TABLE OF RADIOISOTOPES ARRANGED ACCORDING TO HALF-LIFE

Compiled
by
ELAINE DANIELS

From the General Electric Chart of the Nuclides
Fifth Edition (April, 1956)

December, 1957

BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
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INTRODUCTION

The data in this table were taken directly from the General Electric Chart of the Nuclides, Fifth Edition, (revised to April, 1956). This Chart of the Nuclides was originally prepared by G. Friedlander and M. Perlman (Brookhaven National Laboratory) and subsequently revised by J. R. Stehn and E. F. Glancy (Knolls Atomic Power Laboratory).

Great care has been used in copying the data and in proof-reading the copy to eliminate errors in transcription. On the other hand no responsibility can be assumed for any errors which may exist in the chart itself.

The symbols and abbreviations used herein are the same as used in the Chart of the Nuclides:

α	alpha particle
β^-	negative beta particle
β^+	positive beta particle (positron)
γ	gamma ray
SF	spontaneous fission
n	neutron
e^-	internal conversion electron
K	electron capture
IT	isomeric transition
D	radiation delayed
E	disintegration energy (in MEV)
M	isotopic mass (physical scale)
s	second
m	minute
h	hour
d	day
y	year
σ	cross-section, value listed in appendix
()	values in parentheses refer to short-lived daughter

Frequently a metastable state is denoted by a letter m following the mass number. This convention was not used in the present compilation. However, this should create no confusion since a glance at column 4 will show whether the isotope decays by isomeric transition and, therefore, whether it is in a metastable state.

Where the Chart of the Nuclides lists a cross-section value for the radioisotope a symbol σ appears just to the left of column 4. The value for this cross-section may be found in the Appendix where the isotope is listed by atomic number.

The advice and help of L. G. Stang, Jr. and W. D. Tucker is acknowledged.

This work was carried out under the auspices of the Atomic Energy Commission.

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
2×10^{-21} s	He ⁵	n, α		M 5.0139
$\sim 10^{-21}$ s	Li ⁵	p, α		M 5.0139
$\geq 3 \times 10^{-19}$ s	B ⁹	p (2 α)		M 9.0162
$< 4 \times 10^{-15}$ s	Be ⁸	2 α .09		M 8.00785
3×10^{-7} s	Po ²¹²	α 8.78		M 212.055
4×10^{-6} s	Po ²¹³	α 8.34		M 213.059
1.6×10^{-4} s	Po ²¹⁴	α 7.68		M 214.062
$\sim 10^{-4}$ s	At ²¹⁵	α 8.00		M 215.066
$\sim 3 \times 10^{-4}$ s	At ²¹⁶	α 7.79		M 216.070
$\sim 10^{-3}$ s	Em ²¹⁷	α 7.74		M 217.072
1.8×10^{-3} s	Po ²¹⁵	α 7.36 β^-		M 215.067
5×10^{-3} s	W ¹⁸⁰		I.T. γ .35, .22	
1.2×10^{-2} s	N ¹²	β^+ 16.7 (3 $\alpha \sim 4$)		E 17.7
1.8×10^{-2} s	As ⁷⁵		I.T. .28	
1.8×10^{-2} s	At ²¹⁷	α 7.02		M 217.073
1.9×10^{-2} s	Em ²¹⁸	α 7.13, 6.53	γ .61	M 218.074
2×10^{-2} s	Fr ²¹⁹	α 7.30		M 219.078
2.5×10^{-2} s	B ¹²	β^- 13.4, 9.0	γ 4.4	E 13.4
0.16 s	Po ²¹⁶	α 6.77		M 216.069
0.17 s	Li ⁹	β^- (n, 2 α)		E 14
0.18 s	Co ⁵⁴	$\beta^+ > 7$		
0.2 s	Sc ⁴⁰	$\beta^+ 9$	γ 3.7	E 14

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
0.22 s	At ²¹²	α		
0.28 s	Mn ⁵⁰	$\beta^+ > 6$		
0.28 s	P ²⁸	$\beta^+ 11, \sim 8, \dots$	$\gamma 1.78, 2.6-7.6$	E 14
0.3 s	Na ²⁰	β^+ ($\alpha > 2$)		E 15
0.31 s	Cl ³²	$\beta^+ 10, 8, \dots$ ($\alpha \sim 3$)	$\gamma 2.2, 4.8, \dots$	E 13
0.33 s	Ta ¹⁸¹		I.T. $< .02$	
0.4 s	Hg ¹⁹⁴		I.T. (?) $\gamma .048, .134$	
0.4 s	V ⁴⁶	$\beta^+ > 6$		
0.5 s	B ⁸	$\beta^+ 14$ (2 α 3)		E 18
0.52 s	Po ²¹¹	$\alpha 7.43, \dots$	$\gamma .89, .57$	M 211.053
0.53 s	Ge ⁷³	e^-	I.T. .054 $\gamma .0130$	
0.54 s	Tl ¹⁹⁷	e^-	I.T. (?) $\gamma .38$	
0.6 s	Ti ⁴³	β^+		
0.66 s	Sc ⁴²	$\beta^+ \sim 5$		E ~ 6
0.8 s	Zr ⁹⁰		I.T. 2.30	
0.80 s	Pb ²⁰⁷	e^-	I.T. 1.06 $\gamma .57$	
0.82 s	He ⁶	$\beta^- 3.50$	no γ	E 3.50
0.84 s	Li ⁸	$\beta^- 13$ (2 α 3)		E 16.0
0.87 s	Sc ⁴¹	$\beta^+ 5$		E 6
0.95 s	K ³⁸	$\beta^+ 5.1$		E 6.1

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1 s	Cl ³⁸		I.T. .66	
1 s	Xe ¹⁴³	β^-		
1 s	Kr ⁹⁴	β^-		
~ 1 s	Kr ⁹⁷	β^-		
~ 1 s	Xe ¹⁴⁴	β^-		
~ 1 s	V ⁴⁵	β^+		
1.0 s	Ca ³⁹	β^- 5.7		E 6.7
1.1 s	Cr ⁴⁶	β^+		
1.3 s	At ²¹⁸	α 6.63		M 218.077
1.5 s	Cl ³⁴	β^+ 4.5		E 5.5
1.6 s	Ne ¹⁸	β^+ 3.2		E 4.2
1.7 s	Si ²⁶	β^+		
1.8 s	A ³⁵	β^+ 4.95	γ 1.22, 1.76	E 5.97
< 2 s	Ac ²²¹	α 7.6		M 221.085
< 2 s	Fr ²¹⁷	α 8.3		M 217.073
< 2 s	At ²¹³	α 9.2		M 213.060
2 s	Kr ⁹³	β^-		
2.0 s	Pa ²²⁵	α		
2.1 s	Al ²⁴	β^+ <8.5, 8.5 (α ~ 2)	γ 1.38-7.2	E 14
2.3 s	C ¹⁵	β^- 4.3, 9.8	γ 5.3	E 9.8
2.5 s	In ¹¹²	e^-	I.T. .15	
2.5 s	Er [?]	e^-	I.T. .21	
2.6 s	S ³¹	β^+ 4.4		E 5.4

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
2.7 s	I ¹³⁹	β^-		
2.8 s	Cl ³³	β^+ 4.2	γ 2.8 ?	E 5.2
3 s	Cu ⁵⁸	$\beta^+ \sim 8$		
3 s	Xe ¹⁴¹	β^-		
3 s	Kr ⁹²	β^-		
3.92 s	Em ²¹⁹	α 6.82, 6.56, ..	γ .27, .40, ..	M 219.078
4 s	Au ¹⁹³	e^-	I.T. .032, .290 γ .258	
4.14 s	N ¹⁷	β^- 3.7 (n 1.0)		E 8.8
4.4 s	Si ²⁷	β^+ 3.8		E 4.8
4.5 s	P ²⁹	β^+ 3.94, ..	γ 1.28, 2.43	E 4.96
4.5 s	Br ⁸⁹	β^- (n .5)		
< 5 s	Fr ²¹⁸	α 7.85		M 218.076
< 5 s	At ²¹⁴	α 8.78		M 214.063
5 s	P ²¹	β^-		E 5.7
5 s	Ir ¹⁹¹	e^-	I.T. .042 γ .129	
5 s	Tc ¹⁰²	β^- 4		
5.5 s	W ¹⁸³	e^-	I.T. γ .11, .16	
5.5 s	Ac ²²²	α 6.96		M 222.087
5.9 s	I ¹³⁸	β^-		
6 s	Pb ²⁰³	e^-	I.T. .86	
6 s	Yb [?]		I.T. .21 γ .10?	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
6.5 s	Al ²⁶	β^+ 3.21		E 4.23
7.3 s	Al ²⁵	β^+ 3.24		E 4.26
7.4 s	Au ¹⁹⁷		I.T. .130, .409 γ .279	
7.4 s	N ¹⁶	β^- 4, 10.4, ..	γ 6.13, 7.10, 2.7, ..	E 10.4
10 s	Kr ⁹¹	β^- 3.6	γ	
11 s	F ²⁰	β^- 5.42	γ 1.63	E 7.05
12 s	Mg ²³	β^+ 3.0		E 4.0
12.4 s	P ³⁴	β^- 5.1, 3.2	γ 2.1, 4.0	E 7.2
13 s	Kr ⁸¹		I.T. .19	
13 s	In ¹¹⁶	β^- 3.3	no γ	E 3.3
16 s	Y ⁸⁹		I.T. .91	
16 s	Br ⁸⁸	β^-		
16 s	Xe ¹⁴⁰	β^-		
16 s	Tc ¹⁰⁰	β^- 2.8	γ .54	
17 s	Se ⁷⁷		I.T. .16	
18 s	Rh ¹⁰⁸	$\beta^- \sim 4$	γ	
18.5 s	Ne ¹⁹	β^+ 2.2		E 3.2
19 s	Hf ¹⁷⁹	e^-	I.T. .16 γ .22	
19 s	C ¹⁰	β^+ 1.9, ..	γ .72, 1.03	E 3.6
20 s	Sc ⁴⁶	e^-	I.T. .14	
22 s	I ¹³⁷	β^- (n .6)		
23 s	Pd ¹⁰⁵	e^-	I.T. .2	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
23 s	Na ²¹	β^+ 2.50		E 3.52
24 s	Nb ⁹⁰	e^-	I.T. .12	
24 s	Ag ¹¹⁰	β^- 2.22, 2.88, ..	γ .66, ..	E 2.88
~25 s	Au ²⁰²	β^-		
25 s	Po ²¹¹	α 7.1, 8.7, ..	(γ 1.06, .57)	
28 s	Fr ²²⁰	α 6.69		M 220.081
29 s	O ¹⁹	β^- 3.2, 4.4	γ .197D, 1.37, .110	E 4.79
<30 s	Ba ¹⁴³	β^-		
30 s	Ra ²²¹	α 6.71		M 221.083
30 s	Au ¹⁹⁵	e^-	I.T. .057, .318 γ .261	
30 s	Rh ¹⁰⁵	e^-	I.T. .130	
30 s	Rh ¹⁰⁶	β^- 3.53, ..	γ .51, .62, .87-2.66	E 3.53
32 s	Cu ⁶⁸	β^- 3.0	γ	
33 s	Kr ⁹⁰	β^- 3.2	γ	
~36 s	As ⁸⁰	β^-		
38 s	Ra ²²²	α 6.55, 6.23	γ .33	M 222.085
40 s	Ne ²³	β^- 4.2, 3.8, ..	γ .44, 1.65, ..	E 4.2
40 s	Ag ¹⁰⁹	e^-	I.T. .088	
42 s	Hg <195	α 5.6		
42 s	Rh ¹⁰⁴	β^- 2.5, ..	γ .55, 1.24	E 2.5
43 s	At <202	α 6.50		
44 s	Ag ¹⁰⁷	e^-	I.T. .093	
48 s	Sb ¹³⁴	β^-		
49 s	Ge ⁷⁵	e^-	I.T. .14	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
50 s	Ir ¹⁹⁸	β^- 3.6	γ .78	E 4.4
50 s	Yb ²	e^-	I.T. .025	
52 s	Em ²²⁰	α 6.28, 5.75		M 220.080
52 s	Ge ⁷⁷	β^- 2.9, ..	I.T. .16 γ .21	
54 s	Ru ^{<94}	β^+	γ	
54 s	At ²¹⁹	α 6.27 β^-		M 219.080
55 s	Au ²⁰³	β^- 1.9	γ .69	E 1.9
55 s	Xe ¹²⁵		I.T. .075 γ .111	
55 s	V ⁵⁴	β^- 3.3	γ .99, .84, 2.21	
55 s	Kr ⁷⁹		I.T. .13	
56 s	Br ⁸⁷	β^- 2.6, 8.0 (n .3)	γ 3.2, 5.4	E 8.0
<1 m	Em ²¹⁵	α 8.6		M 215.066
<1 m	Th ²²³	α 7.5		M 223.091
<1 m	Ra ²¹⁹	α 8.0		M 219.079
<1 m	Ac ²³⁰	β^- 2.2		
<1 m	In ¹¹⁸	β^- 4		
~1 m	Cs ¹⁴²	β^-		
1 m	Na ²⁵	β^- 4.0, 2.6-3.4	γ .98, .58, .38, 1.60	E 4.0
1 m	Nb ⁹⁷	e^-	I.T. .75	
1.0 m	Pb ²⁰¹	e^-	I.T. .66	
1.0 m	Rb ⁸⁶		I.T. .56	
1.1 m	F ¹⁷	β^+ 1.75		E 2.77

