Syllabus

- **Course Website**: http://www.pa.msu.edu/courses/phy231
- **Lecture**: BPS1410, Sec. 1, 10:20 – 11:40; Sec. 2, 12:40 – 2:00; **Attend ONLY your section.** You will have an assigned seat for every lecture. It will be sent to you by email. Write the seat number on your i-clicker. **You Must Sit In Your Assigned Seat.**
- **Instructor**: C. Bromberg, Rm: BPS3225, Email: bromberg@pa.msu.edu, 517-884-5580
- **Office Hours**: Wednesday 12:00 – 2:00, BPS 1248, or by appointment via email
- **Teaching Assistants**: Strosacker Physics Learning Center (BPS 1248) will have several TAs available during the hrs. 9:00 am - 9:00 pm. See course website for specific TA hours.
- **Textbook (C&J)**: Cutnell & Johnson, PHYSICS 9e (MSU), ISBN 978-1-118-11893-1. Text is loose-leaf 3-hole punched. **You Must Purchase THIS version of the book.** Bring appropriate chapters to class in a small binder, and keep remainder in another binder at home. In class questions may refer to specific pages in the text!
- **Course description and Prerequisites**: see website
- **Readings**: C&J readings are listed in the *Course Schedule (below)* for each lecture. Pay close attention to the worked out examples. Understand the reasoning behind each step.
- **I-clickers**: You must own and bring **(only your own)** "i-clicker" to **(only your)** lecture section, and sit in only your assigned seat.

- **HW “Check your Understanding”**: are listed on the *Course Schedule*. Answers are at the back of the book. Similar questions will be used as “i-clicker” Questions in class. Keep a notebook of your solutions and bring them to any trip to the Learning Center.
- **HW Problems**: from previous lecture due in the lecture listed on the *Course Schedule*. Answers are at the back of the book. Similar ones will be used in “i-clicker” Quizzes. Keep a notebook of your solutions and bring them to any trip to the Learning Center.
- **Quizzes**: Multiple-choice i-clicker Quizzes (open book) will be given in the first 15 minutes of most Tuesday lectures, except after a Midterm Exam. Quiz questions will be similar to the HW assignment questions and problems.
- **Exams**: There will be **two midterm exams** during regular class hours on the dates shown on the *Course Schedule*. The exams will be closed book, but you may use one (double-sided) 8-1/2x11” sheet of notes and equations. Exams may contain material from the textbook, homework and quizzes and will consist of conceptual and numerical problems. There will be a common **2-hr Final Exam on Thurs., May 3, 8:00pm – 10:00pm**, Rm. to be decided. You will need a calculator, a #2 pencil and your student ID when taking an exam. Alternate Final Exam policy will be as stated by the Registrar.
- **Academic Dishonesty**: University rules and procedures regarding academic dishonesty will be strictly applied without exceptions, for i-clicker Questions, Quizzes, and Exams.
- **Grading Criteria**: Grades are based on in-lecture i-clicker Questions (5%), i-clicker Quizzes (15%), two Midterm exams (15% each), Final Exam (50%). 4 lowest Clicker Session grades, and 2 lowest Quizzes will be dropped. See website for details. Only written Medical excuses for ONE missed Midterm will be accepted. Makeup exam or weighting by 2 the other Midterm, will be at the lecturer’s discretion.
- **Grades**: The mean grade in PHY231 will be about 3.0. In *each section* the approximate percentage of the enrollment obtaining each grade are; 4.0(15%), 3.5(25%), 3.0(25%), 2.5(15%), 2.0 or lower (20%).
- **Disabilities**: Students with a disability must register with the instructor in person.

