

HEWLETT-PACKARD

HP-45

**Quick
Reference
Guide**

Table of Contents

Dynamic Range	2
Power Switch	2
Low Battery Condition	2
Blinking Display	2
Keying Numbers	2
Display and Rounding Controls	3
Working Storage Registers	3
Operational Controls and Data Manipulation ..	3
Data Storage Registers	4
Restrictions and Clearing	4
Storage Register Controls	5
Storing	5
Recalling	5
Register Arithmetic	5
Store Arithmetic	5
Recall Arithmetic	6
Preprogrammed Constants	6
General-purpose	6
Metric/U.S. Unit Conversion	7
Monadic Functions and Options	7
General-purpose	7
Reciprocal	7
Factorial	7
Squaring	7
Square Root	7
Logarithms	8
Trigonometric	8
Dyadic Functions and Options	9
Arithmetic	9
Exponential	10
Percentage	10
Polar/Rectangular Coordinate Conversion ...	11
Interactive Functions	12
Increment Summation	12
Decrement Summation	12
Recall Two-dimensional Summation	13
Mean and Standard Deviation	13
Improper Operations	14
Common Equivalents and Conversions	15
Recommended Values of Physical Constants ..	17
Index	19

Dynamic Range

10^{-99} – 10^{99}

Power Switch


OFF  ON

0.00 appears on display when calculator is turned on.




Low Battery Condition


All decimal points light; 2–5 minutes operating time remain. **Plug into charger.**




Blinking Display

Improper operation such as dividing by zero; **press**  .

Keying Numbers

 , . . . ,   Number keys including decimal point; **press** in left-to-right order.

 **Enter exponent:** **press** after keying mantissa. Mantissa is automatically set to 1 if no value is keyed in.

 Change sign: gives opposite sign to displayed value. Affects sign of exponent if pressed after  . **Press**  after keying number.

Display and Rounding Controls

FIX n Selects number of decimal places (n) in **fixed decimal** display mode. n is any number key (0-9). Overflows to scientific notation; underflows to zero.

SCI n Selects number of decimal places (n) in **scientific notation** display mode. n is any number key (0-9).











Working Storage Registers

Consists of a 4-register operational stack. The register is indicated by capital letters; the contents by small letters.

Register Name	Contents
T (top)	t
Z	z
Y	y
X (bottom) — always displayed	x

Operational Controls and Data Manipulation

ENTER ↑ Copies **x** into **Y** (raises stack). Next entry overwrites display. Press **ENTER** ↑ to load **y**-value (first value) in dyadic functions (See *Dyadic Functions and Options*).

-  **Gold key: press** to access alternate functions indicated by .
-   CLEAR **Clears** stack and data storage registers R_5 – R_8 .
-  CLX **Clears X**-register (display) only.
-  $x \leftrightarrow y$ **Exchanges** contents of **X** (display) and **Y**-registers, respectively.
-  $R \downarrow$ **Rolls down** and **displays** contents of working storage registers in last-in, first-out order. Returns to original position with every fourth  $R \downarrow$ operation.
-   LAST x **Recalls** (from Last x register) and **displays** last x -argument. Use for error recovery or when performing multiple functions using same argument.

Data Storage Registers

Consists of 9 registers indicated by R_n ; the contents are indicated by r_n ; n is the register number (1–9).

Restrictions and Clearing

Registers: R_1 – R_4 Unrestricted storage.
Contents: r_1 – r_4 To clear, store new value or turn calculator off, then on.


Registers: R_5 – R_8 Restricted storage when
Contents: r_5 – r_8 performing summations
 (Σ^-). **Clear before using;**
press   .

Register: R_9 Restricted storage when
Contents: r_9 performing trigonometric
 functions.


Contents cleared when
 trigonometric functions (black
 keys) are pressed.

Storage Register Controls

Storing:



 n **Stores** displayed value (x) in R_n .
 ($n = 1, 2, \dots, 9$.)



