For fx-CG10 Series/fx-CG20 Series/fx-CG50 Series/ GRAPH90+ E

E

Physium Application

User's Guide

CASIO Worldwide Education Website

http://edu.casio.com

Manuals are available in multi languages at

http://world.casio.com/manual/calc

CASIO®

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1 Physium Overview

- The Physium application provides you with the following capabilities.

Periodic Table of Elements

- The application can be used to display periodic table of elements.
- Table shows atomic number, element symbol, atomic weight, etc.
- Elements can be search for based on element name, element symbol, atomic number or atomic weight.
- You can edit atomic weight values.
- Atomic numbers, element symbols, electron configurations, and atomic weights can be saved to a spreadsheet in the **Spreadsheet** mode.

Fundamental Physical Constants

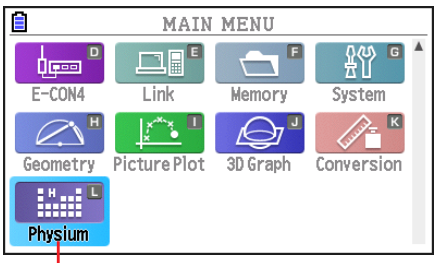
- The application can be used to display fundamental physical constants, which are grouped for easy referencing.
- Physical constants can be edited and saved as required.
- Physical constants can be stored in Alpha memory and used in the **Run-Matrix** mode.

Note

- On-screen messages are displayed in the language selected with the language setting.
- This application can run on calculators installed with OS Version 1.03 or greater. It will not run on a calculator installed with an OS Version lower than 1.03.

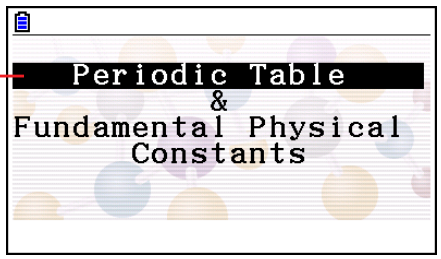
2 Starting Up Physium

1. From the Main Menu, enter the **Physium** mode.



***Physium** mode*

2. This displays an initial screen like the one shown below.

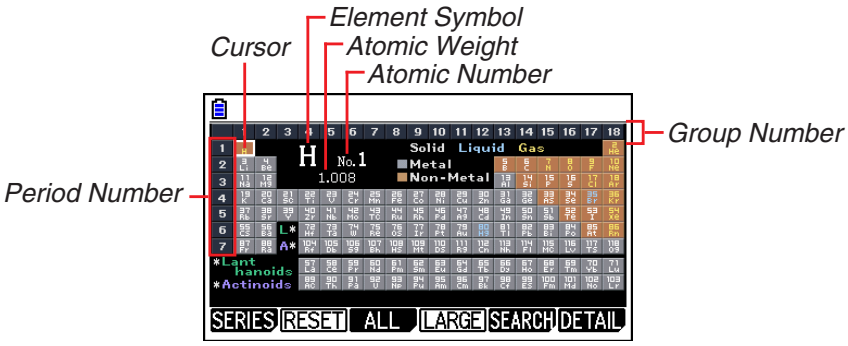


Cursor

3. Use ▲ and ▼ to move the highlighting and select the type of information you want (Periodic Table or Fundamental Physical Constants).
4. Press [EXE] to display the information you selected in step 3 (Periodic Table or Fundamental Physical Constants).

3 Periodic Table

■ Periodic Table Screen



- Group numbers run along top of the screen, while period numbers run down the left.
- Lanthanoids are indicated as L∗, while actinoids are indicated as A∗.
- The atomic number, element symbol, and atomic weight for the element where the cursor is currently located are shown in the area outside of the periodic table.
- Transition elements (lanthanoids and actinoids) are shown below the periodic table.
- When a lanthanoid is selected, the information in the upper right shows the corresponding atomic number (57 to 71), “Lant.” for the element symbol, and blank for the atomic weight. When an actinoid is selected, the information shows the corresponding atomic number (89 to 103), “Acti.” for the element symbol, and blank for the atomic weight.
- Use ▲, ▼, ◀, and ▶ to move the cursor around the screen.

