free42 Custom Constants

Mitch Richling

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Author: Mitch Richling
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Contents

1 Metadata

The home for this HTML file is: `https://richmit.github.io/hp42/cons.html`
A PDF version of this file may be found here: `https://richmit.github.io/hp42/cons.pdf`
Files related to this document may be found on github: `https://github.com/richmit/hp42`
Directory contents:

`src`	-	The org-mode file that generated this HTML document
`src_42s`	-	Ready to convert source listings for 42s code in this document
`docs`	-	This html document
`bin`	-	Importable RAW program files

2 Introduction

Several constants libraries are available for the 42s, and some of them are quite good. Unfortunately nobody is going to make a constants library with just the constants I use. ;)
This Emacs org-file contains a bit of lisp code to write a 42s CONST program with the constants you want.
The constants I use are taken from the NIST 2018 constants DB. As a reference I have included the unused constants from the NIST list.
The flow to create your custom CONST program:

- Evaluate the "Generic menu generator" babel block in hp42s-meta.org. This will define the function `MJR-generate-42-menu-code`
- Put the constants you want into the table in the Constants Used section below (see: Customizing the Constants Table)
- Optional: Customize the generator code in the Code section below. (see: Customizing the Gen Code)

- Evaluate the babel block in the Code section below.
- Load the program on your calculator

2.1 Customizing the Constants Table

The "Menu" column describes the menu keys that will be assigned to the constant. Colons are used to define a menu hierarchy. For example "`top:mid:con1`" means we have a top level menu "`top`" containing a menu "`mid`" containing a constant "`con1`". Another entry like "`top:con2`" would add a constant named "`con2`"to the "`top`" menu – yes menus can contain a mix of constants and menus.

The menu structure can be as deep as you like. The one I use has a top level menu consisting of NIST constant category labels. Each of these menus, except for "`atom`", directly contain constants – so most constants are two key presses away. The exception is the `atom` menu which contains deeper menus – thus making atomic constants three key presses away.

Note the code generator uses two digit local labels in the generated code, and thus you can run out of labels if you have too many constants. Each menu page and each constant consumes one label.

The "Desc" column is the source for the description printed by the `CONS` program. Make sure it is 22 chars or less. Note the description print can be suppressed (see: Customizing the Gen Code)

The "Unit" column is the source for the second line printed by the `CONS` program. Note I use an odd syntax for the units – everything in front of the "`/`" is on the top of the fraction and everything after the "`/`" is on the bottom. While incorrect syntax for an algebraic expression, it is handy and saves some space. Note the units print can be suppressed (see: Customizing the Gen Code)

2.2 Customizing the Gen Code

The generator code can be customized in a few ways:

- `print-desc` can be set to `NIL` to suppress printing the description
- `print-unit` can be set to `NIL` to suppress printing the unit
- The `'exit` argument to `MJR-generate-42-menu-code` can be set to `'stay` if you prefer the menu to remain after a constant is recalled
- The `'up` argument to `MJR-generate-42-menu-code` can be set to `'exit` if you prefer the `[EXIT]` key to entirely exit the application instead of going up one menu level.

3 Constants

3.1 Constant Data (2018 NIST)

3.2 Test Data

Symbol	Value	Description	units	NIST Category
x13	1	0123456789012	u	
x14	1	01234567890123	u	
x15	1	012345678901234	u	
x16	1	0123456789012345	u	
x17	1	01234567890123456	u	
x21	1	012345678901234567890	u	
x22	1	01234567890123456789 01	u	
x23	1	012345678901234567890 12	u	

3.3 Constants Used

Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
univ:h	Planck Constant	Planck constant	6.62607015e-34	0	J/Hz	univ
univ:hbar	Dirac Constant	reduced Planck constant	1.054571817e-34	0	J*s	univ
univ:c	Speed of Light	speed of light in vacuum	299792458	0	m/s	univ
univ:E0	Vac Ele Permittivity	vacuum electric permittivity	8.8541878128e-12	0.0000000013e-12	F/m	univ
univ:μ0	Vac Mag Permeability	vacuum magetic permeability	1.25663706212e-6	0.00000000019e-6	N/A^2	univ
univ:G	Gravitational Constant	Newtonian constant of gravitation	6.67430e-11	0.00015e-11	m^3/kg*s^2	univ
univ:tp	Planck Time	Planck time	5.391247e-44	0.000060e-44	s	univ

