## Solutions to Dimensional Analysis Problems

1. The conversion factors needed here are:

$$
\begin{aligned}
1 \mathrm{~km}^{2} & =1 \times 10^{9} \mathrm{~m}^{3} \\
1 \mathrm{~m}^{3} & =1 \times 10^{6} \mathrm{~cm}^{3} \\
1 \mathrm{~cm}^{3} & =1 \times 10^{-3} \mathrm{~L}
\end{aligned}
$$

Now, we would like to find out how many litres are in 1 cubic kilometre. We do this as follows:

$$
\begin{aligned}
1 \mathrm{~km}^{3} & \times \frac{1 \times 10^{9} \mathrm{~m}^{3}}{1 \mathrm{~km}^{3}} \times \frac{1 \times 10^{6} \mathrm{~cm}^{3}}{1 \mathrm{~m}^{3}} \times \frac{1 \times 10^{-3} L}{1 \mathrm{~cm}^{3}} \\
& =1 \mathrm{~km}^{3} \times \frac{1 \times 10^{9} \mathrm{hr}^{3}}{1 \mathrm{~km}^{3}} \times \frac{1 \times 10^{6} \mathrm{~cm}^{3}}{1 \mathrm{mh}^{K}} \times \frac{1 \times 10^{-3} L}{1 \mathrm{~cm}^{3}}
\end{aligned}
$$

On simplifying this, we find that $1 \mathrm{~km}^{3}=1 \times 10^{12} \mathrm{~L}$. So,

$$
\begin{aligned}
1.35 \times 10^{9} \mathrm{~km}^{3} & =1.35 \times 10^{9} \times 1 \times 10^{12} L \\
& =1.35 \times 10^{21} L
\end{aligned}
$$

That is, the volume of water in the world's oceans is approximately $1.35 \times 10^{21}$ litres.
2. The conversion factors are given:

$$
\begin{aligned}
1 \text { barrel } & =42 \text { gallons } \\
1 \text { gallon } & =4 \text { quarts } \\
1 \text { quart } & =9.46 \times 10^{-4} \mathrm{~m}^{3}
\end{aligned}
$$

Now we would like to find out how many cubic metres are in 1 barrel. We do this as follows:

$$
\begin{aligned}
1 \text { barrel } & \times \frac{42 \text { gallons }}{1 \text { barrel }} \times \frac{4 \text { quarts }}{1 \text { gallon }} \times \frac{9.46 \times 10^{-4} \mathrm{~m}^{3}}{1 \text { quart }} \\
& =1 \text { barrel } \times \frac{42 \text { gallons }}{1 \text { barrel }} \times \frac{4 \text { quarts }}{1 \text { gatlon }} \times \frac{9.46 \times 10^{-4} \mathrm{~m}^{3}}{1 \text { quart }}
\end{aligned}
$$

On simplifying this, we find that:

$$
\begin{aligned}
1 \text { barrel } & =3269.28 \times 10^{-4} \mathrm{~m}^{3} \\
& =3.26928 \times 10^{3} \times 10^{-4} \mathrm{~m}^{3} \\
& =3.26928 \times 10^{-1} \mathrm{~m}^{3}
\end{aligned}
$$

So,

$$
\begin{aligned}
9.6 \times 10^{8} \mid \text { textbarrels } & =9.6 \times 10^{8} \times 3.26928 \times 10^{-1} \mathrm{~m}^{3} \\
& =31.385088 \times 10^{7} \mathrm{~m}^{3} \\
& =3.1385088 \times 10^{8} \mathrm{~m}^{3}
\end{aligned}
$$

That is, the amount in cubic metres is $3.139 \times 10^{8}$.

