



Water & Water Analysis
Chemistry Past Exam Questions
Higher Level

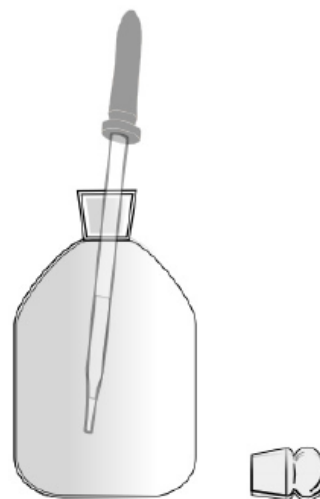
Section A - Question 1

1. In an experiment to measure the dissolved oxygen content of a river water sample, a small amount of a concentrated solution of compound A, followed by a small amount of a concentrated solution of alkaline potassium iodide (KOH/KI), were added to a bottle filled with the river water.

These additions were made using the method shown in the diagram, avoiding the addition of bubbles of air. After both additions the stopper was replaced carefully and the bottle was inverted several times to ensure thorough mixing of the contents. A brown precipitate was observed at this stage.

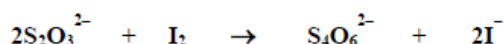
About 1 cm³ of concentrated sulfuric acid (H₂SO₄) was then added, allowing the acid to run down the inside wall of the bottle. Again the bottle was stoppered and inverted several times to ensure thorough mixing.

- (a) Why was it important to avoid trapping air bubbles each time the stopper was inserted into the sample bottle and when using the dropper? (5)
- (b) Identify compound A. (3)
- (c) What was observed on addition of the concentrated sulfuric acid followed by the mixing of the contents of the bottle? (3)



After the three additions, the thoroughly mixed contents of the sample bottle were titrated in 200 cm³ portions with a 0.02 M solution of sodium thiosulfate (Na₂S₂O₃). The average titre was 9.4 cm³.

The balanced equation for the titration reaction is:



- (d) Describe how the burette was rinsed and filled for use in the titrations. (15)
- (e) Name the indicator used in the titrations. (3)
- (f) Calculate the concentration of iodine (I₂) in the sample bottle in moles per litre.
- For every one mole of dissolved oxygen (O₂) in the water sample, two moles of iodine (I₂) are liberated in this experiment. Calculate the concentration of dissolved oxygen in the river water sample
- (i) in moles per litre,
- (ii) in grams per litre,
- (iii) in ppm. (15)
- (g) What conclusion should have been reached had a white precipitate been observed instead of the brown precipitate after the first two additions of reagents to the bottle filled with river water? (3)
- (h) Kits, designed for use in the field, allow the dissolved oxygen concentration to be measured immediately on collection of the sample. Why is the *immediate* determination of dissolved oxygen considered best practice? (3)

Section A - Question 4 (i)

- (i) What happens during secondary sewage treatment?

2012

Section B - Question 4 J

(j) What happens during the secondary treatment of sewage?

Section B - Question 7

7. (a) Explain how hard water is caused and how it wastes soap. How can hard water be softened by ion exchange so that it is suitable for use as deionised water in the laboratory? (11)
- (b) In water treatment, what is the purpose of adding each of the following: (i) a flocculating agent, (ii) chlorine, (iii) a fluorine-containing compound, (iv) calcium hydroxide, (v) sulfuric acid? (15)
State the problem that would arise when each of any two of these substances is added in excessive quantity. (6)
- (c) Why is water pollution by heavy metal ions, e.g. Hg^{2+} or Pb^{2+} , a cause of concern?
Name an instrumental technique that could be used to detect and measure the concentration of a heavy metal ion in a water sample.
Explain how Hg^{2+} or Pb^{2+} ions can be removed from a water supply. (12)
- (d) Describe a test for the presence of chloride ion (Cl^-) in water. (6)

2011

Section B - Question 4 G

(g) Give two methods for removing all of the hardness in a water sample.

Section B - Question 11 A

(a) What is meant by the *biochemical oxygen demand* (BOD) of a water sample? (7)

The BOD of a raw sewage sample was 350 ppm and the BOD of the same sample after treatment was about 25 ppm.

(i) Describe how the BOD was reduced by about 30% in primary sewage treatment. (9)

(ii) Explain the processes by which the BOD was further reduced in secondary sewage treatment. (9)

2010

Section B - Question 4 i

- (i) What happens during the secondary stage of sewage treatment?