Objectives:

Students will know what math and algebra skills they will be expected to use in Physics

Students will have an opportunity to refresh their memory and practice these skills

Students will know which techniques they need to continue to practice and/or seek additional assistance outside of class

Announcements:

- Google classroom
- Math Quiz M/T of next week
- Books
- Readings

Critical Math Tools for Physics:

- Dimensional analysis (for conversions and checking work)
- Radians (for measuring angles)
- Trigonometric ratios (for calculations)
- Significant figures (in case you become a theoretical engineer) 
- Scientific notation (for really big or really small numbers)

Dimensional Analysis:

Convert 15 miles/hr^2 into m/s^2 ...

$$X \cdot 1 = X \qquad \frac{y}{y} = 1$$

$$\frac{15 \text{ miles}}{hr^2} \cdot \frac{1 \text{ hr}}{60 \text{ mins}} =$$

$$\frac{1 \text{ hour}}{60 \text{ mins}} = \frac{60 \text{ mins}}{60 \text{ mins}}$$

$$\frac{1 \text{ hr}}{60 \text{ mins}} = 1 \qquad \frac{1 \text{ min}}{60 \text{ s}} = 1$$

$$\frac{1 \text{ mile} \cdot \cancel{hr}}{4 \cancel{hr^2} \cdot \text{min}} \cdot \frac{1 \cancel{hr}}{60 \text{ mins}} = \frac{1 \text{ mile}}{240 \text{ min}^2} \cdot \frac{1 \text{ min}}{60 \text{ s}} \cdot \frac{1 \text{ min}}{60 \text{ s}} =$$

$$\frac{1 \cancel{\text{mile}}}{240 \cdot 60 \cdot 60 \text{ s}^2} \cdot \frac{1609 \text{ m}}{1 \cancel{\text{mile}}} =$$

$2.54 \text{ cm} = 1 \text{ in}$
$5280 \text{ ft} = 1 \text{ mile}$
$100 \text{ cm} = 1 \text{ m}$
$12'' = 1 \text{ ft}$

$$1609 \frac{\text{m}}{\text{mile}}$$

$$\frac{1609 \text{ m}}{240 \cdot 60 \cdot 60 \text{ s}^2} =$$

Convert 254 N/cm2 to lb/in2. [368 lb/in2]

1 inch = 2.54 cm

0.22 lb = 1 N

Radians:

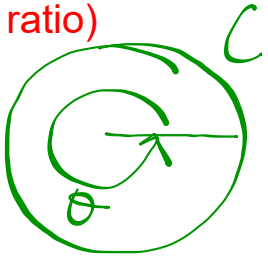
- Relate an angle (theta - θ) to the radius of a circle (r) and the segment length (s)

$$\theta = \frac{s}{r}$$

- One radian is ... (by the way, it's a unitless ratio)

$$\theta = \frac{s}{r} = 1$$

$$s = r$$



$$C = 2\pi \cdot r$$

$$s = C = 2\pi \cdot r$$

$$\theta = \frac{2\pi r}{r} \qquad \theta = 2\pi$$

$2 \cdot 3.14 \approx 6.28$ (circle)

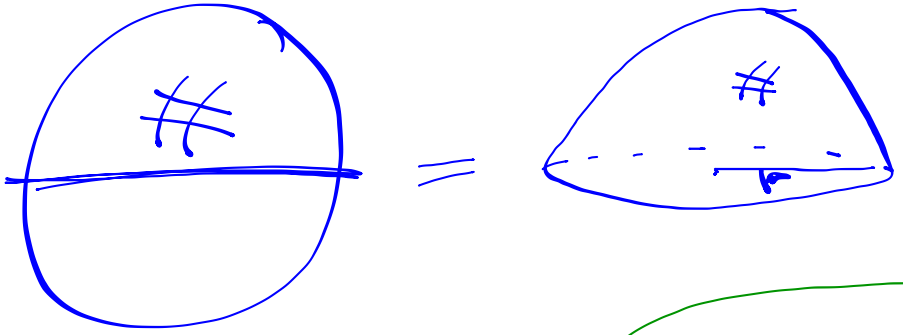
- Radians can be converted to degrees:

