

Calculator Practice



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Be Thankful Rome Fell,
Otherwise Your Calculator Might Be

607 + 108 = 715

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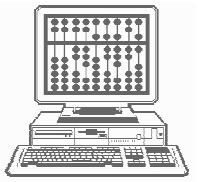
Calculators



Calculators are tools

You still must furnish the thinking
Establish units and sig figs
GI ➔ GO (Garbage In ➔ Garbage Out!)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Calculator Types

Basic	Scientific
simple arithmetic	exponents, logs, trig
	scientific notation
Graphing	
mathematical expressions	






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Two Types of Scientific Calculators:

Algebraic	Reverse Polish Notation (RPN)
Texas Instruments (TI)	Hewlett Packard (HP)
Standard algebra	Reverse Polish Notation
Simple strategy	More complex strategy
Intuitive for most	Requires time to master
Uses Brackets	Brackets Not Needed
Slows calculations	Extremely fast
Matching errors	No bracket errors
Uses = to display result	No = key; auto display


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Calculators

You should be able to do:

Arithmetic: +, -, x, /

Express as Scientific Notation
(both + and – exponents)

Need logarithms for higher level chemistry

Graphing calculators & cell phone not allowed for exams in CEM 101 (Keeps everyone on same page)

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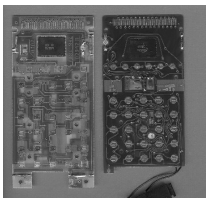
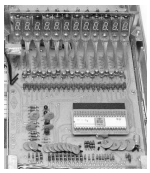
Scientific Notation Display





The calculator integrated circuit:
- **Different processes for coefficient & exponent**
- **Display combines results**

Scientific notation requires separate entry for: coefficient and exponent parts of a number

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Algebraic -Type Scientific Notation

Coefficient & Exponent entered in different modes

Keystrokes for 1.23×10^{99}

1.23 EE 99

E

EXP

SCI

10^x

^

NOT a Multiplication
1.23 x EE 99

Common Error

Your Calculator's Key for designating exponent entry
Informs calculator: keypad is now entering exponent
Some TI's have BOTH EE or 10^x and ^
Practice to ensure calculator displays desired input

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Algebraic -Type Scientific Notation

Coefficient & Exponent entered in different modes

Keystrokes for 7.895×10^{-34}

7.895 EE 34 Chs

E (-)

^ (+/-)

EXP

SCI

10^x

Key for exponent sign

Your Calculator's Key for designating exponent entry
Informs calculator: keypad is now entering exponent
Some TI's have BOTH EE or 10^x and ^
Practice to ensure calculator displays desired input

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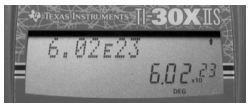
The "E" (for exponent)

Some calculators indicate the exponent with an e



This is 6.02×10^{23}

It is incorrect to report this as 6.02e23

e, in science, is symbol for the natural log
e has a value of ~ 2.71828
e^{23} is ~ 9.74×10^{9}

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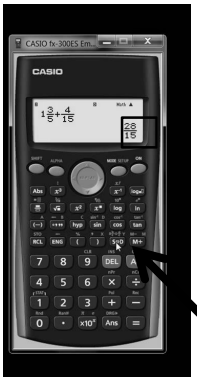
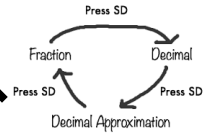
Casio 300 ES Display



Use S↔ D Key
(Toggles Mode)



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This Will Check For Correct Scientific Notation:

$$2.30 \times 10^{22} \text{ fu} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ fu}} \times \frac{110.98 \text{ g}}{\text{mole}} = 4.2401 \text{ g} \rightarrow 4.24 \text{ g}$$

If you get ****** E46**
You must use brackets for scientific notation calculations
(Mass of earth = 5.97×10^{27} g)

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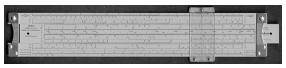
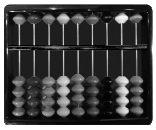
Use Your Calculator On the Problems That Follow


Calculator confidence on exams is a necessity
Practice with device you will use on exams



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Practice Using Only Exponents

$10^2 + 10^2 =$

$10^3 \times 10^5 =$

$10^5 \times 10^{-8} =$

$10^9 / 10^4 =$

$10^7 / 10^{-8} =$

$10^{-5} / 10^{-7} =$

$10^0 / 10^3 =$

$10^0 / 10^0 =$

$10^0 + 10^0 =$

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Practice Using Only Exponents

