Units & Quantitative Reasoning for Linear Equations

This guide teaches you how to use **units** (like dollars, hours, miles) and **quantitative reasoning** (thinking logically about quantities) to understand and build linear equations.

1) What are Units?

Units tell you what a number represents. A unit is the label attached to a quantity, such as minutes, dollars, feet, or miles per hour.

Examples of quantities with units:

- 15 **miles**
- 30 **minutes**
- $12 **dollars**
- 55 **miles per hour** (mph)
- $9.50 **dollars per hour**

2) Why Units Matter in Linear Equations

Units help you avoid mistakes and understand what the equation means. In a linear equation, the numbers usually represent:

- **Rate** (slope): how fast something changes, like dollars per hour.
- **Starting value** (y-intercept): the amount you start with, like a starting fee.

3) Quantitative Reasoning (What It Means)

Quantitative reasoning means using numbers and logic to describe real situations. You focus on:

- What quantities are changing?
- What is the starting amount?
- What is the rate of change?
- Do the units make sense when you add/multiply?
- Is the answer reasonable in the real world?

4) Units in Slope and Intercept

In slope-intercept form **y = mx + b**:

- **m** (slope) has units: (units of y) per (units of x).
- **b** (y-intercept) has the same units as y.

Example:

A gym charges a $20 sign-up fee plus $15 per month. Let x = months and y = total cost.

`y = 15x + 20`

Units check:

- x is in **months**
- 15 is **dollars per month**
- 20 is **dollars**
- y is **dollars**

5) Dimensional Analysis (Unit Checking)

A powerful trick is **dimensional analysis**, which means you treat units like algebra. Units can cancel out just like numbers.

Example: If you drive 60 miles in 2 hours:

`rate = 60 miles / 2 hours = 30 miles/hour`

The unit becomes miles per hour because miles stays on top and hours stays on the bottom.

6) Building Linear Models from Word Problems

Many real-world linear problems follow this pattern:

`Total = Start + Rate × Time`

You can rewrite it as a linear equation:

`y = mx + b`

Common examples:

Situation	Start (b)	Rate (m)	Model
Taxi fare	starting fee ($)	$ per mile	cost = (rate)(miles) + fee
Paycheck	starting amount ($0)	$ per hour	pay = (rate)(hours)
Phone plan	monthly fee ($)	$ per GB	cost = (rate)(GB) + fee
Temperature change	starting temp (°)	° per hour	temp = (rate)(time) + start

7) Reasonableness Checks (Does Your Answer Make Sense?)

After you solve, always ask:

- Is the answer too big or too small?
- Does it match the units the question asked for?
- If x = 0, do you get the starting value?
- If x increases, does y increase/decrease the way the problem describes?

8) Common Unit Mistakes to Avoid

- Adding quantities with different units (like adding miles + hours).
- Forgetting to convert units (minutes vs hours).

- Mixing up which variable is x and which is y.
- Forgetting that slope is a rate (per something).

Summary: Units help you understand what each number means, and quantitative reasoning helps you build and check linear equations that match real situations.