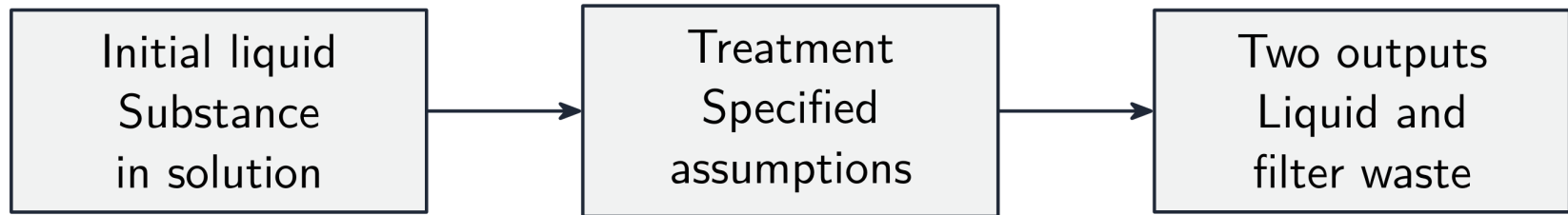
$$m = CV$$

$$m_{initial} = 12.0 \frac{\text{mg}}{\text{L}} \times 10.0 \text{ L} = 120 \text{ mg}$$

Under the supplied assumptions, lower concentration means less substance in the liquid, not proof of destruction. Account for filter waste and compare the final concentration with the actual task target.

Method — Worked example: follow the substance through the stated treatment boundary

Account for filter waste and compare the final concentration with the actual task target



Exercises 2.1-2.3

2.1 State ONE difference between the supplied acid-rain and greenhouse mechanisms.[2]

2.2 Calculate the substance mass remaining in the liquid. [2]

2.3 Calculate the mass retained on the filter and the percentage reduction in liquid concentration. [3]

Exercises 2.1-2.3

2.1 State ONE difference between the supplied acid-rain and greenhouse mechanisms.[2]

2.1

: acid deposition involves atmospheric reactions of sulfur dioxide/nitrogen oxides forming acidic compounds.; the greenhouse mechanism concerns absorption/emission of thermal infrared by gases such as carbon dioxide; do not treat them as identical.

2.2 Calculate the substance mass remaining in the liquid. [2]

2.2

: $m = C \times V$.: $m_{\text{remaining}} = 3.0 \text{ mg/L} \times 10.0 \text{ L} = 30 \text{ mg}$.

2.3 Calculate the mass retained on the filter and the percentage reduction in liquid concentration. [3]

2.3

: removed mass equals initial minus remaining and percentage reduction equals change divided by initial $\times 100\%$.: $120 - 30 = 90 \text{ mg}$ retained under the stated assumptions.: $(12.0 - 3.0)/12.0 \times 100\% = 75\%$.

Exercises 2.4·3.1

2.4 Explain why the target is not met and why the waste still matters. [3]

3.1 Evaluate the report's claims about destruction and complete environmental success using six points. [6]

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2.4

: final 3.0 mg/L exceeds the supplied maximum 2.0 mg/L.: percentage reduction and absolute target are different criteria.: 90 mg remains on the filter under the assumptions, requiring appropriate authorised handling rather than being ignored.

3.1 Evaluate the report's claims about destruction and complete environmental success using six points. [6]

3.1

each: substance remains in liquid; removed substance is assumed retained on filter, not destroyed; other substances/qualities are unmeasured; the task target is fictional rather than an environmental standard; different atmospheric mechanisms need appropriate separate evidence/responses; further treatment/energy/waste effects and approved disposal need assessment before claiming complete success.

Exercise 3.2

3.2 Write an 80–110-word treatment conclusion that retains the calculation and scope limits. [8]

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3.2

Local analytic rubric, 8 ×: state final 3.0 mg/L; give 30 mg remaining; give 90 mg retained; give 75% reduction; say 2.0 mg/L target is unmet; distinguish removal from destruction; avoid purity/universal-success claim; require appropriate authorised waste assessment; coherent truthful 80–110 word response. Example: “The supplied treatment lowers the model substance concentration from 12.0 to 3.0 milligrams per litre, a seventy-five-percent reduction. At the assumed unchanged volume of ten litres, thirty milligrams remain in the liquid and ninety milligrams are retained on the filter. The final concentration still exceeds the fictional two-milligram-per-litre target. Removal from the liquid is therefore neither complete removal nor demonstrated destruction. Other substances and environmental effects were not measured, so purity and universal success cannot be claimed. The next assessment should consider further treatment, energy use and authorised handling of the filter waste before any real application.”