$10^2 + 10^2 = 2 \times 10^2$

$10^3 \times 10^5 = 10^8$

$10^5 \times 10^{-8} = 10^{-3}$

$10^9 / 10^4 = 10^5$

$10^7 / 10^{-8} = 10^{15}$

$10^{-5} / 10^{-7} = 10^2$

$10^0 / 10^3 = 10^{-3}$

$10^0 / 10^0 = 10^0$

$10^0 + 10^0 = 2$

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Complex Calculations

Algebraic calculators may require ( ) 's for multiple operations

Try these (without isolating individual steps) on YOUR calculator
You need to know when YOUR calculator requires brackets

$(15.90 \times 10^{-3}) / (4.470 \times 10^{-3}) =$

$(7.24 \times 10^{-2}) \times [(2.68 \times 10^{7}) / (25.6 \times 10^{-4})] =$

$[(125) / (4.20 \times 10^{-6})] \times [(458 \times 10^{-9}) (345) / 10.3] =$

$V_2 = \frac{(485 \text{ torr}) (14.7 \text{ L}) (273 \text{ K})}{(368 \text{ K}) (760 \text{ torr})} =$

% Water = $\frac{90.08}{(159.62 + 90.08)} \times 100 =$

Practice, Practice, Practice!

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Complex Calculations

Algebraic calculators may require ( ) 's for multiple operations

Try these (without isolating individual steps) on YOUR calculator
You need to know when YOUR calculator requires brackets

$(15.90 \times 10^{-3}) / (4.470 \times 10^{-3}) = 3.557$

$(7.24 \times 10^{-2}) \times [(2.68 \times 10^{7}) / (25.6 \times 10^{-4})] = 7.58 \times 10^{8}$

$[(125) / (4.20 \times 10^{-6})] \times [(458 \times 10^{-9}) (345) / 10.3] = 4.57 \times 10^{2}$

$V_2 = \frac{(485 \text{ torr}) (14.7 \text{ L}) (273 \text{ K})}{(368 \text{ K}) (760 \text{ torr})} = 6.95922 \text{ L} \rightarrow 6.96 \text{ L}$

% Water = $\frac{90.08}{(159.62 + 90.08)} \times 100 = 36.08\ \%$

Practice, Practice, Practice!

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Unit Arithmetic

Solve these with your calculator
Indicate which problems cannot be manually done as written

1. **15.3×10^{-7} m + 9.7×10^{-7} m =**
2. **$(4.86 \times 10^{10}$ mm) x $(7.20 \times 10^{6}$ mm) =**
3. **$(6.49 \times 10^{-3}$ cm^3) / $(1.56 \times 10^{-4}$ cm^2) =**
4. **2.330×10^{4} L + 6.180×10^{3} L =**
5. **$(15.90 \times 10^{-3}$ g) / $(4.470 \times 10^{-3}$ mL) =**
6. **2.14×10^{1} g/mL) x $(5.00 \times 10^{1}$ mL) =**
7. **5.22×10^{-3} g - 2.18×10^{-3} g =**
8. **9.7800×10^{4} km - 6.9100×10^{2} km =**

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Unit Arithmetic

Manually: for + or – , the exponents & units must be equal
With calculator: just enter the numbers and calculate

1. 15.3×10^{-7} m + 9.7×10^{-7} m = 2.5×10^{-6} m or 25×10^{-7} m
2. $(4.86 \times 10^{10}$ mm) x $(7.20 \times 10^{6}$ mm) = 3.50×10^{17} mm^2
3. $(6.49 \times 10^{-3}$ cm^3) / $(1.56 \times 10^{-4}$ cm^2) = 4.16×10^{1} cm
4. 2.330×10^{4} L + 6.180×10^{3} L = 2.948×10^{4} L
5. $(15.90 \times 10^{-3}$ g) / $(4.470 \times 10^{-3}$ mL) = 3.557×10^{0} g/mL
6. 2.14×10^{1} g/mL) x $(5.00 \times 10^{1}$ mL) = 1.07×10^{3} g
7. 5.22×10^{-3} g - 2.18×10^{-3} g = 3.04×10^{-3} g
8. 9.7800×10^{4} km - 6.9100×10^{2} km = 9.7109×10^{4} km

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Unit Conversions

Key

Write final desired unit to the right of the =
Write what units you know on the far left of the =
Is unit on the left of the = the same as the unit on the right?
- **Yes, you are done … calculate result**
- **No, make it go away ("cancel units") with the next term**
- **Continue "canceling" until units on left = units on right**

Write all conversions as linear "string" of fractions

Do not calculate anything until units agree!

