Exercise 1.75

The U.S. quarter has a mass of 5.67 g and is approximately 1.55 mm thick. (**a**) How many quarters would have to be stacked to reach 575 ft, the height of the Washington Monument? (**b**) How much would this stack weigh? (**c**) How much money would this stack contain? (**d**) The U.S. National Debt Clock showed the outstanding public debt to be $16,213,166,914,811 on October 28, 2012. How many stacks like the one described would be necessary to pay off this debt?

Solution

Part (a)

Divide the height of the Washington Monument by the thickness of the quarter to find how many quarters would have to be stacked.

$$\begin{aligned}
\text{\# of Quarters} &= \frac{\text{Washington Monument Height}}{\text{Quarter Thickness}} \\
&= \frac{575\ \text{ft}}{1.55\ \frac{\text{mm}}{\text{quarter}}} \\
&= \frac{575\ \cancel{\text{ft}} \times \frac{12\ \cancel{\text{in}}}{1\ \cancel{\text{ft}}} \times \frac{2.54\ \cancel{\text{cm}}}{1\ \cancel{\text{in}}} \times \frac{10\ \text{mm}}{1\ \cancel{\text{cm}}}}{1.55\ \frac{\text{mm}}{\text{quarter}}} \\
&= \frac{575 \times 12 \times 2.54 \times 10\ \cancel{\text{mm}}}{1.55\ \frac{\cancel{\text{mm}}}{\text{quarter}}} \\
&\approx 1.13 \times 10^5\ \text{quarters}
\end{aligned}$$

Part (b)

Multiply the number of quarters by the mass per quarter to obtain the total mass.

$$\begin{aligned}
\text{Total Mass} &= \text{\# of Quarters} \times \text{Mass per Quarter} \\
&\approx (1.13 \times 10^5\ \cancel{\text{quarters}}) \times \left(5.67\ \frac{\text{g}}{\cancel{\text{quarter}}}\right) \\
&\approx 6.41 \times 10^5\ \text{g}
\end{aligned}$$

Part (c)

Multiply the number of quarters by the value per quarter to obtain the total worth.

$$\begin{aligned}
\text{Total Worth} &= \text{\# of Quarters} \times \text{Value per Quarter} \\
&\approx (1.13 \times 10^5\ \cancel{\text{quarters}}) \times \left(0.25\ \frac{\$}{\cancel{\text{quarter}}}\right) \\
&\approx 2.83 \times 10^4\ \text{dollars}
\end{aligned}$$

Part (d)

Divide the outstanding public debt by the worth of one stack to find how many stacks are needed to pay it off.

$$\begin{aligned} \text{\# of Stacks} &= \frac{\text{Outstanding Public Debt}}{\text{Stack Worth}} \\ &\approx \frac{\$16{,}213{,}166{,}914{,}811}{2.83 \times 10^4 \text{ dollars}} \\ &\approx 5.74 \times 10^8 \text{ stacks} \end{aligned}$$