F1 (SERIES) F1 (TRANS) ..... Highlights the cells of elements whose metallicity makes them transition elements.

F2 (A•METAL) ..... Highlights the cells of elements that are in the Alkali Metals category.

F3 (A•EARTH) ..... Highlights the cells of elements that are in the Alkaline Earth Metal category.

F4 (HALOGEN) ..... Highlights the cells of elements that are in the Halogens category.

F5 (N•GAS) ..... Highlights the cells of elements that are in the Noble Gases category.

F6 (R•EARTH) ..... Highlights the cells of elements that are in the Rare Earth category.

F2 (RESET) ..... Clears highlighting from the periodic table screen.

F3 (ALL) F1 (STORE) ..... Saves all of the atomic numbers, element symbols, electron configurations, and atomic weights in the periodic table to a spreadsheet in the **Spreadsheet** mode.

F2 (INITIAL) ..... Returns all atomic weight values for all of the elements in the periodic table to their initial defaults.

F4 (LARGE) ..... Displays the enlarged periodic table screen (page 3-5).

F5 (SEARCH) F1 (NAME) ..... Displays a dialog box to search for an element name.

F2 (SYMBOL) ..... Displays a dialog box to search for an element symbol.

F3 (No.) ..... Displays a dialog box to search for an atomic number.

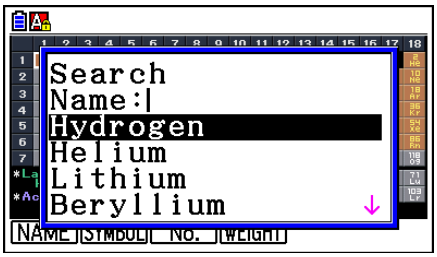
F4 (WEIGHT) ..... Displays a dialog box to search for an atomic weight.

F6 (DETAIL)(or EXE) ..... Displays a screen with details about the element where the cursor is located (page 3-6). Note that the detail screen does not appear when lanthanoids or actinoids are selected.

EXIT ..... Returns to the Physium initial screen.

• Searching for an Element Name

1. On the periodic table screen, press F5 (SEARCH) and then F1 (NAME).
   - This will display an element name search dialog box.

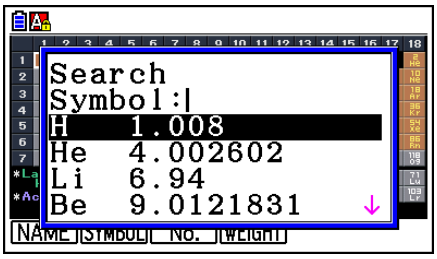


2. Enter up to nine characters for the element name you want to search for.
   - The screen will change to show all elements whose names start with the character(s) you input.
3. Use ▲ and ▼ to select the element name you want.
4. Press EXE to return to the periodic table screen, with the cursor located at the element you selected in step 3.

- "Nothing" will appear on the screen if no element name corresponds to the character(s) you input.
- To close the dialog box and return to the periodic table screen without searching for anything, press EXIT.
- When searching for a name that includes an accented character (á, é, etc.), enter the letter without the accent. Chinese language searches are performed using pinyin.

• Searching for an Element Symbol

1. On the periodic table screen, press [F5](SEARCH) and then [F2](SYMBOL).
   - This will display an element symbol search dialog box.

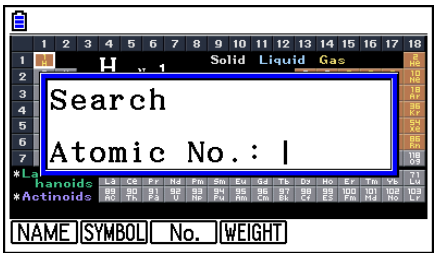


2. Enter up to nine characters for the element symbol you want to search for.
   - The screen will change to show all elements whose element symbols start with the character(s) you input.
3. Use ▲ and ▼ to select the element symbol you want.
4. Press [EXE] to return to the periodic table screen, with the cursor located at the element you selected in step 3.

