Course 22106

Appendix A

Appendix A

(From I.R. Cameron, Nuclear Fission Reactors, Plenum Press, 1982)

Microscopic and Macroscopic Absorption and Scattering Cross Sections for the Emements

Element	Symbol	Atomic number	Density (g cm^{-3})	σ_a (b)	σ_s (b)	Σ_a (cm^{-1})	Σ_s (cm^{-1})
Actinium	Ac	89	10.1	515	-	13.8	-
Aluminum	Al	13	2.70	0.2390	1.49	0.0139	0.898
Antimony	Sb	51	6.69	5.4	4.2	0.179	0.139
Argon	Ar	18	-	0.678	0.644	-	-
Arsenic	As	33	5.73	4.3	7	0.198	0.322
Barium	Ba	56	3.5	1.2	-	0.0184	-
Beryllium	Be	4	1.85	0.0092	6.14	0.00114	0.759
Bismuth	Bi	83	9.75	0.033	-	0.00093	-
Boron	B	5	2.34	759	3.6	98.9	0.469
Bromine	Br	35	3.12	6.8	6.1	0.160	0.143
Cadmium	Cd	48	8.65	2450	5.6	113.6	0.260
Calcium	Ca	20	1.55	0.43	-	0.0100	-
Carbon	C	6	1.6	0.0034	4.75	0.000273	0.381
Cerium	Ce	58	6.77	0.63	4.7	0.0183	0.137
Cesium	Cs	55	1.87	29.0	-	0.246	-
Chlorine	Cl	17	-	33.2	-	-	-
Chromium	Cr	24	7.19	3.1	3.8	0.258	0.316
Cobalt	Co	27	8.9	37.2	6.7	3.38	0.609
Copper	Cu	29	8.96	3.79	7.9	0.322	0.671
Deuterium	D	1	-	0.00053	3.390	-	-
Dysprosium	Dy	66	8.54	930	100	29.4	3.16
Erbium	Er	68	9.05	162	11.0	5.28	0.359
Europium	Eu	63	5.25	4600	8.0	95.7	0.166
Fluorine	F	9	-	0.0095	4.0	-	-
Gadolinium	Gd	64	7.90	49000	-	1480	-
Gallium	Ga	31	5.90	2.9	6.5	0.148	0.331

Element	Symbol	Atomic number	Density (g cm^{-3})	σ_a (b)	σ_s (b)	Σ_a (cm^{-1})	Σ_s (cm^{-1})
Germanium	Ge	32	5.32	2.3	7.5	0.1015	0.331
Gold	Au	79	19.3	98.8	-	5.83	-
Hafnium	Hf	72	13.31	102	8	4.58	0.359
Heavy Water		-	1.105	0.0010	13.6	3.32E-5	0.452
Helium	He	2	-	<0.05	0.76	-	-
Holmium	Ho	67	8.78	66.5	9.4	2.13	0.301
Hydrogen	H	1	-	0.332	20.436	-	-
Indium	In	49	7.31	193.5	-	7.42	-
Iodine	I	53	4.93	6.2	-	0.145	-
Iridium	Ir	77	22.4	426	14	29.9	0.98
Iron	Fe	26	7.87	2.55	10.9	0.216	0.925
Krypton	Kr	36	-	25.0	7.50	-	-
Lanthanum	La	57	6.17	9.0	9.3	0.241	0.249
Lead	Pb	82	11.35	0.170	11.4	0.0056	0.376
Lithium	Li	3	0.534	70.7	-	3.28	-
Lutetium	Lu	71	9.84	77	8	2.61	0.271
Magnesium	Mg	12	1.738	0.063	3.42	0.00271	0.147
Manganese	Mn	25	7.4	13.3	2.1	1.079	0.170
Mercury	Hg	80	13.55	375	-	15.26	-
Molybdenum	Mo	42	10.22	2.65	5.8	0.170	0.372
Neodymium	Nd	60	6.90	50.5	16	1.455	0.461
Neon	Ne	10	-	0.038	2.42	-	-
Nickel	Ni	28	8.90	4.43	17.3	0.404	1.580
Niobium	Nb	41	8.57	1.15	-	0.0639	-
Nitrogen	N	7	-	1.85	10.6	-	-
Osmium	Os	76	22.6	15.3	-	1.095	-
Oxygen	O	8	-	0.00027	3.76	-	-
Palladium	Pd	46	12.0	6.9	5.0	0.469	0.340
Phosphorus	P	15	1.82	0.180	-	0.00637	-
Platinum	Pt	78	21.45	10.0	11.2	0.662	0.742
Plutonium	Pu	94	19.84	1011.3	7.7	50.55	0.385
Potassium	K	19	0.862	2.10	1.5	0.0279	0.0199
Praseodymium	Pr	59	6.77	11.5	3.3	0.333	0.0955
Protactinium	Pa	91	15.37	210	-	8.4	-
Radium	Ra	88	5.0	11.5	-	0.153	-
Radon	Rn	86	-	0.72	-	-	-
Rhenium	Re	75	21.02	88	11.3	5.98	0.77
Rhodium	Rh	45	12.41	150	-	10.9	-
Rubidium	Rb	37	1.532	.37	6.2	0.00399	0.0670
Ruthenium	Ru	44	12.41	2.56	-	0.189	-
Samarium	Sm	62	7.45	5800	-	173	-
Scandium	Sc	21	2.989	26.5	24	1.06	0.96
Selenium	Se	34	4.79	11.7	9.7	0.427	0.354
Silicon	Si	14	2.33	0.16	2.2	0.0080	0.110
Silver	Ag	47	10.50	63.6	-	3.73	-

Element	Symbol	Atomic number	Density (g cm^{-3})	σ_a (b)	σ_s (b)	Σ_a (cm^{-1})	Σ_s (cm^{-1})
Sodium	Na	11	0.971	0.530	3.2	0.0135	0.0814
Strontium	Sr	38	2.54	1.21	10	0.0211	0.175
Sulfur	S	16	2.07	0.520	0.975	0.0202	0.0379
Tantalum	Ta	73	16.65	21	6.2	1.164	0.343
Technetium	Tc	43	11.5	19	-	1.33	-
Tellurium	Te	52	6.24	4.7	-	0.138	-
Terbium	Tb	65	8.234	25.5	20	0.796	0.624
Thallium	Tl	81	11.85	3.4	9.7	0.1187	0.339
Thorium	Th	90	11.72	7.40	12.67	0.225	0.385
Thulium	Tm	69	9.314	103	12	3.42	0.399
Tin	Sn	50	7.31	0.63	-	0.0234	-
Titanium	Ti	22	4.54	6.1	4.0	0.348	0.228
Tungsten	W	74	19.3	18.5	-	1.17	-
Uranium	U	92	19.1	7.59	8.90	0.367	0.430
Vanadium	V	23	6.11	5.04	4.93	0.364	0.356
Water	-	-	1.00	0.664	103	0.0222	3.44
Xenon	Xe	54	-	24.5	4.30	-	-
Ytterbium	Yb	70	6.97	36.6	25.0	0.888	0.607
Yttrium	Y	39	4.46	1.28	7.60	0.0387	0.230
Zinc	Zn	30	7.133	1.10	4.2	0.0723	0.276
Zirconium	Zr	40	6.506	0.185	6.40	0.00795	0.275