

Constants and Physical Values

The ABR provides candidates with this list of constants, physical values, and related information. The ABR does not warrant the list as a compilation of all constants and physical values needed on the exams. The absence of a value from this list will not be used as a reason to reject a question. Candidates should review the list carefully before their exams to familiarize themselves with the contents and list organization. Prudent candidates also will learn any constants not on the list that they think are important.

The value of a constant varies somewhat in the literature. If a question suggests a value different from the value in this table, the candidate should use the value presented in the question.

These values are intended for the ABR exam. They should not be used for clinical calculations without confirmation. The ABR has made every effort to use the most current and correct values. If you believe a value is not correct, please contact the ABR.

LIST OF CONSTANTS AND PHYSICAL VALUES

Name	Symbol	Value	Units
Planck's constant	h	6.626×10^{-34}	$\text{m}^2 \text{ kg s}^{-2}$
Boltzmann's constant	k	1.38×10^{-23}	$\text{m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$
Mass of the electron	m_e	0.511	MeV
Mass of the electron	m_e	9.11×10^{-31}	kg
Charge of the electron	q_e	1.60×10^{-19}	C
Mass of the proton	m_p	938	MeV
Mass of the neutron	m_n	939	MeV
Assumed speed of sound in soft tissue	v_t	1540	m/s
Speed of light	c	3×10^8	m/s
Mass of standard man		70	kg
Molar gas constant	R	8.31	$\text{J mol}^{-1} \text{ K}^{-1}$
Avogadro's Number	N_A	6.02×10^{23}	Atom/mol
Energy mass conversion		931.48	MeV/amu
Electron Volt	eV	1.60×10^{-19}	J/eV
Gyromagnetic ratio - H		42.58	MHz/T
Gyromagnetic ratio - P		17.2	MHz/T
Gyromagnetic ratio - Na		11.26	MHz/T
Ionization constant	Wair/e	33.97	eV/ion-pair in air
Roentgen	R	2.58×10^{-4}	C/kg

Half-lives of common radionuclides

Radionuclide	Half-life	Units
¹¹ C	20.4	minute
¹³ N	10.0	minute
¹⁸ F	110	minute
³² P	14.3	day
⁵⁷ Co	271	day
⁶⁰ Co	5.27	year
⁶⁴ Cu	12.7	hour
⁶⁷ Ga	78.3	hour
⁶⁸ Ga	68	minute
⁸⁹ Sr	50.6	day
⁹⁰ Y	2.67	day
⁹⁰ Sr	28.9	year
⁹⁹ Mo	66	hour
^{99m} Tc	6.01	hour
¹⁰³ Pd	17.0	day
¹¹¹ In	2.80	day
¹²³ I	13.2	hour
¹²⁴ I	4.18	day
¹²⁵ I	59.4	day
¹³¹ I	8.03	day
¹³¹ Cs	9.69	day
¹³³ Xe	5.2	day
¹³⁷ Cs	30.1	year
¹⁷⁷ Lu	6.7	hour
¹⁹² Ir	73.8	day
¹⁹⁸ Au	2.69	day
²⁰¹ Tl	3.04	day
²²³ Ra	11.4	day
²²⁶ Ra	1600	year

ICRP 103 tissue weighting factors

Tissue	(ICRP 103) Tissue weighting factor w_T
Bone-marrow (red), Colon, Lung, Stomach, Breast, Remainder tissues*	0.12
Gonads	0.08
Bladder, Esophagus, Liver, Thyroid	0.04
Bone surface, Brain, Salivary glands, Skin	0.01
*Remainder tissues: Adrenals, Extrathoracic (ET) region, Gall bladder, Heart, Kidneys, Lymphatic nodes, Muscle, Oral mucosa, Pancreas, Prostate (♂), Small intestine, Spleen, Thymus, Uterus/cervix (♀)	

PET effective dose equivalent dose rate constants

Nuclide	Dose rate constant $\mu\text{Sv m}^2 / \text{MBq h}$
^{68}Ga	0.134
^{82}Rb	0.159
^{124}I	0.185
^{18}F	0.143
^{64}Cu	0.029

Radiation weighting factors

Radiation Type	(ICRP 103) Radiation Weighting Factor, w_R
Photons, electrons and muons, all energies	1
Protons	2
Fast Neutrons (1-50 MeV)	5.5
Alpha particles, fission fragments, heavy nuclei	20

Standard Calibration Conditions: Calibrated to deliver 1 cGy/MU at d_{max} in a 10×10 cm² field at the 100-cm source-to-surface distance (SSD).

Standard Environmental Conditions: Conditions of temperature, pressure, and relative humidity for which ion chamber calibration factors apply. In the US and Canada these are:
 Temperature, $T_0 = 22^\circ\text{C}$,
 Pressure, $P_0 = 101.33$ kPa,
 Relative humidity of the air in the ion chamber is between 20% and 80%.

Dose rate constants and TVLs (Handbook of Health Physics and Radiological Health)

Nuclide	Dose rate constant ($\mu\text{Sv/h MBq}$) @ 1 m	TVL (mm Pb)
^{57}Co	0.041	0.7
^{60}Co	0.37	40.0
^{64}Cu	0.036	17.0
^{67}Ga	0.28	6.0
$^{99\text{m}}\text{Tc}$	0.033	0.9
^{103}Pd	0.062	0.03
^{111}In	0.99	2.0
^{123}I	0.074	1.2
^{125}I	0.074	0.07
^{131}I	0.076	11
^{131}Cs	0.033	0.08
^{177}Lu	0.008	2.1

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