Recalling:

 n **Recalls** stored value (r_n) from R_n
 and displays copy in **X**-register.
 ($n = 1, 2, \dots, 9$.)

Register Arithmetic

Store Arithmetic:

  n **Adds** displayed value (x) to r_n ;
 stores result in R_n ($n = 1, 2, \dots,$
 9). Display is unchanged.

  n **Subtracts** displayed value (x)
 from r_n ; stores result in R_n ($n =$
 1, 2, . . . , 9). Display is un-
 changed.

STO **×** n **Multiplies** r_n by displayed value (**x**); stores result in R_n ($n = 1, 2, \dots, 9$). Display is unchanged.

STO **÷** n **Divides** r_n by displayed value (**x**); stores result in R_n ($n = 1, 2, \dots, 9$). Display is unchanged.

Recall Arithmetic:

RCL **+** n **Adds** r_n to displayed value (**x**); displays result in **X**. R_n is unchanged. ($n = 1, 2, \dots, 9$.)





RCL **-** n **Subtracts** r_n from displayed value (**x**); displays result in **X**. R_n is unchanged. ($n = 1, 2, \dots, 9$.)



RCL **×** n **Multiplies** displayed value (**x**) by r_n ; displays result in **X**. R_n is unchanged. ($n = 1, 2, \dots, 9$.)

RCL **÷** n **Divides** displayed value (**x**) by r_n ; displays result in **X**. R_n is unchanged. ($n = 1, 2, \dots, 9$.)




Preprogrammed Constants




General-purpose




  **Pi** (3.14 . . .). Press   as needed in calculation (constant is displayed) followed by operation/function.




  **e** (2.718 . . .). (See *Logarithms*.)




Metric/U.S. Unit Conversion




   Converts displayed value ($x =$ inches) **to centimeters.**

   Converts displayed value ($x =$ centimeters) **to inches.**

   Converts displayed value ($x =$ pounds) **to kilograms.**

   Converts displayed value ($x =$ kilograms) **to pounds.**


   Converts displayed value ($x =$ gallons) **to liters.**



   Converts displayed value ($x =$ liters) **to U.S. gallons.**


Monadic Functions and Options



Monadic functions are operations performed on a single value—the value displayed (x). The stack is raised by next entry into X following monadic functions.

General-purpose

 Calculates **reciprocal** of x .


  Calculates **factorial** of x .



 Calculates **square** of x .



  Calculates **square root** of x .

Logarithms

 Calculates **natural log** (\log_e) of **x**.

 Calculates **natural antilog** (antilog_e) of **x**.



  Calculates **common log** (\log_{10}) of **x**.



  Calculates **common antilog** (antilog_{10}) of **x**.



Trigonometric


Note 1. R_0 is cleared by trig functions.



Note 2. Decimal angles are assumed.


  Selects **decimal degrees mode** prior to calculation. Defaults to decimal degrees mode when calculator is turned off.



  Selects **radians mode** prior to calculation.

  Selects **grads mode** prior to calculation.

 Calculates **sine** of **x**.

  Calculates **arc sine** of **x**.

 Calculates **cosine** of **x**.

  Calculates **arc cosine** of **x**.

TAN

Calculates **tangent** of x .TAN⁻¹Calculates **arc tangent** of x .

→ D.MS

Converts decimal angle (any mode) **to degrees-minutes-seconds** in format dd.mmss.

D.MS →

Converts angle expressed in degrees-minutes-seconds **to decimal** angle in specified mode.

Note 3. Modes are operative until changed or calculator is turned off. Mode is decimal degrees when turned on.

Dyadic Functions and Options

Dyadic functions are operations performed on two arguments (x and y). These functions require that one of the arguments resides in the **Y**-register, which can be accomplished, for example, by an **ENTER ↑** operation after keying the first argument.

