The PocketProfessional®

Chemistry Reference Pac

Owner's Manual

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Notice

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Acknowledgment

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- Installing and Removing the Pocket Professional
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Welcome

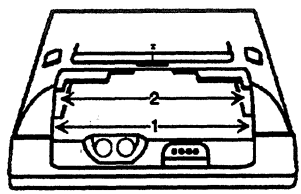
Da Vinci Technology Group's Pocket Professional software is the first of its kind, developed to provide speed, efficiency and portability to students and professionals in the technical fields. The PocketProfessional™ Chemistry Reference Pac instantly transforms the HP 48GX calculator into an electronic handbook, containing over 100 tables of data commonly used by chemists and chemical engineers. The information is organized in a menu tree with topics and sub-topics displayed in an easy-to-use "browser" menu format.

Installing, Removing the Pocket Professional

The HP 48GX has two ports for installing plug-in cards. You can install this card in either port. Be sure to **turn off the calculator** while installing or removing the card. Otherwise, user memory may be erased.

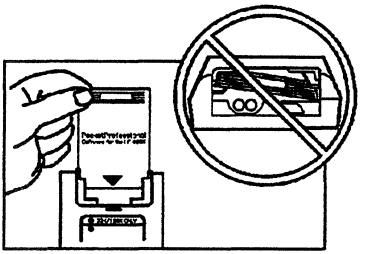
To Install the Card

1. Turn off the calculator. Do not press ON until you have completed the installation procedure.



2. Remove the port cover. Press against the grip lines and push forward. Lift the cover to expose the two plug-in ports.
3. Select either empty port for the PocketProfessional card.

4. Position the card just outside the slot. Point the triangular arrow on the card toward the calculator port opening, as shown below.



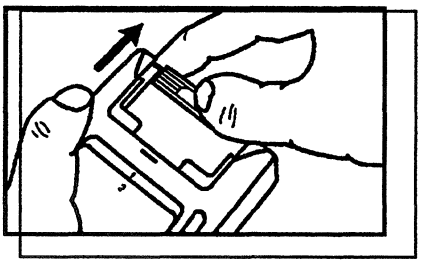
5. Slide the card firmly into the slot. After you first feel resistance, push the card about 1/4 inch further, until it is fully seated.

6. Replace the port cover.

To Remove the Card

1. Turn the calculator off. Do not press [ON] until you have completed the procedure.

2. Remove the port cover. Press against the card's grip and slide the card out of the port.



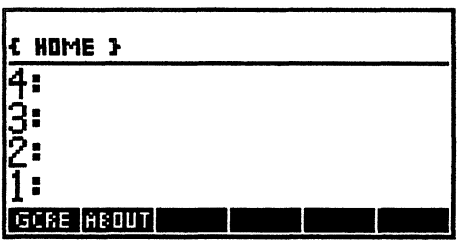
3. Replace the port cover.

To Access the Reference Pac

After you turn your calculator [ON], there are three ways to access the Chemistry Reference Pac.

First Method:

Press [→] [LIBRARY] to display all libraries available to the HP 48GX. Press the [CCRE], "softkey" (the corresponding blank menu key on the top row of the HP 48GX keyboard) to start the Chemistry Reference



Pac.

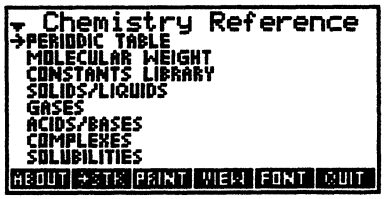
Second Method:
Type in the letters GCREF (using alpha entry mode, as described in the *HP 48GX Owner's Manual*) and press ENTER.

Third Method:

Add the command GCREF to the CST. After the command has been added, press CST, then press GCRE to start the Chemistry Reference application.

Using the Main Menu

After you start the Pac, the main menu screen appears. The main menu lists the main categories available in the Pac in a "browser" menu format. The term "Browser" refers to the ability to use the cursor keys ▼ and ▲ to move the pointer to the menu item desired and access it by pressing ENTER. The row of "softkeys" along the bottom of the screen may give you options that relate to the information displayed on any given screen.



Because the size of the calculator screen is limited, the names of constants and properties are usually abbreviated throughout the reference Pac. This manual includes "translations" of these abbreviations where appropriate.

The items in the main menu are outlined in the Table below:

Periodic Table	Displays selected properties for each element of the Periodic Table
Molecular Weight	Allows for molecular weight and percent composition calculations
Constants Library	Thirty nine constants commonly used by chemists and chemical engineers
Solids/Liquids	Linear, cubic coefficients of expansion

	of materials; cubical cell characteristics for selected materials; physical properties of selective inorganic and organic fluids.
Gases	Vapor pressure, Van der Waals constants for selected gases
Acids/Bases	Dissociation constants for selected inorganic, organic acids, bases and indicators
Complexes	Formation constants of transition metals with common ligands
Solubilities	Solubility products and aqueous solubilities of organic and inorganic compounds
Bonds	Tables of bond lengths, energies; structures of common compounds
Water	Sixteen properties of water and their variation with pressure and temperature
Electrochemistry	Reduction potentials of selected half reactions, and conductivity of pure liquids & common electrolytes.
Thermodynamics	Selected thermodynamic data of inorganic and organic compounds
ABOUT	Displays screen showing information about this software
->STK	Places a single or all browser entries on the calculator stack
PRINT	Allows you to print one or all data entries in a particular field
VIEW	Allows you to vies entries that are too wide to be displayed
FONT	Toggles between small and medium size display font size
QUIT	Exits the Chemistry Reference Pac. Pressing CANCEL performs the same function.

Each main category of the reference pac contains several topics and sub-topics. They are described in detail in Chapter 2. The information

contained in each topic from a variety of sources. Values given in the here may vary slightly from values listed by sources not documented in this manual.

