

Vocabulary

- **model** – a pattern, plan, representation or description designed to show the structure or workings of an object, system, or concept
- **system** – a set of particles or interacting components considered to be a distinct physical entity for the purpose of study
- **controlled experiment** – an experiment that tests only one factor at a time by using a comparison of a control group with an experimental group
- **hypothesis** – an explanation that is based on prior scientific research or observations and that can be tested
- **controlled experiment** – an experiment that tests only one factor at a time by using a comparison of a control group with an experimental group
- **dimension** – physical quantities that denote a measurement
- **unit** – how a physical quantity is represented
- **derived units** – units formed by combining the seven base units with multiplication or division, such as meters per second (m/s)
- **accuracy** – a description of how close a measurement is to the correct or accepted value of the quantity measured
- **precision** – the degree of exactness of a measurement
- **uncertainty** – a numeric measure of confidence in a measurement or result (the lower, the greater the confidence)
- **method error** – the occurrence when measurements are taken using different methods
- **instrument error** – error introduced by a broken or incorrect instrument
- **significant figures** – those digits in a measurement that are known with certainty plus the first digit that is uncertain
- **dimensional analysis** – treating dimensions as algebraic quantities
- **order-of-magnitude** – estimation by determining the powers of 10 closest to the actual numerical values of the quantities, used to check answers or when little information is given
- **scientific law** – a mathematical relationship between two observed variables
- **theory** – a comprehensive explanation
- **experiment** – a controlled test
- **observation** – use of the 5 senses
- **physics** – the study of the natural world using the five senses and logic
- **logic** – mathematical, procedural reasoning
- **inductive reasoning** – from the specific to the general (sun will rise tomorrow)
- **deductive reasoning** – from the general to the specific (slope-intercept formula can be made specific)
- **parabola** – curve of proportionality in a mathematical formula, concave up-rising
- **hyperbola** – concave up-falling curve
- **constant value product** – product of an inverse proportionality
- **constant value proportion** – direct proportionality
- **scale limit** – decimal place of observation in which uncertainty is first encountered; smallest place where accurate measurement can be made
- **parabola test** – if dependent v. independent² is a straight line

Notes

1. Physicists often use models to explain phenomena. Many models used in physics are mathematical models. Simple models are developed first, and later synthesized into more comprehensive models
2. The system is the defined part of a phenomena that is to be studied.
3. Diagrams, replicas, and simulations are used to demonstrate models.
4. Hypotheses must be tested in a controlled experiment, changing one variable at a time to determine what influences the observed phenomena.
5. The universally accepted system of units used for measurements is *SI*. There are seven base units, each describing a dimension and derived from a specific constant phenomena. The basic dimensions are *length*, *mass*, and *time*. *Force*, *velocity*, *energy*, *volume*, and *acceleration* can be described in terms of these.
6. Measurements in a calculation should use the same units.
7. *Accuracy* involves how correct a measurement is, and is subject to method and instrument error; *precision* is how exact a measurement can possibly be. (e.g., 1.325 m is more precise than 1.3 m)
8. *Variables* are normally italicized, whereas units are not.

9. Observations should be recorded 1) immediately 2) accurately, and 3) completely
10. Basic units: meter (m), length; kilogram (kg), mass; second (s), time

Major Areas of Physics

1. **Mechanics:** motion and its causes, interactions between objects
2. **Thermodynamics:** heat and temperature
3. **Vibrations and wave phenomena:** specific types of repetitive motions
4. **Optics:** light
5. **Electromagnetism:** electricity, magnetism, and light
6. **Relativity:** particles moving at any speed, including very high speeds
7. **Quantum mechanics:** behavior of submicroscopic particles

The Scientific Method

1. *Make observations and collect data* that lead to a question.
2. *Formulate and objectively test hypotheses* by experiments.
3. *Interpret results, and revise the hypothesis* if necessary.
4. *State conclusions* in a form that can be evaluated by others.

People

1. **Einstein** – Theory of Relativity
2. **Crookes** – invented the modern vacuum pump in 1872
3. **Newton** – discovered that “white” light is composed of all the “rainbow” colors
4. **Maxwell** – created theory of electromagnetism; Rules of Significant Figures
5. **Hertz** – discovered “radio waves”
6. **Otto von Gericke** – invented primitive vacuum pump
7. **Aristotle** – father of modern scientific thinking, lived in ancient Greece

Rules of Significant Figures

0. All digits in the coefficient of scientific notation are significant.
1. All non-zero digits are significant.
2. A zero that is the *final digit* and is to the right of the decimal point is significant.
3. Zeros between known significant figures are significant.
4. Zeros used *only* for locating the decimal point are *not* significant.
5. Zeros marked by a bar are significant digits on the scale limit place.

Rules of Significant Figure Algebra

1. **addition** – round to highest-placed scale limit
2. **multiplication** – round to the least number of significant digits

Prefixes:

Name	yotta	zetta	exa	peta	tera	giga	mega	kilo	hecto	deca
Symbol	Y	Z	E	P	T	G	M	k	h	da
Factor	10^{24}	10^{21}	10^{18}	10^{15}	10^{12}	10^9	10^6	10^3	10^2	10^1
Name	deci	centi	milli	micro	nano	pico	femto	atto	zepto	yocto
Symbol	d	c	m	μ	n	p	f	a	z	y
Factor	10^{-1}	10^{-2}	10^{-3}	10^{-6}	10^{-9}	10^{-12}	10^{-15}	10^{-18}	10^{-21}	10^{-24}