Arithmetic

+


Adds x and y ; result displayed in **X**. Stack drops.

-



Subtracts x from y ; result displayed in **X**. Stack drops.




×

Multiplies y by x ; result displayed in **X**. Stack drops.


 **Divides y by x** ; result displayed in **X**. Stack drops.

Exponential



  Raises **y** to **power** of **x** ; result displayed in **X**. Stack drops.



   Raises **y** to power of reciprocal (**x**) to **extract roots**. Stack drops.



Percentage

 Calculates **$x\%$** of **y** (base); result (**percentage**) displayed in **X**. Stack doesn't drop. Formulas used:

$$\frac{x \cdot y}{100} \rightarrow \mathbf{X}; y \rightarrow \mathbf{Y}$$

  Calculates net amount of **base (y) + percentage (x)**. Result displayed in **X**.

  Calculates net amount of **base (y) — percentage (x)**. Result displayed in **X**.

  Calculates **percent difference** between **y** and **x** ; result displayed in **X**. Stack doesn't drop. Formulas used:


$$100 \cdot \frac{x - y}{y} \rightarrow \mathbf{X}; y \rightarrow \mathbf{Y}$$


Polar/Rectangular Coordinate Conversion

Note 1. Any trig angular mode may be specified.

Note 2. Contents of R_0 are cleared by conversion functions which utilize trig functions.



Note 3. Polar/rectangular conversions require two arguments—one of which must reside in the **Y**-register. (See *Dyadic Functions and Options*.)


 **P** Converts y-coordinate (**y**) and x-coordinate (**x**) to **polar** form. Magnitude r displayed in **X**.

 Displays angle θ . Formulas used:

$$\sqrt{\mathbf{x}^2 + \mathbf{y}^2} \rightarrow \mathbf{X}$$

$$\tan^{-1} \frac{\mathbf{y}}{\mathbf{x}} \rightarrow \mathbf{Y}$$



  **R** Converts magnitude r (**x**) and angle θ (**y**) to **rectangular** form. Displays x-coordinate in **X**.

 Displays y-coordinate. Formulas used:




$$\mathbf{x} \cos \mathbf{y} \rightarrow \mathbf{X}$$



$$\mathbf{x} \sin \mathbf{y} \rightarrow \mathbf{Y}$$



Interactive Functions



Interactive functions (Σ^+ , Σ^-) use R_5 – R_8 which must be cleared with   before starting a calculation. Interactive functions may involve one or two variables. In the case of two variables, **y**-values must be entered for each **x**-entry, even if the **y**-value is zero.

Increment Summation

 **Sums** number of **x**-entries in R_5 and **displays** in **X**. (If **X** has been altered **press**   to display.)

Sums x^2 in R_6 . (**Press**   to display.)

Sums **x** in R_7 . (**Press**   to display.)

Sums **y** in R_8 . (**Press**   to display.)

Formulas used:





$$r_5 + 1 \rightarrow R_5 \rightarrow \mathbf{X}$$

$$r_6 + \mathbf{x}^2 \rightarrow R_6$$



$$r_7 + \mathbf{x} \rightarrow R_7$$



$$r_8 + \mathbf{y} \rightarrow R_8$$



Decrement Summation

  **Deletes** **x**-entry number from **X** and R_5 . (If **X** has been altered **press**   to display.)

Decrement Summation (contd.)

Deletes x^2 from R_6 . (Press
  **to display.)**

Deletes x from R_7 . (Press
  **to display.)**

Deletes y from R_8 . (Press
  **to display.)**

Formulas used:



$$r_5 - 1 \rightarrow R_5 \rightarrow \mathbf{X}$$




$$r_6 - \mathbf{x}^2 \rightarrow R_6$$

$$r_7 - \mathbf{x} \rightarrow R_7$$






$$r_8 - \mathbf{y} \rightarrow R_8$$

Recall Two-dimensional Summation

  **Recalls and displays copy of R_7**
 (sum of x -values); recalls copy
 of R_8 (sum of y -values) to
Y-register.

To **display R_8** , press  . If
 converting values to polar form
 () be sure to **press** 
 again before proceeding.