Wk	Date	Day	Topics	C&J Reading	✓ Your Understanding HW	HW Problems
1	1/10	T	Syllabus/Units/Trig/Vectors	Ch. 1, Sec. 1-5		
	1/12	Th	Vector Algebra/Components	Ch. 1, Sec. 6-9	Ch.1: 1,2,3,8,10,12,13,18	
2	1/17	T	1D Motion Variables/Equations	Ch. 2, Sec. 1-8	Ch.2: 4,5,12,13,14	Ch. 1: 1,5,11,19,23,31,61
	1/19	Th	2D Motion Equations	Ch. 3, Sec. 1-5	Ch. 3: 2,3,7,8,10,17	Ch. 2: 3,9,15,19,27,29,53,65,67
3	1/14	T	Forces - Newton's 1st & 2nd Law	Ch. 4, Sec. 1-4	Ch. 4: 2,4,5,	Ch. 3: 3,7,13,25,29,43,57,77
	1/26	Th	Newton's 3rd Law - Gravitation	Ch. 4, Sec. 5-7	Ch. 4: 6 - 10	Ch. 4: 1,3,5,9,11,13,15
4	1/31	T	Normal Forces, Friction, Tension	Ch. 4, Sec. 8-10	Ch. 4: 11,12,13,15,17,18	Ch. 4: 21,23,25,27
	2/2	Th	Equilibrium	Ch. 4, Sec. 11	Ch. 4: 19 - 22	Ch. 4: 39,41,45,53,57
5	2/7	T	Forces and Accleration, Review	Ch. 1 - 4	Ch.4: 23,24,25	Ch.4: 59,61,77,79
	2/9	Th	**Midterm Exam 1**	Ch. 1 - 4		
6	2/14	T	Uniform Circular Motion	Ch. 5, Sec. 1-8	Ch. 5: 1 - 8	
	2/16	Th	Work - Kinetic & Potential Energy	Ch. 6, Sec. 1-4	Ch. 6: 1,2,3,4,6,7,8,9	Ch. 5: 1,3,5,11,17,23,31,39,41
7	2/21	T	Conservation of Mechanical Energy	Ch. 6, Sec. 5-6	Ch. 6: 10 - 15	Ch. 6: 1,3,5,11,15,21,29,33
	2/23	Th	Using Energy to Solve Problems	Ch. 6, Sec. 7-10	Ch. 6: 16,17	Ch. 6: 39,41,43,47,49
8	2/28	T	Impulse, Conservation of Momentum	Ch.7, Sec. 1-3	Ch.7: 1,3,4,5,8,9,10,12,14	Ch. 6: 65,67,69
	3/1	Th	1D and 2D Collisions	Ch. 7 Sec. 4-6	Ch. 7: 18,19,20	Ch.7: 1,5,9,11,17,21
9	3/6	T	**Spring Break**			
	3/8	Th	**Spring Break**			
10	3/13	T	Rotational Kinematics	Ch. 8 Sec. 1-8	Ch. 8: 2,5,8,11,13,15,16	Ch. 7: 29, 31,35,43
	3/15	Th	Rotational Dynamics	Ch. 9 Sec. 1-7	Ch. 9: 2,4,5,6,7,8,9,10,12,13	Ch. 8: 1,5,7,9,13,15,23,37,45,51
11	3/20	T	Energy, Momentum, Rotations, Review	Ch. 1-9	Ch. 9: 17,19,20	Ch. 9: 3,9,13,21,23,39,45,51,63
	3/22	Th	**Midterm Exam 2**	Ch. 1-9		
12	3/27	T	Simple Harmonic Motion	Ch. 10, Sec. 1-9	Ch. 10: 1-11, 16,19	
	3/29	Th	Fluids	Ch. 11, Sec. 1-12	Ch. 11: 2,5,6,8,10,11,12,17	Ch. 10: 1,3,5,15,21,27,33,43,51
13	4/3	T	Temperature Heat	Ch. 12, Sec. 1-11	Ch. 12: 3,5,8,11,14,16,17,19	Ch. 11: 3,13,17,27,29,37,43,63
	4/5	Th	Heat Transfer	Ch. 13, Sec. 1-5	Ch. 13: 1,7,8,10,13	Ch. 12:5,11,15,31,47,61,79
14	4/10	T	Ideal Gas Law/Kinetic Theory	Ch. 14, Sec. 1-5	Ch. 14: 1,3,7,12,13,15,	Ch. 13: 1,3,9,13
	4/12	Th	Thermodynamics & the 1st Law	Ch. 15, Sec. 1-6	Ch. 15: 1,2,6,7,8,11	Ch. 14: 1,3,11,13,19,25,33,37,49
15	4/17	T	2nd Law of Thermodynamics	Ch. 15, Sec 7-13	Ch. 15: 12,13,15,16,21,24	Ch. 15 :1, 3,13,14,21,25,35
	4/19	Th	Waves and Sound	Ch. 16, Sec 1-12	Ch. 16: 3,6,9,11,13,15,19,21	Ch. 15: 45,47,51,53,63,67,77,95
16	4/24	T	Diffraction & Interference	Ch. 17, Sec 1-8	Ch. 17:1,2,3,7,9,12,16	Ch.16: 1,7,13,25,31,45,53,67,77
	4/26	Th	Review	Ch. 1-17		Ch. 17: 3,5,19,27,31
17	5/3	Th	**Final Exam 8:00-10:00 pm, Rm TBD**	Ch. 1-17		

Clicker Question Tune-up: This is much like physics!

A man can mow his lawn in 1 hr. His son, who likes to smoke the cut grass, takes 2 hrs. to mow that lawn.
If they work together, how long will it take to mow the lawn?

a) 3.0 hrs.
b) 1.5 hrs.
c) 45 min.
d) 40 min.
e) 30 min.

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Why? Can't really guess this answer! Need algebra – and insight into *what adds together* when they work together.

(speed)

What adds together is their lawn mowing rate.

Man: rate = 1 lawn per hr. = 1 lawn/hr.
Son: rate = 1 lawn per 2 hr. = 1 lawn/2 hr. = ½ lawn/hr.

