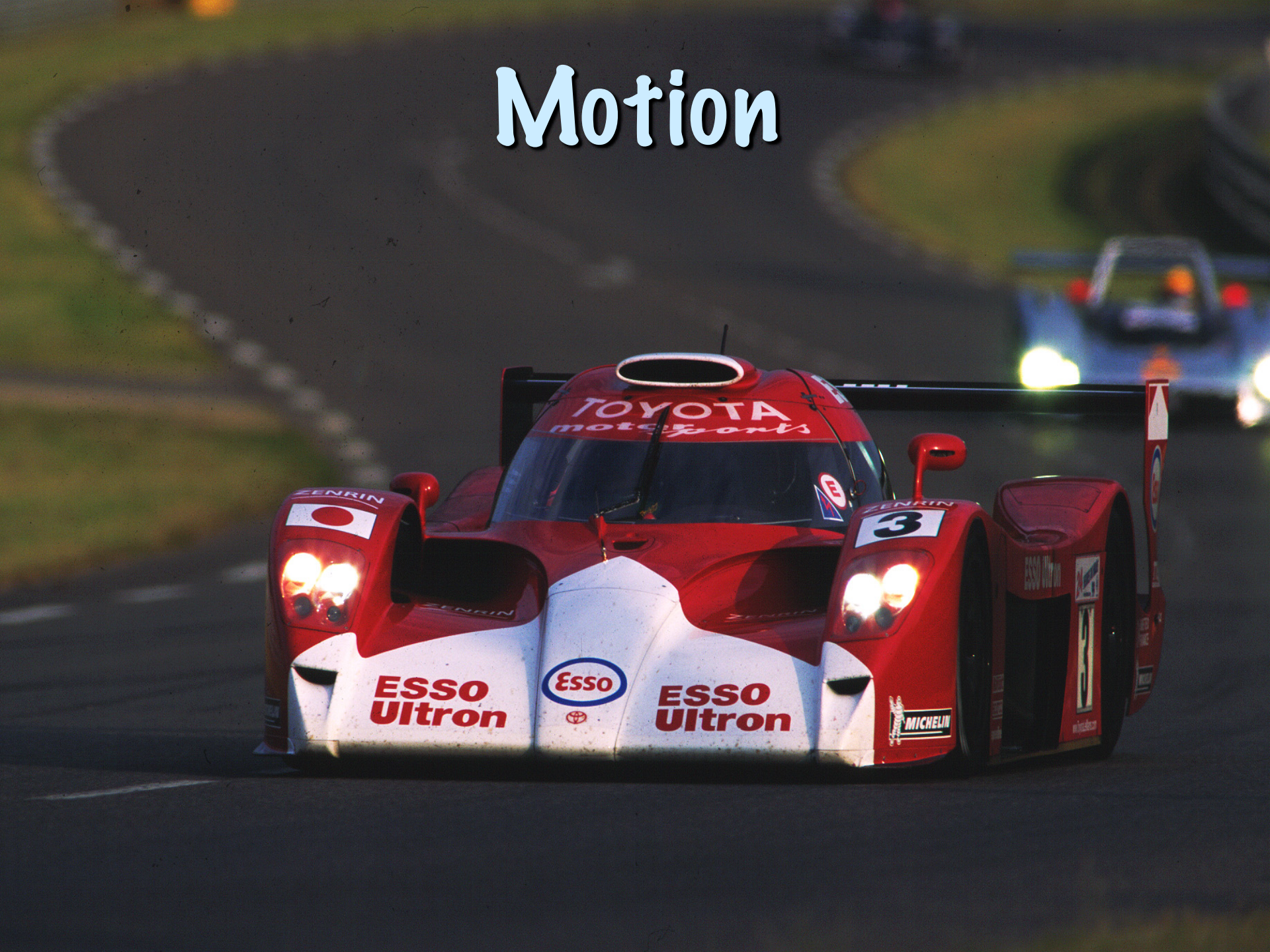
PHYSICS

The study of matter and energy and their interactions

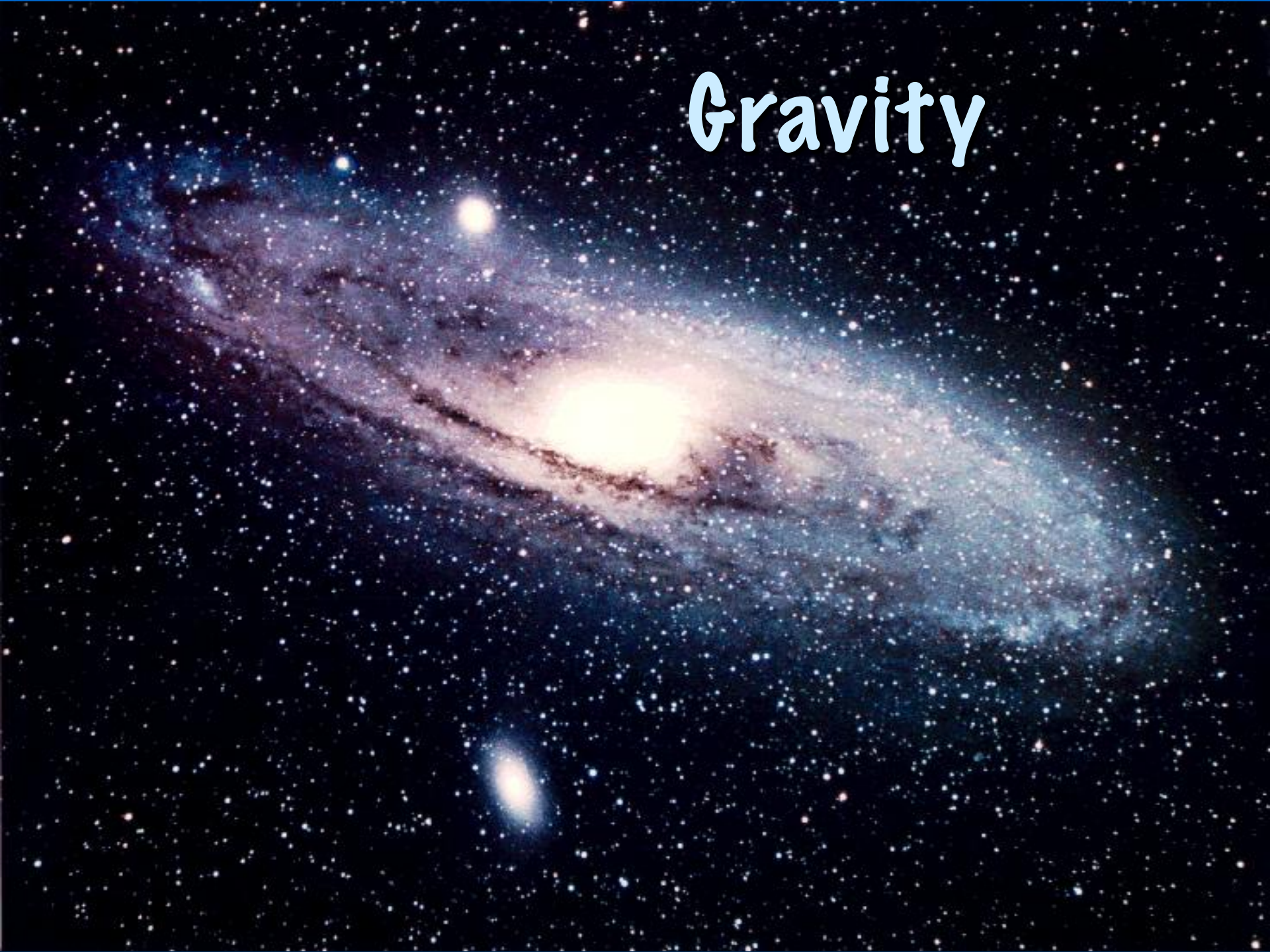
Motion


TOYOTA
motorsports
ESSO
Ultron
Esso
ESSO
Ultron
MICHELIN
ZENRIN
3

Forces

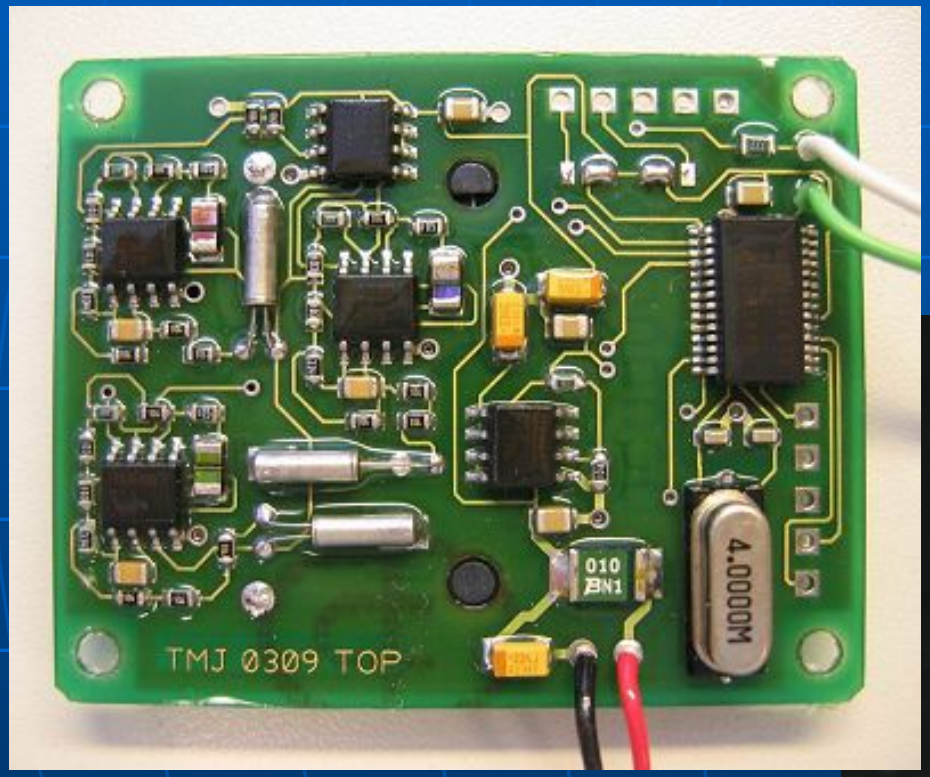
Energy

Gravity

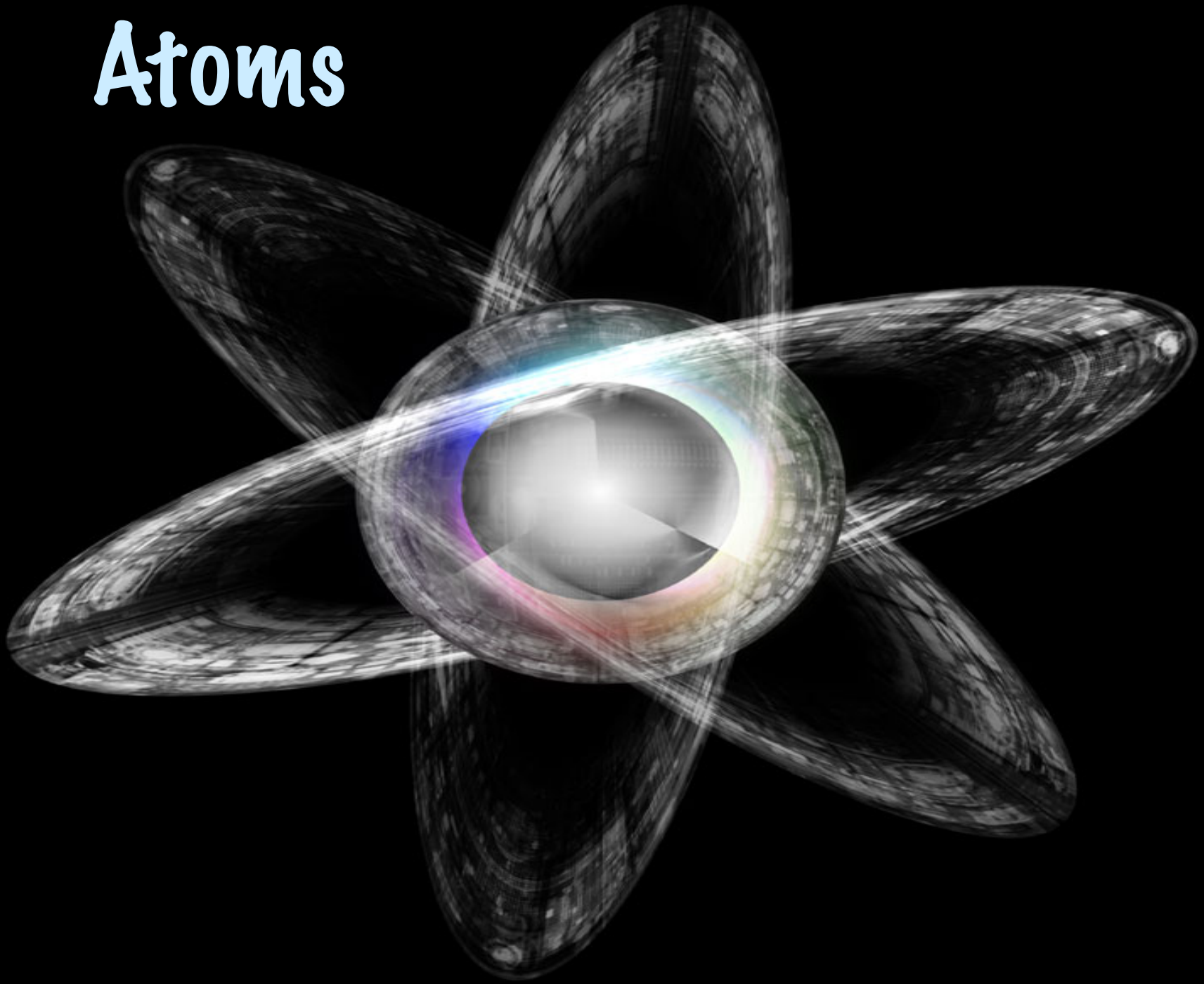


Light

Electricity and Magnetism



