Physics 112
Course Outline 2011 - 2012

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Unit I: Kinematics (15 hours)
Vector Analysis
Graphical Analysis
Mathematical Analysis
(Chapters 2 and 3)

Unit II: Dynamics (20 hours)
Introduction
Newton's Laws
(Chapters 4 and 5)

Unit III: Work and Energy (20 hours)
Work, Power and Efficiency
Transformation, Total Energy and Conservation
(Chapters 6 and 7)

Unit IV: Waves (25 hours)
Fundamental Properties
Sound Waves and Electromagnetic Radiation

Unit V: Refraction and Diffraction of Light
Snell's Law
Total Internal Reflection

Unit VI: Lenses and Mirrors
Converging and Diverging Lenses
Thin Lens Equation
Lens Maker's Formula
Mirror Equation

Evaluation:

Tests, Quizzes, Labs	70%
Final Exam	30%

Materials:
Binder & paper
Lab Book
Scientific Calculator
Ruler/Protractor
Pen/Pencil

Textbook: Physics (McGrawHillRyerson): Text and CD ROM Price > $153.33

What is physics?

Physics is the study of matter and energy and their relationships.

True or False?

Imagination and creativity have no role in the study of physics.

FALSE!!

Throughout history some of the best scientists have been exceptionally creative.

Sometimes, without imagination, training and experience are not enough.

System of Units

Scientists use units to define the measurements of quantities.

The metric system is convenient to use because units of different sizes are related by powers of ten.

The system used throughout the world is the SI system of units. SI stands for Systeme International d'Unite.

The system is based on seven fundamental or base units.

Seven Fundamental/Base Units of the SI System

Quantity	Name of Unit	Symbol of Unit
Length	metre	m
Mass	kilograms	Kg
Time	Seconds	s
Electric Current	Amperes	A
Temperature	Kelvin	K
Amount of Something	mole	mol
Luminous Intensity (brightness)	Candela	Cd
	(lumens)	(lm)

☆ NIST - National Institute of Standards and Technology

Derived Units

Derived units are units that are made up of two or more fundamental (base) units.

Examples: Watt (W)

$= \frac{J}{s}$ ⟸ Joule (Energy)

Newton (Force)

$= \frac{Nm}{s}$

$= \frac{\left(\frac{Kg \cdot m}{s^2}\right) \cdot m}{s} = \frac{Kg \cdot m^2}{s^3}$

Prefixes

Prefixes are used to change SI units by powers of ten.
The metric units for all quantities use the same prefixes.

cm ⇨ cg, cs, cA, cK, cmol, ccd

SI Prefixes		
Power of 10	**Name**	**Symbol**
10^{12}	tera	
10^{9}	giga	
10^{6}	mega	
10^{3}	kilo	
10^{2}	hecto	
10^{1}	deca	
10^{-1}	deci	
10^{-2}	centi	
10^{-3}	milli	
10^{-6}	micro	
10^{-9}	nano	
10^{-12}	pico	

Check

1. What can fundamental units also be called?

2. How many SI fundamental units are there?

3. What are the symbols of the SI fundamental units?

4. What type of unit is N?

5. What SI prefixes are associated with the following powers of 10?

   a) 10^{-9}

   b) 10^{-2}

   c) 10^{3}

   d) 10^{-1}

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Metric Conversions

Metric conversions can be performed by using conversion factors.

Examples:

a) Convert 57.4 m to cm.

b) Convert 1049 μg to kg.

c) Convert 4.51 Ms to ns.

d) Convert 24 m/s to km/h.

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Scientific Notation

Scientific notation is based on exponential notation. The numerical part of a measurement is expressed as a number between 1 and 10 multiplied by a whole number power of 10.

$$M \times 10^n$$

where $1 \leq M < 10$
and n is an integer

Simple Rule

Move the decimal point until only one non-zero digit remains to the left.