Total: rate = 1½ lawn/hr. = 3/2 lawn/hr. = 3 lawns/2 hr.

Now what? Want time/lawn! It's 2 hr./3 lawns = <u>2/3 hr./lawn</u>

How long is 2/3 hr. = (2/3 hr.)(60 min./hr.) = <u>40 min.</u>

$(=1)$

Chapter 1

Introduction and Mathematical Concepts

1.2 Units

Physics experiments involve the measurement of a variety of quantities.

These measurements should be accurate and reproducible.

The first step in ensuring accuracy and reproducibility is defining the units in which the measurements are made.

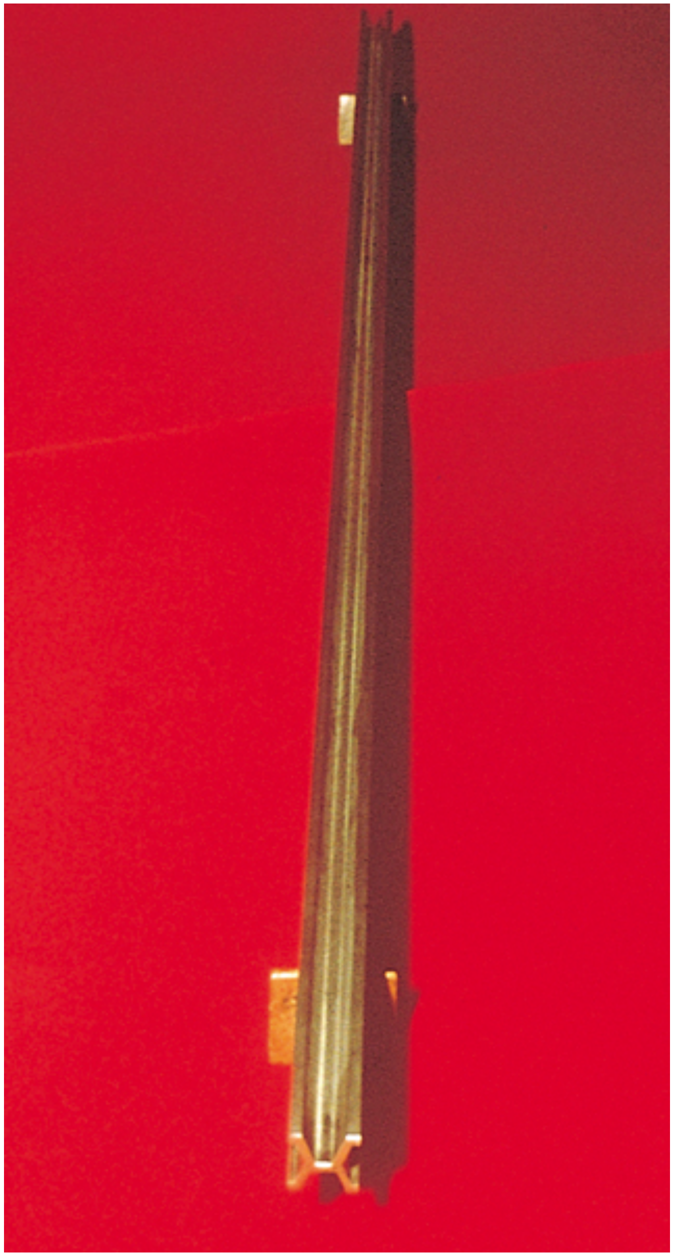
SI units

meter (m): unit of length

kilogram (kg): unit of mass

second (s): unit of time

1.2 Units



1.2 Units

1.2 Units

Table 1.1 **Units of Measurement**

	System		
	SI	CGS	BE
Length	Meter (m)	Centimeter (cm)	Foot (ft)
Mass	Kilogram (kg)	Gram (g)	Slug (sl)
Time	Second (s)	Second (s)	Second (s)

1.2 Units

The units for length, mass, and time (as well as a few others), are regarded as *base* SI units.

These units are used in combination to define additional units for other important physical quantities such as force and energy.

THE CONVERSION OF UNITS

1 ft = 0.3048 m

1 mi = 1.609 km

1 hp = 746 W

1 liter = 10^{-3} m^3

1.3 The Role of Units in Problem Solving

Table 1.2 Standard Prefixes Used to Denote Multiples of Ten

Prefix	Symbol	Factor[a]
tera	T	10^{12}
giga[b]	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

[a]Appendix A contains a discussion of powers of ten and scientific notation.
[b]Pronounced jig′a.

Example 1 The World's Highest Waterfall

The highest waterfall in the world is Angel Falls in Venezuela, with a total drop of 979.0 m. Express this drop in feet.