Moving Around the Screen

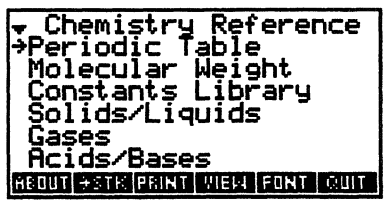
Use the [▼] and [▲] keys to move the pointer up and down in the menu list. Pressing [◄] [▼] moves the pointer to the bottom of the screen, or pages down if the pointer is already at the bottom of the screen. Pressing [◄] [▲] moves to the top of the screen or pages up if the pointer is already at the top of the screen. Pressing [►] [▼] moves the pointer to the bottom of the list or [►] [▲] moves to the top of the list.

Viewing Items Too Wide for the Display

If the text of a topic or subtopic is too wide to fit within the display, an ellipsis (...) appears at the end of the line. Press the softkey VIEW to display the rest of the text. To return the previous display, press [ON] key.

Changing the Font Size

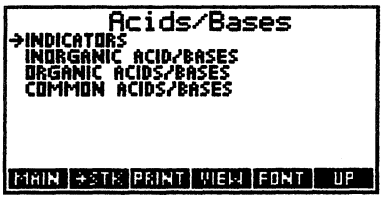
The default font for the Reference Pac displays information in condensed, uppercase letters only. Pressing the softkey FONT displays the information in a larger font, which is case-sensitive. The font size stays large until you press FONT key again.

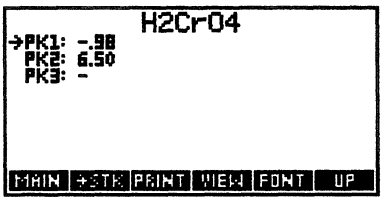


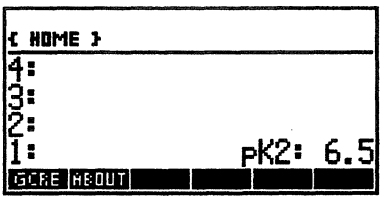
Example: Using the Reference Pac

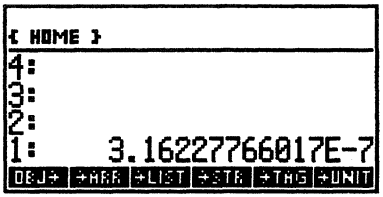
Suppose you need to know the second dissociation constant of Chromic acid (Ka for $HCrO_4^{-1}$). At the main menu, move the pointer to Acids/Bases and press [ENTER]. Move the pointer to Inorganic Acids/Bases and press [ENTER]. In the new screen, move the pointer to H_2CrO_4 and again press [ENTER]. The screen now shows pKa of Chromic acid, and use the pointer to select pK2 and press [→STK]. The calculator prompts you for where the data should be sent as shown in the screen shown. Pressing

ONE will transfer pK2 to the stack. Now press CANCEL at the previous screen to exit the Pac. The resulting display is also shown in the series of displays listed here.



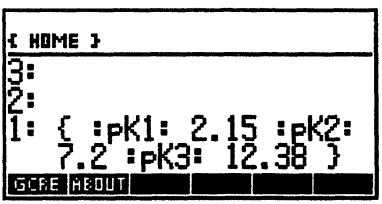






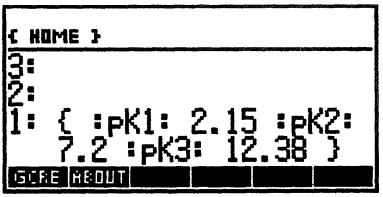
To get Ka from from pKa, (change the sign using the +/-) and press ◀ y^x. This yields the value shown in the last display screen shown above. You can now proceed with other calculations possible in the Pac.

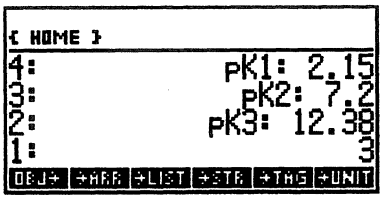
Multiple Stack Entries



Suppose for example, you're interested in retrieving all the three pKas of phosphoric acid instead of just one as shown in the example above. At the prompt simply press →STK ALL and notice the following screen when you exit the Pac.

To extract data from the list, press PRG TYPE OBJ→. This results in all the three values on successive levels of the stack along with total



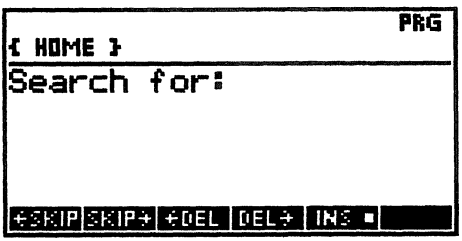


number of stack entries (in this case 3) as shown in the display screens above.

Managing Units

You can choose whether you want the Pac to display units on the screen or not by pressing the UNITS softkey. This softkey toggles between the unit and non-unit modes. UNIT • indicates that units will be displayed with all entries. When units are displayed, pressing ENTER places the entry onto the stack **with** units. When units are not displayed on the screen, units are not included when ENTER is pressed. Note that values in the constants library will be displayed with units whether units are toggled on or off. The Pocket Professional uses standard international units, customarily used in electrical engineering. **Be aware that using units usually increases the processing time for display.**

Using the Search Mode



When data lists are long, it may be faster to locate an item using the search mode. To initiate a search, press the α key. The screen displayed is shown to the right. The calculator is now in **alpha** entry mode, as indicated by the alpha (α) annunciator at the very top of the screen. Alpha entry mode overrides the function of the standard keyboard. This means that each key that has a white capital letter printed to its lower right loses its original function and types that letter onto the command line when pressed. Type the first letter or letters of the name you want to search for, to create the *search string*, and press ENTER. The search function is case-sensitive. The search mode softkeys ← - SKIP

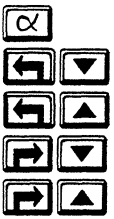
<- DEL INS along the bottom of the screen are command line editing keys which allow you to edit the search string. Their functions are summarized at the end of this chapter.

Null Entries

When a menu displays only a minus sign (-) after its name, it means that the item is being used as a placeholder in the database. The minus sign is not an indication of a minus or zero value.

