

20 JAN 11

- HW ✓ & Q&A with WARM-UP
- Significant figures, SI, orders of magnitude
- Converting units, conversion factors
- Demonstration
- Homework Assignment

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Warm-up

How many significant figures in each?

(a) $1,000,000$ 1
 1×10^6

(e) 12,345 5

(b) $1,000,001$ 7
 1.000001×10^6

(f) 123,450 5

(c) 0.0000001 1
 1×10^{-7}

1.2345×10^5

(d) 0.00000010 2
 1.0×10^{-7}

5. For an answer to be complete, the units need to be specified. Why?

YES! UNITS! UNITS! UNITS!

3.14 ... gallons?
meters?
years?
pounds?

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1. (I) The age of the universe is thought to be about 14 billion years. Assuming two significant figures, write this in powers of ten in (a) years, (b) seconds.

$$14 \text{ billion years} = 14,000,000,000 \text{ years}$$

$$1.4 \times 10^{10} \text{ years}$$

$$? \text{ seconds} = 1.4 \times 10^{10} \text{ yrs} \times \frac{365 \text{ d}}{1 \text{ yr}} \times \frac{24 \text{ h}}{1 \text{ d}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}}$$

$$= 4.415 \times 10^{17} \text{ s}$$

$$\text{to 2 sig figs: } 4.4 \times 10^{17} \text{ s}$$

2. (I) How many significant figures do each of the following numbers have: (a) 214, (b) 81.60, (c) 7.03, (d) 0.03, (e) 0.0086, (f) 3236, and (g) 8700?

(a) 3

(b) 4

(c) 3

(d) 1

(e) 2

(f) 4

(g) 2

$$8.700 \times 10^3$$

8700.

3. (I) Write the following numbers in powers of ten notation: (a) 1.156, (b) 21.8, (c) 0.0068, (d) 27.635, (e) 0.219, and (f) 444.

$$(a) 1.156 \times 10^0$$

$$(b) 2.18 \times 10^1$$

$$(c) 6.8 \times 10^{-3}$$

$$(d) 2.7635 \times 10^1$$

$$(e) 2.19 \times 10^{-1}$$

$$(f) 4.44 \times 10^2$$

4. (I) Write out the following numbers in full with the correct number of zeros: (a) 8.69×10^4 , (b) 9.1×10^3 , (c) 8.8×10^{-1} , (d) 4.76×10^2 , and (e) 3.62×10^{-5} .

$$(a) \underline{8.6900} \Rightarrow 86,900$$

$$(b) \underline{9.100} \Rightarrow 9,100$$

$$(c) \overset{\cdot}{8.8} \Rightarrow 0.88$$

$$(d) \underline{4.76} \Rightarrow 476$$

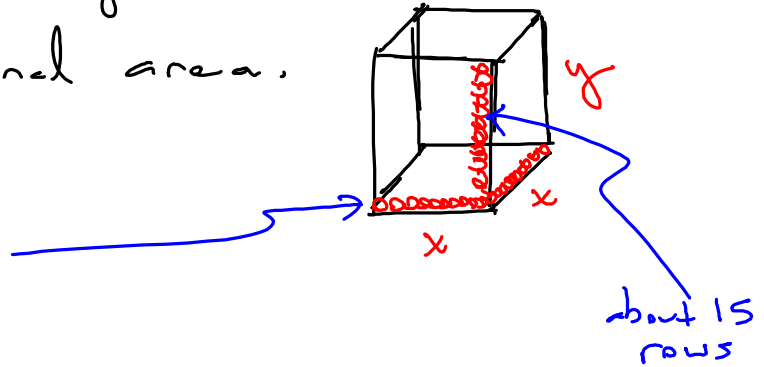
$$(e) \overset{\cdot}{00003.62} \Rightarrow 0.0000362$$

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41. Estimate the number of gumballs in the machine of Fig. 1-15.

assume it's a rectangular box with a square cross-sectional area.

approximate 10 in
the bottom row



$$\sqrt{\approx} 10 \times 10 \times 15 = \boxed{1,500 \text{ gumballs}}$$

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Significant figures

solve the equation for x :

$$x^2 = y \quad \text{for } y = 3.2$$

$$x^2 = 3.2 \Rightarrow x = \pm 1.788854382$$
$$\pm 1.789$$

\Rightarrow Will we strictly use sig figs?

⇒ UNITS! UNITS! UNITS!