Since 3.281 feet = 1 meter, it follows that

Ratio of two identical distances: (3.281 feet)/(1 meter) = 1

$$979.0\text{ meter} = (979.0\text{ meter})\overbrace{\left(\frac{3.281\text{ feet}}{1\text{ meter}}\right)}^{=1} = 3212\text{ feet}$$

Example 1 The World's Highest Waterfall (Again)

The highest waterfall in the world is Angel Falls in Venezuela, with a total drop of 979.0 m. Express this drop in feet.

What if you can't remember 3.281 feet in a meter?
What do you remember? Perhaps 1 inch = 2.54 cm (yes?)
Also, 12 inches = 1 foot, and 100 cm = 1 m.

$$1\text{ m} = (1\text{ m})\underbrace{\left(100\ \frac{\text{cm}}{\text{m}}\right)}_{}\overset{=1}{\left(\frac{1}{2.54}\frac{\text{inch}}{\text{cm}}\right)}\overset{=1}{\left(\frac{1}{12}\frac{\text{ft}}{\text{inch}}\right)} = (1\text{ m})\overset{=1}{\left(\frac{100}{(2.54)(12)}\frac{\text{ft}}{\text{m}}\right)} = 3.281\text{ ft}$$

Since 3.281 feet = 1 meter, it follows that

$$979.0\text{ meters} = (979.0\text{ meters})\left(\frac{3.281\text{ feet}}{1\text{ meter}}\right) = 3212\text{ feet}$$

Reasoning Strategy: Converting Between Units

1. In all calculations, write down the units explicitly.

2. Treat all units as algebraic quantities. When identical units are divided, they are eliminated algebraically.

3. Use the conversion factors located on the page facing the inside cover. Be guided by the fact that multiplying or dividing an equation by a factor of 1 does not alter the equation.

Example 2 Interstate Speed Limit

Express the speed limit of 65 miles/hour in terms of meters/second.

Use 5280 feet = 1 mile and 3600 seconds = 1 hour and
3.281 feet = 1 meter.

$$\text{Speed} = \left(65\,\frac{\text{miles}}{\text{hour}}\right) = \left(65\,\frac{\text{miles}}{\text{hour}}\right)\overbrace{\left(\frac{5280\text{ feet}}{\text{mile}}\right)}^{=1}\overbrace{\left(\frac{1\text{ hour}}{3600\text{ s}}\right)}^{=1} = 95\,\frac{\text{feet}}{\text{second}}$$

$$\text{Speed} = \left(95\,\frac{\text{feet}}{\text{second}}\right) = \left(95\,\frac{\text{feet}}{\text{second}}\right)\overbrace{\left(\frac{1\text{ meter}}{3.281\text{ feet}}\right)}^{=1} = 29\,\frac{\text{meters}}{\text{second}}$$

1.3 The Role of Units in Problem Solving

DIMENSIONAL ANALYSIS

[L] = length   [M] = mass   [T] = time

Is the following equation dimensionally correct?

$$x = \tfrac{1}{2} v t^2$$

$$\left[\mathrm{L}\right] = \left[\frac{\mathrm{L}}{\mathrm{T}}\right]\left[\mathrm{T}\right]^2 = \left[\mathrm{L}\right]\left[\mathrm{T}\right]$$