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1.1 m	Cs ¹⁴⁰	β^-		
1.1 m	Mo ⁹¹	β^+ 2.45, 2.78, 3.99	I.T. .65 γ 1.54, 1.21	
1.15 m	Se ⁸³	β^- 3.4		
1.18 m	Pa ²³⁴	β^- 2.31, ..	I.T. γ .23-1.8	
1.20 m	In ¹¹⁴	β^- 1.98, .. $\beta^+ \sim 1$	K γ .55-1.28	E ⁻ 1.98 E ⁺ 2.3
1.20 m	O ¹⁴	β^+ 1.83	γ 2.30	E 5.15
1.25 m	Rb ⁸²	β^+ 3.2		
1.25 m	Xe ¹²⁷		I.T. .175 γ .125	
1.25 m	Ag ¹¹¹		I.T.	
1.3 m	U ²²⁷	α 6.8		M 227.102
1.3 m	Dy ¹⁶⁵	$\beta^- \sim 1$	I.T. .108 γ .36, .16, .52	
1.3 m	Sb ¹²⁴	β^- 3 e ⁻	I.T. .012	
1.32 m	Tl ²¹⁰	β^- 1.9	γ	E 5.4
~ 1.33 m	Rb ⁹²	β^-		
1.35 m	Cu ⁵⁹	β^+ 3.7	γ .9, 1.3	
1.4 m	Ir ¹⁹²	e ⁻ β^-	I.T. .057	
1.4 m	Cl ⁴⁰	$\beta^- \sim 7, ..$	γ 1.46, 2.75, ~ 6	
1.43 m	I ¹³⁶	β^- 6.4, 5.0, 3.6	γ 1.4, 2.8	E 6.4
1.5 m	Zn ⁶¹	β^+ 5		
1.5 m	Pd ¹¹³	β^-		

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1.6 m	Co ⁶²	β^-	γ	
1.6 m	Cs ¹²⁶	β^+ 3.8, ..	K γ .38	E 4.8
1.7 m	Bi <198	α 6.2		
1.7 m	At <203	α 6.35		
1.7 m	W ¹⁸⁵	e^-	I.T. γ .13, .16	
1.7 m	Mn ⁵⁷	β^- 2.6	γ .117, .134, .69, ..	E 2.7
1.7 m	Sc ⁵⁰	$\beta^- \sim 3.5$	γ 1.6, 1.2	E ~ 6.3
1.7 m	Rb ⁹¹	β^- 4.6	γ	
1.8 m	Pa ²²⁶	α 6.81		M 226.099
< 2 m	Mo ¹⁰⁵	β^-		
2 m	Te ¹³³	β^- 1.4, 2.4	γ .6, 1.0	E 3.0
2 m	Sb ¹³²	β^-		
2 m	Mn ⁵⁴	β^- or e^-	I.T. ?	
2 m	Ag ¹¹⁴	β^-		
~ 2 m	Se ⁸⁴	β^-		
~ 2 m	Sr ⁹⁴	β^-		
2.0 m	V ⁵³	β^- 2.50	γ 1.00	
2.1 m	O ¹⁵	β^+ 1.7		E 2.7
2.1 m	Zn ⁶⁰			
2.15 m	Bi ²¹¹	α 6.62, 6.27, (9) β^- e^-	γ .35	E .63
2.2 m	Ac ²²³	α 6.64	K	M 223.089

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
2.2 m	Tl ²⁰⁹	β^- 1.8, 2.3	γ .11-1.6, .12D	E 3.9
2.2 m	Sn ¹³²	β^-		
2.2 m	Zn ⁷¹	β^- 2.4	γ .51, ..	E 2.9
2.3 m	Ag ¹⁰⁸	β^- 1.77, .. β^+ .8	K γ .62, .43, .60	E ⁻ 1.77 E ⁺ 1.8
2.30 m	Al ²⁸	β^- 2.87	γ 1.78	E 4.65
2.4 m	Re ¹⁸⁰	β^+ 1.1	γ .11, .88	
2.5 m	P ³⁰	β^+ 3.3		E 4.3
2.5 m	Ga ⁶⁴	β^+ ~ 5	γ .97-3.8	E 7
2.5 m	Nb ⁹⁹	β^- 3.2		E 3.2
2.6 m	Sn ¹³⁰	β^-		
2.60 m	Ba ¹³⁷	e ⁻	I.T. .662	
2.7 m	Ra ²¹³	α 6.90		
2.7 m	Rb ⁹⁰	β^- 5.7	γ	
3 m	Em ^{204?}	α 6.3		
3 m	Re ¹⁹⁰	β^- 1.7	γ .19, .36, .56, .40-.80	
3.0 m	Ce ¹⁴⁵	β^- 2.0	γ	
3.0 m	Br ⁸⁵	β^- 2.5	no γ	E 2.8
3.05 m	Po ²¹⁸	α 6.00 β^-		E 218.077
3.1 m	Tl ²⁰⁸	β^- 1.79, 1.28, ..	γ 2.615, .58D, .51, .86, ..	E 4.99
3.2 m	Kr ⁸⁹	β^- 4.2, 2	γ	
3.4 m	Sn ¹³¹	β^-		
3.4 m	Pr ¹⁴⁰	β^+ 2.3	K	E 3.3

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
3.4 m	Ne ²⁴	β^- 1.95, .., (~ 4.3)	γ .47D, .88, ..	E 2.42
3.5 m	I ¹²²	β^+ 3.12		E 4.14
3.5 m	Sb ¹²²	e^-	I.T. .075 γ .060	
3.5 m	Sb ¹¹⁸	β^+ 3.1	I.T. .11	E 4.1
3.6 m	Cr ⁵⁵	β^- 2.8		E 2.8
3.7 m	Gd ¹⁶¹	β^- 1.6	γ .36, .10, .32, ..	E 2.0
3.77 m	V ⁵²	β^- 2.6	γ 1.4	E 4.0
3.8 m	Cs ¹²⁸	β^+ 3.0, 2.5, 1.5	γ .13, .45, .98	E 4.0
3.8 m	Xe ¹³⁷	β^- 3.5	γ	
3.8 m	Tc ^{104?}			
3.9 m	Se ⁷⁹	e^-	I.T. .096	
~ 4 m	Po ^{197?}	α 6.04		
~ 4 m	Ho ^{<157}	α 4.2		
~ 4 m	Ru ¹⁰⁸	β^-		
4.1 m	Sb ¹³³	β^-		
4.20 m	Tl ²⁰⁶	β^- 1.51	no γ	E 1.51
4.3 m	Au ^{≤ 187}	β^+ α 5.1	K	
4.3 m	Tc ⁹²	β^+ 4.1	γ 1.3	
4.4 m	Rh ¹⁰⁴	β^- e^-	I.T. .077 γ .055, ..	
4.5 m	In ¹¹⁸	β^- 1.5	γ	
4.5 m	Ru ¹⁰⁷	β^- 4.3	γ	
4.78 m	Tl ²⁰⁷	β^- 1.45	γ .89	E 1.45
4.8 m	Fr ²²¹	α 6.30, 6.07	γ .22	M 221.083

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
4.8 m	Pd ¹⁰⁹	e ⁻	I.T. .17	
4.9 m	Cd ¹¹¹	e ⁻	I.T. .150 γ .247D	
< 5 m	Ra ²²⁹	β ⁻		
< 5 m	Th ²³⁵	β ⁻		
5.0 m	S ³⁷	β ⁻ 1.6, 4.7	γ 3.1	E 4.7
5.1 m	Cu ⁶⁶	β ⁻ 2.63, 1.59	γ 1.04	E 2.63
5.2 m	Hg ²⁰⁵	β ⁻ 1.6, 1.4	γ .20	E 1.6
5.5 m	Fe ⁶¹	β ⁻	γ	
5.80 m	Ti ⁵¹	β ⁻ 2.1, 1.5	γ .32, .93, .61	E 2.4
< 6 m	Br ⁷⁸	β ⁺ 2.4		E 3.4
6 m	Ba ¹⁴²	β ⁻		
6 m	Cs ¹²³	β ⁺		
~ 6 m	Po ^{198?}	α 5.94		
6.4 m	Br ⁷⁸		I.T. γ .05, .11	
6.5 m	La ¹³⁴	β ⁺ 2.7	K	E 3.7
6.6 m	Nb ⁹⁴	β ⁻ 1.3 e ⁻	I.T. .041 γ .9	
6.6 m	Al ²⁹	β ⁻ 2.5, 1.4	γ 1.28, 2.43	E 3.8
7 m	Em ²⁰⁶	α 6.22	K	
7 m	Dy ^{≤153}	α 4.2		
7 m	Ir ¹⁹⁷	β ⁻ 1.6, ..	γ 1.8	
7 m	At ²⁰³	α 6.10		
7 m	Bi ¹⁹⁸	α 5.83	K	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
7 m	Sr ⁹³	β^-		
~ 7 m	As ⁶⁸	β^+		
7.3 m	E ²⁴⁷	α 7.35	K (?)	M 247.151
7.3 m	Np ²⁴⁰	β^- 2.16, ..	γ .56, .91, 1.4	E 2.16
7.7 m	K ⁻³⁸	β^+ 2.7	γ 2.1	E 5.8
8 m	Bi ²¹⁵	β^-		M 215.069
8 m	Sm ¹⁴³	β^+ 2.3		E 3.3
8 m	Th ²²⁵	α 6.57	K	M 225.094
8 m	Ga ⁶⁵	β^+ 2.2		E 3.2
~ 8 m	Po ²⁰⁰	α 5.77	K	
8.7 m	Ca ⁴⁹	β^- 2.0, 1.0	γ 3.09, 4.05, 4.7	E 5.1
< 9 m	Em ²¹⁶	α 8.01		M 216.068
< 9 m	Th ²²⁴	α 7.13		M 224.091
< 9 m	Ra ²²⁰	α 7.43		M 220.080
9 m	La ¹³⁶	β^+ 2.1	K	
9 m	Os ¹⁹⁰		I.T. .62 γ .19-.56	
9 m	Rh ⁹⁸	β^+ 3.3	γ .65, ..	
9 m	As ⁷⁹	β^- 2.3	(γ .096)	E 2.4
9 m	Fe ⁵³	β^+ 2.6	γ .37	E 3.6
9.3 m	Ta ¹⁷⁸	β^+ 1.1 e^- .08	K γ ~1.5	
9.3 m	U ²²⁸	α 6.67	K	M 228.103
9.5 m	Cs ¹³⁹	β^- ~ 4	γ	
9.5 m	Sn ¹²⁵	β^- 2.1, ..	γ .33, 1.4	E 2.4