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Unit Conversions

Convert 19.4×10^{-4} kilograms to grams

Problem: ? g
Given: 19.4×10^{-4} kilograms
We know: 1000 g = 1 kg

Put known units on the left; desired units on right

19.4×10^{-4} kg = ? g

Add conversions to cancel units

$$19.4 \times 10^{-4} \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} = ? \text{ g}$$

Do the math

$$19.4 \times 10^{-4} \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} = 1.94 \text{ g}$$

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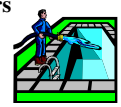
Unit Conversions

A pool contains 5.0×10^7 L of water.
Convert this number of Liters to milliliters



Problem: ? mL
Given: 5.0×10^7 L
We know: 1000 mL = 1 L

Put known units on the left; desired units on right

5.0×10^7 L = ? mL

Add conversions to cancel units

$$5.0 \times 10^7 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} = ? \text{ mL}$$

Do the math

$$5.0 \times 10^7 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 5.0 \times 10^{10} \text{ mL}$$

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Unit Conversions

The human eye is most sensitive to light with a wavelength of 5.55×10^{-9} m. What is this wavelength in millimeters?

Problem: ? mm
Given: 5.55×10^{-9} m
We know: 1000 mm = 1 m

Put known units on the left; desired units on right

5.55×10^{-9} m = ? mm

Add conversions to cancel units

$$5.55 \times 10^{-9} \text{ m} \times \frac{1000 \text{ mm}}{1 \text{ m}} = ? \text{ mm}$$

Do the math

$$5.55 \times 10^{-9} \text{ m} \times \frac{1000 \text{ mm}}{1 \text{ m}} = 5.55 \times 10^{-6} \text{ mm}$$

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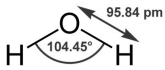
Unit Conversions

The length of the O-H bond in water is 9.6×10^{-11} m. What is the distance in cm?



Problem: ? cm
Given: 9.6×10^{-11} m
We know: 100 cm = 1 m

Put known units on the left; desired units on right

9.6×10^{-11} m = ? cm

Add conversions to cancel units

$$9.6 \times 10^{-11} \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} = ? \text{ cm}$$

Do the math

$$9.6 \times 10^{-11} \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} = 9.6 \times 10^{-9} \text{ cm}$$

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Unit Conversions

The distance from the earth to the sun is 1.5×10^8 kilometers. Calculate this number as millimeters

Problem: ? mm
Given: Distance is 1.5×10^8 kilometers
We know: 1000 mm = 1 m; 1000 m = 1 km

Put known units on the left; desired units on right

$$1.5 \times 10^8 \text{ km} = ? \text{ mm}$$

Add conversions ("per" expression) to cancel units

$$1.5 \times 10^8 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1000 \text{ mm}}{1 \text{ m}} = ? \text{ mm}$$

Do the math

$$1.5 \times 10^8 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1000 \text{ mm}}{1 \text{ m}} = 1.5 \times 10^{14} \text{ mm}$$

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Unit Conversions

Calculate the number of ounces in 1.60×10^4 tons of coal.

Problem: ? oz
Given: 1.60×10^4 tons
We know: 16 oz = 1 lb; 2000 lb = 1 ton

Put known units on the left; desired units on right

$$1.60 \times 10^4 \text{ tons} = ? \text{ oz}$$

Add conversions to cancel units

$$1.60 \times 10^4 \text{ ton} \times \frac{2000 \text{ lbs}}{1 \text{ ton}} \times \frac{16 \text{ oz}}{1 \text{ lbs}} = ? \text{ oz}$$

Do the math

$$1.60 \times 10^4 \text{ ton} \times \frac{2000 \text{ lbs}}{1 \text{ ton}} \times \frac{16 \text{ oz}}{1 \text{ lbs}} = 5.12 \times 10^8 \text{ oz}$$

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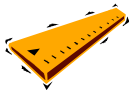
Unit Conversions

Determine the number of centimeters in 8.6×10^{-9} km.