Atoms



The Metric System

- SI Standards of Measure
  - ➢Length is the meter (m)
  - ➢Mass is the kilogram (kg)
  - ➢Time is the second (s)
- English System Standards
  - ➢Length is the foot
  - ➢Mass is the slug
  - ➢Time is the second

Metric Prefixes

NAME	POWER	SYMBOL
• Tera	10^{12}	T
• Giga	10^{9}	G
• Mega	10^{6}	M
• Kilo	10^{3}	k
• Centi	10^{-2}	c
• Milli	10^{-3}	m
• Micro	10^{-6}	μ
• Nano	10^{-9}	n
• pico	10^{-12}	p

Conversion of Units

- Key Facts to Remember:
  - 100 cm = 1 m
  - 1000mm = 1m
  - 1000m = 1km

- We will use dimensional analysis and other strategies when converting units.

Find the way that works best for you.

Convert the following:

1.) 33.4 mm to m

0.0334 m

2.) 1500 cm to km

0.015 km

3.) 0.23 kg to cg

23,000 cg

4.) 90 mm to cm

9.0 cm

5.) 23 mL to L

0.023 L

6.) 4.5×10^{-3}m to km

4.5×10^{-6} km

7.) 12,000 ms to s

12.000 s

8.) 66.7 cm to mm

667 mm

Conversion of Derived Units

- A derived unit is a combination of units, for example:

  meters per second, m/s

  cubic centimeters, cm^3

Convert:

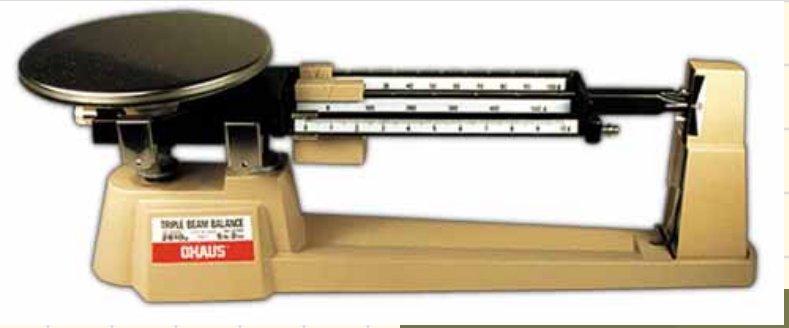
1.) 23.7 m/s to km/h — 85.3 km/h

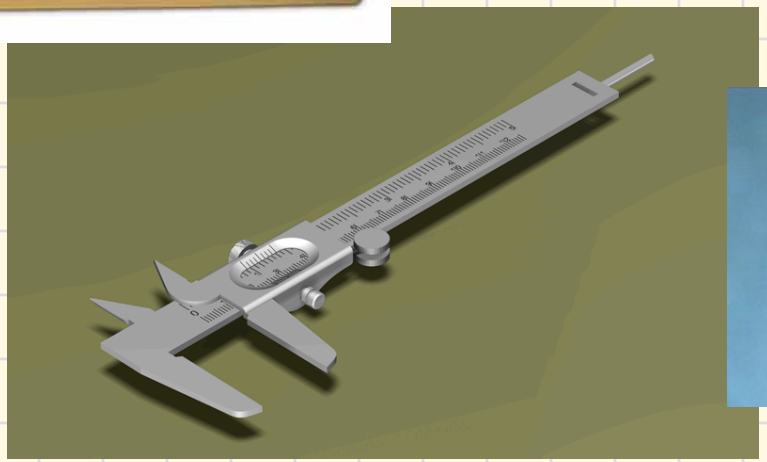
2.) 3.4×10^7 cm^3 to m^3 — 34 m^3

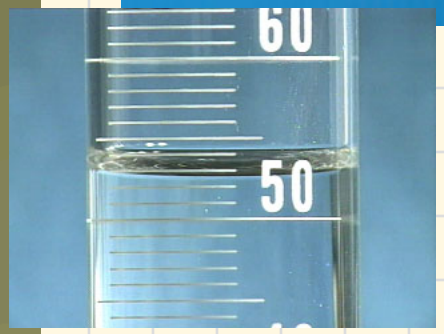
3.) 5 m/s^2 to cm/h^2 — 6.48×10^9 cm/h^2

- When making a measurement there are digits that are known with certainty and a final digit which is uncertain or

Measurements







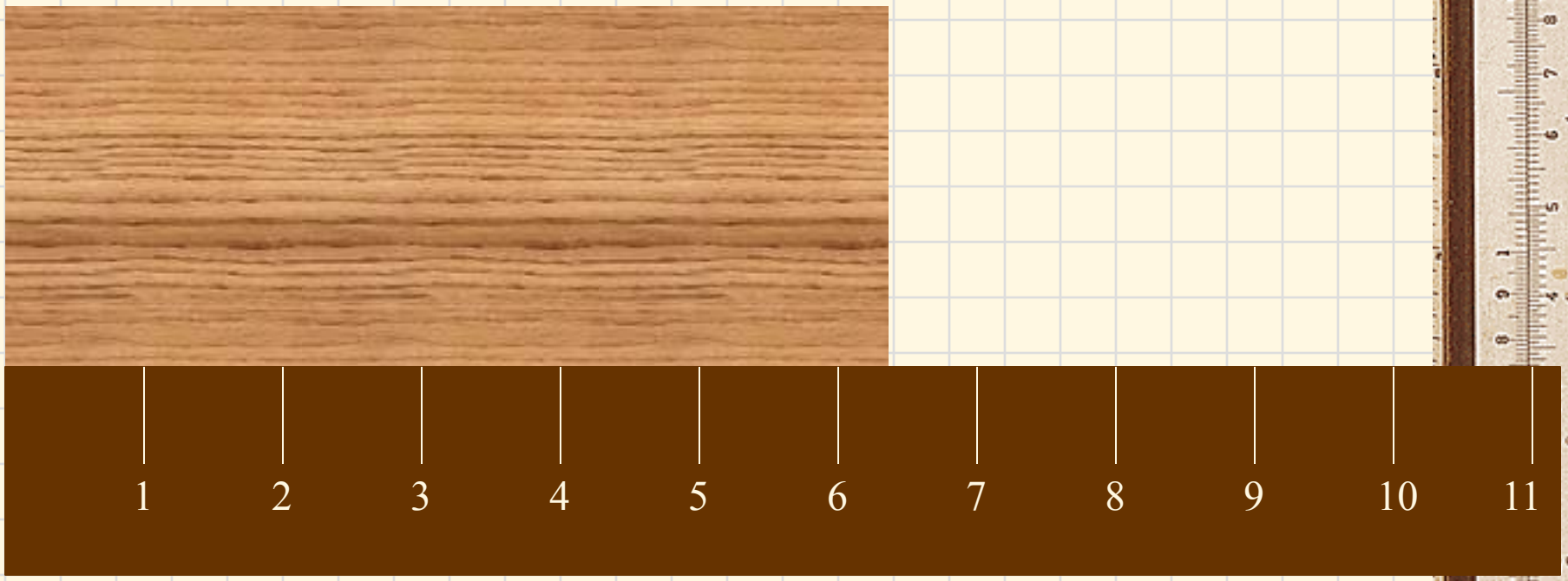
Significant Figures

- Any digit that you measure… plus the one digit you estimate.