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotopes</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
9.5 m	Cu ⁵⁸	β^+ <.7		
9.5 m	Mg ²⁷	β^- 1.75, 1.57	γ .84, 1.02, .18	E 2.59
9.9 m	Cu ⁶²	β^+ 2.9		E 3.9
10 m	Tc ¹⁰⁵	β^-		
10 m	Y ⁹⁵	β^-		
10 m	Re ¹⁹¹	β^- 1.8		
10 m	Ta ¹⁸⁶	β^- 2.2	γ .20, .73, .12-1.2	
10 m	Pa ²³⁷	β^-		
10 m	Sb ¹³⁰	β^- 2.9	γ .19-.76	
10.0 m	N ¹³	β^+ 1.20		E 2.22
10 m	Au ¹⁸⁸			
10.5 m	Co ⁶⁰	β^- 1.5	I.T. .059 γ 1.33	
11 m	Em ²⁰⁷	α 6.12	K	
11 m	Mo ¹⁰²	β^- 1		
~11 m	Po ¹⁹⁹	α 5.85		
12 m	Pb ¹⁹⁹	e^-	I.T. .42	
~12 m	Ba ¹²⁷			
~13 m	Np ²³²		K, γ	
14 m	Ce ¹⁴⁶	β^- .7	γ .32, .05-.22	
14 m	Co ⁶²	β^- 2.8	γ 1.2, 1.0, ..	
14 m	Tb ¹⁶²			
14 m	In ¹¹²	β^- .66 β^+ 1.52	K	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass</u>
14 m	In ¹¹²	β^- .66 β^+	K	E 1.52
14 m	Rb ⁹¹	β^- 3.0	γ	
15 m	Sb ¹¹⁶	β^+ 2.4, ..	γ 1.27, .9, 2.2	E 4.7
15 m	As ⁶⁹	β^+ 2.9	γ .23	
15 m	Nd ¹⁵¹	β^- 1.9	γ .08, .11, .42, .7, 1.1	E 2.0
15 m	Xe ¹³⁵	e^-	I.T. .52	
15 m	Ga ⁶⁵	β^+ 2.5	I.T. .052 γ .09, .11	
15 m	Tc ¹⁰¹	β^- 1.2	γ .30	E 1.5
15 m	Mo ¹⁰¹	β^- 1.2, 2.2	γ .19, .96	E 2.4
15 m	Fr ²²²	β^- α		
15 m	Rb ⁸⁹	β^- 3.9, ..	γ 1.05, .25, .66, 1.26-2.20	E 3.9
~ 15 m	Au ⁻¹⁸⁷			
15.6 m	Mo ⁹¹	β^+ 3.44		E 4.46
16 m	Ag ¹⁰²	β^+		
16 m	Ta ¹⁸²	e^- β^- ?	I.T. .18	
17 m	Pr ¹⁴⁴	β^- 2.98, .8, 2.3	γ .70, 2.18, 1.48	E 2.98
17 m	Xe ¹³⁸	β^- 2.4	γ .42, .51, 1.8, 2.0	
17 m	Rd ⁹⁸	β^+		
17 m	Sb ¹²⁰	β^+ 1.70	γ 1.18	E 2.72
17 m	Y ⁹⁴	β^- 5.4	γ 1.4	E 5.4 (?)

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
18 m	Se ⁸¹	β^- 1.38		E 1.38
18 m	In ¹¹⁹	β^- 2.7	no γ	E 2.7
18 m	I ¹¹⁹	β^+		
18 m	Br ⁸⁰	β^- 2.0, 1.4 β^+ .86	K γ .62	E ⁻ 2.0 E ⁺ 1.9
18 m	Yb ¹⁶⁷		K γ .118, .18?, .33?	
18 m	Ba ¹⁴¹	β^- 2.8	γ	
18 m	Eu ¹⁴⁴	β^+ 2.4		
18 m	Sn ¹⁰⁹	β^+	K γ .073, .68	
18 m	Po ²⁰¹	α 5.67	K	
18 m	Rb ⁸⁸	β^- 5.2, 3.3, 2	γ 1.85, .91, 2.7, 1.39-4.9	E 5.2
19 m	Tm ¹⁷²	β^-		
19 m	Fr ²¹²	α 6.39, 6.41, 6.34	K	
19 m	Ge ⁶⁷	β^+ 3.4	γ .17	
19 m	Dy ^{$\leq$153}	α 4.1		
19 m	Ir [?]		K	
~19 m	La ¹⁴³	β^-		
19.7 m	Bi ²¹⁴	β^- 1.6, 3.17, .. α 5.5, .., (8.3-10.5)	γ .61, 1.12, 1.76, .45-2.43	E 3.17
20 m	Pm ¹⁴¹	β^+ ~2.6		
20 m	Re ¹⁸⁸	e ⁻	I.T. .10 γ .06	
20 m	Eu ¹⁵⁹	β^-		
20.5 m	C ¹¹	β^+ .96	no γ	E 1.98

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
21 m	Rb ⁸⁴		I.T. .23, .46 K Y .23, .89	
21 m	In ¹¹²	e ⁻	I.T. (Y .15)	
21 m	Ga ⁷⁰	β^- 1.65, ..	Y 1.04, .17	E 1.65
21 m	Ag ¹¹⁵	β^- 3	Y .23	E 3
21 m	Mn ⁵²	β^+ 2.7	I.T. .39 Y 1.4	
21 m	Sb ¹²⁴	β^- e ⁻	I.T. .018	
22 m	Ni ¹³⁸	β^+ 2.4 e ⁻ (?)		
22 m	Sb ¹³¹	β^- 1.1		
22 m	Pr ¹³⁵	β^+ 2.5	Y .30, .22, .08	
22 m	Rh ¹⁰⁷	β^- 1.2, ~2	Y .31, .40, .1-.7	
22 m	K ⁴⁴	β^- 4.9, 1.5	Y 1.1, 2.1, 2.5, ..	
22 m	Fr ²²³	β^- 1.0, 1.3 α 5.3	Y .050-.31	M 223.090
22 m	Pd ¹¹¹	β^- 2.14, ..	Y .38-.73	
22 m	Lu ¹⁷⁸	β^-		
22 m	Ho ¹⁶²	β^+ 1.3 e ⁻ .17	K Y ~1.2	
23 m	Em ²⁰⁸	α 6.14	K	
23 m	Em ²¹²	α 6.26		M 212.057
23 m	Sm ¹⁵⁵	β^- 1.8	Y .25, .105	E 2.2
23.3 m	Th ²³³	β^- 1.23, ..	Y .098-.66	E 1.23
23.5 m	U ²³⁹	β^- 1.21	Y .074	E 1.28

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
24 m	Pd ⁹⁹		γ .13	
24 m	Pr ¹⁴⁶	β^- 3.7, 2.3	γ .46, 1.49, .75, ..	E 4.2
24 m	Cu ⁶⁰	β^+ 2.0, 3.0, 3.9	γ 1.33, 1.76, .85, 2.1-4.0	E 6.3
24 m	Ag ¹⁰⁶	β^+ 1.96, 1.45	K γ .51	E 2.98
24 m	Pa ²³⁵	β^- 1.4	no γ	E 1.4
<24 m	Po ²¹⁷	α 6.5		
25 m	Em ²²¹	β^- α		
25 m	Te ¹³¹	β^- 2.1, ..	γ .05-.77	E 2.3
25 m	Cf ²⁴⁴	α 7.17	K (?)	M 244.142
25 m	At ²⁰⁵	α 5.90	K	
25 m	Am ²⁴⁶	β^- 1.22, ..	γ 1.07, .80, .10, .018, ..	E 2.4
25 m	Se ⁸³	β^- 1.5	γ .04, .06, .18, .95	
25 m	Hg ¹⁸⁹	β^+	K γ .029	
~25 m	Bi ¹⁹⁹	α 5.47	K	
~25 m	At ²⁰⁴		K	
25.0 m	I ¹²⁸	β^- 2.12, 1.67, ..	K γ .45, .54-.98	E ⁻ 2.12
26 m	Pu ²³⁵	α 5.85	L, K	M 235.119
26 m	Am ²⁴⁴	β^- 1.5 e^- 1.5	K	M 244.141
26 m	Au ²⁰¹	β^- 1.5	γ .55	E 1.5
26.8 m	Pb ²¹⁴	β^- .7, ..	γ .3520, .2952, .053-.259	E 1.0

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
27 m	Ag ¹⁰⁴	β^+ 2.70	γ .55, .12, ..	
29 m	Sr ⁸¹	β^+ e^-		
30 m	Cs ¹³⁰	β^+ 1.97 β^- .44	K	E^- .44 E^+ 2.99
30 m	W ¹⁷⁹		K	
30 m	Em ²⁰⁹	α 6.04	K	
30 m	Pt ¹⁹⁹	$\beta^- \sim 1.2$	γ .07-.96	$E \geq 1.7$
30 m	Fm ²⁵⁰	α 7.43		M 250.158
30 m	In ¹⁰⁷	β^+ 2	γ	
30 m	Nb ^{98(?)}	β^-		
~ 30 m	Cd ¹¹⁸	(β^- 4)		
31 m	Th ²²⁶	α 6.34, 6.23, 6.10, ..	γ .11, .24, .13, .19	M 226.096
31 m	V ⁴⁷	β^+ 1.89		E 2.89
32 m	Cs ¹³⁸	β^- 3.40, ..	γ 1.43, 1.0, .46, 2.2, .13-3.3	
32 m	Br ⁸⁴	β^- 4.68, ..	γ .89, 1.9	
32.4 m	Cl ³⁴	β^+ 2.5, 1.4	I.T. .14 γ 2.1, 1.1, 3.2, ..	
34 m	K ⁴⁵	β^-		
35 m	Sn ¹¹¹	β^+ 1.51	K	E 2.53
35 m	Np ²³³	α 5.53 e^- .3	K γ	M 233.114
35 m	Bi ²⁰⁰		K	
35 m	Rh ⁹⁷	β^+		
36 m	Br ⁷⁴	β^+	K	
36 m	Pu ²³²	α 6.58	K	M 232.114

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
36.1 m	Pb ²¹¹	β^- 1.4, .5	γ .83, .06-.76	E 1.4
37 m	Ho ¹⁶⁴	β^- .99, .90	K I.T. (?) .046 γ .073, .090D, .037	E ⁻ .99
37.3 m	Cl ³⁸	β^- 4.8, 1.1, 2.7	γ 2.1, 1.6	E 4.8
38 m	Pa ²²⁷	α 6.46	K	M 227.100
38 m	Zn ⁶³	β^+ 2.36, 1.40, ..	K γ .96, 1.9, 2.6	E 3.38
40 m	Sb ¹³⁰	β^-	γ	
40 m	Sn ¹²³	β^- 1.26	γ .15	E 1.41
40 m	Xe ¹²¹	β^+	γ .096	
41 m	Ra ²²⁷	β^- 1.30	γ .29, .50	E 1.30
42 m	Pb ¹⁹⁷		K I.T. (?) γ .17, .22, .23, .32, .39	
42 m	Cr ⁴⁹	β^+ 1.54, .. e^-	γ .15, .09, .06	E 2.56
42 m	Au ⁻¹⁸⁹		K γ .29, .14	
43 m	Hg ¹⁹⁹	e^-	I.T. .368 γ .158D	
44 m	Cf ²⁴⁵	α 7.11	K	
44 m	Te ¹³⁴	β^-		
44 m	Tc ⁹³	e^-	I.T. .39 K γ 2.7	
44 m	Se ⁷⁰	β^+		
44 m	Se ⁷³	β^+ 1.7		E 2.7
45 m	Mn ⁵¹	β^+ 2.2		E 3.2