Mean and Standard Deviation

  finds the mean and standard deviation
 of data summed with  . Clear the calculator
 with   before summing.

$\Sigma+$ **Sums** values keyed in. To **correct** a value before $\Sigma+$ is pressed, press **CLX**. Afterwards, **key in** incorrect value and press **■** $\Sigma-$. **Key in** correct value, press $\Sigma+$. Number of correct **x**-entries displayed in **X** after each $\Sigma+$. R_5 - R_8 can be recalled as shown in *Interactive Functions*.

■ \bar{x}, s Displays **mean** of **x**-entries. Formula used:

$$\frac{1}{n} \sum_{i=1}^n x_i \rightarrow \mathbf{X}$$

xzy Displays **standard deviation** of **x**-entries. Formula used:

$$\sqrt{\frac{\sum_{i=1}^n x_i^2 - \frac{1}{n} \left(\sum_{i=1}^n x_i \right)^2}{n - 1}} \rightarrow \mathbf{Y}$$

Improper Operations

Calculations containing improper operations result in a blinking display. To clear, press **CLX**, or any other key that doesn't result in another error. Examples of improper operations:

\sqrt{x} , where $x < 0$ \div , where $x = 0$

$1/x$, where $x = 0$ y^x , where $y \leq 0$

n!

, where $x < 0$ or is not an integer \bar{x}, s , where number of entries is < 2 $\rightarrow \text{D.MS}$, where angle converted $\geq 100,000^\circ$
($\geq 10^5$)D.MS \rightarrow , where angle converted $\geq 100,000^\circ$
($\geq 10^5$)

log

, where $x \leq 0$

ln

, where $x \leq 0$ SIN^{-1} , where $|x|$ is > 1 COS^{-1} , where $|x|$ is > 1

Common Equivalents and Conversions

U. S.-to-Metric Conversion Constants

U. S.	Metric
1 inch	=25.4 millimeters*
1 foot	=0.3048 meter*
1 yard	=0.9144 meter*
1 mile	=1.60934 kilometers
1 square inch	=6.4516 square centimeters*
1 square foot	=0.0929030 square meter
1 square yard	=0.836127 square meter
1 acre	=0.404686 hectare
1 cubic inch	=16.3871 cubic centimeters
1 cubic foot	=0.0283168 cubic meter
1 cubic yard	=0.764555 cubic meter
1 quart (lq.)	=0.946353 liter
1 gallon	=0.00378541 cubic meter

16

1 ounce (avdp)	=28.3495 grams
1 pound (avdp)	=0.453592 kilogram
1 ton (short ton)	=.907184 metric ton
1 horsepower	=0.745700 kilowatt

* Exact

Temperature Conversion

$$^{\circ}\text{F} = 1.8 ^{\circ}\text{C} + 32$$

Metric-to-U. S. Conversion Constants

Metric	U. S.
1 millimeter	=0.0393701 inch
1 meter	=3.28084 feet
1 meter	=1.09361 yards
1 kilometer	=0.621371 mile
1 square centimeter	=0.155000 square inch
1 square meter	=10.7639 square feet
1 square meter	=1.19599 square yards
1 hectare	=2.47105 acres
1 cubic centimeter	=0.0610237 cubic inch
1 cubic meter	=35.3147 cubic feet
1 cubic meter	=1.30795 cubic yards
1 liter	=1.05669 quarts (lq.)
1 cubic meter	=264.172 gallons
1 gram	=0.0352740 ounce (avdp)
1 kilogram	=2.20462 pounds (avdp)
1 metric ton	=1.102312 tons (short ton)
1 kilowatt	=1.34102 horsepower