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Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
adpt:gacc	Earth Std Grav Accel	standard acceleration of gravity	9.80665	0	m/s	derv
adpt:atm	Standard Atmosphere	standard atmosphere	101325	0	Pa	derv
elec:mN	Nuclear Magneton	nuclear magneton	5.0507837461e-27	0.0000000015e-27	J/*T	elec
elec:μB	Bohr Magneton	Bohr magneton	9.2740100783e-24	0.0000000028e-24	J/T	elec
elec:e	Elementary Charge	elementary charge	1.602176634e-19	0	C	elec
elec:F0	Mag flux quantum	magnetic flux quantum	2.067833848e-15	0	Wb	elec
elec:G0	Conductance Quantum	conductance quantum	7.748091729e-5	0	S	elec
pchm:mu	Atomic Mass Unit	unified atomic mass unit	1.66053906660e-27	0.00000000050e-27	kg	pchem
pchm:F	Faraday	Faraday constant	96485.33212	0	C/mol	pchem
pchm:Na	Avogadro's Number	Avogadro constant	6.02214076e23	0	1/mol	pchem
pchm:k	Boltzmann Constant	Boltzmann constant	1.380649e-23	0	J/K	pchem
pchm:R	Ideal Gas Constant	molar gas constant	8.314462618	0	J/mol*K	pchem
pchm:s	Stefan Constant	Stefan-Boltzmann constant	5.670374419e-8	0	W/m^2*K^4	pchem
pchm:rc1	First Radiation Cnst	first radiation constant	3.741771852e-16	0	W*m^2	pchem
pchm:rc2	Second Radiation Cnst	second radiation constant	1.438776877e-2	0	m*K	pchem
atom:misc:a	Fine Structure	fine-structure constant	7.2973525693e-3	0.0000000011e-3		atom
atom:misc:Eh	Hartree Energy	Hartree energy	4.3597447222071e-18	0.0000000000085e-18	J	atom
atom:misc:Ry	Rydberg Constant	Rydberg constant	10973731.568160	0.000021	1/m	atom
atom:mass:pro	Proton Mass	proton mass	1.67262192369e-27	0.00000000051e-27	kg	atom
atom:mass:ele	Electron Mass	electron mass	9.1093837015e-31	0.0000000028e-31	kg	atom
atom:mass:neut	Neutron Mass	neutron mass	1.67492749804e-27	0.00000000095e-27	kg	atom
atom:mass:muon	Muon Mass	muon mass	1.883531627e-28	0.000000042e-28	kg	atom
atom:magm:pro	Proton Mag Mom	proton magnetic moment	1.41060679736e-26	0.00000000060e-26	J/T	atom
atom:magm:ele	Electron Mag Mom	electron magnetic moment	-9.2847647043e-24	0.0000000028e-24	J/T	atom
atom:magm:neut	Neutron Mag Mom	neutron magnetic moment	-9.6623651e-27	0.0000023e-27	J/T	atom
atom:magm:muon	Muon Mag Mom	muon magnetic moment	-4.49044830e-26	0.00000010e-26	J/T	atom
atom:rad:bohr	Bohr Radius	Bohr radius	5.29177210903e-11	0.00000000080e-11	m	atom
atom:rad:ele	Electron Radius	classical electron radius	2.8179403262e-15	0.0000000013e-15	m	atom
atom:comp:std	Compton Wavelength	Compton wavelength	2.42631023867e-12	0.00000000073e-12	m	atom
atom:comp:pro	Proton Compton waveln	proton Compton wavelength	1.32140985539e-15	0.00000000040e-15	m	atom
atom:comp:neut	Neutron Compton waveln	neutron Compton wavelength	1.31959090581e-15	0.00000000075e-15	m	atom
atom:comp:muon	Nuon Compton waveln	muon Compton wavelength	1.173444110e-14	0.000000026e-14	m	atom
math:grat	Golden ratio		1.618033988749894			
math:emc	Eul-Masc	Euler–Mascheroni	0.577215664901532			
math:omga	Omega	Omega constant	0.567143290409783			
math:lapl	Laplace limit	Laplace limit	0.662743419349181			

3.4 Constants Not Used

Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
		alpha particle mass	6.6446573357e-27	0.0000000020e-27	kg	atom
		alpha particle mass energy equivalent	5.9719201914e-10	0.0000000018e-10	J	atom
		alpha particle mass energy equivalent in MeV	3727.3794066	0.0000011	MeV	atom
		alpha particle mass in u	4.001506179127	0.000000000063	u	atom
		alpha particle molar mass	4.0015061777e-3	0.0000000012e-3	kg/mol	atom
		alpha particle relative atomic mass	4.001506179127	0.000000000063		atom
		alpha particle-electron mass ratio	7294.29954142	0.00000024		atom
		alpha particle-proton mass ratio	3.97259969009	0.00000000022		atom
		Angstrom star	1.00001495e-10	0.00000090e-10	m	
		atomic mass constant	1.66053906660e-27	0.00000000050e-27	kg	atom
		atomic mass constant energy equivalent	1.49241808560e-10	0.00000000045e-10	J	atom
		atomic mass constant energy equivalent in MeV	931.49410242	0.00000028	MeV	atom
		atomic mass unit-electron volt relationship	9.3149410242e8	0.0000000028e8	eV	atom