What Determines the Number of Significant Figures in a Measurement

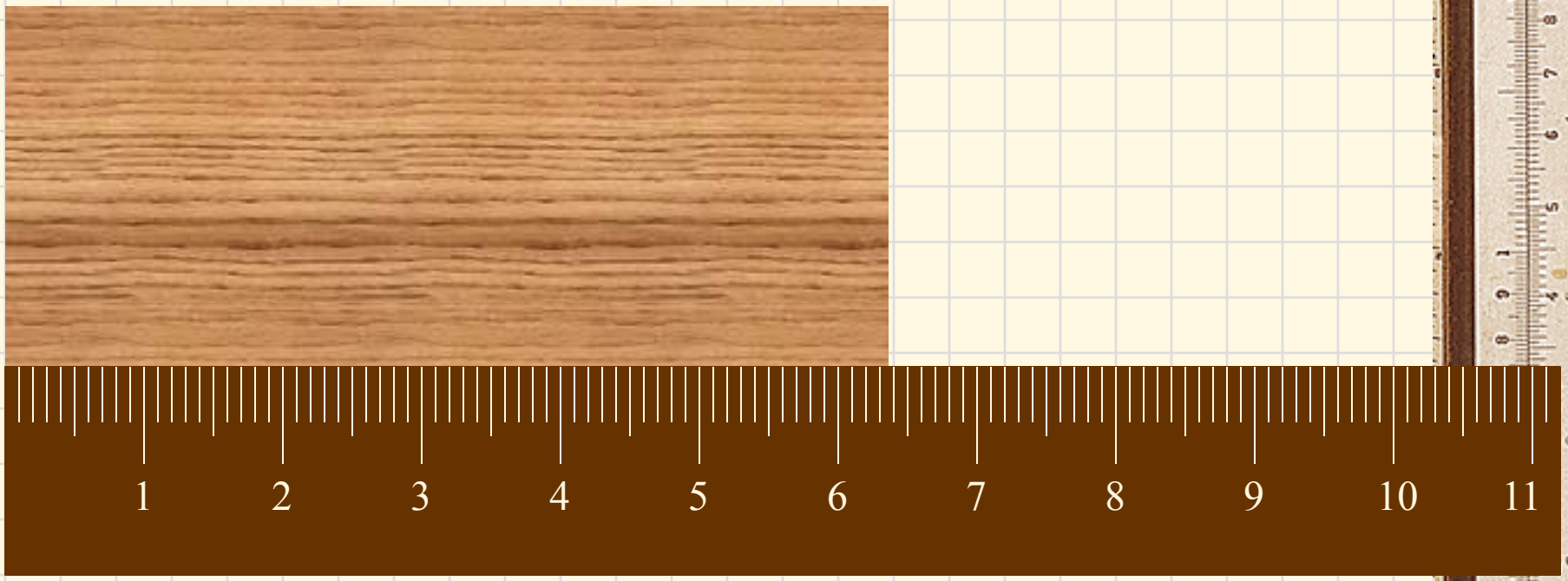
How long is the wooden block using this measuring tool?

What Determines the Number of Significant Figures in a Measurement



Now, what is the measure of the wooden block?

What Determines the Number of Significant Figures in a Measurement



And now what is the measurement?

What Determines the Number of Significant Figures in a Measurement

- **1. The size of divisions on your measuring device**
- **2. The size of the object**
- **3. The difficulty in measuring the object**

Significant Digits

- The Rules:
  - 1. All non-zero digits are significant.
  - 2. Any zeros between non-zero digits are significant.
  - 3. Zeros used to hold place value are not significant.
  - 4. All digits in a scientific notation are significant.
  - 5. Counting numbers have infinite significant digits.

Sig-Fig Practice

- Determine the number of sig-figs in each:
  - 23.000 — 5
  - 23.0 — 3
  - 23 — 2
  - 0.00023 — 2
  - 23,000 — 2
  - 20.003 — 5
  - 23000. — 5
  - 2.3×10^{3} — 2
  - 2.30×10^{-3} — 3

Adding and Subtracting with Significant Figures

- Round off your answer to the

PLACE VALUE

of the left-most uncertain digit in the numbers you are adding

Addition Example

- 13.05 cm + 309.2 cm + 3.785 cm

Addition Example

$$
\begin{array}{rl}
13.0\overline{5} & \text{cm} \\
309.\overline{2} & \text{cm} \\
+\quad 3.78\overline{5} & \text{cm} \\
\hline
326.\overline{0}\overline{3}\overline{5} & \text{cm} = 326.0\ \text{cm}
\end{array}
$$

Multiplying and Dividing with Significant Figures

- Round off your answer so that it has the
- SAME NUMBER OF SIGNIFICANT FIGURES
- as the factor with the least number of significant figures

Multiplication Example

- 6.98 cm
- x .23 cm
-

Operations with Significant Digits

- Addition and Subtraction
  - The answer will be to the least decimal.
    - Add: 2.4700 + 45.67 + 1.555
    - Subtract 88 - 34.27

49.70

54

- Multiplication and Division
  - The weakest link rule
    - Multiply: 0.0450 x 3.297
    - Divide: 300.45 ÷ 77.60

0.148

3.872

Complex Operations

- Use rules learned in math for order of operations

- Round off using significant figure rules when you change from multiplication or division to addition and subtraction or vice versa.