"***n is the the number of places you shift the decimal point***"

n is ***positive*** if you shift the decimal point to the ***left***

and

n is ***negative*** if you shift the decimal point to the ***right***

Examples

1. 0.0000018 kg 1.8×10^{-6}
2. 437 s 4.37×10^{2}
3. 0.158 m 1.58×10^{-1}
4. 900045 cm 9.00045×10^{5}
5. 654.2×10^{-6} m 6.542×10^{-8}

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Error

Every measurement has a degree of error.

a) random error - totally unpredictable

b) systematic error - due to the design of an experiment

Accuracy vs. Precision

accuracy - describes the degree to which the result of an experiment or calculation approximates a true or accepted value

precision - describes the exactness and repeatability of a value

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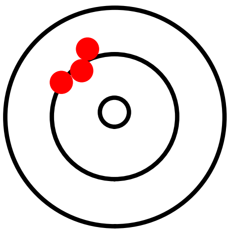
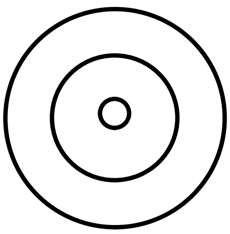
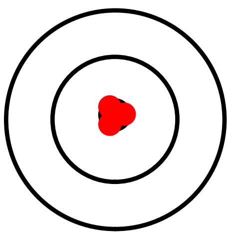


precision without accuracy



same accuracy, limited precision



accurate and precise

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Significant Digits/Figures

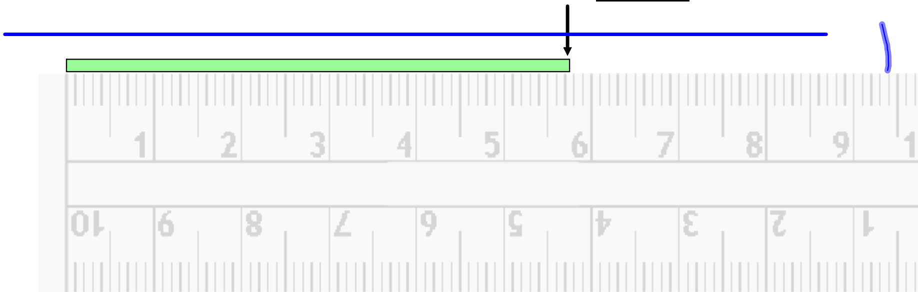
Significant digits are all the digits in a measurement that are certain.

The last digit in a measurement is always an estimate.
Only one estimated digit is significant.

Example

The length of the "green thing" is somewhat longer than 5.7 cm.
The last digit is an estimate.

5.7 5



Let's say the estimated digit is 5.

∴ Our measurement, 5.75 cm, has three significant digits. They are the two digits we are sure of, 5 and 7, and the last 5 that is an estimate.

General Rules

All non-zero digits (1, 2, 3, 4, 5, 6, 7, 8 and 9) in a measurement are significant.

All final zeroes after the decimal point are significant. (ie. 145.600 km)

A zero that only serves to locate the decimal point is not significant. (0.0051 s)

Zeroes between two other significant digits are always significant. (ie. 2.03 m)

Zeroes to the right of a whole number are considered to be ambiguous. (ie. 186 000 kg)

Write results in scientific notation to indicate clearly which zeroes are significant.

After a calculation, keep only those digits that truly reflect the accuracy of the original measurements.

Significant Digits and Operations

Addition & Subtraction

When measurements are added or subtracted, the sum or difference will have the same number of digits after the decimal point as the original measurement with the fewest digits after the decimal point.

$$\begin{array}{r} 49.01\ \text{m} \\ -\ 3.049\ \text{m} \\ \hline 45.961\ \text{m} \end{array}$$

45.96 m

Multiplication and Division

When measurements are multiplied or divided, the product or quotient will have the same number of significant digits as the original measurement with the least number of significant digits.

$$12.5\ \text{m} \times 16\ \text{m} \times 15.88\ \text{m} = 3176\ \text{m}^3$$

$$3.2 \times 10^3\ \text{m}^3$$

Rearranging Equations

Rearrange each equation for the variable in the brackets.