Summary of Functions

FONT	Toggles the display font between condensed and large sizes.
QUIT	Exits the Electrical Engineering Reference Pac.
UP	Moves up one level in the menus.
MAIN	Moves to the main menu of the Electrical Engineering Reference Pac.
PICT	In a few cases, a picture is available to help explain the data item. Pressing this softkey displays the figure on the screen
PRINT	Allows you to print a data field or the entire list of data to an IR printer
ALL	Sends all the data in a list to an IR printer.
ONE	Sends the data in the field selected by the pointer to an IR printer.
UNITS	Toggles between unit and non-unit modes. The Pocket Professional uses standard international (SI) units customarily used in electrical engineering.
<- SKIP	Moves the SKIP>cursor from its current position to the beginning of the word (left).
SKIP ->	Moves the cursor to the beginning of the next word (right).
<- DEL	Deletes all the characters from the cursor's position to the beginning of the word (left).
DEL ->	Delete all the characters from the cursor's position to the first character of the next word (right).
INS	Toggles between insert and typeover modes
VIEW	Displays remaining data (a screen width at a time) on the screen for entries too wide for the screen. If the topic is too long to fit within the display, an ellipsis (...) is displayed on the right of the screen.
ENTER	Moves to the category, topic, or sub-topic indicated by the pointer.
CANCEL	Exits the Electrical Engineering Reference Pac.



Initiates a case sensitive search for a specific entry.

Moves to the bottom of the screen or pages down

Moves to the top of the screen or pages up.

Moves the pointer to the bottom of the list

Moves to the top of the screen or pages up.

2 Reference Library

In This Chapter

The General Chemistry Reference Library consists of reference data commonly used by chemists and chemical engineers. All entries are listed under the ten categories below. Within each category are several topics and sub-topics.

- Constants Library
- Solids/Liquids
- Gases
- Acids/Bases
- Thermodynamics
- Complexes
- Solubilities
- Electrochemistry
- Water
- Bonds

Please note that when chemical formulas are displayed on the screen they are shown without subscripts and superscripts as is normally found in chemistry.

Constants Library

The constants Library offers you immediate access to 39 constants commonly used in general chemistry. Constants are listed under the four categories below:

Fundamental Constants

1.660566×10^{-27}	Atomic mass unit
6.022045×10^{-23} mol^{-1}	Avogadro's number
1.380662×10^{-23} J/K	Boltzmann's constant
1.054589×10^{-23} J· s	Dirac's constant (h/2π)
1.602189×10^{-19} C	Electron charge
9.284832×10^{-24} J/T	Electron magnetic moment
0.910953×10^{-30} Kg	Electron mass
2.675199×10^{8} T^{-1} . s^{-1}	Gyromagnetic ratio
4.490474×10^{-23} J/T	Muon magnetic moment
1.883566×10^{-28}	Muon mass

1.674954×10^{-27} Kg	Neutron mass
1.410617×10^{-26} J/T	Proton magnetic moment
1.672649×10^{-27} Kg	Proton mass
$4\pi \times 10^{-7}$ H·m^{-1}	Permeability of vacuum
6.626176×10^{-34} J·s	Planck's constant
1.09737318×10^{7} m^{-1}	Rydberg's constant
2.99792458×10^{8} m/s	Speed of light
0.28978 cm·K	Wien's displacement constant

Derived Atomic Constants

3.74183×10^{-16} W/m^2	1st radiation constant
1.438786×10^{-2} m·K	2nd radiation constant
9.274078×10^{-24} J/T	Bohr magneton
$0.52917706 \times 10^{-10}$ m	Bohr radius
2.426309×10^{-12} m	Compton's electron wavelength
1.319591×10^{-15} m	Compton's neutron wavelength
1.321410×10^{-15} m	Compton's proton wavelength
1.00002564	Diamagnetic shield of H2O
1.758805×10^{11} C/Kg	Electron charge to mass ratio
1.001159657	Electron g-factor
2.817938×10^{-15} m	Classical electron radius
0.007297351	Fine structure constant
7.727389×10^{-4} J·s/Kg	h to electron mass ratio
4.835939×10^{14} Hz/V	Josephson's frequency to voltage ratio
8.617347×10^{-5} J K^{-1} C^{-1}	k/q ratio
2.067851×10^{-15} Wb	Magnetic flux quantum
1836.15	proton to electron mass ratio
5.050824×10^{-27} J/T	Nuclear magneton
$8.85418782 \times 10^{-12}$ F/m	Permittivity of vacuum
4.135701×10^{-15} J/Hz·C	Quantum of circulation
5.6703×10^{-8} W/(m^2·K^4)	Stefan-Boltzmann constant
6.652448×10^{-29} m^2	Thompson's Cross section
658.210697872	μe/μp ratio

Universal Constants

9.648456×10^{4} C/mol	Faraday's constant
8.31441 J^{-1}· mol^{-1}·K^{-1}	Gas constant
1.98719 cal mol^{-1} ·K^{-1}	Gas constant
82.0568 cm^3 ·atm· mol^{-1}·K^{-1}	Gas constant
6.672×10^{-11} N· m^2 ·Kg^{-2}	Gravitational constant
9.80665 m/s^2	Acceleration of gravity
0.0224138 m^3/mol	Molar volume

General Constants

-459.67 °F	Absolute zero in F
11.9	Dielectric constant of Si
3.9	Dielectric constant of SiO2
13.53362 g/cm^3	Density of Hg at 25 C
273.15 K	Standard temperature
1 atm	Standard pressure

Solids/Liquids

The solids/liquids category includes reference data on the following topics:

- Linear Expansion
- Cubical Expansion
- Simple Cubic
- Body Centered Cubic
- Face-centered cubic
- Ebullioscopic Constants
- Cryoscopic Constants
- Boiling Points

Linear Expansion Coefficient

In this table, coefficients of linear expansion of various solids are given. The coefficient of expansion is defined by:

$$l_t = l_0 \cdot (1 + \alpha \cdot t)$$

where l_0 is the length of the material, l_t is the length at t C, and α is the linear coefficient of expansion. The valid temperature range where the coefficient of expansion is included.