Problem: ? cm
Given: 8.6×10^{-9} km
We know: 100 cm = 1 m; 1000 m = 1 km

Put known units on the left; desired units on right

$$8.6 \times 10^{-9} \text{ km} = ? \text{ cm}$$

Add conversions to cancel units

$$8.6 \times 10^{-9} \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} = ? \text{ cm}$$

Do the math

$$8.6 \times 10^{-9} \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} = 8.6 \times 10^{-4} \text{ cm}$$

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Unit Conversions

Convert 3.59×10^{-2} kg to mg.

Problem: ? mg
Given: 3.59×10^{-2} kg
We know: 1000 mg = 1 g: 1000 g = 1 kg

Put known units on the left; desired units on right
3.59×10^{-2} kg = ? mg

Add conversions to cancel units

$$3.59 \times 10^{-2}\ \text{kg} \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \frac{1000\ \text{mg}}{1\ \text{g}} = ?\ \text{mg}$$

Do the math

$$3.59 \times 10^{-2}\ \text{kg} \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \frac{1000\ \text{mg}}{1\ \text{g}} = 3.59 \times 10^{4}\ \text{mg}$$

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Practical Problem

If a football running back runs the 40.0 yard dash in 4.40 seconds, what is this speed in miles / hour?

$$\frac{40.0\ \text{yd}}{4.40\ \text{sec}} \times \frac{3\ \text{ft}}{1\ \text{yd}} \times \frac{1\ \text{mile}}{5280\ \text{ft}} \times \frac{60\ \text{sec}}{1\ \text{min}} \times \frac{60\ \text{min}}{1\ \text{hr}} = 18.6\ \text{mi/hr}$$

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Practical Problem

The US population is ~3.4×10^{8} people. Virologists suggest that 80% of the population needs to be vaccinated to provide reasonable "herd immunity." How many people need to be vaccinated per day to reach this level of protection in 6 months (180 days)?

$$3.4 \times 10^{8}\ \text{people} \times 0.80 \times \frac{1}{180\ \text{days}} = 1.5 \times 10^{6}\ \text{people / day}$$

Let the units drive the solution

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Practical Problem

The US population is ~3.4 x 10^8 people. Virologists suggest that 80% of the population needs to be vaccinated to provide reasonable "herd immunity." The initial vaccination rate was ~ 4 million doses per month. At this rate, how long will it take to reach "herd immunity?"

$$3.4 \times 10^8 \text{ doses} \times 0.80 \times \frac{1 \text{ month}}{4 \times 10^6 \text{ doses}} = 68 \text{ months} \quad (5.6 \text{ years})$$

Let the units drive the solution

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Practical Problem

Chicago uses 1.2 x 10^9 gallons of water /day. How many gallons per second must be pumped from the lake every second to supply the city?

$$1.2 \times 10^9 \frac{\text{gal}}{\text{day}} \times \frac{1 \text{ day}}{24 \text{ hours}} \times \frac{1 \text{ hour}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 1.4 \times 10^4 \frac{\text{gal}}{\text{sec}}$$

Lake Michigan holds 1.3 x 10^{15} gallons of water. If just Chicago removed water from the lake and it never rained again, how many days would the water last?

$$1.3 \times 10^{15} \text{ gal} \times \frac{1 \text{ sec}}{1.4 \times 10^4 \text{ gal}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times \frac{\text{hours}}{60 \text{ min}} \times \frac{1 \text{ day}}{24 \text{ hours}} = 1.1 \times 10^6 \text{ days}$$

$$1.1 \times 10^6 \text{ days} \times \frac{1 \text{ year}}{365.25 \text{ days}} = 2.9 \times 10^3 \text{ years}$$

Let the units drive the solution

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Static Electricity is ~ 10, 000 volts per inch.

The longest documented lightning strike is 441miles.
What voltage is associated with this lightning strike?

$$441 \text{ miles} \times \frac{5{,}280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{10{,}000 \text{ volts}}{1 \text{ in}} = 2.79 \times 10^{11} \text{ volts}$$

This is 279 billion volts!

This lightning strike covered the 441 miles in 16.4 seconds.
What is the lightning speed in miles / hour?

$$\frac{441 \text{ miles}}{16.4 \text{ sec}} \times \frac{60 \text{ sec}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 9.68 \times 10^4 \text{ mph}$$

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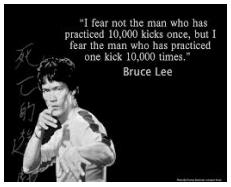
Practice, Practice, Practice

NASA Says
Perfect Practice Prevents Poor Performance
Practice, Practice, Practice
Unit Practice Problems & Unit Practice Quizzes



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