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
45 m	Cs ¹²⁵	β^+ 2.05, ..	K Y .111	
47 m	Po ²⁰³		K	
47 m	Bi ²¹³	β^- 1.39, .96 α 5.9	Y .43	
48 m	Au ²⁰⁰	β^- 2.2	Y .39, 1.13	E 2.2
49 m	Ta ¹⁸⁵	β^- 1.7 e^-	Y .13, .18, .24	
50 m	Sn ¹²⁶	β^-		
50 m	Cd ¹¹⁷	β^- 1.6, 3.0	Y 1.3, .27-2.0	
50 m	Np ²³¹	α 6.28		M 231.111
50 m	As ⁷⁰	β^+ 1.4, 2.5	Y 1.1, 2.0, ..	E 6.6
50 m	Y ⁹¹	e^-	I.T. .55	
50 m	In ¹⁰⁸	β^+ 2.3 e^-		
52 m	I ¹³⁴	β^- 1.5, 2.5	Y .86, 1.1, 1.8	E 3.4
52 m	Zn ⁶⁹	β^- .90		E .90
52 m	Tc ⁹⁶	β^+ e^-	I.T. .034 K	
53 m	Tc ⁹⁴	β^+ 2.41, ..	K Y .87, 1.85, 3.3, 2.7	E 4.30
54 m	Rh ¹⁰³	e^-	I.T. .040	
54.0 m	In ¹¹⁶	β^- 1.00, ..	Y 1.27, 1.09, 2.1, 1.5, ..	E 3.36
55 m	Cl ³⁹	β^- 3.0, 1.7	Y .3, 1.3	E 3.3
55 m	Cd ¹⁰⁵	β^+ 1.69, .. e^-	K Y .025-2.32	
56 m	Po ²⁰²	α 5.59	K	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
57 m	Se ⁸¹	e ⁻	I.T. .103	
57 m	Hg ¹⁹¹	e ⁻	K Y .253, ..	
57 m	Sc ⁴⁹	β^- 2.0	no Y	E 2.0
58 m	U ²²⁹	α 6.42	K	M 229.105
58 m	La ¹³¹	β^+ 1.6		
59 m	Cd ¹⁰⁴		K Y .067, .084, .124, .134	
<1 h	Rh ¹⁰⁹			
1 h	Sb ¹¹⁶	β^+ 1.4	Y 1.27, .9, .41	E 4.7
1 h	Eu ¹⁵⁸	β^- 2.6	Y	
1 h	Ra ²³⁰	β^- 1.2		
1 h	Mv ²⁵⁶		K	
1 h	Np ²⁴⁰	β^- .90	Y .56, .43, .16-1.16	E 2.06
1 h	Ru ⁹⁴	K		
1.0 h	Bi ²⁰¹	α 5.15	K	
~ 1 h	Am ²³⁷	α 6.01	K	M 237.124
~ 1 h	Sb ¹²⁸	β^-		
1.01 h	Bi ²¹²	β^- 2.25 α 6.05, 6.09, .., (9.5-10.5)	Y .040-2.20	E 2.25
1.05 h	Te ¹³³	e ⁻	I.T. -.4	
1.09 h	Ac ²²⁹	β^-		
1.09 h	In ¹¹⁰	β^+ 2.25	K Y .66D	E 3.93
1.1 h	In ¹¹⁷	β^- .74	Y .56, .16	E 1.46

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1.1 h	Ag ¹⁰³	β^+ 1.3 e ⁻	K Y .76, .55	
1.13 h	Pb ²⁰⁴	e ⁻	I.T. .91 Y .37D, .89D, ..	
1.13 h	Ga ⁶⁸	β^+ 1.88, .78	K Y 1.10	E 2.90
1.17 h	Pr ¹³⁶	β^+ 2.0	Y .17, .8, 1.1	
1.17 h	Sr ⁸⁵		I.T. .007, .23 } 86% Y .22 } K, Y .150 ← 14%	
1.17 h	Y ⁸²	β^+ 2		
1.2 h	Tl ¹⁹⁵			
1.2 h	Kr ⁷⁷	β^+ 1.86, 1.67, ..	K Y .108, .131, .024, .149-.87	
1.20 h	Te ¹²⁹	β^- 1.46, 1.01, ..	Y .03, .45, 1.08, ..	E 1.49
1.20 h	Nb ⁹⁷	β^- 1.27	Y .66	E 1.93
1.23 h	Yb ^{165?}	β^+ 2.4		
1.25 h	Er ¹⁶³		K Y .43, 1.10	
1.28 h	La ¹⁴²	β^- > 2.5	Y .63, .87	
1.3 h	W ¹⁷⁶	$\beta^+ \sim 2$ e ⁻	K Y ~ 1.3	
1.30 h	Kr ⁸⁷	β^- 3.8; 1.3, ~ 3.3	Y .40, 2.57, .85, ..	E 4.2
>1.3 h	I ¹²⁰	β^+ 4.0		
1.37 h	Ge ⁷⁵	β^- 1.18, .92, ..	Y .27, .07-.63	E 1.18
1.4 h	Pt ¹⁹⁷	e ⁻	I.T. .34	
1.4 h	I ¹²¹	β^+ 1.13, ..	Y .213	
1.42 h	Ba ¹³⁹	β^- 2.22, .8, 2.38 e ⁻	Y .165D, 1.43	E 2.38

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1.43 h	Ge ⁷⁸	β^- .9	γ	
1.5 h	Pb ¹⁹⁹		K γ .37, .35, .72	
1.5 h	Po ²⁰⁵	α 5.2	K	
1.50 h	Hg ¹⁹⁰	e^-	K	
1.50 h	As ⁷⁸	β^- 4.1, ..	γ	E 4.1
1.6 h	Ho ¹⁶⁹	β^-		
1.6 h	Bi ²⁰²		K	
1.6 h	Br ⁷⁵	β^+ 1.70, ..	K γ .6	
1.6 h	Zr ⁸⁷	β^+ 2.10	K γ .6, .3	E 3.50
1.62 h	Ba ¹²⁶	(β^+ 3.8)	K γ .22, .70, (.38)	
1.63 h	Ru ⁹⁵	β^+ 1.2	K γ 1.1	E 2.2
1.65 h	Co ⁶¹	β^- 1.22	γ .070	E 1.29
1.7 h	At ²⁰⁸	α 5.65	K γ .18, .66	
1.73 h	In ¹¹³	e^-	I.T. .39	
1.8 h	Nd ¹⁴⁹	β^- 1.5, ..	γ .11, .03-.65	E 1.6
1.8 h	Hf ¹⁷⁰	β^+ 2.4		
1.8 h	At ²⁰⁷	α 5.75	K	
1.8 h	Xe ¹²³	β^+ 1.7	K γ .15	
1.82 h	A ⁴¹	β^- 1.20, 2.49	γ .129D	E 2.49
1.86 h	Kr ⁸³		I.T. .032 γ .009	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1.87 h	F ¹⁸	β^+ .65		E 1.67
1.9 h	Tl ¹⁹⁸		K I.T. .26 γ .28, .049, .44-.64	
1.9 h	Am ²³⁸	e^-	K γ .98, .58, .102	
1.9 h	In ¹¹⁷	β^- 1.77, 1.61	I.T. .31 γ .16	
1.9 h	Ba ¹²⁹	β^+ 1.6 e^- .13	γ	
1.9 h	Nb ⁸⁹	β^+ 2.9		E 3.9
2 h	E ²⁴⁹	α 6.76		M 249.154
2 h	Rh ¹⁰⁶	$\beta^- \sim 1$	γ .2-1.5	
~ 2 h	Nb ⁸⁹	β^+	(γ .59)	
~ 2 h	Bi ²⁰¹		K	
2.0 h	Pr ¹³⁸	β^+ 1.4	γ 1.0, .8, .3-1.7	
2.0 h	Am ²⁴⁵	β^- .90	γ .036, .12, .26, .06-.23	
2.0 h	Yb ¹⁷⁷	β^- 1.30, .. e^-	γ .146D, .119, 1.08, 1.23	E 1.30
2.1 h	Ta ¹⁷⁸	$\beta^+ \sim 1$ $e^- \sim .1$	K $\gamma \sim 1.4$	
2.2 h	W ¹⁷⁷	e^- .13, $\sim .4$	K $\gamma \sim .5, 1.2$	
2.3 h	I ¹³²	β^- .9-2.12	γ .67, .78, .53-2.2	E 3.57
2.3 h	Dy ^{≤ 153}	α 3.6		
2.3 h	Ir ¹⁹⁵	β^- 1.2, 2.1, ..	γ .42, .66, .88, >1	E 2.1
2.3 h	Pb ¹⁹⁸		K γ .17, .29, .36, .28-.42	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
2.3 h	Cm ²³⁸	α 6.50	K	M 238.128
2.3 h	Br ⁸³	β^- .94, ..	γ .051, (.032, .009)	E .98
2.32 h	Dy ¹⁶⁵	β^- 1.25, ..	γ .09-1.0	E 1.25
2.4 h	Ni ¹⁴¹	β^+ .7	K γ 1.1	E 1.7
2.5 h	Cf ²⁴⁷		K γ .28, .49	
2.5 h	Hb ¹⁶¹		K γ .090, .17	
2.5 h	Te ¹¹⁷	β^+ 2.5		
2.5 h	Ge ⁶⁶	β^+ (?)	K	
2.56 h	Ni ⁶⁵	β^- 2.10, .6, 1.0	γ 1.5, 1.12, .37	E 2.10
2.58 h	Mn ⁵⁶	β^- 2.8, 1.0, .7	γ .85, 1.8, 2.1-3	E 3.7
2.6 h	At ²⁰⁶		K	
2.62 h	Si ³¹	β^- 1.48, ..	γ 1.26	E 1.48
2.7 h	Em ²¹⁰	α 6.04	K	M 210.057
2.7 h	Pm ¹⁵⁰	β^- 2.0, 3.0	γ .34, .82, .43, 1.0-3.0	
2.7 h	Tc ⁹³	β^+ .80, .6	K γ 1.3, 1.5, 2.0	E 3.1
2.7 h	Sr ⁹²	$\beta^- \sim 5.5$	γ 1.38	E 1.9
2.8 h	Kr ⁸⁸	β^- .52, 2.7, ..	γ 2.4, .19, .85, .028-2.2	E 2.9
2.8 h	Sb ¹¹⁷	e^-	K γ .16	
2.8 h	Tl ¹⁹⁷		K γ .152, .43, ..	
2.8 h	Sr ⁸⁷		I.T. .39	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
2.9 h	Ac ²²⁴	α 6.17	K	M 224.092
3 h	Ir ¹⁹⁰	β^+ 2.0	K γ .19, .36, .51, .62	
3 h	Ir [?]	no β^+	K γ .12	
3 h	Er ¹⁶¹	β^+ 1.2	K γ .82, 1.12, ..	
3 h	Pt ¹⁸⁷			
3 h	Zn ⁷¹	β^- 1.5	γ .4, .5, .6	E 3.0
3 h	Au ⁻¹⁹¹		K γ .30, .048-.6	
~3 h	Hg ^{<192}	e^- .088		
~3 h	Cm ²³⁹		K	
~3 h	Te ¹¹⁶	(β^+ 2.4)		
3.0 h	Ho ¹⁶⁷	β^- 1.0, .28	γ .35, .70	
3.0 h	Cd ¹¹⁷		I.T.	
3.1 h	Cs ¹³⁴	β^- .55 e^-	I.T. .13, .14 γ .0100	
3.1 h	Bk ²⁵⁰	β^- .9, 1.9	γ 1.0	
3.1 h	Fm ²⁵⁶	SF		
3.08 h	Ti ⁴⁵	β^+ 1.02	K	E 2.04
3.12	Ag ¹¹²	β^- 3.5, 4.1, 2.7, ..	γ .62, 1.39, 1.1-2.8	E 4.1
3.3 h	Pb ²⁰⁹	β^- .62	no γ	E .62
3.3 h	Cu ⁶¹	β^+ 1.22, ..	K γ .28, .66, 1.22, .070, ..	E 2.24
3.4 h	Fm ²⁵⁴	α 7.22, 7.18, .. SF	γ .042, .094	M 254.166

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
3.5 h	Pb ²⁰²		I.T. .79, .13 K Y .96, .42, .39-.66	
3.5 h	Y ⁹²	β^- 3.60, 2.7, 1.3	Y .94, .21-2.4	E 3.60
3.5 h	Y ⁸³			
3.7 h	Lu ¹⁷⁶	β^- 1.2, .. e ⁻	Y .089	E 1.2
3.7 h	Y ⁸⁴	β^+ 2.0	K Y	
3.8 h	Po ²⁰⁴	α 5.37	K	
3.8 h	La ¹⁴¹	β^- 2.43, .9	Y $\sim$ 1.5	E 2.43
3.9 h	Sc ⁴³	β^+ 1.19, .82, .39	Y .37, .62, .25, .84	E 2.21
4 h	La ¹³³	β^+ 1.2 e ⁻ .26	K Y .8	
4 h	Sn ¹⁰⁸		K	
4 h	Sn ¹¹⁰		K Y .28	
$\sim$ 4 h	Tl ¹⁹⁶		K Y .43	
4.0 h	Lu ¹⁷²	β^+ 1.2		
4.0 h	Sc ⁴⁴	β^+ 1.47	K Y 1.16, 2.54	E 3.65
4.1 h	Tb ¹⁴⁹	α 3.95	K (?)	
4.3 h	In ¹⁰⁹	β^+ .7	K Y .058, .20, .35, .43	
4.4 h	Bk ²⁴⁴	α 6.66	K Y .90-1.72	
4.4 h	Kr ⁸⁵	β^- .83	I.T. .31 Y .15	
4.5 h	? Rh ⁹⁹	β^+ .74	Y .29	

* Total Disintegration Energy (Mev), or Isotopic Mass.