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Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
		atomic mass unit-hartree relationship	3.4231776874e7	0.0000000010e7	E_h	atom
		atomic mass unit-hertz relationship	2.25234271871e23	0.00000000068e23	Hz	atom
		atomic mass unit-inverse meter relationship	7.5130066104e14	0.0000000023e14	1/m	atom
		atomic mass unit-joule relationship	1.49241808560e-10	0.00000000045e-10	J	atom
		atomic mass unit-kelvin relationship	1.08095401916e13	0.00000000033e13	K	atom
		atomic mass unit-kilogram relationship	1.66053906660e-27	0.00000000050e-27	kg	atom
		atomic unit of 1st hyperpolarizability	3.2063613061e-53	0.0000000015e-53	C^3*m^3*J^-2	atom
		atomic unit of 2nd hyperpolarizability	6.2353799905e-65	0.0000000038e-65	C^4*m^4*J^-3	atom
		atomic unit of action	1.054571817e-34	0	J*s	atom
		atomic unit of charge	1.602176634e-19	0	C	atom
		atomic unit of charge density	1.08120238457e12	0.00000000049e12	C*m^-3	atom
		atomic unit of current	6.623618237510e-3	0.000000000013e-3	A	atom
		atomic unit of electric dipole moment	8.4783536255e-30	0.0000000013e-30	C*m	atom
		atomic unit of electric field	5.14220674763e11	0.00000000078e11	V/m	atom
		atomic unit of electric field gradient	9.7173624292e21	0.0000000029e21	V/m^2	atom
		atomic unit of electric polarizability	1.64877727436e-41	0.00000000050e-41	C^2*m^2/J	atom
		atomic unit of electric potential	27.211386245988	0.000000000053	V	atom
		atomic unit of electric quadrupole moment	4.4865515246e-40	0.0000000014e-40	C*m^2	atom
		atomic unit of energy	4.3597447222071e-18	0.0000000000085e-18	J	atom
		atomic unit of force	8.2387234983e-8	0.0000000012e-8	N	atom
		atomic unit of length	5.29177210903e-11	0.00000000080e-11	m	atom
		atomic unit of magnetic dipole moment	1.85480201566e-23	0.00000000056e-23	J/T	atom
		atomic unit of magnetic flux density	2.35051756758e5	0.00000000071e5	T	atom
		atomic unit of magnetizability	7.8910366008e-29	0.0000000048e-29	J/T^2	atom
		atomic unit of mass	9.1093837015e-31	0.0000000028e-31	kg	atom
		atomic unit of momentum	1.99285191410e-24	0.00000000030e-24	kg*m/s	atom
		atomic unit of permittivity	1.11265005545e-10	0.00000000017e-10	F/m	atom
		atomic unit of time	2.4188843265857e-17	0.0000000000047e-17	s	atom
		atomic unit of velocity	2.18769126364e6	0.00000000033e6	m/s	atom
		Bohr magneton in eV/T	5.7883818060e-5	0.0000000017e-5	eV/T	atom
		Bohr magneton in Hz/T	1.39962449361e10	0.00000000042e10	Hz/T	atom
		Bohr magneton in inverse meter per tesla	46.686447783	0.000000014	1/m*T	atom
		Bohr magneton in K/T	0.67171381563	0.00000000020	K/T	atom
		Boltzmann constant in eV/K	8.617333262e-5	0	eV/K	pchem
		Boltzmann constant in Hz/K	2.083661912e10	0	Hz/K	pchem
		Boltzmann constant in inverse meter per kelvin	69.50348004	0	1/m*K	pchem
		characteristic impedance of vacuum	376.730313668	0.000000057	ohm	
		conventional value of ampere-90	1.00000008887	0	A	
		conventional value of coulomb-90	1.00000008887	0	C	
		conventional value of farad-90	0.99999998220	0	F	
		conventional value of henry-90	1.00000001779	0	H	
		conventional value of Josephson constant	483597.9e9	0	Hz/V	
		conventional value of ohm-90	1.00000001779	0	ohm	
		conventional value of volt-90	1.00000010666	0	V	
		conventional value of von Klitzing constant	25812.807	0	ohm	
		conventional value of watt-90	1.00000019553	0	W	
		Copper x unit	1.00207697e-13	0.00000028e-13	m	
		deuteron g factor	0.8574382338	0.0000000022		atom
		deuteron magnetic moment	4.330735094e-27	0.000000011e-27	J/T	atom
		deuteron magnetic moment to Bohr magneton ratio	4.669754570e-4	0.000000012e-4		atom
		deuteron magnetic moment to nuclear magneton ratio	0.8574382338	0.0000000022		atom
		deuteron mass	3.3435837724e-27	0.0000000010e-27	kg	atom
		deuteron mass energy equivalent	3.00506323102e-10	0.00000000091e-10	J	atom
		deuteron mass energy equivalent in MeV	1875.61294257	0.00000057	MeV	atom

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Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
		deuteron mass in u	2.013553212745	0.000000000040	u	atom
		deuteron molar mass	2.01355321205e-3	0.00000000061e-3	kg/mol	atom
		deuteron relative atomic mass	2.013553212745	0.000000000040		atom
		deuteron rms charge radius	2.12799e-15	0.00074e-15	m	atom
		deuteron-electron magnetic moment ratio	-4.664345551e-4	0.000000012e-4		atom
		deuteron-electron mass ratio	3670.48296788	0.00000013		atom
		deuteron-neutron magnetic moment ratio	-0.44820653	0.00000011		atom
		deuteron-proton magnetic moment ratio	0.30701220939	0.00000000079		atom
		deuteron-proton mass ratio	1.99900750139	0.00000000011		atom
		electron charge to mass quotient	-1.75882001076e11	0.00000000053e11	C/kg	atom
		electron g factor	-2.00231930436256	0.00000000000035		atom
		electron gyromagnetic ratio	1.76085963023e11	0.00000000053e11	1/s*T	atom
		electron gyromagnetic ratio in MHz/T	28024.9514242	0.0000085	MHz/T	atom
		electron magnetic moment anomaly	1.15965218128e-3	0.00000000018e-3		atom
		electron magnetic moment to Bohr magneton ratio	-1.00115965218128	0.00000000000018		atom
		electron magnetic moment to nuclear magneton ratio	-1838.28197188	0.00000011		atom
		electron mass energy equivalent	8.1871057769e-14	0.0000000025e-14	J	atom
		electron mass energy equivalent in MeV	0.51099895000	0.00000000015	MeV	atom
		electron mass in u	5.48579909065e-4	0.00000000016e-4	u	atom
		electron molar mass	5.4857990888e-7	0.0000000017e-7	kg/mol	atom
		electron relative atomic mass	5.48579909065e-4	0.00000000016e-4		atom
		electron to alpha particle mass ratio	1.370933554787e-4	0.000000000045e-4		atom
		electron to shielded helion magnetic moment ratio	864.058257	0.000010		atom
		electron to shielded proton magnetic moment ratio	-658.2275971	0.0000072		atom
		electron volt	1.602176634e-19	0	J	atom
		electron volt-atomic mass unit relationship	1.07354410233e-9	0.00000000032e-9	u	atom
		electron volt-hartree relationship	3.6749322175655e-2	0.0000000000071e-2	E_h	atom
		electron volt-hertz relationship	2.417989242e14	0	Hz	atom
		electron volt-inverse meter relationship	8.065543937e5	0	1/m	atom
		electron volt-joule relationship	1.602176634e-19	0	J	atom
		electron volt-kelvin relationship	1.160451812e4	0	K	atom
		electron volt-kilogram relationship	1.782661921e-36	0	kg	atom
		electron-deuteron magnetic moment ratio	-2143.9234915	0.0000056		atom
		electron-deuteron mass ratio	2.724437107462e-4	0.000000000096e-4		atom
		electron-helion mass ratio	1.819543074573e-4	0.000000000079e-4		atom
		electron-muon magnetic moment ratio	206.7669883	0.0000046		atom
		electron-muon mass ratio	4.83633169e-3	0.00000011e-3		atom
		electron-neutron magnetic moment ratio	960.92050	0.00023		atom
		electron-neutron mass ratio	5.4386734424e-4	0.0000000026e-4		atom
		electron-proton magnetic moment ratio	-658.21068789	0.00000020		atom
		electron-proton mass ratio	5.44617021487e-4	0.00000000033e-4		atom
		electron-tau mass ratio	2.87585e-4	0.00019e-4		atom
		electron-triton mass ratio	1.819200062251e-4	0.000000000090e-4		atom
		elementary charge over h-bar	1.519267447e15	0	A/J	
		Fermi coupling constant	1.1663787e-5	0.0000006e-5	1/GeV^2	
		first radiation constant for spectral radiance	1.191042972e-16	0	W*m^2/sr	
		Hartree energy in eV	27.211386245988	0.000000000053	eV	
		hartree-atomic mass unit relationship	2.92126232205e-8	0.00000000088e-8	u	
		hartree-electron volt relationship	27.211386245988	0.000000000053	eV	
		hartree-hertz relationship	6.579683920502e15	0.000000000013e15	Hz	
		hartree-inverse meter relationship	2.1947463136320e7	0.0000000000043e7	1/m	
		hartree-joule relationship	4.3597447222071e-18	0.0000000000085e-18	J	
		hartree-kelvin relationship	3.1577502480407e5	0.0000000000061e5	K	
		hartree-kilogram relationship	4.8508702095432e-35	0.0000000000094e-35	kg	