Temperature Conversion

$$^{\circ}\text{C} = \frac{1}{1.8} (^{\circ}\text{F} - 32)$$

















Recommended Values of Physical Constants

Quantity	Symbol	Value	Units	
			mks	cgs
Electron rest mass	m_e	9.109558	10^{-31} kg	10^{-28} g
	m_e	5.485930	10^{-4} amu	10^{-4} amu
Proton rest mass	M_p	1.672614	10^{-27} kg	10^{-24} g
	M_p	1.00727661	amu	amu
Ratio of proton mass to electron mass	M_p/m_e	1,836.109		
Electron charge to mass ratio	e/m_e	1.7588028	10^{11} C/kg	10^7 emu/g
		5.272759	. . . . .	10^{17} esu/g
Magnetic flux quantum . .	Φ	2.067854	10^{-15} T-m ²	10^{-7} G-cm ²
Boltzmann's constant . . .	k	1.380622	10^{-23} J/K	10^{-16} erg/K
	k/e	8.617087	10^{-5} V/K	
Gravitational constant . . .	γ	6.6732	10^{-11} N-m ² /kg ²	10^{-8} dyn-cm ² /g ²

Recommended Values of Physical Constants

Quantity	Symbol	Value	Units	
			mks	cgs
Velocity of light	c	2.9979250	10^8 m/sec	10^{10} cm/sec
Electron charge	e	1.6021917	10^{-19} C	10^{-20} emu
		4.8032250	. . . . .	10^{-10} esu
Electron volt . . . . .	. . . . .	1.6021917	10^{-19} J	10^{-12} erg
Equivalent to . . . . .	. . . . .	2.4179659	10^{14} Hz	
Equivalent to . . . . .	. . . . .	8.065465	10^5 m ⁻¹	10^3 cm ⁻¹
Equivalent to . . . . .	. . . . .	1.160485	10^4 K	
Planck's constant	h	6.626196	10^{-34} J-sec	10^{-27} erg-sec
	h/e	4.135708	10^{-15} J-sec/C	10^{-7} erg-sec/emu
Avogadro's number	N	6.022169	10^{26} kmole ⁻¹	10^{23} mole ⁻¹
Atomic mass unit	amu	1.660531	10^{-27} kg	10^{-24} g

Key Index

Key	Function/Operation	Page
OFF  ON	Power switch	2
y^x	Exponential	10
	Reciprocal	7
log	Common logarithm	8
	Natural logarithm	8
10^x	Common antilogarithm	8
	Natural antilogarithm	8
SCI	Scientific notation display mode	3
FIX	Fixed decimal notation display mode	3
	Gold key; alternate function	4
\sqrt{x}	Square root of x	7
	x squared	7
$\rightarrow R$	Polar-to-rectangular conversion	11
$\rightarrow P$	Rectangular-to-polar conversion	11
SIN^{-1}	Arc sine	8
	Sine	8
COS^{-1}	Arc cosine	8
	Cosine	8
TAN^{-1}	Arc tangent	9
	Tangent	9
$n!$	Factorial	7
	Exchange x and y	4
\bar{x}, s	Mean, standard deviation	13
	Roll down stack	4
$\rightarrow \text{DMS}$	Convert <i>to</i> degrees-minutes-seconds . .	9
	Store value in R_n ($n = 1, 2, \dots, 9$) . .	5
$\text{DMS} \rightarrow$	Convert <i>from</i> degrees-minutes-seconds	9
	Recall stored value from R_n ($n = 1, 2, \dots, 9$)	5
$\Delta\%$	Percent difference	10
	x percent of y	10
DEG	Degrees mode	8
	Copy x into Y	3
RAD	Radians mode	8
	Change sign	2

GRD	Grads mode	8
EE \times	Enter exponent	2
CLEAR	Clear stack and $R_5 - R_8$	4
CL \times	Clear X	4
-	Subtract	9
+	Add	9
\times	Multiply	9
\div	Divide	10
cm/in	Centimeters/inches conversion	7
kg/lb	Kilograms/pounds conversion	7
ltr/gal	Liters/U.S. gallons conversion	7
LAST x	Recall last x argument	4
π	Pi constant (3.14...)	6
Σ^-	Decrement summation	12
Σ^+	Summation	12
0-9	Numeric key set	2
& .		