SCIENTIFIC NOTATION

- A POSITIVE NUMBER EXPRESSED IN THE FORM

  - $M \times 10^{n}$

  - in which M is a number between 1 and 10
  - and n is an integral power of ten

EXAMPLES

29,900,000,000 cm/s = 2.99×10^{10} cm/s

0.000,000,000,000,000,000,000,000,000,911g =

9.11×10^{-28} g

ANALYZING DATA AND GRAPHS

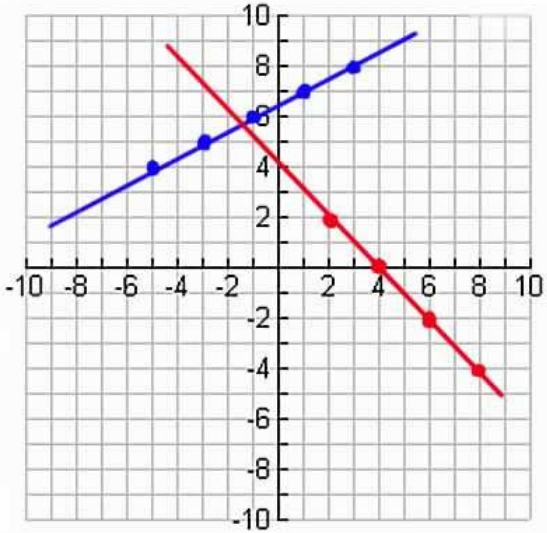
- **DIRECTLY PROPORTIONAL**
  - As one quantity (independent variable) increases the other quantity (dependent variable) increases in proportion.

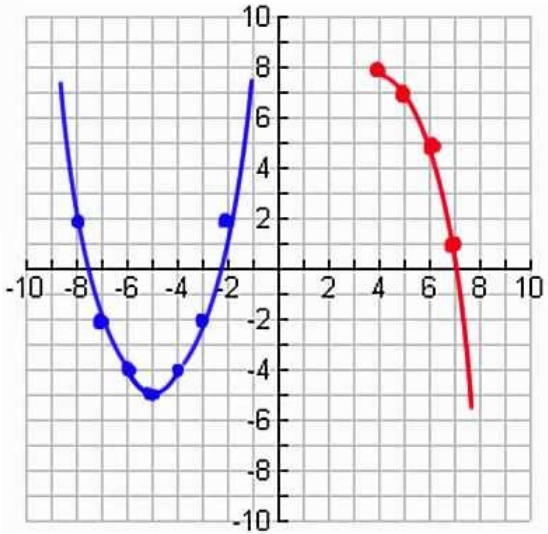
ANALYZING DATA AND GRAPHS

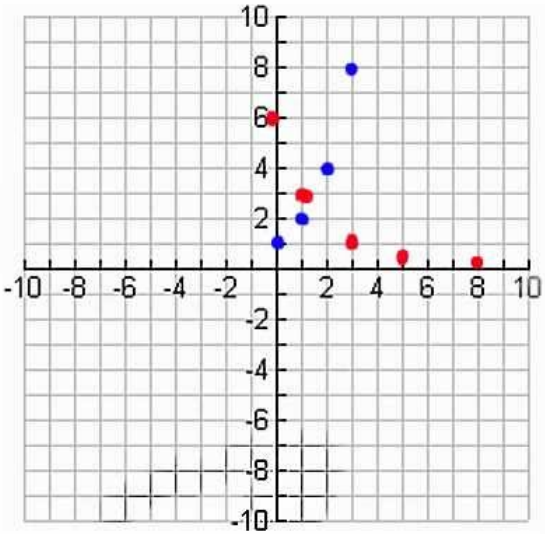
- **INVERSELY PROPORTIONAL**
  - As one quantity (independent variable) increases the other quantity (dependent variable) decreases in proportion.

