HEWLETT-PACKARD

HP-45

Quick Reference Guide

Table of Contents

PRINTED IN U.S.A.

Dynamic Range

10^{-99}–10^{99}

Power Switch

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** CLx .

Keying Numbers

0 , · · · 9 • Number keys including decimal point; **press** in left-to-right order.

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

CHS Change sign: gives opposite sign to displayed value. Affects sign of exponent if pressed after EEX . **Press** CHS 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 [ ].

[gold] [CLEAR] **Clears** stack and data storage registers R_5–R_8.

[CLx] **Clears X**-register (display) only.

[x≷y] **Exchanges** contents of **X** (display) and **Y**-registers, respectively.

[R↓] **Rolls down** and **displays** contents of working storage registers in last-in, first-out order. Returns to original position with every fourth [R↓] operation.

[gold] [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
Contents: r_5–r_8

Restricted storage when performing summations ($\Sigma+$). **Clear before using; press** [f] CLEAR .

Register: R_9
Contents: r_9

Restricted storage when performing trigonometric functions.

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

Storage Register Controls

Storing:

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

Recalling:

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

Register Arithmetic

Store Arithmetic:

STO + n **Adds** r_n to displayed value (**x**); stores result in R_n. (n = 1, 2, . . . , 9.)

STO − n **Subtracts** r_n from displayed value (**x**); stores result in R_n. (n = 1, 2, . . . , 9.)

STO × n **Multiplies** displayed value (**x**) by r_n; stores result in R_n. (n = 1, 2, . . . , 9.)

STO ÷ n **Divides** displayed value (**x**) by r_n; stores result in R_n. (n = 1, 2, . . . , 9.)

Recall Arithmetic:

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

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

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

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

Preprogrammed Constants

General-purpose

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

1 e^x *e* (2.718 . . .). (See *Logarithms*.)

Metric/U.S. Unit Conversion

[ ] [cm/in] [×] Converts displayed value (**x** = inches) **to centimeters.**

[ ] [cm/in] [÷] Converts displayed value (**x** = centimeters) **to inches.**

[ ] [kg/lb] [×] Converts displayed value (**x** = pounds) **to kilograms.**

[ ] [kg/lb] [÷] Converts displayed value (**x** = kilograms) **to pounds.**

[ ] [ltr/gal] [×] Converts displayed value (**x** = gallons) **to liters.**

[ ] [ltr/gal] [÷] 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

[1/x] Calculates **reciprocal** of **x**.

[ ] [n!] Calculates **factorial** of **x**.

[x^2] Calculates **square** of **x**.

[ ] [$\sqrt{x}$] Calculates **square root** of **x**.

Logarithms

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

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

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

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

Trigonometric

Note 1. R_9 is cleared by trig functions.
Note 2. Decimal angles are assumed.

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

[ ] **RAD** Selects **radians mode** prior to calculation.

[ ] **GRD** Selects **grads mode** prior to calculation.

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

[ ] **SIN^{-1}** Calculates **arc sine** of **x**.

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

[ ] **COS^{-1}** Calculates **arc cosine** of **x**.

TAN Calculates **tangent** of **x**.

TAN^{-1} Calculates **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

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

1/x [ ] y^x 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:

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

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

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

[ ] $\triangle\%$ Calculates **percent difference** between **y** and **x**; result displayed in **X**. Stack doesn't drop. Formulas used:

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

Polar/Rectangular Coordinate Conversion

Note 1. Any trig angular mode may be specified.

Note 2. Contents of R_9 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**.

x≷y Displays angle θ. Formulas used:

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

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

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

x≷y 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- x̄,s) use R_5–R_8 which must be cleared with [f] CLEAR 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

Σ+ **Sums** number of **x**-entries in R_5 and **displays** in **X**. (If **X** has been altered **press** RCL 5 to display.)

Sums $\mathbf{x}^2$ in R_6. (**Press** RCL 6 to display.)

Sums x in R_7. (**Press** RCL 7 to display.)

Sums y in R_8. (**Press** RCL 8 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

[g] Σ- **Deletes x**-entry number from **X** and R_5. (If **X** has been altered **press** RCL 5 to display.)

Decrement Summation (contd.)

Deletes x^2 from R_6. (**Press** RCL 6 to display.)

Deletes x from R_7. (**Press** RCL 7 to display.)

Deletes y from R_8. (**Press** RCL 8 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

RCL Σ+ **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** x⇄y . If converting values to polar form (→P) be sure to **press** x⇄y again before proceeding.

Mean and Standard Deviation

f x̄,s finds the mean and standard deviation of data summed with Σ+ (Σ−). Clear the calculator with f CLEAR before summing.

[Σ+] **Sums** values keyed in. To **correct** a value before [Σ+] is pressed, **press** [CLx] . Afterwards, **key in** incorrect value and **press** [f] [Σ-] .**Key in** correct value, **press** [Σ+] . Number of correct **x**-entries displayed in **X** after each [Σ+] . R_5–R_8 can be recalled as shown in *Interactive Functions*.

[f] [$\bar{x}$, s] Displays **mean** of **x**-entries. Formula used:

$$\frac{r_7}{r_5} \rightarrow \mathbf{X}$$

[x≷y] Displays **standard deviation** of **x**-entries. Formula used:

$$\sqrt{\frac{1}{r_5 - 1}\left[r_6 - \frac{{r_7}^2}{r_5}\right]} \rightarrow \mathbf{Y}$$

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:

[÷] , where $\mathbf{x} = 0$

[y^x] , where $\mathbf{y} \leq 0$

[$\sqrt{x}$] , where $\mathbf{x} < 0$

[1/x] , where $\mathbf{x} = 0$

[n!] , where **x** < 0 or is not an integer

[$\bar{x}$, s] , where number of entries is < 2

[→D.MS] , where angle converted $\geq 100{,}000^{o}$ ($\geq 10^{5}$)

[D.MS→] , where angle converted $\geq 100{,}000^{o}$ ($\geq 10^{5}$)

[log] , where **x** ≤ 0

[ln] , where **x** ≤ 0

[SIN^{-1}] , where **x** is > 1

[COS^{-1}] , where **x** is > 1

Common Equivalents and Conversions

Metric-to-U. S. Conversion Constants

U. S.	Metric
1 inch	=25.4 millimeters*
1 foot = 12 in	=0.3048 meter*
1 yard = 3 ft	=0.9144 meter*
1 mile = 1760 yards	=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

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

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

U. S.-to-Metric 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

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

$n^n = A \rightarrow n_{max} = 56,96124842$

$n^{(n^n)} = A \rightarrow n_{max} = 3,830482864$

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

47

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
		4.803250	. . . . .	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
$(c)^{-1}(hc/2e)$	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

18

Key Index

Subject Index

HEWLETT hp PACKARD

Sales, service and support in 172 centers in 65 countries

ADVANCED PRODUCTS DIVISION

10900 Wolfe Road • P.O. Box 3500

Cupertino, California 95014. Offices in principal cities throughout the U.S.

For Additional Sales and Service Information Contact Your Local Hewlett-Packard Sales Office or Call 408/996-0100 (Ask for Calculator Customer Service).

00045-90303 Printed in U.S.A.