Subject Index

- Addition function, **9**
- Arc cosine function, **8**
- Arc sine function, **8**
- Arc tangent function, **9**
- Battery condition, low, **2**
- Changing sign, **2**
- Clearing, **4**
- Common antilog function, **8**
- Common log function, **8**
- Constants, physical: recommended values for, **17**;
preprogrammed e , **6**; preprogrammed metric/
U.S. unit conversion, **7**; preprogrammed Pi, **6**
- Controls: data manipulation, **3**; display, **3**;
operational, **3**; rounding, **3**; storage register, **5**
- Conversion tables: common metric/U.S.
equivalents, **15, 16**; temperature equivalents, **16**
- Conversions of: centimeters/inches, **7**; degrees-
minutes-seconds, **9**; kilograms/pounds, **7**;
liters/gallons, **7**; metric/U.S. unit, **7**; polar/
rectangular coordinates, **11**

- Correcting input, 4
- Cosine function, 8
- Cube root, 10
- Data: manipulation, 3; recalling, 5; storage registers, 4
- Decimal place setting, 3
- Degrees-minutes-seconds conversions, 9
- Degrees mode, 8
- Display, control of, 3
- Division function, 10
- Dyadic functions and options, 9
- e, 6
- Error indication, 2
- Exchanging contents of x and y , 4
- Exponent, entering, 2
- Exponential function, 10
- Factorial function, 7
- Fixed decimal display, 3
- Gold key, 4
- Grads mode, 8
- Improper operations, 14
- Interactive functions, 12
- Keying numbers, 2
- Last x , recalling, 4
- Logarithmic functions, 8
- Mean function, 13
- Metric/U.S. conversion constants, 7, 15, 16
- Monadic functions and options, 7
- Multiplication function, 9
- Natural antilog function, 8
- Natural log function, 8
- Negative numbers, 2
- Numbers: entry of, 3; keying of, 2; powers of, 10
- Operational controls, 3
- Operational stack, 3
- Percentage functions, 10
- Physical constants, recommended values for, 17

- Pi (π), **6**
- Polar/rectangular coordinates conversion, **11**
- Power switch, **2**
- Powers of numbers, **10**
- Radians mode, **8**
- Range, dynamic, **2**
- Recalling data, **5, 13**
- Recalling Last x , **4**
- Reciprocal function, **7**
- Register arithmetic: use of addition in recall operations, **6**; use of addition in storing operations, **5**; use of division in recall operations, **6**; use of division in storing operations, **6**; use of multiplication in recall operations, **6**; use of multiplication in storing operations, **6**; use of subtraction in recall operations, **6**; use of subtraction in storage operations, **5**
- Registers: data storage, **4**; working storage, **3**
- Roll down stack, **4**
- Rounding, control of, **3**
- Scientific notation display, **3**
- Sign, changing, **2**
- Sine function, **8**
- Square root function, **7**
- Squaring function, **7**
- Stack, operational, **3**
- Standard deviation, **13**
- Storage registers, data: clearing of, **4, 5**; contents of, **4, 5**; names of, **4, 5**; restrictions on, **4, 5**; unrestricted, **4**
- Storage registers working, **3**
- Storing data, **5**
- Subtraction function, **9**
- Summation function: decrement, **12**; increment, **12**; recall of two-dimensional, **13**
- Tangent function, **9**
- Trigonometric functions, **8**
- Trigonometric modes, **8**
- Vector arithmetic (see *Interactive Functions*)
- Working storage registers, **3**



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