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
4.5 h	Bk ²⁴³	α 6.55, 6.72, 6.20	K γ .74, .84, .96, ..	M 243.139
4.5 h	Pr ¹³⁹	β^+ 1.0	γ 1.3, 1.6, .17?	
4.5 h	La ¹³²	β^+ 3.5	γ 1.0	
4.5 h	In ¹¹⁵	β^- .83 e^-	I.T. .33	
4.5 h	Ru ¹⁰⁵	β^- 1.15	γ .73, (.130)	E 2.02
4.6 h	Br ⁸⁰	e^-	I.T. .05 γ .04	
4.6 h	Sb ¹²⁹	β^- .92, 1.70	γ .16-.78	
4.7 h	Rb ⁸¹	β^+ 1.0	K γ .9, (.19)	E 2.2
5 h	Y ⁸⁵			
5 h	Hg ¹⁹³		K γ .038, .032-1.63	
5 h	Tb ¹⁵⁶	β^- .14		
5 h	Ga ⁷³	β^- 1.4	(γ .054, .013D)	E 1.5
5 h	Tl ¹⁹⁸		K γ .41D, .68, .19-1.20	
~5 h	Lu ¹⁷⁹	β^-		
5.0 h	Ho ¹⁶⁰		γ .19, .72, .96, .. K	
5.0 h	Pu ²⁴³	β^- .57, .48, .. e^-	γ .085, ..	E .57
5.0 h	In ¹¹⁰		K I.T. .12 γ .66, .88, .94	
5.1 h	Sb ¹¹⁸	β^+ .7 e^- .2	K γ .26, 1.5	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
5.3 h	Ag ¹¹³	β^- 2.0	γ .29	E 2.0
5.5 h	Ni ¹³⁹	β^+ 3.1 e^- .28	K γ 1.3	E 4.1
5.5 h	At ²⁰⁹	α 5.64	K γ .195, .091, .55, .78	
5.5 h	Hf ¹⁸⁰		I.T. γ .057-.44	
5.5 h	Pd ¹¹¹	β^-	I.T. γ .16, 1.77	
5.7 h	Po ²⁰⁷	α 5.10	K γ .41, .74, .99, ..	M 207.047
5.7 h	Mo ⁹⁰	β^+ 1.2 e^-	γ .25D, (.12) K	
5.9 h	Pr ¹⁴⁵	β^- 1.7	γ .070	
6 h	Os ¹⁹⁰		I.T. ?	
6 h	At ²⁰⁸		K	
6 h	Hg ¹⁹²	β^+ 1.2	K γ .031-.275	
6.0 h	Tc ⁹⁹	e^-	I.T. .002, .142 γ .140	
6.13 h	Ac ²²⁸	β^- 1.11, .45-2.18	γ .058, .10, .91, .08-1.64	E 2.18
6.2 h	Cs ¹²⁷	β^+ 1.06, .7, ..	K γ .41, .125, .175-.44	
6.3 h	Ce ¹³³	β^+ 1.3	K γ 1.8	
6.3 h	Rb ⁸²	β^+ .77, ..	K γ .78, .32-1.46	
6.66 h	Pa ²³⁴	β^- .5, ..	γ .04-1.7	M 234.117
6.7 h	I ¹³⁵	β^- 1.0, .5, 1.4	γ 1.3, 1.8, 2.4, (.52)	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
6.7 h	Cd ¹⁰⁷	β^+ .32 (e ⁻)	K Y .85, (.094)	E 1.43
6.9 h	Mo ⁹³	e ⁻	I.T. .26 Y 1.48, .69	
7 h	Tb ¹⁵⁴	β^- ?	K	
7.1 h	Se ⁷³	β^+ 1.29, 1.65	Y .36D, .066D	E 2.74
7.4 h	Tl ¹⁹⁹		K Y .33, .158, .208, .247, .050-.49	
7.5 h	At ²¹¹	α 5.86, (7.43, ..)	K, L Y .67, (.89, .57)	M 211.053
7.5 h	Er ¹⁷¹	β^- 1.06, .67, 1.48	Y .113D, .31, .12-.81	E 1.48
7.7 h	Tm ¹⁶⁶	β^+ 2.1 e ⁻	K Y .08D-1.32	
8 h	Pd ¹⁰¹	β^+ .5, 2.3?	K	E 1.5 (?)
8 h	Fe ⁵²	β^+ .80, (2.7)	K (Y 1.4, .39)	E 2.21
8.0 h	Ta ¹⁷⁶	e ⁻ .1, .2, ~1	K Y ~2	
8.1 h	Ta ¹⁸⁰	β^- .70, ..	K Y .093D, .102	
8.2 h	Dy ¹⁵⁷		K Y .32	
8.3 h	At ²¹⁰	α 5.35-5.52	K Y 1.18, .25, .047- 2.6	M 210.053
8.7 h	Ta ¹⁸⁴	β^- 1.26, .15	Y .40, .89, .24, 1.18, .11-.78	
9 h	Pu ²³⁴	α 6.19	K	M 234.117
9 h	Ce ¹³⁷		K Y .44	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
9 h	Sb ¹²⁶	β^- 1	γ .07-.9	
9 h	Pb ²⁰¹		K γ .33, .36, .13-1.10	
9 h	Co ⁵⁸	e^-	I.T. .025	
9 h	Zn ⁶²	β^+ .66 e^-	K γ .041	E 1.7
9.2 h	Xe ¹³⁵	β^- .91, .54	γ 25D, .62, .37	E 1.16
9.3 h	Eu ¹⁵²	β^- 1.88	K γ .34, .12D, ..	E 1.88
9.3 h	Te ¹²⁷	β^- .68		E .68
9.4 h	Ga ⁶⁶	β^+ 4.15, ...	K γ 1.04, 2.75, .8-4.8	E 5.17
9.5 h	Hg ¹⁹⁵	e^-	K γ .061, .18, .60 .37-1.15	
9.7 h	Sr ⁹¹	β^- .61-2.67	γ (.55), .65-1.41	E 2.67
10 h	Y ⁹³	β^- 3.1	γ .7	E 3.1 (?)
10 h	Os ¹⁸³		K γ .14, .17, 1.10, ..	
10 h	Er ¹⁶⁵	e^- .1, ..	K	
10 h	Kr ⁷⁶		K γ .028-.40	
~10 h	Sm ¹⁵⁶	β^- .9		
10.64 h	Pb ²¹²	β^- .34, .58	γ .2386, .30, .11-.25	E .58
11 h	Pu ²⁴⁵	β^-		
11 h	Pt ¹⁸⁹		K γ .14, ..	
12 h	Am ²³⁹	α 5.78	K γ .045-.49	M 239.128

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
12 h	Hg ¹⁹³		I.T. .101 Y .039 K	
12 h	Bi ²⁰³	α 4.85	K Y .03-1.6	
12 h	Bi ²⁰⁴	e^-	K Y .22, .08-1.23 (Y .91, .37, .89)	
12 h	Ir ¹⁸⁷	β^+ 2.2 e^-	K Y .30, .14, .44, ..	
12 h	Ge ⁷⁷	β^- 2.20, ..	Y .21-2.3	E 2.7
12.5 h	K ⁴²	β^- 3.5, 2.0, ..	Y 1.5, .32	E 3.5
12.6 h	I ¹³⁰	β^- 1.02, .60	Y .74, .66, .53, .41	E 2.95
12.8 h	Cu ⁶⁴	β^- .57 β^+ .66	K Y 1.34	E ⁻ .57 E ⁺ 1.68
13 h	Nb ⁹²		K Y 2.35	
13 h	Re ¹⁸²		K Y .11-.35, ~ 1	
13 h	I ¹²³	e^-	K Y .159	
13.6 h	Rd ¹⁰⁹	β^- 1.0	(Y .088)	E 1.1
14 h	Y ⁸⁷	e^-	I.T. .38	
14 h	Eu ¹⁵⁰	β^- 1.1		
14 h	Os ¹⁹¹		I.T. .074	
14 h	U ²⁴⁰	β^- .36, (2.16, ..)	(Y .56, ..)	E .36
14 h	Zn ⁶⁹		I.T. .44	
14.1 h	Ga ⁷²	β^- .64-3.17	Y .84, .60-3.35, .69D	E 4.00
14.6 h	Nb ⁹⁰	β^+ 1.50, ..	Y 1.14, 2.23, .14, ..	E 3.80

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
15 h	Y^{86}	β^+ 1.80, 1.2	γ 1.93, 1.08, .18, .63	E 6.01
15 h	Os^{183}		K γ .11, .38, ..	
15 h	Eu^{157}	β^- 1.0, ~ 1.7	γ .6, .2	
15.0 h	Na^{24}	β^- 1.39, ...	γ 2.753, 1.368, ...	E 5.51
16 h	Em^{211}	α 5.78, 5.85, 5.61	K γ .07, .15, .40, .60	M 211.057
16 h	Hf^{171}		K γ 1.02, .63	
16 h	Te^{119}	e^-	K γ .56	
16.0 h	Am^{242}	β^- .62, ..	K γ .04	E ⁻ .62
17 h	Au^{193}		K γ .11, .17, .19, .10-.44	
17 h	Re^{188}	β^- 2.12, ..	γ .155D, .44-1.96	
17 h	Br^{76}	β^+ 3.57, ..	K γ 1.2, .20-.96	E 4.59
17 h	Zr^{97}	β^- 1.91, (1.27)	(γ .75, .66)	E 2.66
~ 17 h	Zr^{86}		K γ .24	
17.2 h	Tb^{154}	β^+ 2.75, 1.66 e^-	K γ .2-.6	
18 h	Co^{55}	β^+ 1.50, 1.0, ..	K γ .93, .48-2.2	E 3.45
18 h	Gd^{159}	β^- .95, .60, ..	γ .36, .057, .23, .08, ..	E .95
18 h	Xe^{125}		K γ .187, .243, .056-.46	
~ 18 h	Bk^{248}	β^- .67	K	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
19 h	Pt ¹⁹⁷	β^- .67, .48, .47	γ .077D, .19, .28	E .75
19 h	Ir ¹⁹⁴	β^- 2.24, 1.91, ..	γ .33, .64, .29-2.0	E 2.24
19 h	La ¹³⁵		K γ .49, .66	
19 h	Tb ¹⁵⁰	α 3.4	K (?)	
19 h	Xe ¹²²	(β^+ 3.12)	K γ .18, .23	
19.1 h	Pr ¹⁴²	β^- 2.16, .6	γ 1.59	E 2.16
20 h	Fm ²⁵⁵	α 7.08		
20 h	Tc ⁹⁵		K γ .76, 1.1	E 1.6
21 h	I ¹³³	β^- 1.3, .4	γ .53, .85, 1.4	E 1.8
21 h	Pb ²⁰⁰		K γ .148, .142, .24, .27, .033-.45	
21 h	Rh ¹⁰⁰	β^+ 2.62, ..	K γ .53, .44, .30-2.4	E 3.64
21 h	Pd ¹¹²	β^- .28	γ .018	E .30
21.3 h	Mg ²⁸	β^- .45	γ .032, 1.35, .95, .40	E 1.83
22 h	Pa ²²⁸	α 6.09, 5.85	K γ .058, .130	M 228.102
22 h	Np ²³⁶	β^- .52, ..	K γ .043, .044	E ⁻ .52
22 h	Ce ¹³⁵	β^+ .8	K	
22 h	K ⁴³	β^- .83, .24-1.84	γ .62, .37, ..	E 1.84
23 h	Cr ⁴⁸	e^-	K γ .30, .12	
23 h	Nb ⁹⁶	β^- .7, .4	γ .77, .22-1.19	E 3.1

