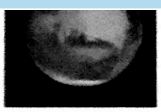
Ratios

- **Relative scales** are often the only meaningful way to express comparisons in astronomy.
- In the **table on page 194 (former textbook)**, look for the column headed "**Distance from Sun**". By setting up the appropriate ratios, we can calculate the **actual distance** of each planet from the **Sun** if **Earth** is **150,000,000 km or 1 Astronomical Unit (AU)** from the **Sun**.
- Now, find the column headed "**Revolution period**" and calculate the **relative revolution period** of each planet compared to **Earth's** year.

Table on p.194 of former textbook



Object	Diameter (Earth=1)	Mass (Earth=1)	Density (water=1)	Distance from Sun (Earth's distance=1)	Rotation period†
SUN	109.1	332,946	1.41	—	25 to 35 days
MERCURY	0.382	0.055	5.43	0.387	176 days
VENUS	0.949	0.815	5.24	0.723	117 days
EARTH	1.000	1.000	5.52	1.000	24 hours
MARS	0.532	0.107	3.94	1.524	24h 39m
JUPITER	11.19	317.8	1.33	5.20	9h 50m
SATURN	9.41	95.2	0.77	9.54	10h 39m
URANUS	4.01	14.5	1.27	19.18	17h 14m
NEPTUNE	3.88	17.2	1.64	30.06	16h 06m
PLUTO*	0.19	0.0028	1.8	29.6 to 49.3	6d 9.3h

*Pluto, now classified as a dwarf planet, is included here for comparison

Object	Revolution period (length of year)	Average amount of sunlight received (Earth=1)	Surface gravity†† (Earth=1)	Known moons	Axis inclination	Minimum light-time from Earth
SUN	—	—	27.9	—	7.3°	8.3 min.
MERCURY	88.0 days	6.6	0.38	0	0.0°	4.5 min.
VENUS	224.7 days	2.2	0.91	0	177.3°	2.3 min.
EARTH	365.3 days	1.0	1.00	1	23.4°	—
MARS	687.0 days	0.44	0.38	2	25.2°	3.1 min.
JUPITER	11.86 years	0.037	2.69	62	3.1°	33 min.
SATURN	29.46 years	0.011	1.19	61	26.7°	66 min.
URANUS	84.0 years	0.0028	0.91	27	97.9°	2.5 hours
NEPTUNE	164.8 years	0.0011	1.19	13	28.8°	4.0 hours
PLUTO	247.7 years	0.001 to 0.0004	0.06	1	120°	3.9 hours

†Rotation period of the Sun varies with latitude; for the planets, the figure given is period from one sunrise to the next at the equator.
††For Sun and giant planets, "surface" refers to *visible* surface (cloud tops and solar photosphere).
Earth's diameter is 12,756 kilometers; its distance from the Sun is 149.6 million kilometers.

Scientific Notation

In science, we come across numbers which are **very large**, i.e. **mass of the Earth** = **5,974,200,000,000,000,000,000,000 kg**

Or **very small**, i.e. the **mass of a proton is**
0.00000000000000000000000000167262158 kg

It is much more ***convenient*** to express these numbers in **scientific notation**

For example: $23400 = 2.34 \times 10000 = \mathbf{2.34 \times 10^4}$

Then, we can write the **mass of the Earth** as

$$\mathbf{5.9742 \times 10^{24}\ kg}$$

and the **mass of a proton** as

$$\mathbf{1.67262158 \times 10^{-27}\ kg}$$

Converting from a Regular Number to Scientific Notation

Procedure:

- **Step 1**: Move the decimal point so that the coefficient is equal to or greater than 1 and less than 10, i.e. between 1 to 9.9999 recurring.

  (Note: if the number is already between 1 and 10 it is already in scientific notation)

  Step 2: Determine the exponent by counting the number of decimal places moved in **Step 1**. The exponent is positive if the decimal point was moved to the **left** and negative if the decimal was moved to the **right**.

- **Step 3**: Write as a product of the coefficient (found in **Step 1**) and 10 raised to the power of exponent (found in **Step 2**).

Converting from a Regular Number to Scientific Notation

Example 1: Express the number 123 in scientific notation

- **Step 1:** 1.23
- **Step 2:** Decimal point was moved 2 places to the left, so the exponent is 2
- **Step 3:** 1.23×10^{2}

If the number is 10 or greater and has no decimal point, omit trailing zeros

Example 2: Express the number 0.00123 in scientific notation

- **Step 1:** 1.23 0.0 0 1.23
- **Step 2:** decimal point was moved 3 places to the right, so the exponent is negative 3, i.e., –3
- **Step 3:** 1.23×10^{-3}

If the number is less than 1, include trailing zeros in the scientific notation

Converting from Scientific Notation to a Regular Number

- **Step 1**: Write the coefficient.
- **Step 2**: Move the decimal place the number of positions indicated by the exponent, *left* for a negative exponent and *right* for a positive exponent.
- **Step 3**: Fill any blank spaces with zeros and put a zero to the left of the decimal point if there is no number there.

Example: Express the number 4.56×10^{3} as a regular number:

- **Step 1:** 4.5 6 .
- **Step 2:**
- **Step 3:** There is a blank space between the 6 and the decimal point, so we put a zero in this space, i.e. 4560

- **MOVE THE DECIMAL POINT LEFT FOR A NEGATIVE EXPONENT**
- **MOVE THE DECIMAL POINT RIGHT FOR A POSITIVE EXPONENT**