Problem of the Week
Problem B and Solution
Water, Water, Everywhere...

Problem

Very little of Earth's fresh water is accessible for human consumption, particularly in dry countries, making alternative sources necessary.

(a) The per capita (per person) daily water consumption for nine different countries is given below.

$$155\,L, \ 251\,L, \ 200\,L, \ 147\,L, \ 135\,L, \ 235\,L, \ 373\,L, \ 145\,L, \ 380\,L$$

What is the average per capita daily water consumption for these countries? Round your answer to the nearest whole number.

(b) A small city of 110 000 people in an arid (very dry) country obtains its fresh water by desalination of sea water. If the per capita consumption in this city is equal to the average from part (a), how much fresh water must be produced each day by the city's desalination plant?

(c) Sea water is 3.5% salt; the remaining 96.5% is fresh water. Thus, if 1000 L of sea water was desalinated, the amount of fresh water produced would be $0.965 \times 1000 = 965\,L$. In general, we can use the following equation to show the relationship between the amount of sea water and fresh water in the desalination process.

$$0.965 \times \text{amount of sea water} = \text{amount of fresh water}$$

Use this equation and your answer from part (b) to find the amount of sea water that must be processed by the desalination plant every day in order to fulfill the city's fresh water needs.

Solution

(a) Adding the nine countries' daily consumption figures gives 2021 L. Thus, the average daily consumption per capita is $2021 \div 9 = 224.555... \approx 225\,L$.

(b) If each of the 110 000 people consumes 225 litres of water per day, then the city's desalination plant must produce $110\,000 \times 225 = 24\,750\,000$ litres of fresh water per day.

(c) Once we substitute our answer from part (b), the equation becomes $0.965 \times \text{amount of sea water} = 24\,750\,000$. We can find the amount of sea water by trial and error, but a more efficient method is to notice that amount of sea water $= 24\,750\,000 \div 0.965 \approx 25\,647\,668$. Thus the amount of sea water needed each day is approximately $25\,647\,668\,L$, or about 25.65 million litres.