- "Nothing" will appear on the screen if no element name corresponds to the character(s) you input.
- To close the dialog box and return to the periodic table screen without searching for anything, press [EXIT].

• Atomic Number Search

1. On the periodic table screen, press [F5](SEARCH) and then [F3](No.).
   - This will display an atomic number search dialog box.

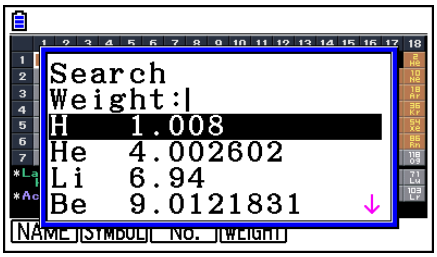


2. Enter up to three digits for the atomic number you want to search for.
3. Press [EXE] to return to the periodic table screen, with the cursor located at the element that corresponds to the atomic number you input in step 2.

- If there is no element that corresponds to the atomic number you input, pressing [EXE] will return to the periodic table screen with the cursor at the same location it was when you started this procedure.
- To close the dialog box and return to the periodic table screen without searching for anything, press [EXIT].

• Atomic Weight Search

1. On the periodic table screen, press F5 (SEARCH) and then F4 (WEIGHT).
   - This will display an atomic weight search dialog box.

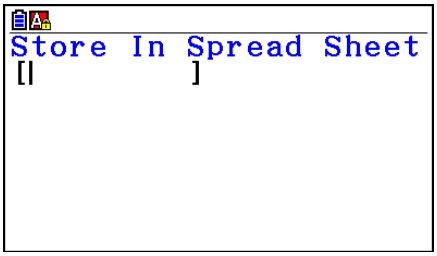


2. Enter a value up nine digits long (including numbers and decimal point) for the atomic weight you want to search for.
   - The screen will change to show all elements whose atomic weight corresponds to the numbers you input.
3. Use ▲ and ▼ to select the atomic weight you want.
4. Press EXE to return to the periodic table screen, with the cursor located at the element you selected in step 3.

- "Nothing" will appear on the screen if no atomic weight corresponds to the number(s) you input.
- To close the dialog box and return to the periodic table screen without searching for anything, press EXIT.

• To store atomic numbers, element symbols, electron configurations, and atomic weights to a spreadsheet in the Spreadsheet mode

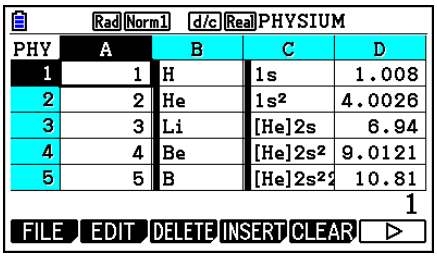
1. While the periodic table is displayed, press F3 (ALL) F1 (STORE).
   - This displays the file name input screen.



2. Input a file name and then press EXE.

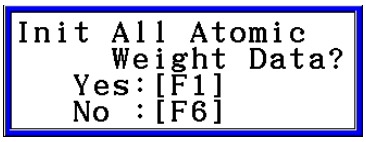
Note

The data shown below is saved to the spreadsheet.
Column A: Atomic numbers (values from 1 to 118)
Column B: Element symbols
Column C: Electron configurations
Column D: Atomic weights (Values edited on the detail screen)



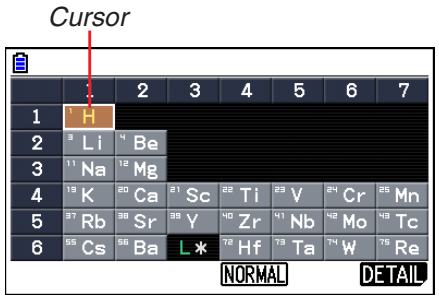
• To return atomic weight values to their initial defaults

