Questions?

<u>Class Website</u>: community.wvu.edu/~miholcomb/phys101.html

You have a short lab this week, but no lab next week!

Lecture slides online <u>shortly before class</u> (& other stuff)

Make sure you have printed your name on the seating chart!

Meetings required before accommodations put in place.

Homework at <u>11:59pm</u> Mondays/Fridays via WebAssign/Cengage

Email

joshua.swinehart@cengage.com

if access problems or Q's (try a different browser/computer)

(10% bonus if correct before 9:59am)

Cengage has virtual office hours in case you are having issues:

Jan. 11 – Feb. 17

(every) Tuesday | Wednesday | Thursday

10 am -12 pm, Zoom:

https://cengage.zoom.us/j/97652162052

The WebAssign Homework

1. –/1 points

List one or more topics discussed in the most recent reading assignment that you do not understand.

This helps me fine tune our lecture

This answer has not been graded yet.

You have 10 submissions per question, or even question part.

2. –/7 points SerCP9 1.AE.007.

EXAMPLE 1.7 Stack One-Dollar Bills to the Moon

GOAL Estimate the number of stacked objects required to reach a given height.

PROBLEM How many one-dollar bills, stacked one on top of the other, would reach the Moon?

STRATEGY The distance to the Moon is about 400,000 km. Guess at the number of dollar bills in a millimeter, and multiply the distance by this number, after converting to consistent units.

This is a problem with an example. They won't always have examples.

SOLUTION

We estimate that ten stacked bills form a layer of 1 mm. Convert mm to km.

$$\frac{10 \text{ bills}}{1 \text{ mm}}\left(\frac{10^3 \text{ mm}}{1 \text{ m}}\right)\left(\frac{10^3 \text{ m}}{1 \text{ km}}\right) = \frac{10^7 \text{ bills}}{1 \text{ km}}$$

Multiply this value by the approximate

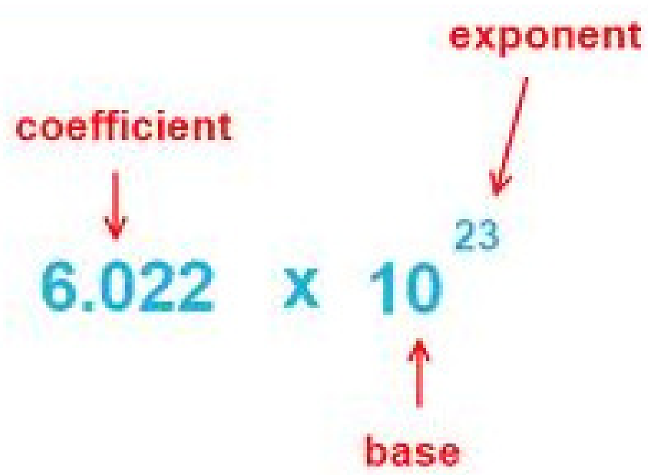
Main Ideas in Class Today

- Scientific Notation
- Units and Converting Units
- Estimating
- Significant Figures
- (later) Trigonometry (Ch.3 and on Test 1)
- Not polar coordinates or atoms/quarks

Practice Problems (Answers in back): 1.7, 1.9, 1.11, 1.15, 1.17, 1.19, 1.21, 1.23, 1.25, 1.27, 1.33, 1.35, Conceptual 1, 3, 5, & 11

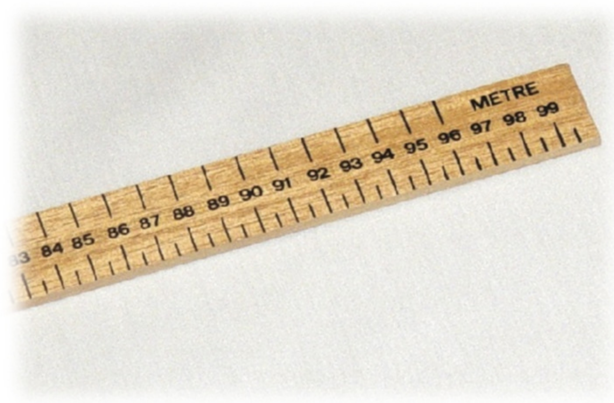
Scientific Notation

- Sometimes inconvenient to write a long number
- Example: 602,200,000,000,000,000,000,000
- Instead, write 6.022×10^{23} (scientific notation)
- Warning: to write this # in WebAssign or Google, you would write “6.022e+23” (or with all the zeros)
- For example, “0.000023” and “2.3e-5” are same in WebAssign (like EE in calculator, not e^x!)