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Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
		helion g factor	-4.255250615	0.000000050		atom
		helion magnetic moment	-1.074617532e-26	0.000000013e-26	J/T	atom
		helion magnetic moment to Bohr magneton ratio	-1.158740958e-3	0.000000014e-3		atom
		helion magnetic moment to nuclear magneton ratio	-2.127625307	0.000000025		atom
		helion mass	5.0064127796e-27	0.0000000015e-27	kg	atom
		helion mass energy equivalent	4.4995394125e-10	0.0000000014e-10	J	atom
		helion mass energy equivalent in MeV	2808.39160743	0.00000085	MeV	atom
		helion mass in u	3.014932247175	0.000000000097	u	atom
		helion molar mass	3.01493224613e-3	0.00000000091e-3	kg/mol	atom
		helion relative atomic mass	3.014932247175	0.000000000097		atom
		helion shielding shift	5.996743e-5	0.000010e-5		atom
		helion-electron mass ratio	5495.88528007	0.00000024		atom
		helion-proton mass ratio	2.99315267167	0.00000000013		atom
		hertz-atomic mass unit relationship	4.4398216652e-24	0.0000000013e-24	u	
		hertz-electron volt relationship	4.135667696e-15	0	eV	
		hertz-hartree relationship	1.5198298460570e-16	0.0000000000029e-16	E_h	
		hertz-inverse meter relationship	3.335640951e-9	0	1/m	
		hertz-joule relationship	6.62607015e-34	0	J	
		hertz-kelvin relationship	4.799243073e-11	0	K	
		hertz-kilogram relationship	7.372497323e-51	0	kg	
		hyperfine transition frequency of Cs-133	9192631770	0	Hz	
		inverse fine-structure constant	137.035999084	0.000000021		
		inverse meter-atomic mass unit relationship	1.33102505010e-15	0.00000000040e-15	u	
		inverse meter-electron volt relationship	1.239841984e-6	0	eV	
		inverse meter-hartree relationship	4.5563352529120e-8	0.0000000000088e-8	E_h	
		inverse meter-hertz relationship	299792458	0	Hz	
		inverse meter-joule relationship	1.986445857e-25	0	J	
		inverse meter-kelvin relationship	1.438776877e-2	0	K	
		inverse meter-kilogram relationship	2.210219094e-42	0	kg	
		inverse of conductance quantum	12906.40372	0	ohm	
		Josephson constant	483597.8484e9	0	Hz/V	
		joule-atomic mass unit relationship	6.7005352565e9	0.0000000020e9	u	
		joule-electron volt relationship	6.241509074e18	0	eV	
		joule-hartree relationship	2.2937122783963e17	0.0000000000045e17	E_h	
		joule-hertz relationship	1.509190179e33	0	Hz	
		joule-inverse meter relationship	5.034116567e24	0	1/m	
		joule-kelvin relationship	7.242970516e22	0	K	
		joule-kilogram relationship	1.112650056e-17	0	kg	
		kelvin-atomic mass unit relationship	9.2510873014e-14	0.0000000028e-14	u	
		kelvin-electron volt relationship	8.617333262e-5	0	eV	
		kelvin-hartree relationship	3.1668115634556e-6	0.0000000000061e-6	E_h	
		kelvin-hertz relationship	2.083661912e10	0	Hz	
		kelvin-inverse meter relationship	69.50348004	0	1/m	
		kelvin-joule relationship	1.380649e-23	0	J	
		kelvin-kilogram relationship	1.536179187e-40	0	kg	
		kilogram-atomic mass unit relationship	6.0221407621e26	0.0000000018e26	u	
		kilogram-electron volt relationship	5.609588603e35	0	eV	
		kilogram-hartree relationship	2.0614857887409e34	0.0000000000040e34	E_h	
		kilogram-hertz relationship	1.356392489e50	0	Hz	
		kilogram-inverse meter relationship	4.524438335e41	0	1/m	
		kilogram-joule relationship	8.987551787e16	0	J	
		kilogram-kelvin relationship	6.509657260e39	0	K	
		lattice parameter of silicon	5.431020511e-10	0.000000089e-10	m	
		lattice spacing of ideal Si (220)	1.920155716e-10	0.000000032e-10	m	