Standard units will use:

TABLE 1-5 SI Base Quantities and Units

Quantity	Unit	Unit Abbreviation
Length	meter	m
Time	second	s
Mass	kilogram	kg
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

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DERIVED
UNITS?

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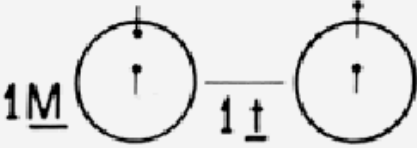
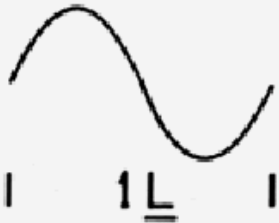
Where do we get units of:

⇒ LENGTH

⇒ TIME

⇒ MASS

*on Earth, 1 kg \approx 2.2 lbs

	
$1 \frac{42}{100} \times 10^9 \underline{t} = 1 \underline{s}$	$\frac{1}{21} \underline{L} = 1 \underline{cm}$
$86400 \underline{s} = 1 \underline{d}$	$1 \underline{L} = 21 \times 10^8 \underline{a}$
$365 \underline{d} = 1 \underline{y}$	$10^2 \underline{cm} = 1 \underline{m}$
$6 \times 10^{23} \underline{M} = 1 \underline{g}$	$1000 \underline{m} = 1 \underline{km}$
$1000 \underline{g} = 1 \underline{kg}$	
$6 \times 10^{27} \underline{g} = 1 \underline{e}$	

from the
VOYAGER
records

TABLE 1-4
Metric (SI) Prefixes

Prefix	Abbreviation	Value
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	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}
atto	a	10^{-18}
zepto	z	10^{-21}
yocto	y	10^{-24}

[†] μ is the Greek letter "mu."

1,000,000,000
1,000,000
1,000

1×10^7

meter, gram, second

$1/100$

$1/1000$

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Converting within metric

using the prefixes

$$328\text{cm} \times \frac{1\text{ m}}{100\cancel{\text{cm}}} = 3.28\text{m}$$

$$328\text{cm} \times \frac{\frac{1}{100}\text{ m}}{1\text{ cm}} = 3.28\text{ m}$$

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Fun example: Roughly how many seconds since your birth?

$$? s = 33 \cancel{\text{yr}} \times \frac{365 \cancel{\text{d}}}{1 \cancel{\text{yr}}} \times \frac{24 \cancel{\text{hr}}}{1 \cancel{\text{d}}} \times \frac{60 \cancel{\text{min}}}{1 \cancel{\text{hr}}} \times \frac{60 \text{ s}}{1 \cancel{\text{min}}}$$

$$1,040,688,000 \text{ s}$$

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Converting distances

(conversion factors)

$$1 \text{ in} = 2.54 \text{ cm}$$

$$1 \text{ mi} = 5,280 \text{ ft}$$

$$3 \text{ ft} = 1 \text{ yd}$$

$$? \text{ cm} = 2.8 \text{ yd} \times \frac{3 \text{ ft}}{1 \text{ yd}} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 256.032 \text{ cm}$$

$$? \text{ ft} = \frac{1 \text{ cm}}{2.54 \text{ cm}} \times \frac{1 \text{ in}}{12 \text{ in}} \times \frac{1 \text{ ft}}{1 \text{ ft}} = 0.0328 \text{ ft}$$

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Converting rates

$$? \frac{3}{5} = 80 \frac{\cancel{\text{km}}}{\cancel{\text{h}}} \times \frac{1000 \text{ (m)}}{1 \cancel{\text{km}}} \times \frac{1 \cancel{\text{h}}}{3600 \text{ (s)}} = \boxed{22.222 \frac{\text{m}}{\text{s}}}$$

$$? \frac{\text{m}}{\text{s}} = 25 \frac{\cancel{\text{mi}}}{\cancel{\text{h}}} \times \frac{1 \cancel{\text{h}}}{3600 \text{ s}} \times \frac{5280 \cancel{\text{ft}}}{1 \cancel{\text{mi}}} \times \frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}} \times \frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{in}}} \times \frac{1 \text{ m}}{100 \cancel{\text{cm}}}$$

$$= 11.176 \frac{\text{m}}{\text{s}}$$

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★ Homework Assignment ★

assign hw

Chapter 1

⇒ READ & TAKE NOTES ON SECTIONS 1-7 & 1-8

⇒ PROBLEMS: #'s 12, 13, 14, 15, 18, 22

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