Cubical Expansion

The coefficient of cubical expansion is defined as the increase in volume per unit volume per degree C rise in temperature. In this table, cubical expansion coefficients of various crystalline solids are given along with their valid temperature range.

$$V = V0 \cdot (1 + \alpha' \cdot t)$$

Cubic Structures

Cubic structures (simple, body-centered, and face-centered) contain lattice parameters of the three simplest unit cell structures. the information contained for each cubic structure is:

- Lattice points/cell
- Number of nearest neighbor
- Nearest neighbor distance
- Atomic radius
- Packing fraction

Ebullioscopic Constants

The ebullioscopic constants Kb gives the increase of the boiling point, ΔT (in °C), produced when one mole of solute is dissolved in 1000g of a solvent. Note that molecular weights can be determined with the relation

$$M = K_b \cdot \frac{1000 \cdot w_2}{w_1 \cdot \Delta T_b}$$

where ΔT_b is the elevation of the boiling point brought about by the addition of w_2 grams of solute to w_1 grams of solvent and K_b is the ebullioscopic constant. The normal boiling point is listed for each solvent.

Cryoscopic Constants

The cryoscopic constant Kf gives the depression of the melting point, ΔT(in °C), produced when one mole of solute is dissolved in 1000g of a solvent. Once again this equation may be used to determine molecular weight with the following relation

$$M = K_1 \cdot \frac{1000 \cdot w_2}{w_1 \cdot \Delta T_b}$$

In this table, the cryoscopic constant and normal freezing point of each solvent is listed.

Boiling Points

This table contains 72 solvents arranged in order of increasing boiling point.

Gases

This section concentrates on the vapor pressure of various substances,

inlcuding mercury. It also includes Vander Waals constants and properties of selected cryogenic gases:

- Vapor Pressure
- Van der Waals
- Cryogenic Gases
- Density of Hg
- Vapor Pressure of Hg

Vapor Pressure

There are several mathematical relationships between the temperature of a condensed phase and its equilibrium vapor pressure. The Antoine equation (Eq 1) correlates well with experimental values. Equation 2 is simpler and is often accurate over limited temperature ranges.

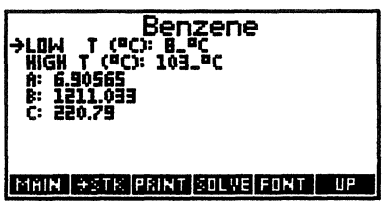
$$\log p = A - \frac{B}{t+C} \quad \text{(Eq.1)} \qquad \log p = A - \frac{B}{t} \quad \text{(Eq.2)}$$

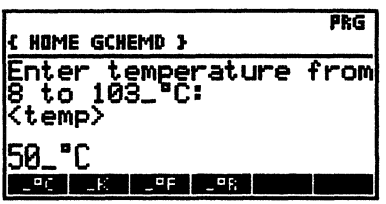
In these equations, p is the vapor pressure of the compound in mm Hg (torr) t is the temperature in ° Celsius, and T is the temperature in Kelvin.

In this table, the constants A,B, and C are listed for various organic compounds along with the temperature range for which they are valid. To obtain the vapor pressure at any temperature, press the SOLVE softkey . You may then enter the temperature and the vapor pressure will be calculated automatically using the proper equation.

Note: Calculations are only valid in the suggested temperature range. However, if you compute outside the range, the result should be treated as an estimate.

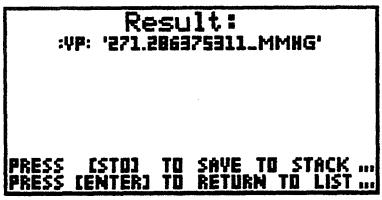
Example - To obtain the vapor pressure of benzene at 50 °C, highlight





benzene with the pointer and press ENTER to display the screen shown .

This shows the constants A, B, C for benzene and that the valid temperature range for these constants is 8 to 103 °C. Press SOLVE to enter temperature. You may append any unit onto your entered value of temperature by pressing the appropriate softkey. In this case, the temperature of 50 °C has been entered. Press ENTER and the vapor pressure of benzene at 50 °C is calculated. Press the STO key to store the vapor pressure on the calculator stack or ENTER to return to the list.



Van der Waals

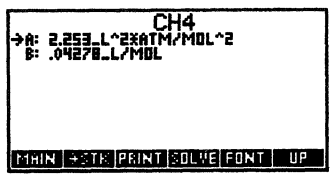
The Van der Waals equation offers empirical corrections to the ideal gas law by assuming a finite particle volume and molecular interactions. This equation has the form:

$$(P+\frac{n^2\cdot a}{V^2})\cdot(V-n\cdot b)=n\cdot R\cdot T \qquad Tc=\frac{8\cdot a}{27\cdot b\cdot R}$$

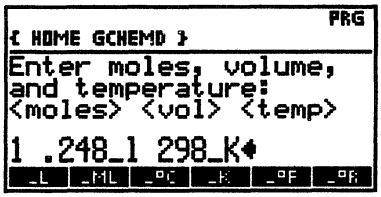
$$Vc=3\cdot n\cdot b \qquad Pc=\frac{a}{27\cdot b^2}$$

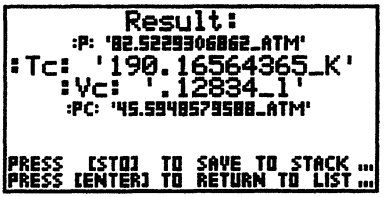
where a and b are constants, R is the universal gas constant, n is the number of moles of gas, V is the gas volume, P is the pressure, and Tc, Vc, and Pc are the critical temperature, volume, and pressure respectively.

This table contains a and b for 61 gases. To obtain the pressure of a gas at any given temperature, volume, and quantity, press the SOLVE key. You may then enter T, n and V and the pressure will be calculated automatically. For example, suppose your interested in calculating the pressure of required to confine 1 mol of methane to a volume of 0.248 liters at a temperature of 298 K. Position the pointer to CH4 (use the search mode to find CH4 or move the pointer down 29 times) and press ENTER . This displays the a and b constants for CH4, as shown:



Press SOLVE and enter the number of moles, the temperature, and





volume all on one line, separated by spaces as shown: Then press ENTER. The pressure and critical temperature, volume, and pressure are calculated. Note that all units of temperature and milliliters and liters are supported by the softkeys. Press STO to store the pressure and critical parameters on the calculator stack or ENTER to return to the list.