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Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
		Loschmidt constant (273.15 K, 100 kPa)	2.651645804e25	0	1/m^3	pchem
		Loschmidt constant (273.15 K, 101.325 kPa)	2.686780111e25	0	1/m^3	pchem
		luminous efficacy	683	0	lm/W	
		molar mass constant	0.99999999965e-3	0.00000000030e-3	kg/mol	
		molar mass of carbon-12	11.9999999958e-3	0.0000000036e-3	kg/mol	
		molar Planck constant	3.990312712e-10	0	J/Hz*mol	pchem
		molar volume of ideal gas (273.15 K, 100 kPa)	22.71095464e-3	0	m^3/mol	pchem
		molar volume of ideal gas (273.15 K, 101.325 kPa)	22.41396954e-3	0	m^3/mol	pchem
		molar volume of silicon	1.205883199e-5	0.000000060e-5	m^3/mol	
		Molybdenum x unit	1.00209952e-13	0.00000053e-13	m	
		muon g factor	-2.0023318418	0.0000000013		atom
		muon magnetic moment anomaly	1.16592089e-3	0.00000063e-3		atom
		muon magnetic moment to Bohr magneton ratio	-4.84197047e-3	0.00000011e-3		atom
		muon magnetic moment to nuclear magneton ratio	-8.89059703	0.00000020		atom
		muon mass energy equivalent	1.692833804e-11	0.000000038e-11	J	atom
		muon mass energy equivalent in MeV	105.6583755	0.0000023	MeV	atom
		muon mass in u	0.1134289259	0.0000000025	u	atom
		muon molar mass	1.134289259e-4	0.000000025e-4	kg/mol	atom
		muon-electron mass ratio	206.7682830	0.0000046		atom
		muon-neutron mass ratio	0.1124545170	0.0000000025		atom
		muon-proton magnetic moment ratio	-3.183345142	0.000000071		atom
		muon-proton mass ratio	0.1126095264	0.0000000025		atom
		muon-tau mass ratio	5.94635e-2	0.00040e-2		atom
		natural unit of action	1.054571817e-34	0	J*s	
		natural unit of action in eV s	6.582119569e-16	0	eV*s	
		natural unit of energy	8.1871057769e-14	0.0000000025e-14	J	
		natural unit of energy in MeV	0.51099895000	0.00000000015	MeV	
		natural unit of length	3.8615926796e-13	0.0000000012e-13	m	
		natural unit of mass	9.1093837015e-31	0.0000000028e-31	kg	
		natural unit of momentum	2.73092453075e-22	0.00000000082e-22	kg*m/s	
		natural unit of time	1.28808866819e-21	0.00000000039e-21	s	
		natural unit of velocity	299792458	0	m/s	
		neutron g factor	-3.82608545	0.00000090		atom
		neutron gyromagnetic ratio	1.83247171e8	0.00000043e8	1/s*T	atom
		neutron gyromagnetic ratio in MHz/T	29.1646931	0.0000069	MHz/T	atom
		neutron magnetic moment to Bohr magneton ratio	-1.04187563e-3	0.00000025e-3		atom
		neutron magnetic moment to nuclear magneton ratio	-1.91304273	0.00000045		atom
		neutron mass energy equivalent	1.50534976287e-10	0.00000000086e-10	J	atom
		neutron mass energy equivalent in MeV	939.56542052	0.00000054	MeV	atom
		neutron mass in u	1.00866491595	0.00000000049	u	atom
		neutron molar mass	1.00866491560e-3	0.00000000057e-3	kg/mol	atom
		neutron relative atomic mass	1.00866491595	0.00000000049		atom
		neutron to shielded proton magnetic moment ratio	-0.68499694	0.00000016		atom
		neutron-electron magnetic moment ratio	1.04066882e-3	0.00000025e-3		atom
		neutron-electron mass ratio	1838.68366173	0.00000089		atom
		neutron-muon mass ratio	8.89248406	0.00000020		atom
		neutron-proton magnetic moment ratio	-0.68497934	0.00000016		atom
		neutron-proton mass difference	2.30557435e-30	0.00000082e-30	kg	atom
		neutron-proton mass difference energy equivalent	2.07214689e-13	0.00000074e-13	J	atom
		neutron-proton mass difference energy equivalent in MeV	1.29333236	0.00000046	MeV	atom
		neutron-proton mass difference in u	1.38844933e-3	0.00000049e-3	u	atom
		neutron-proton mass ratio	1.00137841931	0.00000000049		atom
		neutron-tau mass ratio	0.528779	0.000036		atom
		Newtonian constant of gravitation over h-bar c	6.70883e-39	0.00015e-39	c^4/GeV^2	