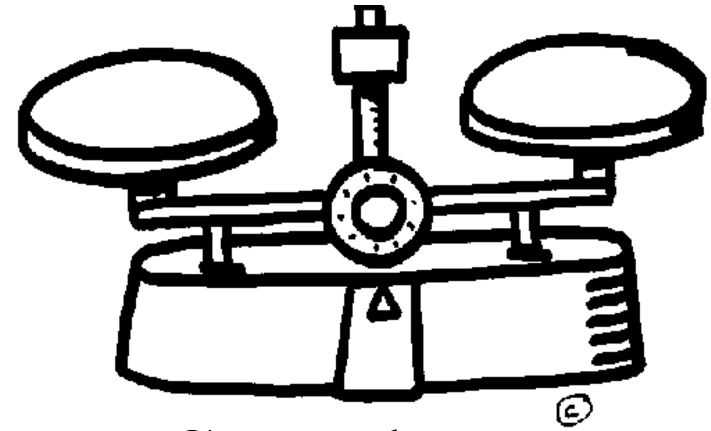


Coefficient should be between 1 and 9.9999

Exponent is direction and number of spots the decimal point is shifted



Units



- Basically everyone besides the U.S. and England uses the SI (Sisteme International) measuring system (AKA metric system)

Length: meters (m)
1 m = 3.28 ft

Scientific Notation: 2×10^{-9} m Big or Small?