1. While the periodic table is displayed, press [F3](ALL)[F2](INITIAL).
   - This displays the message shown below.



2. Press [F1](Yes).

■ Enlarged Screen

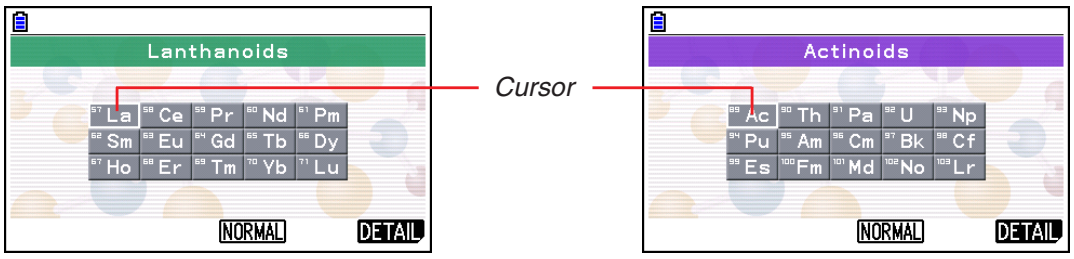


- The periodic table is displayed as a maximized screen.
- Use ▲, ▼, ◀, and ▶ to move the cursor around the screen.

[F4](NORMAL) (or [EXIT]) .... Returns to the periodic table screen.

[F6](DETAIL) (or [EXE]) ..... Displays a screen with details about the element where the cursor is located (page 3-6). The lanthanoids screen will appear when L∗ is selected, and the actinoids screen will appear when A∗ is selected.

• Lanthanoids Screen and Actinoids Screen



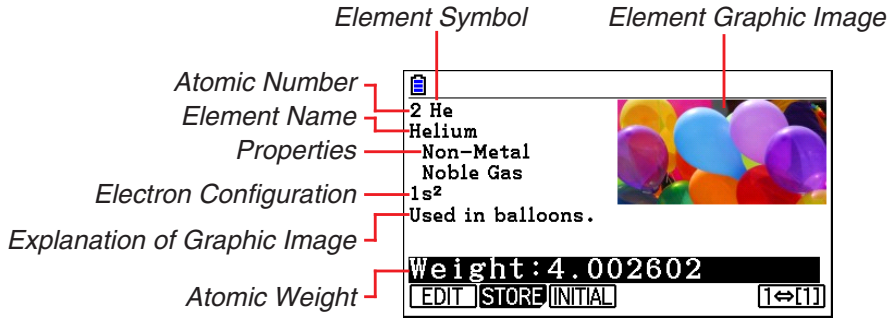
- Selecting L∗ on the enlarged screen and pressing [F6](DETAIL) or [EXE] displays the lanthanoids screen, while selecting A∗ and pressing [F6](DETAIL) or [EXE] displays the actinoids.
- Use ▲, ▼, ◀, and ▶ to move the cursor around the screen.

[F6](DETAIL) (or [EXE]) ..... Displays a screen with details about the element where the cursor is located.

[EXIT] ..... Returns to the enlarged screen.

■ Detail Screen

Pressing [F6](DETAIL) or [EXE] while the Periodic Table Screen or enlarged screen is displayed will display a detail screen of the element where the cursor is located.



- The detail screen shows the atomic number, element symbol, element name, properties, electron configuration, atomic weight, and a graphic image of the element.
- An atomic weight value in square brackets ([ ]) indicates the atomic weight of the most well-known element among isotopes. In this case, an asterisk (*) will be appended at the end of the element name.

[F1](EDIT) ..... Edits the atomic weight.

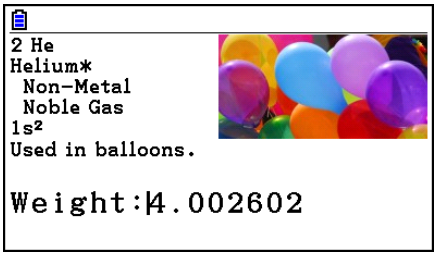
[F2](STORE) ..... Saves the atomic weight value to Alpha memory.

[F3](INITIAL) ..... Returns the atomic weight value to their default.

[F6](1⇔[1]) ..... Changes the display format of the atomic weight.