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Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
		nuclear magneton in eV/T	3.15245125844e-8	0.00000000096e-8	eV/T	
		nuclear magneton in inverse meter per tesla	2.54262341353e-2	0.00000000078e-2	1/m*T	
		nuclear magneton in K/T	3.6582677756e-4	0.0000000011e-4	K/T	
		nuclear magneton in MHz/T	7.6225932291	0.0000000023	MHz/T	
		Planck constant in eV/Hz	4.135667696e-15	0	eV/Hz	
		Planck length	1.616255e-35	0.000018e-35	m	
		Planck mass	2.176434e-8	0.000024e-8	kg	
		Planck mass energy equivalent in GeV	1.220890e19	0.000014e19	GeV	
		Planck temperature	1.416784e32	0.000016e32	K	
		proton charge to mass quotient	9.5788331560e7	0.0000000029e7	C/kg	atom
		proton g factor	5.5856946893	0.0000000016		atom
		proton gyromagnetic ratio	2.6752218744e8	0.0000000011e8	1/s*T	atom
		proton gyromagnetic ratio in MHz/T	42.577478518	0.000000018	MHz/T	atom
		proton magnetic moment to Bohr magneton ratio	1.52103220230e-3	0.00000000046e-3		atom
		proton magnetic moment to nuclear magneton ratio	2.79284734463	0.00000000082		atom
		proton magnetic shielding correction	2.5689e-5	0.0011e-5		atom
		proton mass energy equivalent	1.50327761598e-10	0.00000000046e-10	J	atom
		proton mass energy equivalent in MeV	938.27208816	0.00000029	MeV	atom
		proton mass in u	1.007276466621	0.000000000053	u	atom
		proton molar mass	1.00727646627e-3	0.00000000031e-3	kg/mol	atom
		proton relative atomic mass	1.007276466621	0.000000000053		atom
		proton rms charge radius	8.414e-16	0.019e-16	m	atom
		proton-electron mass ratio	1836.15267343	0.00000011		atom
		proton-muon mass ratio	8.88024337	0.00000020		atom
		proton-neutron magnetic moment ratio	-1.45989805	0.00000034		atom
		proton-neutron mass ratio	0.99862347812	0.00000000049		atom
		proton-tau mass ratio	0.528051	0.000036		atom
		quantum of circulation	3.6369475516e-4	0.0000000011e-4	m^2/s	atom
		quantum of circulation times 2	7.2738951032e-4	0.0000000022e-4	m^2/s	atom
		reduced Compton wavelength	3.8615926796e-13	0.0000000012e-13	m	
		reduced muon Compton wavelength	1.867594306e-15	0.000000042e-15	m	
		reduced neutron Compton wavelength	2.1001941552e-16	0.0000000012e-16	m	
		reduced Planck constant in eV s	6.582119569e-16	0	eV*s	
		reduced Planck constant times c in MeV fm	197.3269804	0	MeV*fm	
		reduced proton Compton wavelength	2.10308910336e-16	0.00000000064e-16	m	
		reduced tau Compton wavelength	1.110538e-16	0.000075e-16	m	
		Rydberg constant times c in Hz	3.2898419602508e15	0.0000000000064e15	Hz	
		Rydberg constant times hc in eV	13.605693122994	0.000000000026	eV	
		Rydberg constant times hc in J	2.1798723611035e-18	0.0000000000042e-18	J	
		Sackur-Tetrode constant (1 K, 100 kPa)	-1.15170753706	0.00000000045		pchem
		Sackur-Tetrode constant (1 K, 101.325 kPa)	-1.16487052358	0.00000000045		pchem
		shielded helion gyromagnetic ratio	2.037894569e8	0.000000024e8	1/s*T	atom
		shielded helion gyromagnetic ratio in MHz/T	32.43409942	0.00000038	MHz/T	atom
		shielded helion magnetic moment	-1.074553090e-26	0.000000013e-26	J/T	atom
		shielded helion magnetic moment to Bohr magneton ratio	-1.158671471e-3	0.000000014e-3		atom
		shielded helion magnetic moment to nuclear magneton ratio	-2.127497719	0.000000025		atom
		shielded helion to proton magnetic moment ratio	-0.7617665618	0.0000000089		atom
		shielded helion to shielded proton magnetic moment ratio	-0.7617861313	0.0000000033		atom
		shielded proton gyromagnetic ratio	2.675153151e8	0.000000029e8	1/s*T	atom
		shielded proton gyromagnetic ratio in MHz/T	42.57638474	0.00000046	MHz/T	atom
		shielded proton magnetic moment	1.410570560e-26	0.000000015e-26	J/T	atom
		shielded proton magnetic moment to Bohr magneton ratio	1.520993128e-3	0.000000017e-3		atom
		shielded proton magnetic moment to nuclear magneton ratio	2.792775599	0.000000030		atom
		shielding difference of d and p in HD	2.0200e-8	0.0020e-8		atom

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Menu	Desc	Quantity	Value	Uncertainty	Unit	Category
		shielding difference of t and p in HT	2.4140e-8	0.0020e-8		atom
		standard-state pressure	100000	0	Pa	
		tau Compton wavelength	6.97771e-16	0.00047e-16	m	atom
		tau energy equivalent	1776.86	0.12	MeV	atom
		tau mass	3.16754e-27	0.00021e-27	kg	atom
		tau mass energy equivalent	2.84684e-10	0.00019e-10	J	atom
		tau mass in u	1.90754	0.00013	u	atom
		tau molar mass	1.90754e-3	0.00013e-3	kg/mol	atom
		tau-electron mass ratio	3477.23	0.23		atom
		tau-muon mass ratio	16.8170	0.0011		atom
		tau-neutron mass ratio	1.89115	0.00013		atom
		tau-proton mass ratio	1.89376	0.00013		atom
		Thomson cross section	6.6524587321e-29	0.0000000060e-29	m^2	
		triton g factor	5.957924931	0.000000012		atom
		triton magnetic moment	1.5046095202e-26	0.0000000030e-26	J/T	atom
		triton magnetic moment to Bohr magneton ratio	1.6223936651e-3	0.0000000032e-3		atom
		triton magnetic moment to nuclear magneton ratio	2.9789624656	0.0000000059		atom
		triton mass	5.0073567446e-27	0.0000000015e-27	kg	atom
		triton mass energy equivalent	4.5003878060e-10	0.0000000014e-10	J	atom
		triton mass energy equivalent in MeV	2808.92113298	0.00000085	MeV	atom
		triton mass in u	3.01550071621	0.00000000012	u	atom
		triton molar mass	3.01550071517e-3	0.00000000092e-3	kg/mol	atom
		triton relative atomic mass	3.01550071621	0.00000000012		atom
		triton to proton magnetic moment ratio	1.0666399191	0.0000000021		atom
		triton-electron mass ratio	5496.92153573	0.00000027		atom
		triton-proton mass ratio	2.99371703414	0.00000000015		atom
		von Klitzing constant	25812.80745	0	ohm	
		W to Z mass ratio	0.88153	0.00017		
		weak mixing angle	0.22290	0.00030		
		Wien frequency displacement law constant	5.878925757e10	0	Hz/K	pchem
		Wien wavelength displacement law constant	2.897771955e-3	0	m*K	pchem

