The bacterium *Azotobacter chroococcum*, growing aerobically in a medium free of nitrogen containing compounds, obtains all of its nitrogen by the "fixation" of atmospheric N\textsubscript{2}. The solubility of N\textsubscript{2} in water is governed by the following equilibrium:

\[
\text{N}_2(\text{aq}) \rightleftharpoons \text{N}_2(\text{g}) \quad K = 1.6 \times 10^3 \text{ atm L mol}^{-1}
\]

What is the concentration of dissolved N\textsubscript{2} available to the bacterium at 1.0 atm and 30 °C? (Air is 78% N\textsubscript{2}.)

A culture of these bacteria (1.0 L) grows to a density of 0.84 mg dry weight per mL of culture and has a nitrogen content of 7.0% of the dry weight. What volume of air at 1.0 atm and 30 °C would supply this nitrogen requirement?
In the refining of copper, impure copper electrodes are electrolysed in a manner such as described in the following figure. Indicate in the boxes on the figure, which electrode is the anode and which is the cathode.

Why are noble metals left as a mud on the bottom of the reaction cell?

Explain why Zn\(^{2+}\) and Fe\(^{2+}\) are not deposited from solution during this reaction.

How many kilograms of pure copper will be obtained when the electrolytic cell is operated for 24.0 hours at a constant current of 100.0 A?

Answer:
• Calculate the mass of aluminium metal that would be produced by the 
electroreduction of Al\(^{3+}\) by a current of 2.5 \(\times 10^5\) A for a period of 1.0 hour.

| Marks | 4 |

Answer:

Explain why, in the Hall-Heroult process, a molten mixture of Al\(_2\)O\(_3\) and Na\(_3\)AlF\(_6\) is 
electrolysed, rather than either an aqueous solution of Al\(^{3+}\) or molten Al\(_2\)O\(_3\).

• In the chlor-alkali process OH\(^–\) (aq) and Cl\(_2\) (g) are produced from the electrolysis of a 
saturated solution of sodium chloride. Write the half-reactions for the production of 
each of these.

| OH\(^–\) | Cl\(_2\) |

Compare the oxidation potential of Cl\(^–\) to that of water and explain why Cl\(^–\) is 
oxidised preferentially.