• To edit the atomic weight

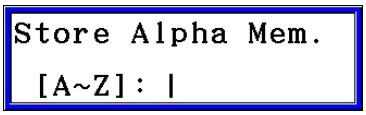
1. Press [F1](EDIT).
   - This enters the atomic weight editing mode.



2. Input the atomic weight value you want.
   - You can input up to 12 digits, including values and a decimal point for an atomic weight.
3. Press [EXE].
   - This saves the value you input.
   - Pressing [F3](INITIAL) returns the atomic weight to its initial default.

• To save an atomic weight value to Alpha memory

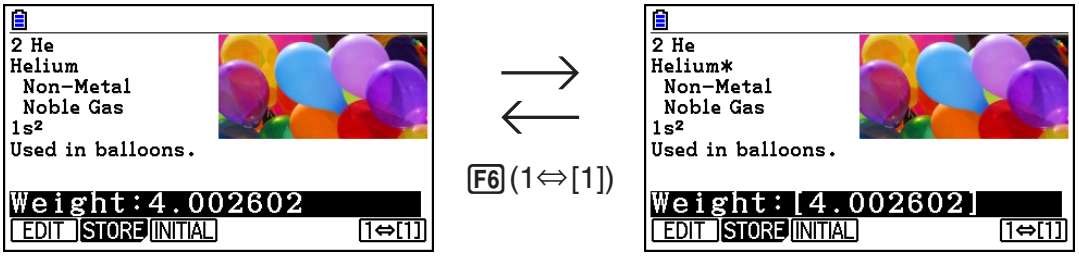
1. Press F2 (STORE).
   - This displays the “Store Alpha Mem.” dialog box.



2. Enter a character for the Alpha memory where you want to save the value.
3. Press EXE.

• To change the display format of the atomic weight

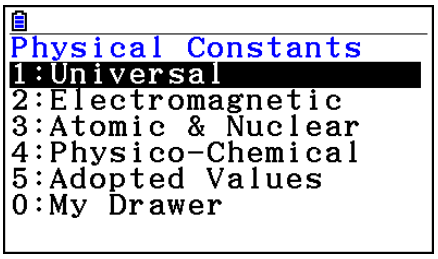
1. Press F6 (1⇔[1]).
   - Each press of F6 (1⇔[1]) toggles the atomic weight value between being enclosed in square brackets ([ ]) and not enclosed in square brackets.



   - Enclosing the atomic weight value in square brackets also causes an asterisk (*) to be appended to the end of the element name.

4 Fundamental Physical Constants

■ Category Selection Screen



[1] (Universal) ..... Displays a list of universal physical constants.
[2] (Electromagnetic) ..... Displays a list of electromagnetic physical constants.
[3] (Atomic & Nuclear) ..... Displays a list of atomic and nuclear physical constants.
[4] (Physico-Chemical) ..... Displays a list of physico-chemical physical constants.
[5] (Adopted Values)..... Displays a list of adopted values physical constants.
[0] (My Drawer)..... Displays the “My Drawer” screen.
[EXIT] ..... Returns to the Physium initial screen.

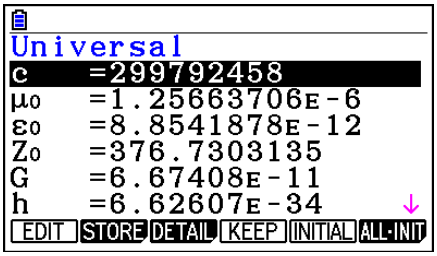
■ Built-in Constants

- The following is a list of the constants that this application includes as built-in fundamental physical constants.

Category	Quantity	Value
Universal	c : speed of light in vacuum	299792458
	μ_0 : magnetic constant	1.2566370614E–6
	ε_0 : electric constant	8.854187817E–12
	Z_0 : characteristic impedance of vacuum	376.730313461
	G : Newtonian constant of gravitation	6.67408E–11
	h : Planck constant	6.62607004E–34
	$\hbar$: Planck constant over 2 pi	1.0545718E–34
	m_p : Planck mass	2.17647E–8
	l_p : Planck length	1.616229E–35
	t_p : Planck time	5.39116E–44
Electromagnetic	e : elementary charge	1.6021766208E–19
	ϕ_0 : magnetic flux quantum	2.067833831E–15
	G_0 : conductance quantum	7.748091731E–5
	K_J : Josephson constant	4.835978525E14
	R_K : von Klitzing constant	25812.8074555
	μ_B : Bohr magneton	9.274009994E–24
	μ_N : nuclear magneton	5.050783699E–27