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1 d	Os ¹⁸²		K	
1 d	W ¹⁸⁷	β^- .62, 1.31	γ .072-.87	E 1.31
1 d	Hf ¹⁷³		K γ .12, .30	
1.04 d	Hg ¹⁹⁷	e^-	I.T. .165 K γ .134D, (.28, .13)	
1.04 d	Tm ¹⁶⁵		K γ .20, .81, 1.16, 1.38	
1.07 d	Th ²³¹	β^- .09, .30, .22	γ .022D, .085D, .059-.23	E .32
1.08 d	As ⁷²	β^+ 2.50, 3.34, ..	K γ .84, .69D, 1-3	E 4.36
1.12 d	As ⁷⁶	β^- 2.96, 2.41, ..	γ .55, 1.19, .64, 1.4, 2.1	E 2.96
1.13 d	Ho ¹⁶⁶	β^- 1.85, ..	γ .081D, 1.4-1.6	E 1.85
1.13 d	Pm ¹⁵¹	β^- 1.1	γ .34, .17, .06-1.5	
1.13 d	Tl ²⁰⁰	β^+	K γ .37, 1.20, .83, .58, .116-1.52	
1.13 d	Sn ¹²¹	β^- .38		E .38
1.21 d	Ba ¹³⁵	e^-	I.T. .268	
1.21 d	Ac ²²⁶	β^- 1.2		E 1.2
1.21 d	Er ¹⁶⁰		K	
1.25 d	Fm ²⁵²	α 7.1		M 252.162
1.25 d	Te ¹³¹	β^- .4-2.5 e^-	I.T. .18 γ .77, .05-1.2	
1.29 d	Os ¹⁹³	β^- 1.10, ..	γ .073D, .14-.56	E 1.10
1.29 d	Cs ¹²⁹		K γ .38, .56	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1.31 d	Pa ²³²	β^- .28, .4-1.24	γ .047-1.15	E 1.24
1.37 d	Ce ¹⁴³	β^- 1.09, .3-1.38	γ .29, .06-1.10	E 1.44
1.37 d	Sr ⁸³	β^+ 1.2 e^-	K γ .04-.16	
1.42 d	Kr ⁷⁹	β^+ .60, .34	K, L γ .26, .044, .08-.83	E 1.62
1.46 d	Ce ¹³⁷	e^-	I.T. .26	
1.46 d	Os ¹⁸⁷		I.T. ?	
1.5 d	Pa ²²⁹	α 5.69	K	M 229.104
1.5 d	E ²⁵¹	α 6.48	K	M 251.159
1.50 d	Br ⁸²	β^- .46	γ .55, .77, 1.04, .6-2	E 3.1
1.50 d	Cr ²⁴⁶	α 6.75, 6.71, .. SF e^-	γ .044, .10, .15	M 246.146
1.50 d	Ni ⁵⁷	β^+ .84	K γ 1.38, 1.91, .12	E 3.24
1.50 d	Rh ¹⁰⁵	β^- .25, .56	γ .31, ..	E .56
1.54 d	E ²⁵⁴	β^- 1.1, ..	K γ .68	
1.58 d	Eu ¹⁴⁶	e^- .4	K	
1.58 d	Sb ¹¹⁹	e^-	K γ .024D	E .59
1.62 d	As ⁷⁷	β^- .69, ..	γ .24, .52, .086, .160, ..	E .69
1.62 d	Au ¹⁹⁴	β^+ 1.55, 1.22 e^-	K γ .33, 1.48, .29-2.1	E 2.57
1.62 d	Ba ¹³³	e^-	I.T. .276	
1.67 d	Hg ¹⁹⁵	e^-	K I.T. .123 γ .26, .04-.56	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1.67 d	Ge ⁶⁹	β^+ 1.21, .6, ..	K Y 1.12, .58, .87, .09-1.6	
1.67 d	La ¹⁴⁰	β^- 1.34, .8-2.15	Y 1.60, .11-2.9	E 3.75
1.71 d	Ir ¹⁸⁸	β^+ 2 e ⁻	K Y .155D, .63, 48, ..	
1.7 d	Lu ¹⁷⁰	e ⁻ .1	K Y ~ 2.5	
1.8 d	Bk ²⁴⁶		K Y .80, .145, .98, 1.0, 1.1	
1.83 d	Sc ⁴⁸	β^- .64	Y 1.32, 1.04, .99	E 4.0
1.96 d	Am ²⁴⁰		K Y 1.02, 1.40, .92	
1.96 d	Sm ¹⁵³	β^- .71, .64, .81, ..	Y .102D, .069D, .08- .54	E .81
~ 2 d	Tm ¹⁷⁴	β^-		
2.04 d	Zn ⁷²	β^- .3, 1.6	Y	
2.08 d	Pm ¹⁴⁹	β^- 1.05	Y .29, 1.3	E 1.34
2.10 d	Np ²³⁸	β^- 1.26, .27, ..	Y .044, .99, 1.03, ..	E 1.30
2.17 d	Pb ²⁰³		K Y .28, .40, .68	E 1.4
2.2 d	Ta ¹⁷⁷	e ⁻ .1	K Y ~ 1.4	
2.2 d	Re ¹⁸⁴	e ⁻	K Y .04, .16	
2.26 d	Cd ¹¹⁵	β^- 1.11, ..	Y .52, .., (.34)	E 1.45
2.3 d	Xe ¹³³	e ⁻	I.T. .233	
2.33 d	Np ²³⁹	β^- .33-.72	Y .061D, .105D, .045-.49	E .72

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
2.36 d	Ni ⁶⁶	β^- .3		
2.37 d	Br ⁷⁷	β^+ .34	K Y .52, .086-1.0, (.16)	E 1.36
2.4 d	Sc ⁴⁴	e^-	I.T. .271	
2.4 d	Ba ¹²⁸	(β^+ 3.0, ..)	K Y .27, (.13-.98)	
2.54 d	Cu ⁶⁷	β^- .40, .48, .58 e^-	Y .182, .090, .092D	E .58
2.58 d	As ⁷¹	β^+ .81, .. e^-	Y .175, .023	
2.67 d	Re ¹⁸²	e^-	K Y .11-.35, 1.5	
2.67 d	Y ⁹⁰	β^- 2.27, .. e^- 1.7		E 2.27
2.70 d	Hg ¹⁹⁷	e^-	K Y .077D, .191	
2.70 d	Au ¹⁹⁸	β^- .96, .28, 1.37	Y .4118D, .68, 1.09	E 1.37
2.79 d	Mo ⁹⁹	β^- 1.23, .45, ..	Y (.14), .74, .04- .78	E 1.37
2.8 d	In ¹¹¹	e^-	K Y .247D, .172, .33, .09, (.150)	
2.8 d	Sb ¹²²	β^- 1.4, 1.98, .73 β^+ .5	K Y .56, .7-1.2	E ⁻ 1.98 E ⁺ 1.5
2.9 d	Ru ⁹⁷	e^-	K Y .22, .33, .57, .11	
3 d	Ce ¹³⁴		K no Y	
3 d	Fm ²⁵³		K	
3.0 d	Tl ²⁰¹	e^-	K Y .167, .135, .032, .031	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
3.0 d	Pt ¹⁹¹	e ⁻	K Y .129, .042, .54, .047-.63	
3.15 d	Au ¹⁹⁹	β^- .30, .25, .46	Y .158D, .208D, .050D	E .46
3.21 d	Te ¹³²	β^- .22, .. (β^- .9-2.1)	Y .23, .. (Y .67-2.2)	
3.25 d	Ga ⁶⁷	e ⁻	K Y .092D, .18, .30, .090-.88	E 1.00
3.3 d	Ni ¹⁴⁰		K	E .1
3.34 d	Y ⁸⁷	β^+ .7	K Y .48, (.39)	E 2.1
3.4 d	Pt ¹⁹³		I.T. .135	
3.4 d	Sc ⁴⁷	β^- .44, .60	Y .16	E .60
3.42 d	Dy ¹⁶⁶	β^- .3	Y <.05	E .3
3.50 d	Nb ⁹⁵	e ⁻	I.T. .23	
3.64 d	Ra ²²⁴	α 5.68, 5.44	Y .24	M 224.090
3.79 d	Re ¹⁸⁶	β^- 1.07, .93, ..	K Y .137D, .123, .76, .63	E 1.07
3.825 d	Em ²²²	α 5.48		M 222.087
3.89 d	Sb ¹²⁷	β^- .86, 1.57, 1.11	Y .67, .46, .24, .058-.76	
4.0 d	Rd ¹⁰⁰		K Y .081, 1.8?	
4.2 d	Yb ¹⁷⁵	β^- .47, .07, .36	Y .40, .28, .113, .14, ..	E .47
4.3 d	U ²³¹	α 5.45	K Y .051, .064, .076	M 231.109
4.3 d	Tc ⁹⁶		K Y .84, .77, .81, 1.12, ..	E 3.0