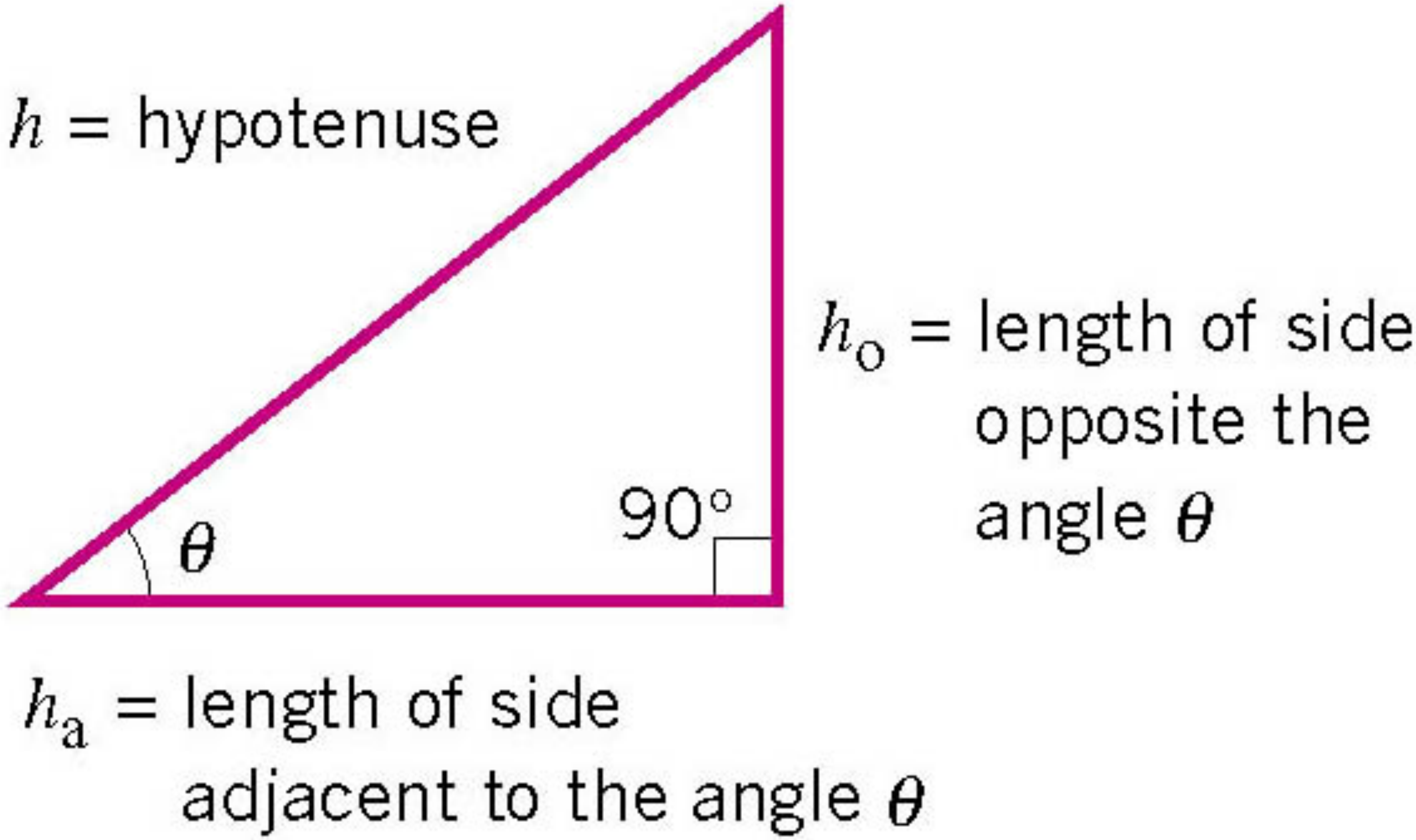
1.3 The Role of Units in Problem Solving

Is the following equation dimensionally correct?

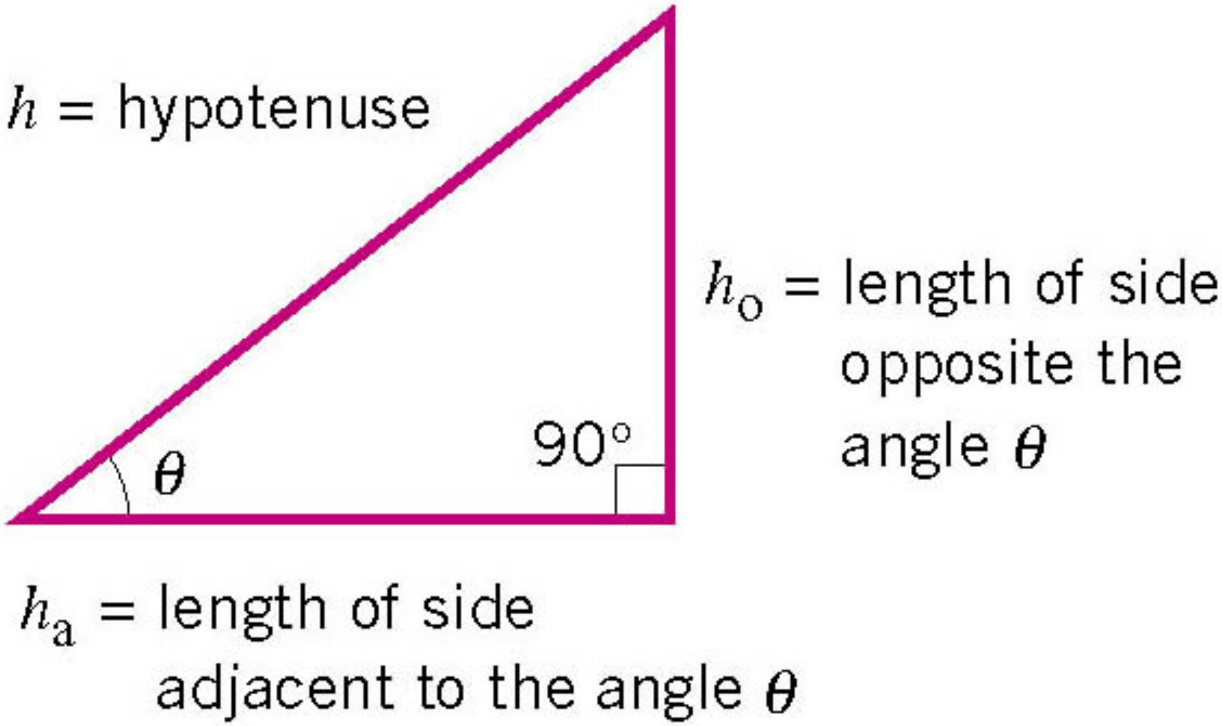
$$x = vt$$

$$[\mathrm{L}] = \left[\frac{\mathrm{L}}{\mathrm{T}}\right][\mathrm{T}] = [\mathrm{L}]$$