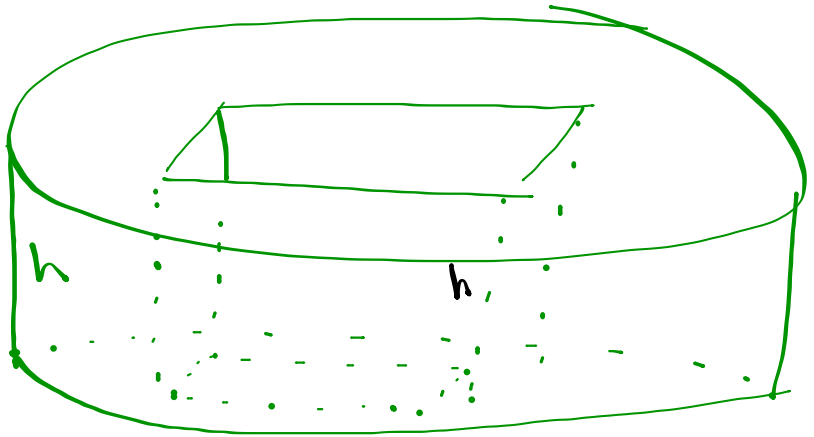
$$\text{circle} = 360^\circ = 2\pi \text{ radians}$$

$$1 \text{ rad} = \frac{360^\circ}{2\pi} = \frac{180^\circ}{\pi}$$

$$1^\circ = \frac{2\pi \text{ rad}}{360} = \frac{\pi}{180} \text{ rad}$$

12. Find the area and volume for a) half of a solid sphere of radius r, and b) for a disk of radius r and height h with a square hole of side s removed from its middle. Think of this as a donut with a square hole. [for a, area = $3\pi r^2$, volume = $2\pi r^3/3$]; [for b, area = $2(\pi r^2-s^2)+2\pi rh+4sh$; volume = $(\pi r^2-s^2)h$]



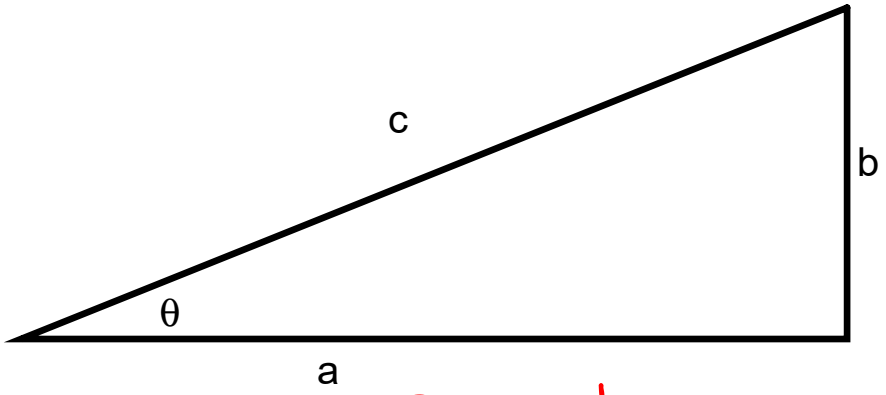


$2\pi r^2 - 2s^2$

$+ 2\pi r \cdot h + 4s \cdot h$

$\pi r^2 \cdot h - (s \cdot s \cdot h)$

Trig ratios:



$\sin\theta = \frac{o}{h} = \frac{b}{c}$

$\cos\theta = \frac{a}{h} = \frac{a}{c}$

$\tan\theta = \frac{o}{a} = \frac{b}{a}$

$\sin^{-1}\frac{o}{h} = \theta$

$\cos^{-1}\frac{a}{h} = \theta$

$\tan^{-1}\frac{o}{a} = \theta$

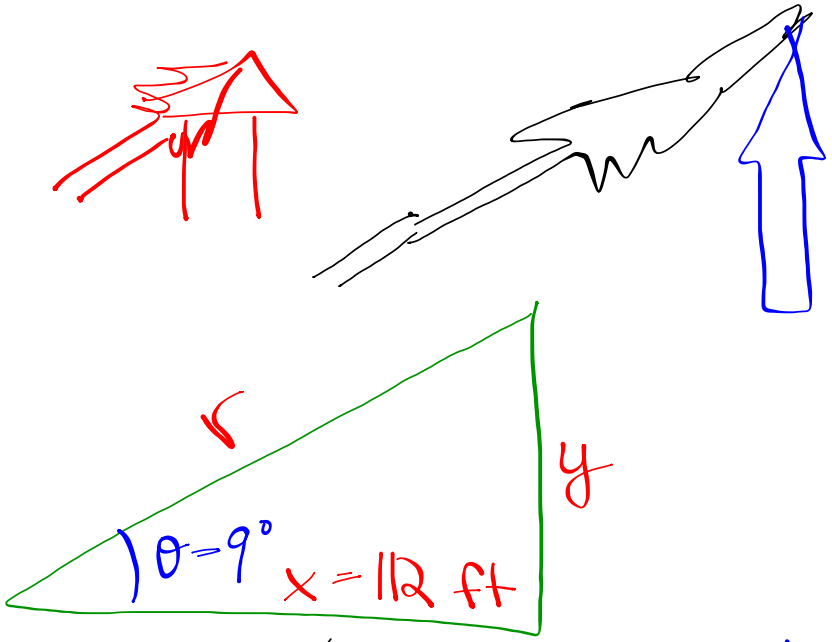
$\sin\theta = \frac{o}{h}$

$h\sin\theta = o$

15. To let in more sunlight, Tim Burr decides to cut down a tree near his house. Unfortunately, when he cuts his tree down, the top of the tree lands on his house. If the tree was located 112 feet away from his house, and the tree, as it rests on his house, now makes an angle of 9.00° with the ground,

a) How tall was the tree? [113 ft]

b) How tall is his house (now that the tree has landed on it)? [17.7 ft]



$\cos\theta = \frac{x}{r}$

$r = \frac{x}{\cos\theta} = \frac{112\text{ ft}}{\cos 9^\circ}$

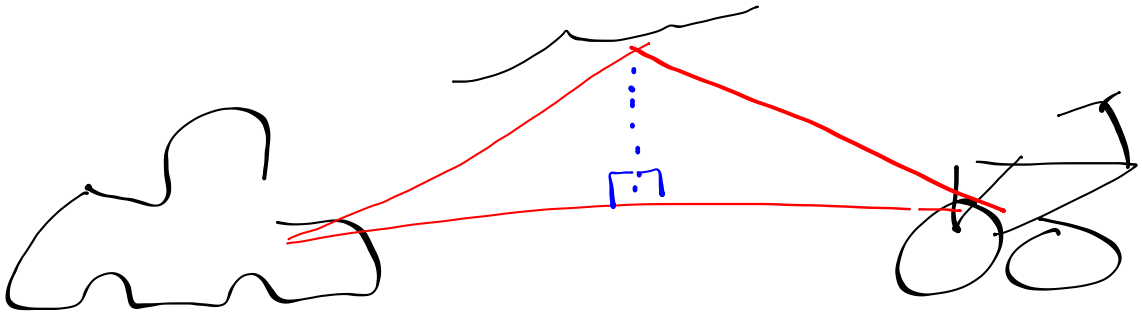
$r = 113.4\text{ ft}$

$\tan\theta = \frac{y}{x}$

$y = x\tan\theta$

$= 112\tan 9^\circ$

$= 17.7\text{ ft}$



Convert 11.2 (N x m^3)/sec^2 into (lb x ft^3)/min^2. [3.20 x 10^5 (lb x ft^3)/min^2]

$$\frac{11.2\ N \cdot m^3}{s^2} \Longrightarrow \frac{lb \cdot ft^3}{min^2}$$

$$\frac{0.22\ lb}{1\ N} \quad \frac{1\ m}{3.29\ ft} \quad \frac{60\ s}{1\ min}$$

Significant Figures:

- Show how precise a measurement or calculation is

- Don't count leading zeros, or zeros immediately following a decimal point

- Do count zeros that follow the last non-zero digit of a decimal number

- Sometimes count zeros before the decimal point ...

- Always count non-zero numbers

- Addition: Round answers to the same number of decimal digits as the number with the least number of decimal digits ...

- Multiplication: Round answers to the same number of significant figures as the number with the smallest number of significant figures ...

Scientific Notation:

- A decimal number, usually with a single digit to the left of the decimal point, multiplied by a factor of ten

- Convert by counting how far you move the decimal point

- Useful for very large or very small numbers

- Makes significant figures easier to determine ...

Scientific Notation Calculations:

- Addition: Convert each number so that it's the same power of ten, then add, and re-convert to simplify

- Multiplication / Division: Multiply or divide the "mantissas" and combine the powers of ten. Then convert to simplify.

$$\text{Speed} = \frac{\text{distance}}{\text{time}} \qquad S = \frac{d}{t}$$

$$\text{density} = \frac{\text{mass}}{\text{volume}} \qquad d = \frac{m}{v}$$

$$\text{linear density} = \frac{\text{mass}}{\text{length}}$$