

Essential Question

How can a graph or table show how two variables are related?

Direct Relationships

- Straight line through the origin
- Double x, and y doubles
- Example: mass vs. volume

In a **direct relationship**, the two variables change by the same factor: if x doubles, y doubles, and if x triples, y triples.

Direct: The Ratio Test

- Divide y by x for each row
- Same answer every time: direct
- The ratio is the constant

To test a table for a direct relationship, divide y by x in every row.

Inverse Relationships

- Curve that drops, then flattens
- Double x , and y is cut in half
- Example: Boyle's law, P vs. V

In an **inverse relationship**, one variable goes up as the other goes down by the same factor:
if x doubles, y is cut in half.

Inverse: The Product Test

- Multiply x by y for each row
- Same answer every time: inverse
- The product is the constant

To test a table for an inverse relationship, multiply x by y in every row.

Other Relationships

- Straight line, not through origin: linear
- Curves upward: often squared

A straight line that does **not** pass through the origin is linear but not direct.

Example: Heating a Gas

Try it first!

A gas is heated in a sealed syringe that can expand. Is the relationship between temperature and volume direct or inverse? Find the constant.

Diagram: A table for a gas in a sealed syringe. Temperature in kelvins and volume in liters: 200 and 1.0, 300 and 1.5, 400 and 2.0.

Example: Squeezing a Gas

Try it first!

A gas sample is kept at constant temperature. Decide the type of relationship, then predict the volume at 150 kPa.

Diagram: A table with pressure in kilopascals and volume in liters: 50 and 6.0, 100 and 3.0, 200 and 1.5. A last row in red reads 150 and a question mark.

Example: Falling Ball

Try it first!

A ball is dropped from rest. Is the relationship between time and distance fallen direct, inverse, or something else?

Diagram: A ball falling downward next to a table. Time in seconds and distance in meters: 1.0 and 4.9, 2.0 and 19.6, 3.0 and 44.1.

Big Ideas

- Direct: $y \div x$ stays constant
- Inverse: $x \times y$ stays constant
- Squared: double x , $y \times 4$
- Test by doubling x