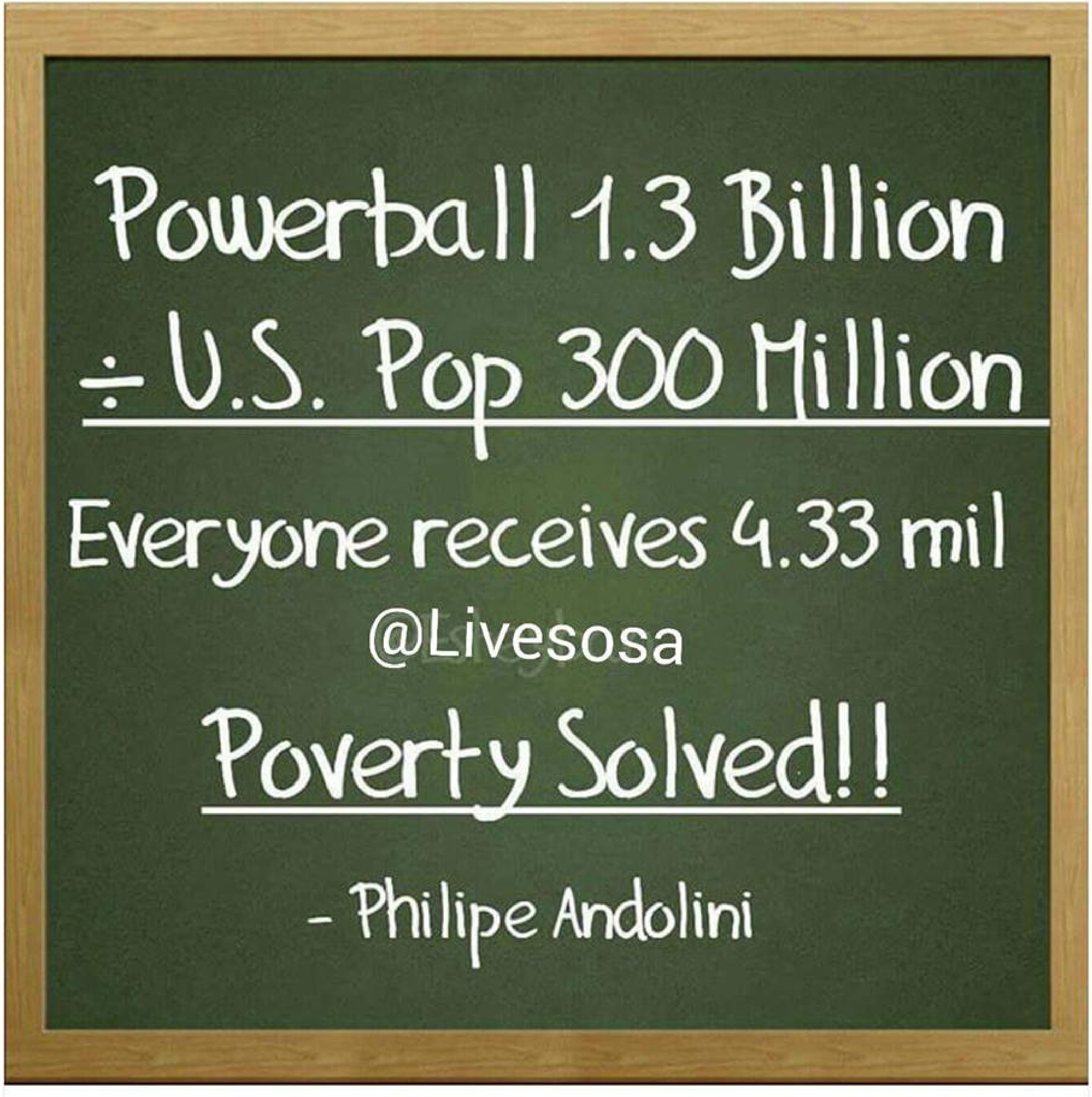
Mass: kilogram (kg)
1 kg = 2.2 lb

Time: seconds (s)
1 hr = 60 x 60 s
= 3600 s

Prefixes:
kilo(k) = 1000 or 10^3
centi(c) = 1/100 or 10^{-2}
milli(m) = 1/1000 or 10^{-3}
micro(µ) = 10^{-6}
nano(n) = 10^{-9}

Conversion examples: 100 cm = 1m ; 1000 mm = 1m; 1000 grams = 1 kg

Be Careful with Your Units!



Powerball
"Math"

People often struggle with large number math.

Conversion of units

- You might need to convert from familiar to standard units or vice versa
- Let's say we are driving our car at 28.0 m/s. Is this fast?

$$28.0 \text{ m/s} \times \frac{1.00 \text{ mi}}{1609 \text{ m}} = 0.0174 \text{ mi/s}$$

$$0.0174 \text{ mi/s} \times 60.0 \text{ s/min} \times 60.0 \text{ min/h}$$

$$= 62.6 \text{ mi/h}$$

Conversion of units

A student is going to study abroad during the summer and is looking for an apartment in Europe. She finds an ad for an apartment of 90 square meters. How many square feet is that? Is this a big apartment? (1 m = 3.28 ft)

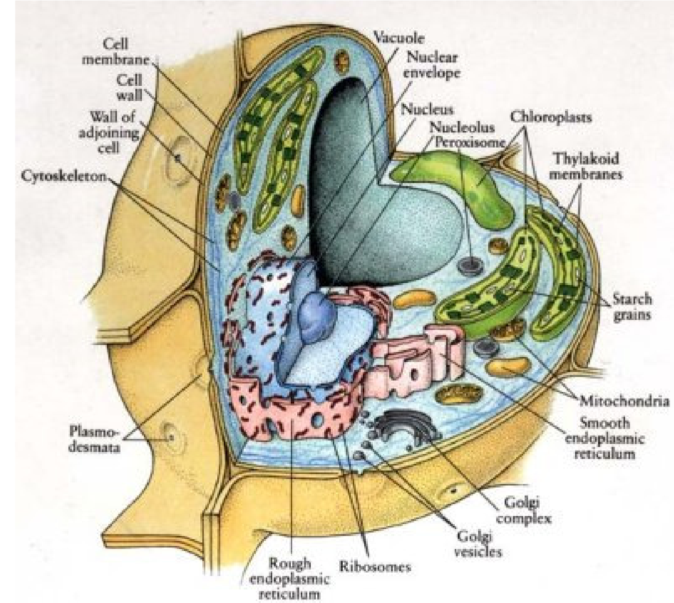
$$90 \text{ m}^2 \times \frac{3.28 \text{ ft}}{1 \text{ m}} \times \frac{3.28 \text{ ft}}{1 \text{ m}} = 968 \text{ ft}^2$$