Note: It is possible for you to enter values for T, V, U which would result in a non-realizable negative pressure.

Cryogenic Gases

This topic lists the following properties for a wide variety of gases used in low temperature applications.

- Density of liquid
- Boiling point
- Melting point
- Heat of vaporization
- Heat of fusion
- Heat capacity
- Heat capacity ratio (Cp/Cv)
- Critical temperature
- Critical Pressure
- Vapor density at boiling point

Density - Hg

This table lists the density of mercury versus temperature over the temperature range from 10 to 30 °C. To obtain the density of mercury at other temperatures, press the SOLVE. You may then enter temperature and the density will be calculated automatically.

Vapor Pressure- Hg

This table lists the vapor pressure of mercury versus temperature over the temperature range from 10 to 30 °C.

Acids and Bases

The reference data included for acids and bases covers four tables:

- Indicators
- Inorganic Substances
- Organic Substances
- Common Acids/Bases

Indicators

This table lists the pH range, the pKa, and the expected color change for selected pH indicators. The pH range or transition interval may vary appreciably from one observer to another and is affected by ionic strength, temperature, and light source. The values listed refer to solutions of low ionic strength and room temperature. The pKa (= -log Ka) is offered in some cases. The abbreviations used to describe color change are shown below:

- B Blue
- G Green
- P Purple
- V Violet
- Br Brown
- C Colorless
- O Orange
- R Red
- Y Yellow

Inorganic Acids/Bases

The table lists the pKa (= - log Ka) for the dissociation of inorganic acids at 25 °C defined for the general reaction: HB $\Leftrightarrow$ H^+ + B. The acid dissociation constant is formulated as follows:

$$Ka = \frac{[H^+][B]}{[HB]}$$

where the brackets (ie [H+]) refer to concentrations in moles/liter.

Organic Acids/Bases

The table lists the pKa (= - log Ka) for the dissociation of organic materials at 25 °C defined for the general reaction: HB $\Leftrightarrow$ H^+ + B. The acid dissociation constant is formulated as follows:

$$Ka = \frac{[H^+][B]}{[HB]}$$

where the brackets (ie [H+]) refer to concentrations in moles/liter. Ionic strengths are assumed to be zero unless otherwise noted. Protonated cations are designated (+1), (+2), etc after the pKa value. Neutral species

are designated by (0) unless obvious, and negatively charged species by (-1), (-2), etc.

Common Acids/Bases

This table lists typical densities, weight percents, and molarities of commercial concentrated acids and bases. When bottles of concentrated reagents are freshly opened, they are generally at the concentrations listed in this table. This may not be true of bottles opened for long periods and is especially ture of ammonium hydroxide. A concentrated C.P. grade reagent comes with a assay label which states its molecular weight, MWT, density or specific gravity, d, and its percentage assay, p. When such a reagent is used to prepare an aqueous solution of desired molarity M, a convenient formula is:

$$V = \frac{100 \cdot MWT \cdot T}{p \cdot d}$$

where V is the number of mililiters of concentrated reagent required for one liter of dilute solution.

Example: Nitric acid has a molecular weight of 63.01 g/mol. If the concentrated reagent has an assay of 70.0% and a density of 1.41 g/ml, the volume required for 1 liter of a 0.1 molar solution is:

$$V = \frac{100 \cdot 63.01 \cdot 0.1}{70.0 \cdot 1.41} = 6.38 \text{ ml}$$

To perform this calculation for material in this table, press SOLVE. Enter the desired molarity and then the weight percent and density (if desired). The volume of acid will be calculated automatically.

Thermodynamics

The reference data for thermodynamics is included in the following nine tables:

- Elements and Oxides
- Group I
- Group II
- Group III
- Group IV
- Group V
- Group VI
- Group VII
- Group 0

Elements and Oxides

Thermodynamic calculations over a wide range of temperatures are generally made with the aid of algebraic equations representing the properties of substances. The most convenient starting point for such calculations is the equation for the heat capacity at constant pressure. From this quantity and a knowledge of the properties of any phase transitions, other thermodynamic properties may be computed.

Empirical heat capacity equations are generally of the form of a power series with absolute temperature as the independent variable, ie:

$$Cp = a + (b \cdot 10^{-3}) \cdot T + (c \cdot 10^{-6}) \cdot T^2 + \frac{d \cdot 10^5}{T^2}$$

where a, b, c and d are constants. The enthalpy H, entropy S, and Free Energy Function, FFN are determined from the heat capacity by a simple integration over temperature. Thus, if 298 K (25 °C) is taken as the reference temperature,

$$\Delta H = H_T - H_{298} = a \cdot T + \frac{1}{2} \cdot (b \cdot 10^{-3}) \cdot T^2 + \frac{1}{3} \cdot (c \cdot 10^{-6}) \cdot T^3 - \frac{d \cdot 10^5}{T} - A$$

$$S_T = a \cdot \ln T + (b \cdot 10^{-3}) \cdot T^2 + \frac{1}{2}(c \cdot 10^{-6}) \cdot T^3 - \frac{d \cdot 10^5}{2 \cdot T} - B$$

$$FFN = \frac{G_T - H_{298}}{T} = -a \cdot \ln T - \frac{1}{2} \cdot (b \cdot 10^{-3}) \cdot T - \frac{1}{6}(c \cdot 10^{-6}) \cdot T^2 - \frac{d \cdot 10^5}{2 \cdot T^2} + (B + a$$

In the this table, the constants a, b, c, d, A, and B are listed for selected elements and their oxides. Units for all constants are cal/mol except for A which has units of kcal/mol.

To calculate Cp, ΔH, ST or FFN for any substance in the table, you may press SOLVE. Enter temperature and these values will be calculated automatically.