1.4 Trigonometry



1.4 Trigonometry

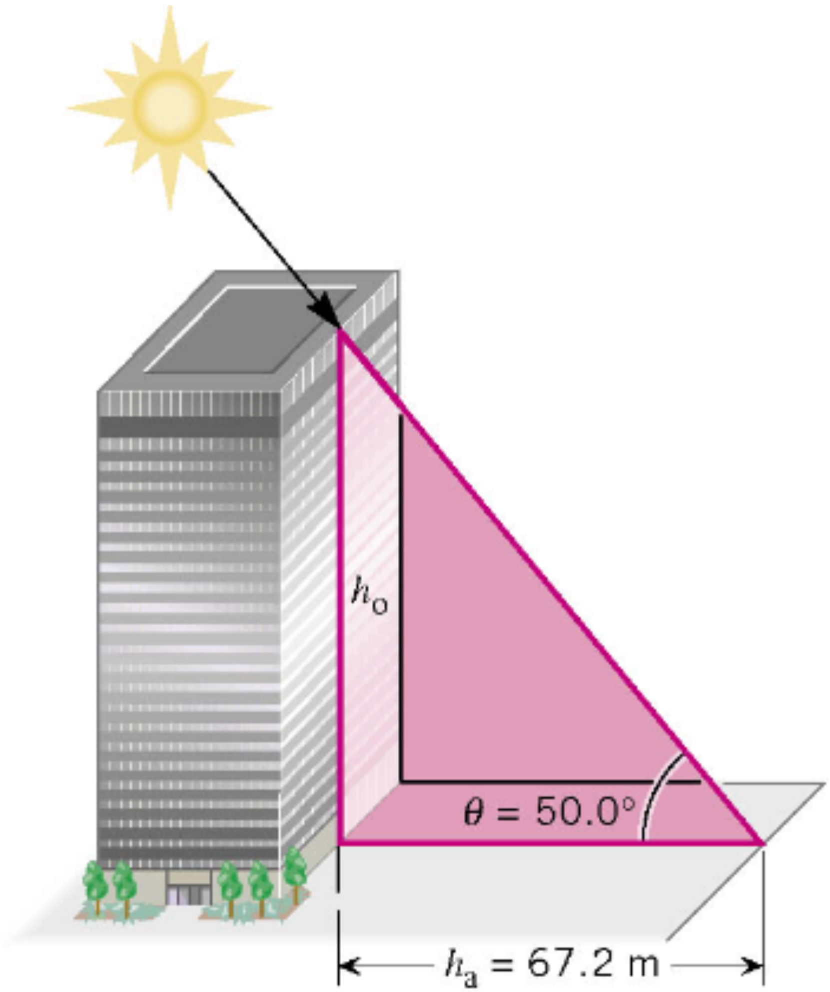


$$\sin\theta = \frac{h_o}{h}$$

$$\cos\theta = \frac{h_a}{h}$$

$$\tan\theta = \frac{h_o}{h_a}$$

1.4 Trigonometry

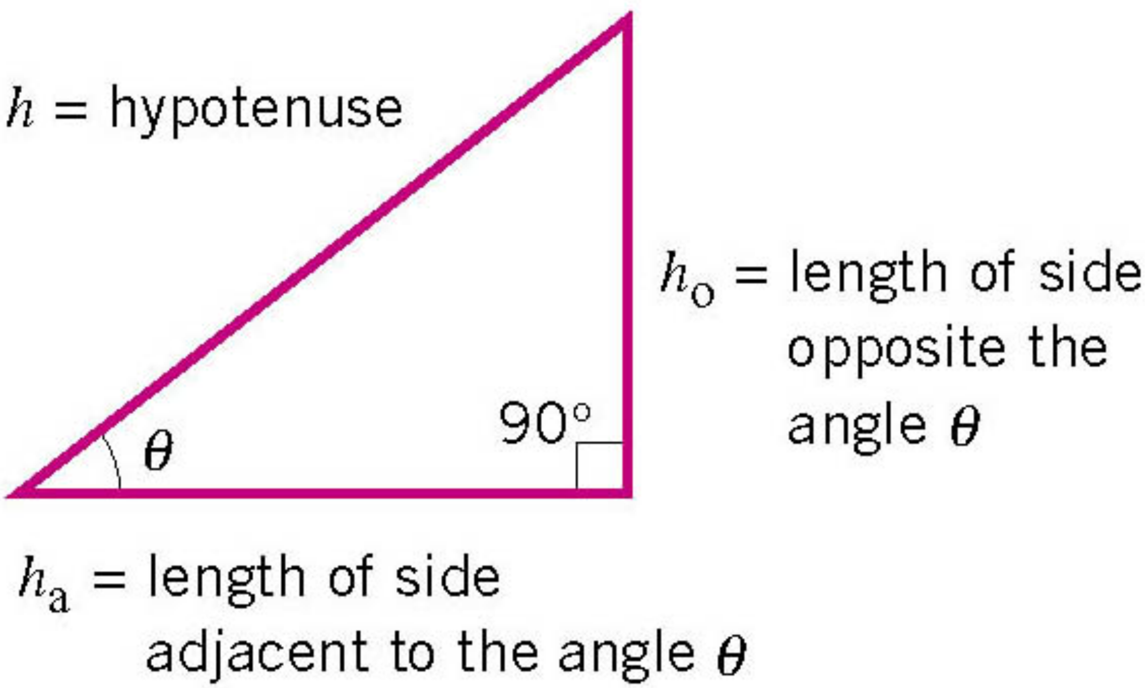


$$\tan\theta = \frac{h_o}{h_a}$$

$$\tan 50^\circ = \frac{h_o}{67.2\text{m}}$$

$$h_o = \tan 50^\circ (67.2\text{m}) = 80.0\text{m}$$

1.4 Trigonometry

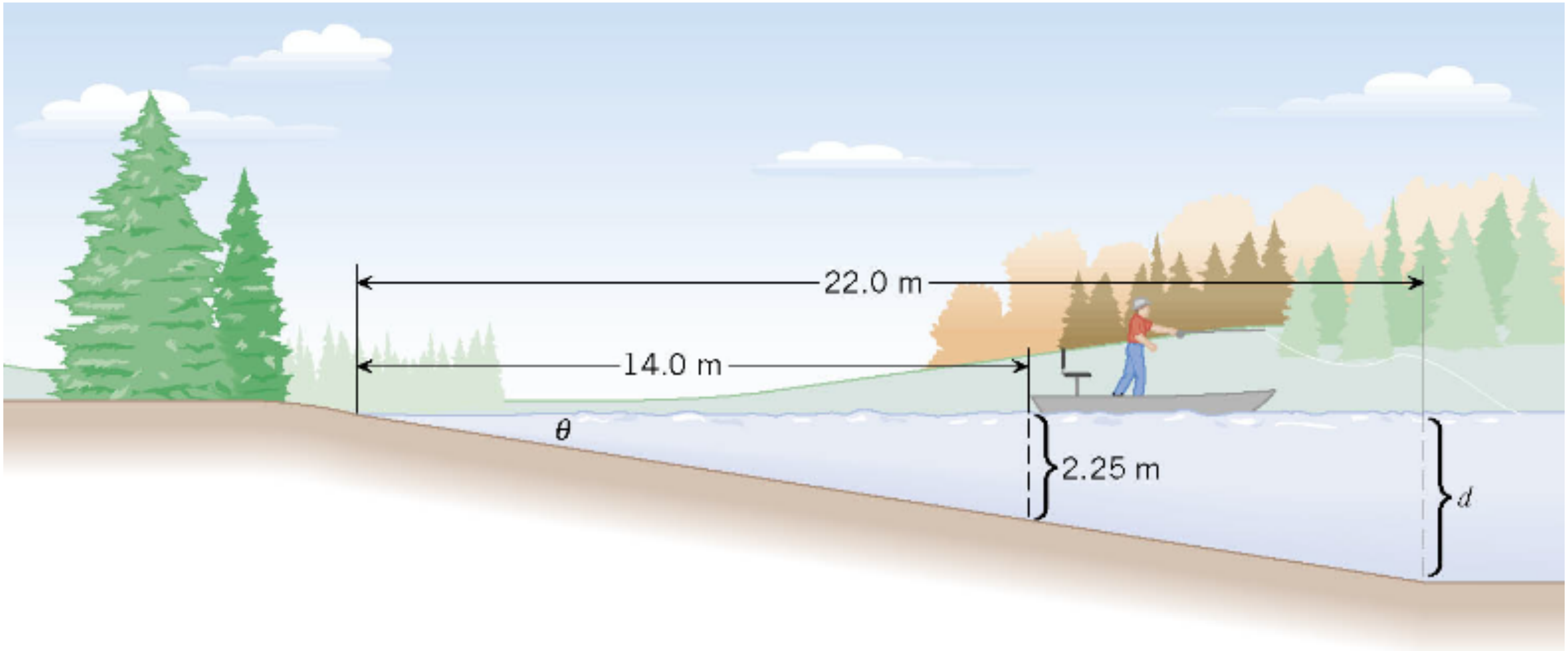