3.5 Code

You must first define the `MJR-generate-42-menu-code` by evaluating the code block in the `hp42s-meta.org` file.

```
(MJR-generate-42-menu-code "CONS"
                           0
                           tbl
                           0
                           nil
                           'exit ;; Change to 'stay to prevent application exit after a constant is pushed to the stack
                           'up   ;; Change to 'exit to have the application exit when [EXIT] is pressed
                           #'MJR-local-only-gen-lab
                           (lambda (atrg target row) (cl-destructuring-bind (sym desc desc-long val uncertainty units cat) row
                                       (let ((print-desc 't)    ;; Set to NIL to not print description
                                             (print-unit 't))   ;; Set to NIL to not print units
                                         (let* ((dlen (length desc))
                                                (ulen (length units))
                                                (dsc1 (cond ((< dlen 15) (concat desc (if (and (< 0 ulen) print-unit) "[LF]")))
                                                            ((>=  dlen 15) (substring desc 0 15))))
                                                (dsc2 (if (> dlen 14)
                                                          (if (< dlen 22)
                                                              (concat (substring desc 15) (if (and (< 0 ulen) print-unit) "[LF]"))
                                                              (substring desc 15 22)))))
```

```
                                   (mapconcat #'identity
                                              (cl-remove nil (list (message "%s" val)
                                                                   (and (< 0 dlen) print-desc
                                                                        (message "\"%s\"" dsc1))
                                                                   (and (< 0 dlen) print-desc dsc2
                                                                        (message "⊢\"%s\"" dsc2))
                                                                   (and (< 0 ulen) print-unit
                                                                        (message "%s\"%s\""
                                                                                 (if (and (< 0 dlen) print-desc) "⊢" "")
                                                                                 units))
                                                                   "AVIEW"))
                                              "\n")))))))

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@      (CONS)
@@@@ DSC: Auto-generated menu program
LBL "CONS"
LBL 01              @@@@ Page 1 of menu CONS
CLMENU
"univ"
KEY 1 GTO 02
"adpt"
KEY 2 GTO 03
"elec"
KEY 3 GTO 04
"pchm"
KEY 4 GTO 05
"atom"
KEY 5 GTO 06
"math"
KEY 6 GTO 07
KEY 9 GTO 00
MENU
STOP
GTO 00
LBL 02              @@@@ Page 1 of menu univ
CLMENU
"h"
KEY 1 XEQ 09
"hbar"
KEY 2 XEQ 10
"c"
KEY 3 XEQ 11
"E0"
KEY 4 XEQ 12
"μ0"
KEY 5 XEQ 13
"G"
KEY 6 XEQ 14
KEY 7 GTO 08
KEY 8 GTO 08
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 08              @@@@ Page 2 of menu univ
CLMENU
"tp"
```

```
KEY 1 XEQ 15
KEY 7 GTO 02
KEY 8 GTO 02
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 03            @@@@ Page 1 of menu adpt
CLMENU
"gacc"
KEY 1 XEQ 16
"atm"
KEY 2 XEQ 17
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 04            @@@@ Page 1 of menu elec
CLMENU
"mN"
KEY 1 XEQ 18
"μB"
KEY 2 XEQ 19
"e"
KEY 3 XEQ 20
"F0"
KEY 4 XEQ 21
"G0"
KEY 5 XEQ 22
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 05            @@@@ Page 1 of menu pchm
CLMENU
"mu"
KEY 1 XEQ 24
"F"
KEY 2 XEQ 25
"Na"
KEY 3 XEQ 26
"k"
KEY 4 XEQ 27
"R"
KEY 5 XEQ 28
"s"
KEY 6 XEQ 29
KEY 7 GTO 23
KEY 8 GTO 23
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 23            @@@@ Page 2 of menu pchm
CLMENU
"rc1"
KEY 1 XEQ 30
```

```
"rc2"
KEY 2 XEQ 31
KEY 7 GTO 05
KEY 8 GTO 05
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 06            @@@@ Page 1 of menu atom
CLMENU
"misc"
KEY 1 GTO 32
"mass"
KEY 2 GTO 33
"magm"
KEY 3 GTO 34
"rad"
KEY 4 GTO 35
"comp"
KEY 5 GTO 36
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 32            @@@@ Page 1 of menu misc
CLMENU
"a"
KEY 1 XEQ 37
"Eh"
KEY 2 XEQ 38
"Ry"
KEY 3 XEQ 39
KEY 9 GTO 06
MENU
STOP
GTO 00
LBL 33            @@@@ Page 1 of menu mass
CLMENU
"pro"
KEY 1 XEQ 40
"ele"
KEY 2 XEQ 41
"neut"
KEY 3 XEQ 42
"muon"
KEY 4 XEQ 43
KEY 9 GTO 06
MENU
STOP
GTO 00
LBL 34            @@@@ Page 1 of menu magm
CLMENU
"pro"
KEY 1 XEQ 44
"ele"
KEY 2 XEQ 45