Group 1 through 0

The reference data in this section contain values of the enthalpy and Gibbs free energy of formation, entropy, and heat capacity at 298.15_K (25 °C). The physical state of each substance is abbreviated as follows: Crystalline solid (s), liquid (l), gaseous (g). The values of the thermodynamic properties given in this section assume that the substances are pure and

are in the following standard states: A pure solid or liquid is in the condensed phase under a pressure of one atmosphere. Gas is the hypothetical ideal gas at unit fugacity, where the enthalpy is that of the real gas at the same temperature and at zero pressure.

The change in thermodynamic quantity when one gram of the substance is formed isothermally, at the temperature listed and in its standard reference state, is represented by the values of $\Delta H_t°$ and $\Delta G_t°$. The standard reference state used for each element is at 25 °C and one atmosphere. The values of S° indicate the "thermal" entropy of the substance in the standard state at 298.15 K, and do not take into account influences from nuclear spins. Also largely omitted are isotope mixing effects.

The values of $\Delta H_t°$ and $\Delta G_t°$ in the tables are expressed in kilocalories per mole; values of S° and Cp° are expressed in calories per degree per mole.

Complexes

This section included tables of dissociation constants for inorganic complexes with 14 common ligands. All tables are listed under the ligand name and include cation name and charge (if not obvious) and dissociation constants $\log K_1$ through $\log K_6$ as appropriate:

- Ammonia
- Bromine
- Chloride
- Cyanide
- Fluoride
- Hydroxide
- Iodate
- Iodide
- Nitrate
- Pyrophosphate
- Sulfate
- Sulfite
- Thiocyanate
- Thiosulfate

Solubilities

This section lists the solubilities of selected gases, inert gases, and various electrolytes in water at three temperatures. Also contained are the solubility products of selected inorganic precipitates at 25 °C. The reference material in this section is listed under the following four categories.

- Gases, 100g (water)
- Inert Gases, 1ml (water)
- Air Solubility, 1ml (Water)
- Compounds in Water
- Solubility Products

Gases in 100 g water

In this table, solubilities of selected gases are listed at 0 °C, 20 °C, and 80 °C. Solubilites are offered in terms of the weight of gas dissolved in 100 grams of water when the pressure of the gas plus that of the water vapor is 760 mmHg.

Inert Gases (1 ml Water)

In this table, solubilities of inert gases are listed at 0 °C, 20 °C, and 80 °C. Unless noted otherwise, solubilites are offered in terms of the weight of gas dissolved in 100 grams of water when the pressure of the gas plus that of the water vapor is 760 mmHg.

Air Solubility, 1ml Water

In this table, the solubility of Air at 0 °C, 20 °C, and 80 °C are listed.

Compounds in water

In this table, solubilities of compounds are listed at 0 °C, 20 °C and 80°C. Unless noted otherwise, solubilites are offered in terms of the mass dissolved per 100 g of water.

Solubility Products

This table contains solubility products of common precipitates at room temperature. The solubility product of a compound AnBm undergoing dissociation by the reaction $AnBm \Leftrightarrow [A]^n + [B]^m$ is defined by the following equation

$$Ksp = [A]^n[B]^m$$

where A and B are in units of mole/liter.

Electrochemistry

This section lists half-reaction reduction potentials, conductivities of puer liquids, and conductivities of electrolytes at various ionic strengths.

- Reduction Potentials
- Liquid Conductivities
- Electrolytes

Reduction Potentials

It is convenient to consider that the total emf of an electrochemical cell is the sum of two "single electrode potentials." That is,

$$Ecell = Eox + Ered$$

where E_{ox} is the single electrode potential of the electrode forming the negative pole of the cell, and E_{red} is the single electrode potential of the electrode forming the positive pole of the cell. This table lists the half reaction potentials, E_{red}, when each substance involved in the electode reaction is at unit "activity." Values of E_{ox} may be obtained merely by changing the sign of the E_{red} values. If the half-reaction involves H^+ as product or reactant, the solution is acid. Half-reactions involving OH^-, NH^3, CN^-, CO_3^{2-}, or S^{2-} are reactions occurring in an alkaline solution.

Liquid Conductivities

This table contains the electrical conductivity of various pure liquids. All conductivities are 25 °C unless otherwise noted and have units of $1/(\Omega \cdot cm)$.

Electrolytes

This table contains the electrical conductivity of various electrolytes at 18 °C at concentrations of 0.01, 0.1, and 1 N. All conductivities have units of cm^2/Ω.

Water

This section lists tables for the following properties of water:

- Boiling Point (P)
- Compressibility (P)
- Conductivity (T)
- Density (T)
- Dielectric Constant (T)
- Expansion Coefficient (T)
- Heat Capacity versus (T)
- Ionization (P)
- Ionization constant (T)

- Mass H_2O in Saturated Air (T)
- Refractive Index (T)
- Surface Tension (T)
- Thermodynamic values
- Vapor Pressure (T)
- Viscosity (T)

Note that (T) and (P) in the above list indicates that the property is listed as a function of temperature or pressure. To calculate the expansion coefficient, density, or vapor pressure of water in the table, you may press SOLVE. Enter temperature and these values will be calculated automatically.

Bonds

This section gives the bond lengths and energies for a wide variety of chemical bonds. Also included are molecular shapes and characteristics for 12 compounds along with a separate section on bond calculations.

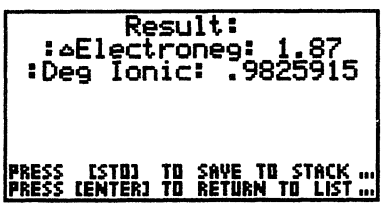
Bond Calculations

To access the bond character between a pair of atoms it is useful to calculate the following:

$$\Delta Electronegativity = |EA - EB|$$

$$DegreeIonicCharecter = 0.46 \cdot |EA - EB| - 0.035 \cdot (EA - EB)^2$$

For example, to examine the bonding between Cesium and Iodine, select "Bond Calculations" with the pointer and press ENTER. In the screen



displayed, enter Cs and I with a space in between the elements as shown in the input screen. Press ENTER to perform calculations. The resulting calculations are displayed in the screen shown herewith. After viewing the results, you can store them on the stack, or return to list without any further activity.