Category	Quantity	Value
Atomic & Nuclear	α : fine-structure constant	7.2973525664E–3
	R_∞ : Rydberg constant	10973731.568508
	a_0 : Bohr radius	5.2917721067E–11
	m_e : electron mass	9.10938356E–31
	μ_e : electron magnetic moment	–9.28476462E–24
	m_μ : muon mass	1.883531594E–28
	μ_μ : muon magnetic moment	–4.49044826E–26
	m_τ : tau mass	3.16747E–27
	m_p : proton mass	1.672621898E–27
	μ_p : proton magnetic moment	1.4106067873E–26
	m_n : neutron mass	1.674927471E–27
	μ_n : neutron magnetic moment	–9.662365E–27
Physico-Chemical	N_A : Avogadro constant	6.022140857E23
	m_u : atomic mass constant	1.66053904E–27
	F : Faraday constant	96485.33289
	R : molar gas constant	8.3144598
	k : Boltzmann constant	1.38064852E–23
	V_m : molar volume of ideal gas (273.15 K, 100 kPa)	0.022710947
	σ : Stefan-Boltzmann constant	5.670367E–8
Adopted Values	K_{J-90} : conventional value of Josephson constant	483597.9
	R_{K-90} : conventional value of von Klitzing constant	25812.807
	g_n : standard acceleration of gravity	9.80665

■ Constant List Screen



- The constant list screen shows each constant in the format: Symbol = Value.
- Use ▲ and ▼ to move the highlighting to the constant you want to select.

F1 (EDIT) ..... Enters the editing mode for editing the currently selected constant. The editing mode is also entered automatically whenever a number key is pressed while a constant is selected.

F2 (STORE) ..... Stores the currently selected constant in Alpha memory.

F3 (DETAIL) (or EXE) ..... Displays a dialog box with details about the currently selected constant.

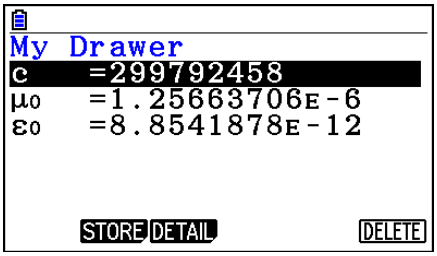
F4 (KEEP) ..... Stores the currently selected constant in My Drawer.
- Press F4 (KEEP) causes the message “Complete!” to appear on the display. Press EXIT to clear the message from the screen.

F5 (INITIAL) ..... Returns the currently selected constant to its initial default value.

F6 (ALL•INIT) ..... Returns all constants to their initial default values.

EXIT ..... Returns to the category selection screen.

■ My Drawer Screen



- Pressing F4 (KEEP) while the constant list screen is on the display will save the currently selected constant to the My Drawer screen. The My Drawer screen displays constants in the sequence they are saved.

F2 (STORE) ..... Stores the currently selected constant in Alpha memory.

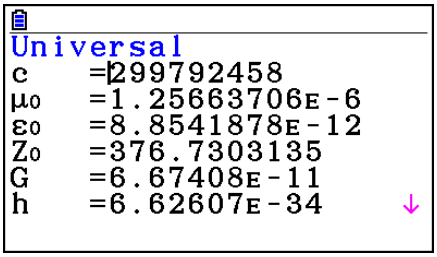
F3 (DETAIL) (or EXE) ..... Displays a dialog box with details about the currently selected constant.

F6 (DELETE) ..... Deletes the currently selected constant.

EXIT ..... Returns to the category selection screen.