$v = f\lambda$, [f]

$v = f\lambda$ ← Lambda

$\frac{v}{\lambda} = \frac{f\lambda}{\lambda}$

$\boxed{\frac{v}{\lambda} = f}$

$W = 5 + T - g$, [g]

$W + g = 5 + T$

$\boxed{g = 5 + T - W}$

$v_f^2 = v_i^2 + 2ad$, [v_i]

$v_f^2 - 2ad = v_i^2$

$\sqrt{v_f^2 - 2ad} = \sqrt{v_i^2}$

$\sqrt{v_f^2 - 2ad} = v_i$

$b = \sqrt{d - v}$, [d]

$d = b^2 + v$

$b^2 = \left(\sqrt{d - v}\right)^2$

$b^2 = d - v$

$\boxed{b^2 + v = d}$

$T = 2\pi\sqrt{\frac{L}{g}}$, [g]

$g = \frac{4\pi^2 L}{T^2}$

$\frac{T}{2\pi} = \sqrt{\frac{L}{g}}$

$\left(\frac{T}{2\pi}\right)^2 = \left(\sqrt{\frac{L}{g}}\right)^2$

$\frac{T^2}{4\pi^2} = \frac{L}{g}$

$gT^2 = 4\pi^2 L$

$g = \frac{4\pi^2 L}{T^2}$

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Stuff You Need to KNOW

1. Measured quantities have units.

2. Scientists use the SI system of units.
   (Systeme International d'Unites)

3. Units can be fundamental or derived.

4. Prefixes are used to signify the magnitude of units.

5. Large and small measurements are most clearly written using scientific notation.

6. All measurements are subject to some uncertainty.

7. The number of digits that are valid for any measurement is limited by the precision of the measuring device.

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Conversions and Rearranging Formulas – Extra Space

Perform the following conversions.

1. 2.04 s to Gs (2.04 x 10^{-9} Gs)

2. 187 cm to m (1.87 m)

3. 0.926 pg to g (9.26 x 10^{-13} g)

4. 21 Mm to μm (2.1 x 10^{13} μm)

5. 2748 kg to ng (2.748 x 10^{15} ng)

6. 0.0512 ms to Ts (5.12 x 10^{-17} Ts)

7. 40.17 μg to cg (4.017 x 10^{-3} cg)

8. 0.213 nm to pm (213 pm)

9. 2.96 m/s to km/h (10.7 km/h)

10. 115 km/h to m/s (31.9 m/s)

Solve each equation for the variable in the square brackets.

1. $A = \frac{1}{2}bh$ [b]

$b = \frac{2A}{h}$

2. $V = \pi r^2 h$ [r]

$r = \sqrt{\frac{V}{\pi h}}$

3. $Ax + By + C = 0$ [x]

$x = \frac{-By - C}{A}$

4. $A = \frac{1}{2}h(a + b)$ [a]

$\frac{2A}{h} - b = a$

5. $F = \frac{9}{5}C + 32$ [C]

$\frac{5}{9}(F - 32) = C$

or

$\frac{5}{9}F - 17.8 = C$

6. $b = \sqrt{c^2 - a^2}$ [c]

$\sqrt{b^2 + a^2} = c$

7. $v = \sqrt{\frac{2K}{m}}$ [K]

$$\frac{v^2 m}{2} = K$$

8. $h = \frac{A - 2lw}{2w + 2l}$ [l]

$$l = \frac{A - 2hw}{2h + 2w}$$

9. $\frac{x}{L} = \frac{\lambda}{d}$ [d]

$$d = \frac{\lambda L}{x}$$

10. $x = \frac{b+3}{s}$ [s]

$$s = \frac{b+3}{x}$$

11. $P = hy + s^2$ [s]

$$\sqrt{P - hy} = s$$

12. $\frac{f_o}{f_s} = \frac{v - v_o}{v + v_s}$ [v_s]

$$v_s = \frac{f_s v - f_s v_o - f_o v}{f_o}$$

(12) $\frac{f_o}{f_s} = \frac{v - v_o}{v + v_s}$

$\Rightarrow f_o(v + v_s) = f_s(v - v_o)$

$\Rightarrow f_o v + f_o v_s = f_s v - f_s v_o$

$\Rightarrow f_o v_s = f_s v - f_s v_o - f_o v$

$\Rightarrow v_s = \frac{f_s v - f_s v_o - f_o v}{f_o}$

Examples of LARGE and small quantities

6.4 Mm - radius of the Earth

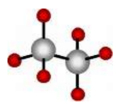
60 kg - a person's mass 

28 cm - length of a piece of paper

1 ms - time for one vibration of a guitar string playing the note D 

10 μm - size of a white blood cell 

0.154 nm - distance between carbon nuclei in an ethane molecule



Attachments

Physics 112 & 111 - Conversions and Formulas.doc

Physics 112&111 What Do You Know.doc