Choosing a Linear, Quadratic, and Exponential Model

Linear	Quadratic	Exponential
$y = mx + b$	$y = ax^2 + bx + c$	$y = ab^x$







Dimensional Analysis

Physical Quantity- A physical property that can be quantified, that is with a number and a dimension (unit).

Examples are length, mass, time, current, and temperature, and any and all combinations of these.

Dimensionless Quantity- numbers without units.

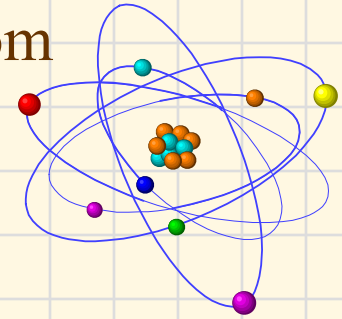
Examples are pi, numbers without units, trig functions, log functions

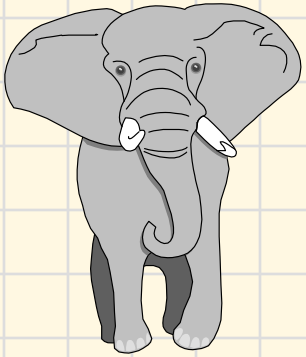
ORDER OF MAGNITUDE

- A numerical approximation to the nearest power of ten

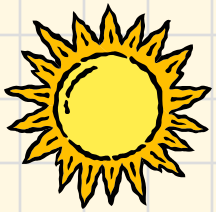
ORDER OF MAGNITUDE MASS

Uranium atom
4×10^{-26} kg



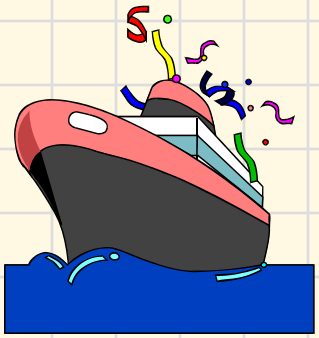


Elephant
5×10^{3} kg



Proton
2×10^{-27} kg

Sun
2×10^{30} kg

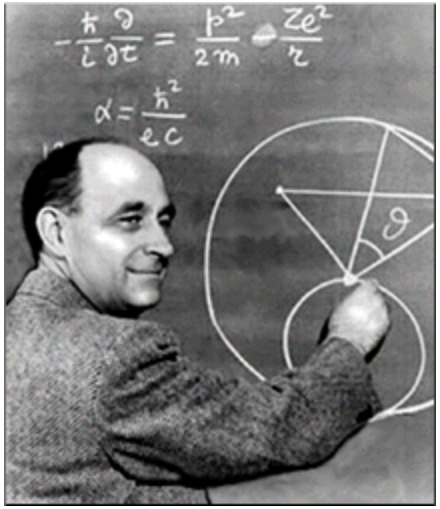


Grape
3×10^{-3} kg

Electron
9×10^{-31} kg

Milky Way
2×10^{41} kg

Ocean Liner
7×10^{7} kg



Fermi Questions (Order of Magnitude)

The method of obtaining a quick approximation to a seemingly difficult mathematical process by using a series of "educated guesses' and rounded calculations. Your logical imagination is important in solving the following problems:

Question # 1

- Given normal lifetime expectations, how many more seconds do you have to live?
  - Key facts
    - 60 seconds in 1 minute
    - 60 minutes in 1 hour
    - 24 hours in a day
    - 365 days in 1 year

Question # 2

- Suppose 5 of you could stand on each others' shoulders to form a human tower. Now imagine someone making a pile of $100 bills as tall as the human tower. How much money would it take?
  - Key facts
    - 1 foot = 0.3048 meters
    - All the money goes to me!

Question # 3

- A thunderstorm drops half an inch of rain on Utica, which covers an area of 16 square miles. Estimate the number of raindrops that fell during that storm.
- Key facts:

  1 inch = 2.54 cm

  1 mile = 1609 m

  Volume of a sphere is

$$V = \frac{4}{3}\pi r^3$$

How Many Jelly Beans are in the Jar?

Assumptions: the jar is a rectangular box

:the jelly beans are cylindrical

Formulae:

$$V_{box} = l \bullet w \bullet h$$

$$V_{cylider} = \pi r^2 h$$

Estimations:

$$l = 5cm, w = 5cm, h = 10cm$$

$$r = 0.25cm, h = 1cm$$