"neut"
```

```
KEY 3 XEQ 46
"muon"
KEY 4 XEQ 47
KEY 9 GTO 06
MENU
STOP
GTO 00
LBL 35            @@@@ Page 1 of menu rad
CLMENU
"bohr"
KEY 1 XEQ 48
"ele"
KEY 2 XEQ 49
KEY 9 GTO 06
MENU
STOP
GTO 00
LBL 36            @@@@ Page 1 of menu comp
CLMENU
"std"
KEY 1 XEQ 50
"pro"
KEY 2 XEQ 51
"neut"
KEY 3 XEQ 52
"muon"
KEY 4 XEQ 53
KEY 9 GTO 06
MENU
STOP
GTO 00
LBL 07            @@@@ Page 1 of menu math
CLMENU
"grat"
KEY 1 XEQ 54
"emc"
KEY 2 XEQ 55
"omga"
KEY 3 XEQ 56
"lapl"
KEY 4 XEQ 57
KEY 9 GTO 01
MENU
STOP
GTO 00
LBL 00 @@@@ Application Exit
EXITALL
RTN
LBL 09    @@@@ Action for menu key h
6.62607015e-34
"Planck Constant"
⊢"[LF]"
⊢"J/Hz"
AVIEW
RTN
LBL 10    @@@@ Action for menu key hbar
1.054571817e-34
```

```
"Dirac Constant[LF]"
├"J*s"
AVIEW
RTN
LBL 11    @@@@ Action for menu key c
299792458
"Speed of Light[LF]"
├"m/s"
AVIEW
RTN
LBL 12    @@@@ Action for menu key E0
8.8541878128e-12
"Vac Ele Permitt"
├"ivity[LF]"
├"F/m"
AVIEW
RTN
LBL 13    @@@@ Action for menu key μ0
1.25663706212e-06
"Vac Mag Permeab"
├"ility[LF]"
├"N/A^2"
AVIEW
RTN
LBL 14    @@@@ Action for menu key G
6.6743e-11
"Gravitational C"
├"onstant"
├"m^3/kg*s^2"
AVIEW
RTN
LBL 15    @@@@ Action for menu key tp
5.391247e-44
"Planck Time[LF]"
├"s"
AVIEW
RTN
LBL 16    @@@@ Action for menu key gacc
9.80665
"Earth Std Grav "
├"Accel[LF]"
├"m/s"
AVIEW
RTN
LBL 17    @@@@ Action for menu key atm
101325
"Standard Atmosp"
├"here[LF]"
├"Pa"
AVIEW
RTN
LBL 18    @@@@ Action for menu key mN
5.0507837461e-27
"Nuclear Magneto"
├"n[LF]"
├"J/*T"
AVIEW
```

```
RTN
LBL 19    @@@@ Action for menu key μB
9.2740100783e-24
"Bohr Magneton[LF]"
⊢"J/T"
AVIEW
RTN
LBL 20    @@@@ Action for menu key e
1.602176634e-19
"Elementary Char"
⊢"ge[LF]"
⊢"C"
AVIEW
RTN
LBL 21    @@@@ Action for menu key F0
2.067833848e-15
"Mag flux quantu"
⊢"m[LF]"
⊢"Wb"
AVIEW
RTN
LBL 22    @@@@ Action for menu key G0
7.748091729e-05
"Conductance Qua"
⊢"ntum[LF]"
⊢"S"
AVIEW
RTN
LBL 24    @@@@ Action for menu key mu
1.6605390666e-27
"Atomic Mass Uni"
⊢"t[LF]"
⊢"kg"
AVIEW
RTN
LBL 25    @@@@ Action for menu key F
96485.33212
"Faraday[LF]"
⊢"C/mol"
AVIEW
RTN
LBL 26    @@@@ Action for menu key Na
6.02214076e+23
"Avogadro's Numb"
⊢"er[LF]"
⊢"1/mol"
AVIEW
RTN
LBL 27    @@@@ Action for menu key k
1.380649e-23
"Boltzmann Const"
⊢"ant[LF]"
⊢"J/K"
AVIEW
RTN
LBL 28    @@@@ Action for menu key R
8.314462618
```

```
"Ideal Gas Const"
├"ant[LF]"
├"J/mol*K"
AVIEW
RTN
LBL 29    @@@@ Action for menu key s
5.670374419e-08
"Stefan Constant"
├"[LF]"
├"W/m^2*K^4"
AVIEW
RTN
LBL 30    @@@@ Action for menu key rc1
3.741771852e-16
"First Radiation"
├" Cnst[LF]"
├"W*m^2"
AVIEW
RTN
LBL 31    @@@@ Action for menu key rc2
0.01438776877
"Second Radiatio"
├"n Cnst[LF]"
├"m*K"
AVIEW
RTN
LBL 37    @@@@ Action for menu key a
0.0072973525693
"Fine Structure"
AVIEW
RTN
LBL 38    @@@@ Action for menu key Eh
4.3597447222071e-18
"Hartree Energy[LF]"
├"J"
AVIEW
RTN
LBL 39    @@@@ Action for menu key Ry
10973731.56816
"Rydberg Constan"
├"t[LF]"
├"1/m"
AVIEW
RTN
LBL 40    @@@@ Action for menu key pro
1.67262192369e-27
"Proton Mass[LF]"
├"kg"
AVIEW
RTN
LBL 41    @@@@ Action for menu key ele
9.1093837015e-31
"Electron Mass[LF]"
├"kg"
AVIEW
RTN
LBL 42    @@@@ Action for menu key neut
```

```
1.67492749804e-27
"Neutron Mass[LF]"
├"kg"
AVIEW
RTN
LBL 43    @@@@ Action for menu key muon
1.883531627e-28
"Muon Mass[LF]"
├"kg"
AVIEW
RTN
LBL 44    @@@@ Action for menu key pro
1.41060679736e-26
"Proton Mag Mom[LF]"
├"J/T"
AVIEW
RTN
LBL 45    @@@@ Action for menu key ele
-9.2847647043e-24
"Electron Mag Mo"
├"m[LF]"
├"J/T"
AVIEW
RTN
LBL 46    @@@@ Action for menu key neut
-9.6623651e-27
"Neutron Mag Mom"
├"[LF]"
├"J/T"
AVIEW
RTN
LBL 47    @@@@ Action for menu key muon
-4.4904483e-26
"Muon Mag Mom[LF]"
├"J/T"
AVIEW
RTN
LBL 48    @@@@ Action for menu key bohr
5.29177210903e-11
"Bohr Radius[LF]"
├"m"
AVIEW
RTN
LBL 49    @@@@ Action for menu key ele
2.8179403262e-15
"Electron Radius"
├"[LF]"
├"m"
AVIEW
RTN
LBL 50    @@@@ Action for menu key std
2.42631023867e-12
"Compton Wavelen"
├"gth[LF]"
├"m"
AVIEW
RTN
```

```
LBL 51    @@@@ Action for menu key pro
1.32140985539e-15
"Proton Compton "
├"waveln[LF]"
├"m"
AVIEW
RTN
LBL 52    @@@@ Action for menu key neut
1.31959090581e-15
"Neutron Compton"
├" waveln"
├"m"
AVIEW
RTN
LBL 53    @@@@ Action for menu key muon
1.17344411e-14
"Nuon Compton wa"
├"veln[LF]"
├"m"
AVIEW
RTN
LBL 54    @@@@ Action for menu key grat
1.618033988749894
"Golden ratio"
AVIEW
RTN
LBL 55    @@@@ Action for menu key emc
0.577215664901532
"Eul-Masc"
AVIEW
RTN
LBL 56    @@@@ Action for menu key omga
0.567143290409783
"Omega"
AVIEW
RTN
LBL 57    @@@@ Action for menu key lapl
0.662743419349181
"Laplace limit"
AVIEW
RTN
@@@@ Free labels start at: 58
END
```

4 EOF