$$\theta = \sin^{-1}\left(\frac{h_o}{h}\right)$$

$$\theta = \cos^{-1}\left(\frac{h_a}{h}\right)$$

$$\theta = \tan^{-1}\left(\frac{h_o}{h_a}\right)$$

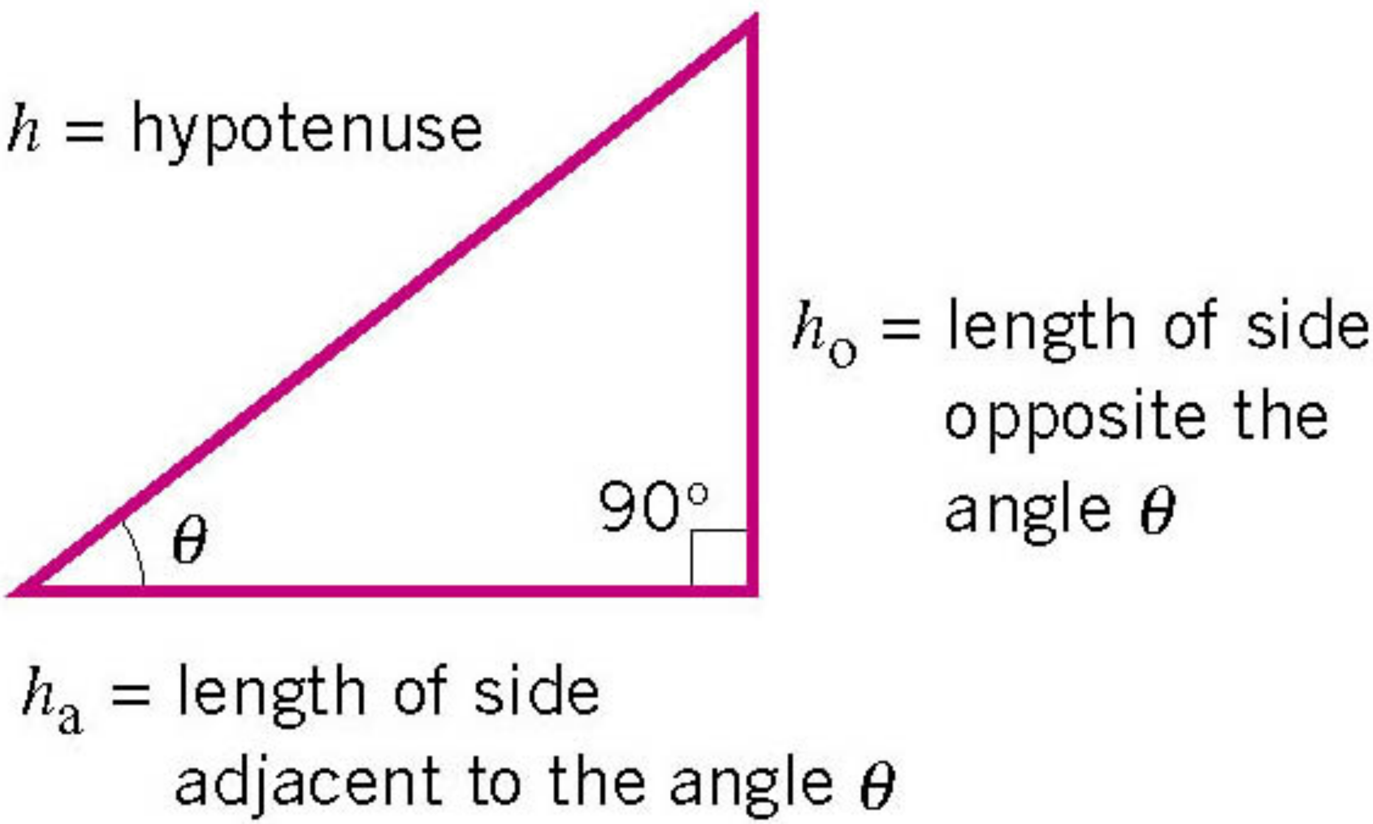
1.4 Trigonometry



$$\theta = \tan^{-1}\left(\frac{h_o}{h_a}\right) \qquad \theta = \tan^{-1}\left(\frac{2.25\text{m}}{14.0\text{m}}\right) = 9.13^\circ$$

1.4 Trigonometry

Pythagorean theorem: $$h^2 = h_o^2 + h_a^2$$



1.5 Scalars and Vectors

A *scalar* quantity is one that can be described by a single number:

speed, mass, temperature

(-10°C?)

A *vector* quantity deals inherently with both magnitude and direction:

velocity, force, displacement

1.5 Scalars and Vectors

Arrows are used to represent vectors. The direction of the arrow gives the direction of the vector.

By convention, the length of a vector arrow is proportional to the magnitude of the vector.