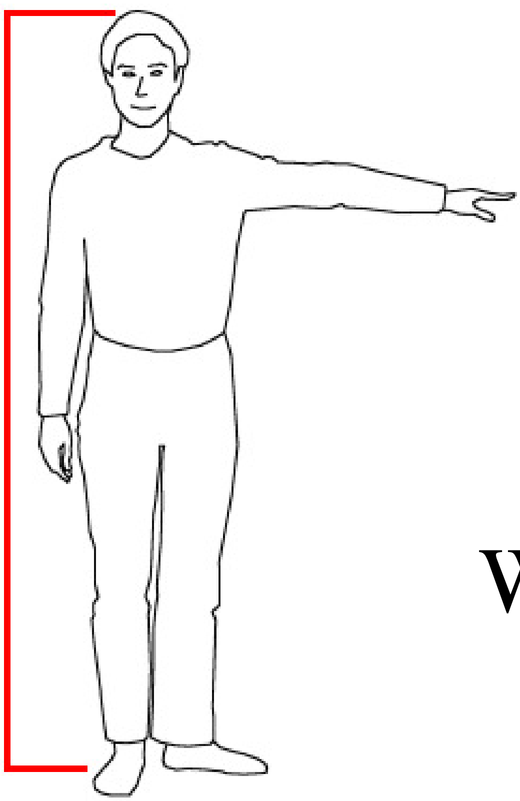
Order of Magnitude Calculations

- **Sometimes** an exact answer is not necessary. Within a factor of 10 might be fine.
- Used when you are told to "**estimate**"
  - Only concerned whether answer is more or less correct
  - For example, a typical square footage for an apartment
  - Estimate the cost to buy carpet for a room
  - Time to pay off student loans, or the carpet, or a guitar
  - Or how many gumballs fit in a jar (contests)?
  - Uncertainty in numbers used in calculation is large

Can make calculations easier. Examples…

Approximate Values in SI Units





Height of person

~ 2 m (6.5 feet)

Average weight of person

~ 80 kg (176 lbs.)

Would 100 kg be an incorrect **estimate**?

Average life of person

~ 2×10^9 s (2 billion) = 63.4 years

Can figure this out by converting

Size of a cell ~ 1×10^{-5} m or 10 μm

Significant Figures

- Measurements are not typically perfect
- Even if not estimating, there is some error (polls)
- Significant figures are used to indicate how confident you are in the number given

22 inches means accurate to 1 inch (mean could be 21 to 23 inches)

2 significant figures

22.0 inches means accurate to 0.1 inches (or 21.9 to 22.1 inches)

3 significant figures

Significant Figures in Scientific Notation

- All Significant Figures should always appear when a number is in scientific notation.
- Examples:

	Scientific Notation
1204.730	1.204730×10^3

How many significant figures are in this **number**?

1200	1.2×10^3, 1.20×10^3 or 1.200×10^3 (If needed, problem should state uncertainty)

Significant Figures:

To a physicist, SigFigs are of minor importance. It is more important to be able to estimate an answer.

- My tests and WebAssign will not test you on significant figures (3 or 4 will be fine).
- If use less, could have rounding error on WA
- Sum or subtraction: use accuracy of least accurate number (decimal position)
  - $120.031 + 11.3 = 131.3$
- Multiplication or division: use smallest number of significant digits.
  - $28.0 \times 21.3 = 596$
  - $28 \times 21.3 = 600$ or 6.0×10^2

The Importance of Recycling

Soft drinks are commonly sold in aluminum containers. **Estimate** how many such containers are thrown away or recycled each year by U.S. consumers?

In some states, you can get 5 cents per can. Estimate how much money would you get if you recycled all of the cans in the US for one year?

About how much would the average US citizen get?

Quick Summary of Dimensional Analysis

I won't test you on this, but it is useful

$$A + B = C$$

To add terms together, they must have the same units.

$$7\text{ m} + 10\text{ m} = 17\text{ m}$$

$$A \text{ x } B = C$$

Units on each side of the equation must be the same.

Length x Width = Area

$$7\text{ m x } 10\text{ m} = 70\text{ m}^2$$

Estimate the volume of your head.