Bond Energies

This table lists energies for selected bonds. Bond energies are categorized under the following eight elements.

- Bromine
- Carbon
- Chlorine
- Fluorine
- Hydrogen
- Iodine
- Nitrogen
- Oxygen

All bonds listed are in kcal/mole.

Bond Lengths

This table lists lengths for selected bonds. Bond lengths are categorized under the following eight elements.

- Bromine
- Carbon
- Chlorine
- Fluorine
- Hydrogen
- Iodine
- Nitrogen
- Oxygen

All lengths listed are in Angstroms.

Bond Structures

This topic includes molecular structures of 10 compounds. For each of the substances listed below, the formula, structure, bond length, and bond angle(s) are included.

- Ammonia
- Arsine
- Chlorine Dioxide
- Hydrogen Phosphide
- Oxygen Chloride
- Sulfur Dioxide
- Chloroform
- Water
- Carbon Tetrachloride
- Ethane
- Formaldehyde
- Hydrogen Sulfide

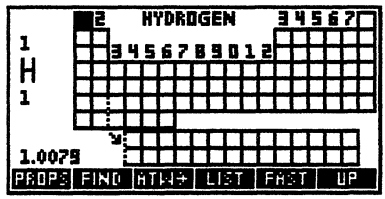
3 Periodic Table

In This Chapter

The Periodic Table function is a quick reference tool that provides basic information, such as mass number, electron configuration, oxidation state, and atomic weight, for each element.

Using the Periodic Table

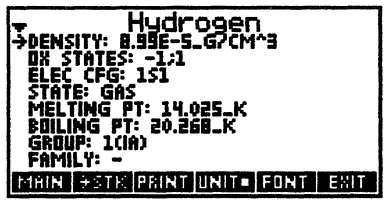
The Periodic Table screen displays after selecting this topic at the main menu. The figure below illustrates the information given on the screen for each element:



In the Periodic Table display, each square represents one element. The square, black cursor marks the selected element. The element name, mass number, symbol, atomic number and molecular weight, are displayed.

Properties of Each Element

Press PROPS or ENTER to view a list of properties for the current element: Use the cursor keys to scroll down the list to the desired property. Pressing ENTER places the data on the calculator stack.



The properties listed for each element (if available) are:

- Atomic Number (Table)
- Mass Number (Table)
- Atomic Weight (Table)
- Density
- Oxidation State
- Electron Configuration

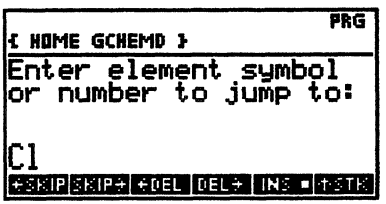
- Physical State
- Selected radioactive isotopes
- Group and family
- Aqueous radii
- Natural occurring isotopes
- Ionic radii
- Electronegativity (Pauling's)
- Atomic Radii
- Covalent Radii
- First Ionization Potential
- Boiling Point
- Group and Family
- Melting Point

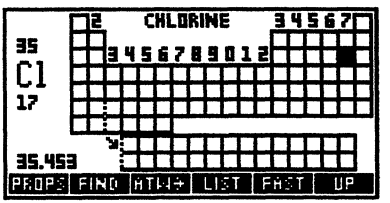
Moving Around the Periodic Table

Use the cursor keys [▼], [►], [◄] and [▲] to move the points to any element. Pressing [↰] key with a cursor key moves the cursor to the beginning of the current row or column. Pressing FAST eliminates element information on the screen and allows you to quickly move from element to element using the cursor keys. Press FAST again to retrieve the screen information.

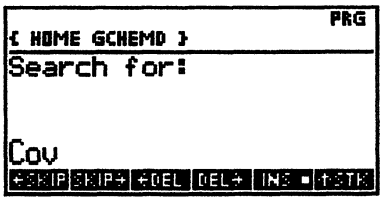
Using Search and List Utilities

To search for a particular element press the FIND key. At the prompt, type in the symbol or atomic number of the element you are searching. The input screen for entering this data is shown here. If you are entering an element's symbol, the second letter must be in lower case. Lower case entries are made by pressing [↰] before typing the letter. Press ENTER to move to the Periodic Table screen containing the element you were searching for; in the case shown here, Chlorine.





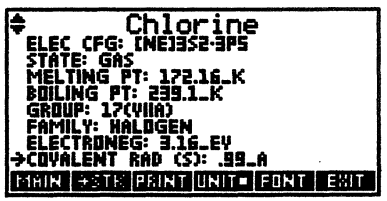
List of Elements and Symbols



Pressing LIST displays the names and symbols of all the elements in the Periodic Table in alphabetical order.; this provides an alternative way to search for an element, if you are unsure of the atomic number or symbol.

Searching for a Property

To search for particular property, press [α] at the list of properties screen. At the "search for" prompt, type in the desired variable, remembering that searches are case sensitive. For example, to search for



the Covalent radii of Chlorine, type in "Cov" at the prompt as shown.

Then Press [ENTER] to initiate the search. The screen display is shown above. Press [EXIT] to return to the Periodic Table screen.

Using the Print Function

You can send data from the Periodic Table directly to an infrared (IR) printer compatible with the HP 48 via the infrared port. Follow the printer instructions in the HP 48 documentation.

Summary of Softkeys

MAIN	Returns to the main menu
→STK	Copies selected entry or entries to the calculator stack
PRINT	Send data to an IR printer
UNITS	Toggles Units On and Off
UNIT■	Indicates that Units are On

EXIT	Exits to the Periodic Table of Elements Screen
FONT	Toggles the display between large and small fonts
TABLE	Returns to the Periodic Table display from the element list
PROPS	Displays a list of various properties for each element
FIND	Initiates a search for an element by name, atomic number or symbol
FAST	Toggles fast display mode
ATW->	Places the atomic weight of the current element on the stack as a tagged object.