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
4.4 d	Np ²³⁴	β^+ .8	K, L γ .8, 1.57, ..	
4.5 d	?Rh ¹⁰¹	e^-	K γ .30, .15, .56	
4.5 d	I ¹²⁴	β^+ 2.20, ..	K γ .60, 1.7, 2.0, .7	E 3.22
4.5 d	Te ¹¹⁹	e^- .2, .5	K γ 1.6	
4.7 d	Ca ⁴⁷	β^- .7, 2.0	γ 1.30, .81, .50	E 2.0
4.8 d	Au ¹⁹²	β^+ 1.9	K γ .317, .296, .137- 1.16	
5 d	Eu ¹⁴⁵	e^- .2	K	
5 d	Tb ¹⁵⁶	β^- ? .6, .2	γ .10-2.0	
5.0 d	Bk ²⁴⁵	α 6.17, 6.33, 5.90	K γ .25, .38, .16	
5.0 d	Bi ²¹⁰	β^- 1.17 α		E 1.17
5.1 d	Tb ¹⁵³	e^- .15, ~.3	K γ .23, 1.2	
5.2 d	Ta ¹⁸³	β^- .62, ..	γ .041-.41	E 1.07
5.27 d	Xe ¹³³	β^- .35 e^-	γ .081D	E .43
5.3 d	Pm ¹⁴⁸	β^- 2.5	γ .8	
5.7 d	Mn ⁵²	β^+ .6	K γ 1.4, .9, .7	E 4.7
5.8 d	Sb ¹²⁰	e^-	K γ 1.18, 1.04, .20, .09	
~6 d	Pt ¹⁹⁵		I.T. .130 γ .099, .031	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
6.0 d	Te ¹¹⁸	(β^+ 3.1)	K (γ .11)	
6.2 d	Cs ¹³²		K γ .67, 1.27, 1.10	
6.4 d	Bi ²⁰⁶	e^-	K γ .80D, .88D, .52D, 1.72, .107-1.60	E 3.6
6.4 d	Ni ⁵⁶		K γ .16, .85, .26-1.74	
6.7 d	Lu ¹⁷²	e^- .13, $\sim$.6	K γ 1.2	
6.75 d	U ²³⁷	β^- .24, .. e^-	γ .21, .059, .027-.43	E .51
6.8 d	Lu ¹⁷⁷	β^- .50, .18, .39	γ .113, .208, .07-.32	E .50
7 d	Tb ¹⁶¹	β^- .55, ..	γ .049, .08	E .6
7.5 d	Ag ¹¹¹	β^- 1.04, .7, ..	γ .34, .247D	E 1.04
8 d	Xe ¹²⁹	e^-	I.T. .196 γ .040	
8 d	Rb ^{<81}			
8.05 d	Il ¹³¹	β^- .61, .25-.81	γ .36, .080D-.72	E .97
8.3 d	Ag ¹⁰⁶		K γ .51, .22-2.66	
8.5 d	Lu ¹⁷¹	e^- .17, .5	K $\gamma \sim 1.2$	
9 d	Po ²⁰⁶	α 5.22, ..	K γ .060-1.03	M 206.046
9 d	Gd ¹⁴⁹	e^- .3 α 3.0	K γ	
9.4 d	Er ¹⁶⁹	β^- .33	no γ	E .33
9.6 d	Tm ¹⁶⁷		K γ .20, .72, .51, .11	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
9.7 d	Ir ¹⁹⁶	β^- .08	γ .58, .76, ~ 1	
9.7 d	Cs ¹³¹		K, L	E .35
9.7 d	Se ⁷²		K	
10 d	Sn ¹²⁵	β^- 2.4, ..	γ .33-2.0	E 2.4
10 d	Nb ⁹²		K γ .93, 1.83, .90	E 1.9
10 d	Pt ¹⁸⁸		K γ .192, .28, .043-.4	
~ 10 d	Sr ⁸⁹		I.T. γ	
10.0 d	Ac ²²⁵	α 5.80	γ .085	M 225.093
11 d	Ir ¹⁹⁰		K γ .19, .36-1.3	
11 d	Pu ²⁴⁶	β^- .15, ..	γ .10, .22, .043, .18	
11 d	Ir ¹⁸⁹		K γ .24, ..	
11.6 d	Ra ²²³	α 5.70, 5.60, 5.42- 5.86	γ .026-.44	M 223.088
11.6 d	Nd ¹⁴⁷	β^- .81, .37, ..	γ .092, .53, .12-.69	E .90
11.6 d	Ba ¹³¹		K γ .50, .122D, .214, .04-1.03	
12 d	Xe ¹³¹	e^-	I.T. .164	
12 d	Tl ²⁰²	e^-	K, L γ .44D	
12 d	Ge ⁷¹		K	E .23
12.8 d	Ba ¹⁴⁰	β^- 1.02, .48, (1.3-2.3)	γ .54, .31, .16, .. (1.6, 1-2.5)	
13 d	Cs ¹³⁶	β^- .34, .66	γ 1.04, .82, .067-2.5	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
13.3 d	I ¹²⁶	β^- .87, .. β^+ 1.11, ..	K γ .38, .65, .., 1.4	E ⁻ 1.25 E ⁺ 2.13
13.8 d	Pr ¹⁴³	β^- .92	no γ	E .92
14 d	Bi ²⁰⁵		K γ .70, 1.77, 1.04, .99, .11-1.91	
14 d	Sn ¹¹⁷	e^-	I.T. .159 γ .162	
14.5 d	P ³²	β^- 1.71	no γ	E 1.71
14.8 d	Ra ²²⁵	β^- .32	γ .040	E .36
15 d	Eu ¹⁵⁶	β^- .4, 2.4	γ 2.0	E 2.4
15 d	?Rh ⁹⁹	β^+ e^-	γ .353, .086	
16 d	Os ¹⁹¹	β^- .14	(γ .042, .129)	E .31
16.2 d	V ⁴⁸	β^+ .69	K γ .99, 1.32, 2.23	E 4.02
17 d	As ⁷⁴	β^- 1.36, .72 β^+ .93, 1.53	K γ .60, .64	E ⁻ 1.36 E ⁺ 2.55
17 d	Pa ²³⁰	β^- .40 β^+ .2, .4 α	K γ .94, .30, .46, .052-1.18	
17 d	Te ¹²¹	e^-	K γ .57, .51	
17 d	Pd ¹⁰³	e^-	K γ (.040), .053, ..	E .57
18 d	Cr ²⁵³	β^-		
18.2 d	Th ²²⁷	α 5.97, 5.65-6.03	γ .050, .087, .23, .03-.64	M 227.099
18.6 d	Rb ⁸⁶	β^- 1.77, .7	γ 1.08	E 1.77
20 d	E ²⁵³	α 6.64, 6.60, 6.55, .. SF	γ .042, .054, .39	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
21 d	U ²³⁰	α 5.89, 5.82, 5.66	γ .07, .16, .23	M 230.106
21 d	W ¹⁷⁸		K $\gamma \sim .3$	
24 d	Eu ¹⁴⁷	e^- .2 α 2.9	K γ .21, .12	
24.10 d	Th ²³⁴	β^- .19, .10	γ .093, .064, .029, ..	E .19
25 d	P ³³	β^- .25	no γ	E .25
26 d	Sr ⁸²	(β^+ 3.2)	K	
27 d	Cr ⁵¹		K γ .32	E .75
27 d	Cm ²⁴⁰	α 6.25 SF		M 240.131
27.4 d	Pa ²³³	β^- .26, .14, .57	γ .086, .31, .075, .016-.42	E .57
28 d	Sb ¹²⁶	β^- 1.9		
~ 30 d	E ²⁵⁵	β^-		
32 d	Ce ¹⁴¹	β^- .43, .57	γ .145D	E .57
32 d	Yb ¹⁶⁹	e^-	K γ .064, .008D, .094- .308D	
33 d	Te ¹²⁹	e^-	I.T. .106	
33 d	Rb ⁸⁴	β^+ 1.7, .. β^- .4	K γ .89-1.9	E ⁻ .4 E ⁺ 2.7
35 d	Cm ²⁴¹	α 5.95	K γ .47, .59, ..	
35 d	A ³⁷		K, L	E .82
35 d	Nb ⁹⁵	β^- .16	γ .76, ..	E .92
36.4 d	Xe ¹²⁷		K γ .203, .057-.36	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
40 d	Ag ¹⁰⁵		K Y .34, .28, .064, .65, .16-.44	
40 d	Pu ²³⁷		K Y ~.064	
40 d	Ru ¹⁰³	β^- .20, .13, .69, ..	Y (.040), .50, .05- .61	E .73
42 d	Pm ¹⁴⁸	β^- .6, 2.4	Y 1, ..	
43 d	Cd ¹¹⁵	β^- 1.63, ..	Y .95, .45-1.28	E 1.63
45 d	Fe ⁵⁹	β^- .46, .27, 1.56	Y 1.10, 1.29, .19	E 1.56
46 d	Hf ¹⁸¹	β^- .41 e ⁻	Y .13D-.61D	E 1.02
48 d	Hg ²⁰³	β^- .21 e ⁻	Y .279D	E .49
49 d	In ¹¹⁴		I.T. .190 K Y .72, .56	
53 d	Be ⁷		K Y .48	E .86
54 d	Yb ¹⁶⁶		K, Y? (Y .08-1.32)	
54 d	Sr ⁸⁹	β^- 1.48, ..	(Y .91)	E 1.48
58 d	Y ⁹¹	β^- 1.54, ..	Y 1.19	E 1.54
58 d	Eu ¹⁴⁸	e ⁻	K Y .57, 1.0	
58 d	Te ¹²⁵	e ⁻	I.T. .11 Y .035D	
60 d	Sb ¹²⁴	β^- 2.31, ..	Y .60-2.11	E 2.91
60 d	Tc ⁹⁵	β^+ .6	K I.T. .039 Y .20-1.0	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
60 d	I ¹²⁵		K, L Y .035	E .15
62 d	Nb ⁹¹	e ⁻	I.T. .105 K Y 1.19	
65 d	W ¹⁸⁸	β^-		
65 d	Zr ⁹⁵	β^- .36, .39, .88 (e ⁻)	Y .75, .72, (.23)	E 1.12
65 d	Sr ⁸⁵		K Y .51D	
70 d	Cf ²⁵⁴	SF		
70 d	Hf ¹⁷⁵		K Y .343, .089, .113- .432	
71 d	Co ⁵⁸	β^+ .48, ..	K Y .81, 1.64	E 2.31
72 d	Tb ¹⁶⁰	β^- .56, .85, ..	Y .96, .086D-1.45	E 1.81
74 d	Ir ¹⁹²	β^- .67, ..	K Y .31, .47, .136- 1.16	E 1.58
74 d	W ¹⁸⁵	β^- .43, ..	Y .056	E .43
76 d	As ⁷³	(e ⁻)	K (Y .054, .013D)	E .37
77 d	Co ⁵⁶	β^+ 1.50, ..	K Y .85, 1.2, 1.7-3.2	E 4.62
83 d	Rb ⁸³		K Y .52 (Y .032, .09)	
85 d	Zr ⁸⁸	e ⁻	K Y .39D	
85 d	Sc ⁴⁶	β^- .36, ..	Y 1.12, .88, ..	E 2.36

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
87 d	Tm ¹⁶⁸	e ⁻ β^- .5 (?)	K γ .8, .20	
87 d	S ³⁵	β^- .167	no γ	E .167
91 d	Tc ⁹⁷	e ⁻	I.T. .099 γ .090, ..	
95 d	Os ¹⁸⁵		K, L γ .65, .88, .23, .16, ..	
104 d	Te ¹²³	e ⁻	I.T. .088 γ .159D	
110 d	Te ¹²⁷	e ⁻	I.T. .008	
112 d	Ta ¹⁸²	β^- .51, ..	γ 1.1, 1.2, ..	E 1.7
112 d	Sn ¹¹³	(e ⁻)	K, L γ .26 (γ .39)	
120 d	Eu ¹⁴⁹	e ⁻	K γ .29, .57	
127 d	Se ⁷⁵		K γ .27, .14, (.28), .066-.40	
129 d	Tm ¹⁷⁰	β^- .97, .89 e ⁻	γ .084D	E .97
130 d	Sn ¹²³	β^- 1.42		
~130 d	Hg ¹⁹⁴		K	
134 d	Dy ¹⁵⁹		K, L	
138.40 d	Po ²¹⁰	α 5.30, ..	γ .80	M 210.049
140 d	Ce ¹³⁹	e ⁻	K γ .165D	E .3
140 d	W ¹⁸¹		K, L γ .137, .153	E .9
150 d	Re ¹⁸³	e ⁻	K γ .08, .25, 1	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
150 d	Te ¹²¹	e ⁻	I.T. .082 Y .213	
~150 d	Gd ¹⁵¹	e ⁻	K Y .26	
~150 d	E ²⁵²	α 6.64		
160 d	Ca ⁴⁵	β^- .25	no Y	E .25
163 d	Cm ²⁴²	α 6.11, 6.07, .. SF	Y .044, .102, .157	M 242.135
165 d	Lu ¹⁷⁴	β^- .6	K Y ~1	
180 d	Au ¹⁹⁵	e ⁻	K Y .099, .031, .14	E .27
~200 d	Re ¹⁸⁹	β^- .2	Y 1	
220 d	Rh ¹⁰²	β^- 1.15 β^+ 1.24, ..	K Y .48, .20, 1.1, .12-1.7	E ⁻ 1.15 E ⁺ 2.26
225 d	Cr ²⁴⁸	α 6.26 SF		M 248.150
236 d	Gd ¹⁵³	e ⁻	K Y .102D, .069D, .097	
245 d	Zn ⁶⁵	β^+ .33	K Y 1.12	E 1.35
250 d	Ge ⁶⁸		K	
267 d	Co ⁵⁷	e ⁻	K Y .123, .014D, .137, ..	E .5
270 d	Ag ¹¹⁰	β^- .53, .1, ..	I.T. .12 Y .66, .89, .93-2	
275 d	Sn ¹¹⁹	e ⁻	I.T. .065 Y .024	
285 d	Ce ¹⁴⁴	β^- .30, .., (2.98, ..)	Y .03-1.4 (.70-2.18)	E .30
290 d	Bk ²⁴⁹	β^- .09 α 5.40, 5.08 SF	Y .32	

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
300 d	Mn ⁵⁴		K Y .84	E 1.38
~ 300 d	Pm ¹⁴³		K Y .9	
~ 300 d	Pm ¹⁴⁴		K Y .7, .4, .2	
~ 1 y	E ²⁵⁴	α 6.44 SF		M 254.168
~ 1 y	V ⁴⁹		K	E .62
1.0 y	Sm ¹⁴⁵		K Y .061	
1.0 y	Ru ¹⁰⁶	β^- .04, (3.53, ..)	(Y .51, .62-2.4)	E .04
> 1 y	Sn ¹²¹	β^- .42		
>> 1 y	Cm ²⁴⁷			
1.1 y	Np ²³⁵	α 5.06	L, K Y .026, .085	M 235.118
1.3 y	Cd ¹⁰⁹	(e ⁻)	K, L (Y .087)	E .15
1.4 y	Lu ¹⁷³	e ⁻ .1, .2	K Y ~.2, .8	
1.6 y	Lu ¹⁷¹	e ⁻ .1	K Y ~1	
~ 1.6 y	Ta ¹⁷⁹	e ⁻ .1	K, Y .7	
1.7 y	Eu ¹⁵⁵	β^- .15, .25	Y .019-.137	E .25
1.9 y	Tm ¹⁷¹	β^- .10	no Y	E .10
1.90 y	Th ²²⁸	α 5.42, 5.34, ..	Y .09, .21, .13, .17	M 228.100
~ 2 y	Os ¹⁹⁴	β^-		
~ 2 y	Pm ¹⁴⁶	β^- .7		

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<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
>2 y	Mo ⁹³		K	E .49
2.2 y	Cr ²⁵²	α 6.11, 6.07 e ⁻ SF	γ .042, .100	
2.3 y	Cs ¹³⁴	β^- .65, ..	γ .60, .80, .47-1.37	E 2.05
2.6 y	Pm ¹⁴⁷	β^- .23		E .23
2.6 y	Na ²²	β^+ .54, ...	K γ 1.28	E 2.84
2.7 y	Pu ²³⁶	α 5.75, .. e ⁻ SF	γ .047	M 236.120
2.7 y	Sb ¹²⁵	β^- .30, .12-.62 e ⁻	γ .035, .42, (.11)- .60	E .76
2.9 y	Po ²⁰⁸	α 5.11	K γ .28, .6	M 208.046
2.9 y	Fe ⁵⁵		K	E .22
>3.5 y	A ⁴²	β^-		
3.7 y	Nb ⁹³	e ⁻	I.T. .029	
4.1 y	Tl ²⁰⁴	β^- .76	K	E ⁻ .76 E ⁺ .34
5 y	Cd ¹¹³	β^- .58		
~5 y	Hf ¹⁷²	e ⁻ .2	K γ .8, .3	
~5 y	? Rh ¹⁰¹		I.T. (?) .127 γ .198	
5.2 y	Co ⁶⁰	β^- .31, ..	γ 1.33, 1.17, ..	E 2.81
6.7 y	Ra ²²⁸	β^- <.02		E <.05
8 y	Ba ¹³³	e ⁻	K γ .082D, .36, .30, .06, .07	

