Energy Equivalents†

	Relevant unit			
	J	kg	$[\mathrm{m}^{-1}]^*$	Hz
1 J	$(1\ \mathrm{J}) =$ $1\ \mathrm{J}$	$(1\ \mathrm{J})/c^2 =$ $1.112\,650\,056\ldots\times 10^{-17}\ \mathrm{kg}$	$(1\ \mathrm{J})/hc =$ $5.034\,116\,567\ldots\times 10^{24}\ \mathrm{m}^{-1}$	$(1\ \mathrm{J})/h =$ $1.509\,190\,179\ldots\times 10^{33}\ \mathrm{Hz}$
1 kg	$(1\ \mathrm{kg})c^2 =$ $8.987\,551\,787\ldots\times 10^{16}\ \mathrm{J}$	$(1\ \mathrm{kg}) =$ $1\ \mathrm{kg}$	$(1\ \mathrm{kg})c/h =$ $4.524\,438\,335\ldots\times 10^{41}\ \mathrm{m}^{-1}$	$(1\ \mathrm{kg})c^2/h =$ $1.356\,392\,489\ldots\times 10^{50}\ \mathrm{Hz}$
1 $[\mathrm{m}^{-1}]^*$	$(1\ \mathrm{m}^{-1})hc =$ $1.986\,445\,857\ldots\times 10^{-25}\ \mathrm{J}$	$(1\ \mathrm{m}^{-1})h/c =$ $2.210\,219\,094\ldots\times 10^{-42}\ \mathrm{kg}$	$(1\ \mathrm{m}^{-1}) =$ $1\ \mathrm{m}^{-1}$	$(1\ \mathrm{m}^{-1})c =$ $299\,792\,458\ \mathrm{Hz}$
1 Hz	$(1\ \mathrm{Hz})h =$ $6.626\,070\,15\times 10^{-34}\ \mathrm{J}$	$(1\ \mathrm{Hz})h/c^2 =$ $7.372\,497\,323\ldots\times 10^{-51}\ \mathrm{kg}$	$(1\ \mathrm{Hz})/c =$ $3.335\,640\,951\ldots\times 10^{-9}\ \mathrm{m}^{-1}$	$(1\ \mathrm{Hz}) =$ $1\ \mathrm{Hz}$
1 K	$(1\ \mathrm{K})k =$ $1.380\,649\times 10^{-23}\ \mathrm{J}$	$(1\ \mathrm{K})k/c^2 =$ $1.536\,179\,187\ldots\times 10^{-40}\ \mathrm{kg}$	$(1\ \mathrm{K})k/hc =$ $69.503\,480\,04\ldots\ \mathrm{m}^{-1}$	$(1\ \mathrm{K})k/h =$ $2.083\,661\,912\ldots\times 10^{10}\ \mathrm{Hz}$
1 eV	$(1\ \mathrm{eV}) =$ $1.602\,176\,634\times 10^{-19}\ \mathrm{J}$	$(1\ \mathrm{eV})/c^2 =$ $1.782\,661\,921\ldots\times 10^{-36}\ \mathrm{kg}$	$(1\ \mathrm{eV})/hc =$ $8.065\,543\,937\ldots\times 10^{5}\ \mathrm{m}^{-1}$	$(1\ \mathrm{eV})/h =$ $2.417\,989\,242\ldots\times 10^{14}\ \mathrm{Hz}$
1 u	$(1\ \mathrm{u})c^2 =$ $1.492\,418\,085\,60(45)\times 10^{-10}\ \mathrm{J}$	$(1\ \mathrm{u}) =$ $1.660\,539\,066\,60(50)\times 10^{-27}\ \mathrm{kg}$	$(1\ \mathrm{u})c/h =$ $7.513\,006\,6104(23)\times 10^{14}\ \mathrm{m}^{-1}$	$(1\ \mathrm{u})c^2/h =$ $2.252\,342\,718\,71(68)\times 10^{23}\ \mathrm{Hz}$
1 E_h	$(1\ E_\mathrm{h}) =$ $4.359\,744\,722\,2071(85)\times 10^{-18}\ \mathrm{J}$	$(1\ E_\mathrm{h})/c^2 =$ $4.850\,870\,209\,5432(94)\times 10^{-35}\ \mathrm{kg}$	$(1\ E_\mathrm{h})/hc =$ $2.194\,746\,313\,6320(43)\times 10^{7}\ \mathrm{m}^{-1}$	$(1\ E_\mathrm{h})/h =$ $6.579\,683\,920\,502(13)\times 10^{15}\ \mathrm{Hz}$