■ Editing a Constant

1. Select the constant you want to edit, and then press F1 (EDIT).
   - This enters the editing mode.

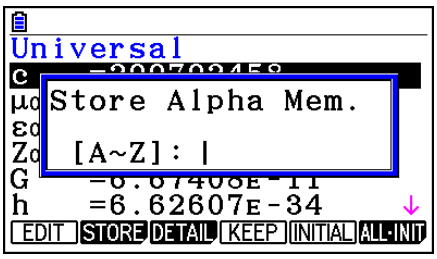


2. Edit the constant as desired.
3. Press EXE.

- This saves the edited version of the constant.
- Even if you input more than 15 digits for a constant value, only the 15 most significant digits are saved.
- A Syntax ERROR occurs if the resulting constant is the wrong format.
- An Ma ERROR occurs if the resulting constant is mathematically incorrect or illegal.

■ Saving a Constant to Alpha Memory

1. Select the constant you want to save in Alpha memory and then press F2 (STORE).
   - This displays the “Store Alpha Mem.” dialog box.

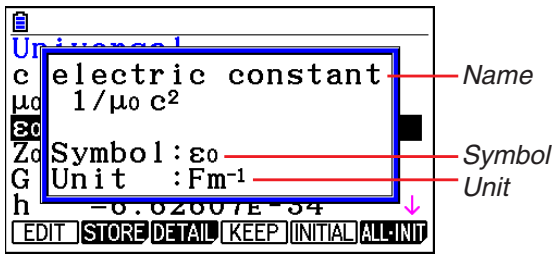


2. Enter a letter that represents the Alpha memory where you want to store the constant.
3. Press EXE.

- Now when you recall the applicable Alpha memory in the **Run-Matrix** mode, the calculator will input the constant stored there.

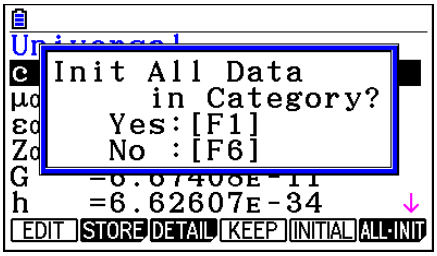
■ Details Dialog Box

- Selecting a constant and pressing [F3](DETAIL) or [EXE] will display a dialog box with details about the selected constant.
- The details dialog box shows the constant name, symbol, and unit.



■ Returning All Constants to their Initial Default Values

- While the constant list screen is on the display, press [F6](ALL•INIT) to display the Init All dialog box.



- Press [F1](Yes) to return all of the constants to their initial default values.

5 Calling Physium Functions from an eActivity

You can call Physium functions from an eActivity by including a “Physium strip” in the eActivity file.

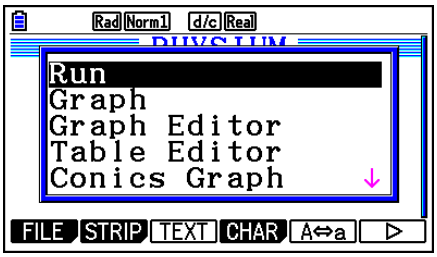
This section explains how to insert a Physium strip into an eActivity file, and how to use inserted a Physium strip. For details about eActivity operations, see “Chapter 10 eActivity” in the Software User’s Guide that comes with the calculator.

■ Inserting a Physium Strip into an eActivity File

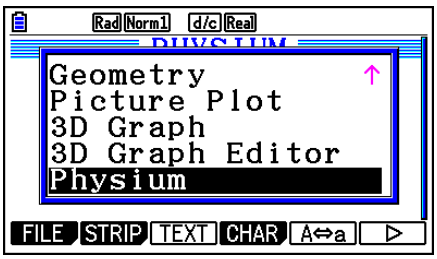
The following procedure assumes that the eActivity file into which you want to insert the Physium strip is already open. For information about creating a new file and other basic eActivity operations, see “3. eActivity File Operations” (page 10-4) in the Software User’s Guide that comes with the calculator.