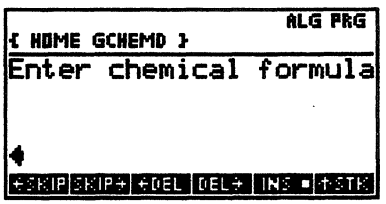
4 Molecular Weight

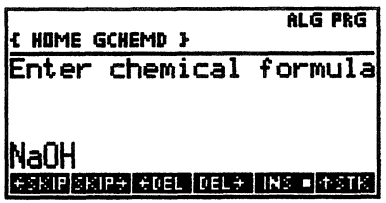
In This Chapter

The Molecular Weight function allows you to calculate molecular weights and percent elemental compositions of compounds you enter.

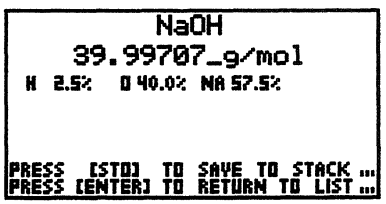
Using the Molecular Weight Function

To calculate molecular weights of chemical compounds, select Molecular Weight from the main menu and press ENTER. This yields:
Suppose you want to calculate the molecular weight of sodium hydroxide, NaOH. Type N ⇆ A O H at the prompt, as shown:





Press ENTER to calculate molecular weight and percent composition:



Press STO to store the molecular weight on the calculator stack, or press ENTER to return to the main menu.

Entering Molecular Formulas

Chemical formulas consist of a series of element symbols and chemical groups of element symbols in parenthesis. Optional trailing multipliers may be entered to indicate more than one of a given element or group. Fractional multipliers may be entered, in decimal format. Some examples of acceptable chemical formulas are:

Compound	Input
HCl	HC ← L
HNO_3	HNO3
$Ca(NO_3)_2$	C ← A ← ÷ NO3 α ▶ 2
$C(CH_3)_3$	C ← ÷ C H 3 α ▶ 3

After unlocking alpha-entry mode to enter parentheses or to move the cursor, it is necessary to press α once or twice to re-lock alpha-entry mode for subsequent alphabetic entry. For more information on the alpha entry mode of the calculator, see the *HP 48GX Owner's Manual.*

Appendix A

Warranty and Service

PocketProfessional Support

Get answers to your questions about your PocketProfessional card from da Vinci Technologies Group, Inc. If you don't find the information in this manual or in the HP 48GX owner's manual, contact us in writing at:

da Vinci Technologies Group, Inc.
899 NW Grant Avenue
Corvallis, OR 97330
Tel: (541) 757-8416
e-Mail: support@sparcom.com
Website: http://www.sparcom.com

Limited One Year Warranty

What is covered

The PocketProfessional is warranted by da Vinci Technologies Group, Inc. against defects in material and workmanship for one year from the date of original purchase. If you sell your card or give as a gift, the warranty is automatically transferred to the new owner and remains in effect for the original one-year period. During the warranty period, we will repair or replace (at no charge) a product that proves to be defective, provided you return the product and proof of purchase, shipping prepaid to Da Vinci Technologies Group, Inc.

What is not Covered

No other warranty is given. Any other implied warranty of merchantability or fitness is limited to the one-year duration of this written warranty. In no event shall da Vinci Technologies Group, Inc., be liable for consequential damages. Products are sold on the basis of specifications applicable at the time of manufacture. Da Vinci

Technologies Group, Inc. has no obligation to modify or update products, once sold.

If the Card Requires Service

Da Vinci Technologies Group will repair a card, or replace it with the same model or one of equal or better functionality. There is a fixed charge for out-of-warranty repairs which is subject to the customer's local sales or value-added tax, wherever applicable. Cards damaged by accident or misuse are not covered by fixed charges.

Shipping Instructions

If your card requires service, follow this procedure:

1. Call Da Vinci Technologies Group, Inc. at (541) 757-8416 and obtain authorization by obtaining a RMA number.
2. Ship the card back to Da Vinci Technologies in the following manner:
    - Include your return address, phone number and a brief description of the nature of the problem.
    - Include the RMA number outside the package.
    - If the card is still under warranty, include proof of purchase.
    - Include a check, purchase order, or a credit card number (only VISA, MASTER CARD and DISCOVER cards are honored) and the expiration date to cover the estimated charges.
    - Ship the card, postage prepaid, in protective packing adequate to prevent damage. We strongly recommend that you insure your package. Ship the package to

Da Vicni Technologies Group, Inc.
RMA #:_____
Technical Support
899 NW Grant Avenue
Corvallis, OR 97330 USA

Cards are serviced and reshipped in five business days.

Environmental Limits

Safe temperature and humidity range for PocketProfessional cards is:

- Operating temperature: 0 to 45°C (32 to 113°F)
- Storage temperature: -20 to 60°C (-4 to 140°F)
- Operating and storage humidity: 90% RH at 40°C(104°F)

Appendix B

References

- Handbook of Chemistry and Physics, Chemical Rubber Company, 70th Edition, 1990
- Charles Hill, "Chemical Engineering Kinetics and Reactor Design", John Wiley and Sons
- Sargent-Welsch company, Periodic table of Elements, 1980
- Lang's Handbook of Chemistry, 13th Edition

Appendix C

Commonly Asked Questions

Q. I'm not sure whether the Pocket Professional card is malfunctioning or I'm doing something improperly. How can I verify that the card and the calculator are functioning properly.

A. There are several possibilities for this condition to occur.

- check to make sure that the card is properly seated in the calculator port.
- turn the calculator ON and press [→] [LIBRARY]. The calculator checks the reference card when it turns on; if "Invalid Card Data or Port Not Available" message is displayed, then the card may require service. If the library menu does not include the reference name shown in Chapter 1, then the card may require service.
- a third possibility occurs when you remove a merged RAM card incorrectly and install the Pocket Professional card. In this case, the calculator display shows "Recovering Memory".

Q. What do three dots (...) mean at the end of a display line?

A. The three dots indicate that the object is displayed too long to show on one line. To view the complete object, select the object using the [▼] or the [▲] key by moving the pointing arrow to the object to be displayed, press the softkey [VIEW]. Pressing [ENTER] will return to the browser.

Q. While searching a list of information, I used the alpha key to do the search, but the search did not work. Why?

A. Most likely, the search did not work because of case sensitivity of the alpha search.

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