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
8.0 y	Bi ²⁰⁷		K, L Y .57, 1.77, .. (1.07, .57)	E 2.4
10 y	Cf ²⁵⁰	α 6.02, 5.98 SF	Y .043	M 250.155
10.4 y	Kr ⁸⁵	β^- .67, ..	Y .52	E .67
12.26 y	H ³	β^- .018	no Y	E .018
13 y	Eu ¹⁵²	β^- .70, ..	K Y .12D, .34, 1.1, ..	
13 y	Pu ²⁴¹	β^- .02 α 4.89, 4.85	Y .100, .145	E .020
16 y	Eu ¹⁵⁴	β^- 1.5, ..	Y .123D, 1.42, .78, 1.12	
18 y	Cm ²⁴⁴	α 5.80, 5.76, .. SF	Y .043, ..	M 244.139
20 y	Pb ²¹⁰	β^- .020 e ⁻	Y .047, ..	E .067
>20 y	Ti ⁴⁴		K Y .16	
22 y	Ac ²²⁷	β^- .046 α 4.94		M 227.099
25 y	Pm ¹⁴⁵		K, L Y .068, .073	
28 y	Sr ⁹⁰	β^- .54, (2.2)	no Y	E .54
30 y	Cs ¹³⁷	β^- .52, 1.18	(Y .662)	E 1.18
>30 y	Ho ¹⁶⁶	β^- .2, ..	Y .081D-.84	E 2.4
35 y	Cm ²⁴³	α 5.78, 5.73, 5.99, ..	Y .23, .28, .21, .046-.33	M 243.137
>35 y	Gd ¹⁴⁸	α 3.2		
74 y	U ²³²	α 5.32, 5.26, 5.13 e ⁻ SF	Y .058, .130, .27, .33	M 232.110

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
80 y	Sm ¹⁵¹	β^- .076	γ .020	E .096
80 y	Ni ⁶³	β^- .063	no γ	E .063
90 y	Pu ²³⁸	α 5.49, 5.45, .. SF	γ .044, .100, .15	M 238.124
~100 y	Am ²⁴²	β^- .59, .. α	K γ .04	
~100 y	Po ²⁰⁹	α 4.88	K γ .90, .60, .29	
~140 y	Mn ⁵³		K no γ	E .60
260 y	A ³⁹	β^- .57	no γ	E .57
~300 y	Si ³²	β^- .1	no γ	E .1
470 y	Am ²⁴¹	α 5.48, 5.38-5.54 e^- SF	γ .060, .026-.37	M 241.132
500 y	Cf ²⁴⁹	α 5.81, 6.00, .. SF	γ .40, .34, ..	
~700 y	Cf ²⁵¹	α		
4000 y	Cm ²⁴⁶	α 5.36 SF		M 246.144
$\geq$ 5000 y	Np ²³⁶	β^-		M 236.121
5600 y	Cl ¹⁴	β^- .158	no γ	E .158
6600 y	Pu ²⁴⁰	α 5.16, 5.12, ..	γ .045	M 240.129
7000 y	Bk ²⁴⁷	α 5.50, 5.67, 5.30	γ .085, .26, .42	M 247.148
7300 y	Th ²²⁹	α 4.85, 4.94, 5.02		M 229.103
~8000 y	Am ²⁴³	α 5.27, 5.22, 5.17-5.34	γ .075, ..	M 243.137
11,000 y	Cm ²⁴⁵	α 5.34, ..	γ .101, .17	M 245.142
20,000 y	Nb ⁹⁴	β^- .5	γ .87, .70, 1.57	E 2.1

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
7×10^4 y	Se ⁷⁹	β^- .16	no γ	E .16
8×10^4 y	Ni ⁵⁹		K	E 1.07
80,000 y	Th ²³⁰	α 4.68, 4.61, ..	γ .068, .14-.26	M 230.105
$\sim 10^4$ y	Tc ⁹⁸	β^- .3	γ .74, .65	E 1.7
1.1×10^5 y	Ca ⁴¹		K	E .44
1.62×10^5 y	U ²³³	α 4.82, 4.78, 4.73	γ .044, .050, .094	M 233.112
2×10^5 y	Kr ⁸¹		K	
2.1×10^5 y	Tc ⁹⁹	β^- .29		E .29
3.1×10^5 y	Cl ³⁶	β^- .71	K no γ	E ⁻ .71
3.8×10^5 y	Pu ²⁴²	α 4.90, 4.85 SF		M 242.134
$\sim 3 \times 10^5$ y	Fe ⁶⁰	β^-	(γ .059, ..)	
4×10^5 y	Cm ²⁴⁸	α 5.05		
9×10^5 y	Zr ⁹³	β^- .063, ..	(γ .029)	E .063
$\sim 10^5$ y	Tc ⁹⁷		K	
$\sim 10^5$ y	Pb ²⁰²		L	
$> 10^5$ y	La ¹³⁷			
$> 10^5$ y	Gd ¹⁵⁰	α 2.7		
2.0×10^6 y	Cs ¹³⁵	β^- .21	no γ	E .21
2.6×10^6 y	Bi ²¹⁰	α 4.94 β^-	no γ	E 1.14
7×10^6 y	Pd ¹⁰⁷	β^- .04		E .04
$> 10^6$ y	Pb ²⁰⁵		L	
$\sim 10^6$ y	Al ²⁶	β^+ 1.2	γ 1.82, .72, 2.9	E 4.0

* Total Disintegration Energy (Mev), or Isotopic Mass

<u>Half-Life</u>	<u>Isotope</u>	<u>Particles and Energies (Mev)</u>	<u>Gamma Energies (Mev)</u>	<u>Total Energy or Mass*</u>
1.7×10^7 y	I^{129}	β^- .15 e^-	γ .038	E .19
2.39×10^7 y	U^{236}	α 4.50, .. e^- SF	γ .05	M 236.120
$\sim 5 \times 10^7$ y	Sm^{146}	α 2.5		
8×10^7 y	Pu^{244}	α SF		
1.3×10^9 y	K^{40}	β^- 1.33,	K γ 1.46	E $^-$ 1.33

* Total Disintegration Energy (Mev), or Isotopic Mass

APPENDIX

Table of thermal neutron absorption cross-sections. Values are in barns.

<u>Isotope</u>	<u>Half-Life</u>	<u>Cross-Section</u>	<u>Isotope</u>	<u>Half-Life</u>	<u>Cross-Section</u>
Be ⁷	53 d	np ~ 10 ⁴	Cs ¹³⁵	2.0 x 10 ⁶ y	~ 15
Cl ³⁴	5600 y	< 10 ⁻⁶	Cs ¹³⁷	30 y	< 2
Cl ³⁶	3.1 x 10 ⁵ y	~ 90	Ba ¹³⁹	1.42 d	4
A ⁴¹	1.82 h	> .06	La ¹⁴⁰	1.67 d	3
K ⁴⁰	1.3 x 10 ⁹ y	70	Ce ¹⁴³	1.37 d	6
Sc ⁴⁶	85 d	.25	Pr ¹⁴²	19.1 h	20
Co ⁶⁰	5.2 y	6	Pm ¹⁴⁷	2.6 y	(~ 60* + ?)
Co ⁶⁰	10.5 m	~ 100	Sm ¹⁵¹	80 y	12,000
Cu ⁶⁶	5.1 m	140	Eu ¹⁵²	13 y	5000
Kr ⁸⁵	10.4 y	< 15	Eu ¹⁵⁴	16 y	1400
Kr ⁸⁷	1.30 h	< 600	Eu ¹⁵⁵	1.7 y	13,000
Rb ⁸⁸	18 m	< 200	Tb ¹⁶⁰	72 d	~ 600
Sr ⁸⁹	54 d	< 130	Dy ¹⁶⁵	2.32 h	4700
Sr ⁹⁰	28 y	1	Tm ¹⁷⁰	129 d	~ 2000
Y ⁹⁰	2.67 d	6	Ta ¹⁸²	112 d	~ 20,000
Zr ⁹³	9 x 10 ⁵ y	< 5	W ¹⁸⁷	1 d	~ 80
Nb ⁹⁴	20,000 y	~ 15	Re ¹⁸⁸	17 h	< 3
Tc ⁹⁹	2.1 x 10 ⁵ y	20	Os ¹⁹³	1.29 d	200
I ¹²⁹	1.7 x 10 ⁷ y	30	Au ¹⁹⁸	2.70 d	26,000
I ¹³¹	8.05 d	~ 600	Au ¹⁹⁹	3.15 d	~ 30
Xe ¹³⁵	9.2 h	(3.2 x 10 ⁶)	Em ²²²	3.825 d	.7

* To metastable state.

<u>Isotope</u>	<u>Half-Life</u>	<u>Cross-Section</u>	<u>Isotope</u>	<u>Half-Life</u>	<u>Cross-Section</u>
Ra ²²³	11.6 d	125	Pu ²⁴¹	13 y	~380 (also $\sigma_f = 1100$)
Ra ²²⁴	3.64 d	12	Pu ²⁴²	3.8×10^5 y	23
Ra ²²⁸	6.7 y	~36	Pu ²⁴³	5.0 h	~100
Ac ²²⁷	22 y	~520	Pu ²⁴⁴	8×10^7 y	~1.4
Th ²²⁷	18.2 d	(f) ~1500	Pu ²⁴⁵	11 h	~260
Th ²²⁸	1.90 y	120	Am ²⁴¹	470 y	(700* + <50) (also $\sigma_f = 3.2$)
Th ²²⁹	7300 y	(f) ~45	Am ²⁴²	~100 y	~4500 (also $\sigma_f = \sim 3500$)
Th ²³⁰	80,000 y	35	Am ²⁴²	16.0 h	(f) ~2500
Th ²³³	23.3 m	1400	Am ²⁴³	~8000 y	82
Th ²³⁴	24.10 d	1.8	Cm ²⁴²	163 d	~20
Pa ²³⁰	17 d	(f) 1500	Cm ²⁴³	35 y	~300
Pa ²³²	1.31 d	700 (also $\sigma_f = 700$)	Cm ²⁴⁴	18 y	~15
Pa ²³³	27.4 d	(40* + 26)	Cm ²⁴⁵	11,000 y	~200 (also $\sigma_f = 1800$)
U ²³⁰	21 d	(f) ~25	Cm ²⁴⁶	4000 y	~15
U ²³¹	4.3 d	(f) ~400	Cm ²⁴⁷	>> 1 y	180
U ²³²	74 y	~300 (also $\sigma_f = 80$)	Bk ²⁴⁹	290 d	~500
U ²³³	1.62×10^5 y	60 (also $\sigma_f = 520$)	Cf ²⁴⁹	500 y	~270 (also $\sigma_f = \sim 600$)
U ²³⁶	2.39×10^7 y	8	Cf ²⁵⁰	10 y	~1500
U ²³⁹	23.5 m	22 (also $\sigma_f = \sim 12$)	Cf ²⁵¹	~700 y	~3000
Np ²³⁴	4.4 d	(f) ~900	Cf ²⁵²	2.2 y	~30
Np ²³⁶	≥ 5000 y	(f) 2800	Cf ²⁵⁴	70 d	≤ 2
Np ²³⁸	2.10 d	(f) 1600	E ²⁵³	20 d	~200
Np ²³⁹	2.33 d	80			
Pu ²³⁸	90 y	450 (also $\sigma_f = 18$)			
Pu ²⁴⁰	6600 y	~510			

* To metastable state.

<u>Isotope</u>	<u>Half-Life</u>	<u>Cross-Section</u>
E ²⁵⁴	1.54 d	≤ 15
E ²⁵⁵	~ 30 d	~ 40
Fm ²⁵⁵	20 h	< 100