Practice Conversions and Sig Figs

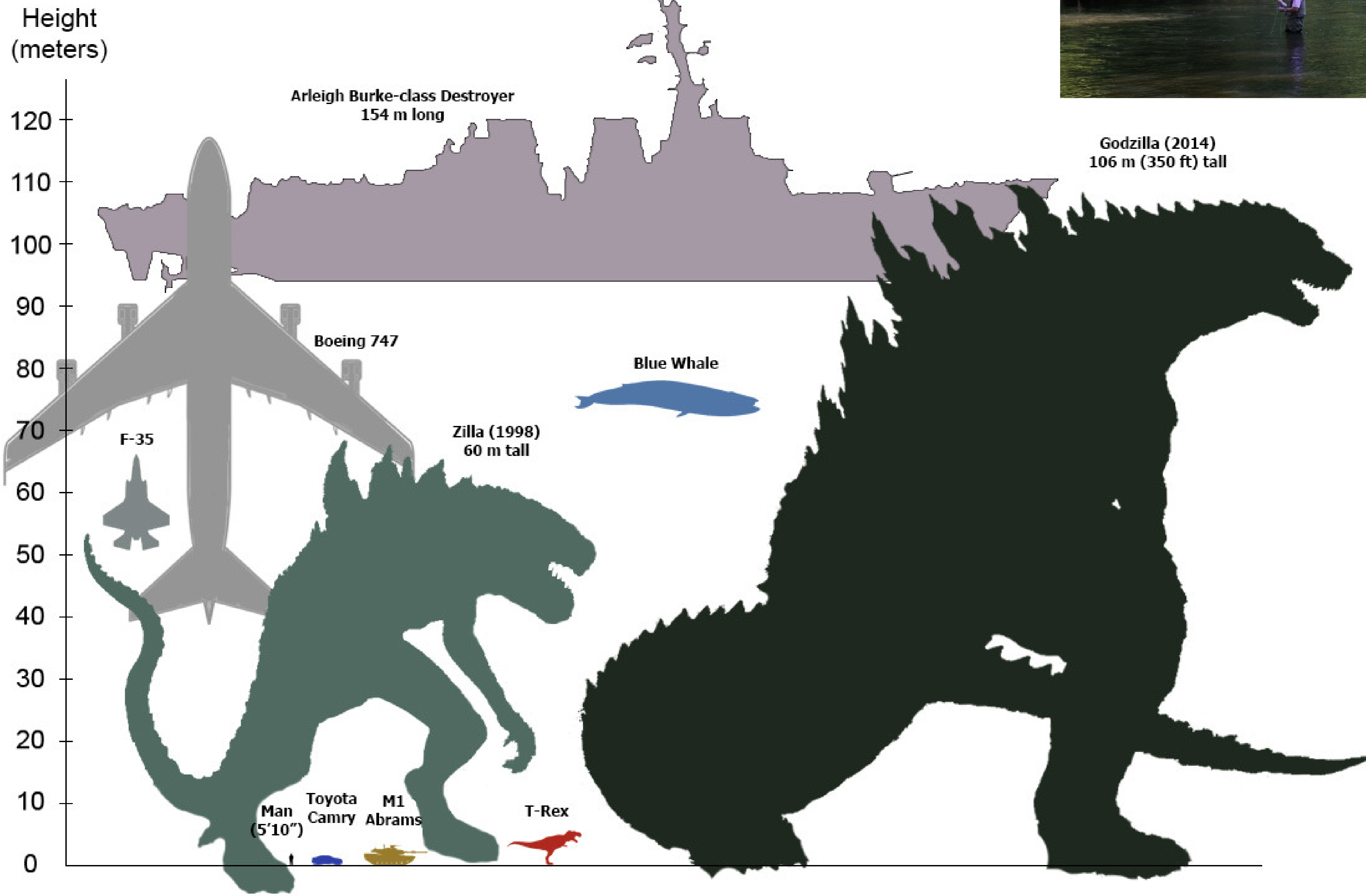
- A rectangular building lot measures 104 ft by 151 ft. Determine the area of this lot in square meters (m^2). Area = length x width
- Two possible strategies. Convert ft to meters of each dimension before multiplying or
- Find the answer in square feet and then convert to square meters

Estimate the height of Godzilla.

Picture of toy Godzilla

853 ft

Godzilla gets bigger with time



I always have extra slides

- You aren't required to look at them, but sometimes there are extra examples or ways to discuss the material. Some people like to look at them.