• To insert a Physium Strip into an eActivity file

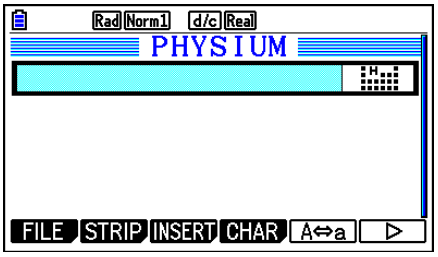
1. On the eActivity workspace screen, move the cursor the location where you want to insert the Physium strip.
2. Press F2 (STRIP).
   - This will display a dialog box with a list of insertable strips.



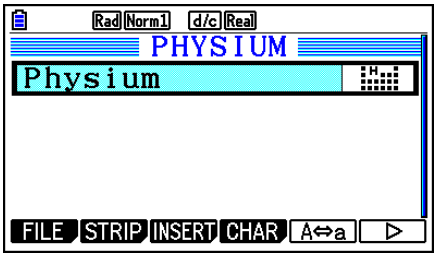
3. Use ▲ and ▼ to move the highlighting to the Physium strip you want to insert.



4. Press [EXE].
   - The strip is inserted above the line or the strip where the cursor is currently located.



5. Enter up to 16 characters for the strip title.
6. Press [EXE] to assign the title to the strip.

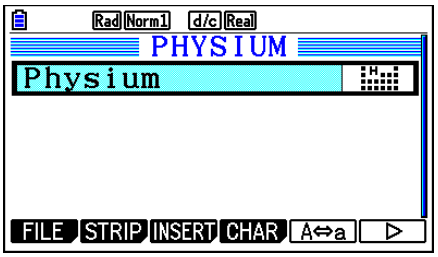


   - This will highlight the strip.
   - You can execute the strip here by pressing [EXE]. For details about operations that are required when you execute a strip, see “Calling a Physium Function from a Physium Strip” below.

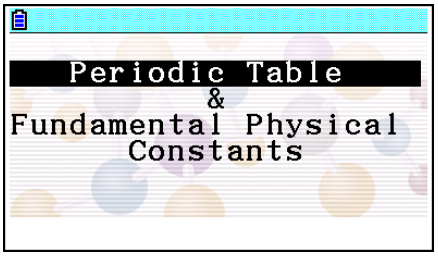
■ Calling a Physium Function from a Physium Strip

This section explains operations for Physium strip that can be inserted into an eActivity file. The following procedure assumes that the applicable Physium strip has already been inserted into an eActivity file that is currently open.

1. On the eActivity workspace screen, use the ▲ and ▼ keys to move the highlighting to the Physium strip.



2. Press [EXE].
   - This launches the Physium and displays the initial screen.



3. Perform the procedure under “Starting Up Physium” (page 2-1) from step 3.
4. To return to the eActivity workspace screen, press [SHIFT] [→] (⮌).

• Physium Strip Memory Capacity Precautions

- For information about checking the current memory usage of each strip, see “To display the strip memory usage screen” (page 10-21) in the Software User’s Guide that comes with the calculator.

6 Precautions

- You can save screen captures of Physium screens and dialog box. For details, see “Chapter 1 – 9. Using Screen Capture” in the Software User’s Guide that comes with the calculator.
- Note that the Catalog Function described in the Software User’s Guide that comes with the calculator is not supported by Physium.
- The atomic weights in this application are based on those recommended by 2015 IUPAC (International Union of Pure and Applied Chemistry).
- Electron configurations are based on information in the “CRC Handbook of Chemistry and Physics 91st Edition”.
- The physical constants in this application are based on those recommended by the 2014 CODATA.
- A scientific constant in this application may be slightly different depending on the year it is presented or books it is presented. Refer to appropriate information that fits your purpose before use.
- The classification of rare earth elements may be slightly different from those in typical textbooks or magazines in the USA.
- The classification of transition elements may be slightly different from those in typical textbooks or magazines in the USA.
- If the atomic weights and physical constants of your calculator have been modified, the modified values will be retained even if you update the Physium application to the latest version. For the latest values, perform the operations below to return the atomic weights and physical constants to their initial default values.
  - While the periodic table is displayed: F3 (ALL) F2 (INITIAL) F1 (Yes)
  - While the constant list screen is displayed: F6 (ALL•INIT) F1 (Yes)

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