† The values of some energy equivalents derived from the relations $E = mc^2 = hc/\lambda = h\nu = kT$, and based on the 2018 CODATA adjustment of the values of the constants; 1 eV $= (e/\mathrm{C})$ J, 1 u $= m_\mathrm{u} = \frac{1}{12}m(^{12}\mathrm{C})$, and $E_\mathrm{h} = 2R_\infty hc = \alpha^2 m_\mathrm{e}c^2$ is the Hartree energy (hartree).

* The full description of m^{-1} is cycles or periods per meter and that of m is meter per cycle (m/cycle). The scientific community is aware of the implied use of these units. It traces back to the conventions for phase and angle and the use of unit Hz versus cycles/s. No solution has been agreed upon.

Energy Equivalents†

	Relevant unit			
	K	eV	u	E_h
1 J	(1 J)/k = $7.242\,970\,516\ldots \times 10^{22}$ K	(1 J) = $6.241\,509\,074\ldots \times 10^{18}$ eV	(1 J)/c^2 = $6.700\,535\,2565(20) \times 10^{9}$ u	(1 J) = $2.293\,712\,278\,3963(45) \times 10^{17}$ E_h
1 kg	(1 kg)c^2/k = $6.509\,657\,260\ldots \times 10^{39}$ K	(1 kg)c^2 = $5.609\,588\,603\ldots \times 10^{35}$ eV	(1 kg) = $6.022\,140\,7621(18) \times 10^{26}$ u	(1 kg)c^2 = $2.061\,485\,788\,7409(40) \times 10^{34}$ E_h
1 [m^{-1}]*	(1 m^{-1})hc/k = $1.438\,776\,877\ldots \times 10^{-2}$ K	(1 m^{-1})hc = $1.239\,841\,984\ldots \times 10^{-6}$ eV	(1 m^{-1})h/c = $1.331\,025\,050\,10(40) \times 10^{-15}$ u	(1 m^{-1})hc = $4.556\,335\,252\,9120(88) \times 10^{-8}$ E_h
1 Hz	(1 Hz)h/k = $4.799\,243\,073\ldots \times 10^{-11}$ K	(1 Hz)h = $4.135\,667\,696\ldots \times 10^{-15}$ eV	(1 Hz)h/c^2 = $4.439\,821\,6652(13) \times 10^{-24}$ u	(1 Hz)h = $1.519\,829\,846\,0570(29) \times 10^{-16}$ E_h
1 K	(1 K) = 1 K	(1 K)k = $8.617\,333\,262\ldots \times 10^{-5}$ eV	(1 K)k/c^2 = $9.251\,087\,3014(28) \times 10^{-14}$ u	(1 K)k = $3.166\,811\,563\,4556(61) \times 10^{-6}$ E_h
1 eV	(1 eV)/k = $1.160\,451\,812\ldots \times 10^{4}$ K	(1 eV) = 1 eV	(1 eV)/c^2 = $1.073\,544\,102\,33(32) \times 10^{-9}$ u	(1 eV) = $3.674\,932\,217\,5655(71) \times 10^{-2}$ E_h
1 u	(1 u)c^2/k = $1.080\,954\,019\,16(33) \times 10^{13}$ K	(1 u)c^2 = $9.314\,941\,0242(28) \times 10^{8}$ eV	(1 u) = 1 u	(1 u)c^2 = $3.423\,177\,6874(10) \times 10^{7}$ E_h
1 E_h	(1 E_h)/k = $3.157\,750\,248\,0407(61) \times 10^{5}$ K	(1 E_h) = $27.211\,386\,245\,988(53)$ eV	(1 E_h)/c^2 = $2.921\,262\,322\,05(88) \times 10^{-8}$ u	(1 E_h) = 1 E_h

† The values of some energy equivalents derived from the relations $E = mc^2 = hc/\lambda = h\nu = kT$, and based on the 2018 CODATA adjustment of the values of the constants; 1 eV = (e/C) J, 1 u = $m_\mathrm{u} = \frac{1}{12}m(^{12}\mathrm{C})$, and $E_\mathrm{h} = 2R_\infty hc = \alpha^2 m_\mathrm{e} c^2$ is the Hartree energy (hartree).

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