8c. Atomic Mass Formulas

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8c-1. Introduction. The nuclear or atomic mass is a direct measure of the total binding energy of the nucleus, and thus of the ground state of the nuclear Hamiltonian. If the Hamiltonian were known, the mass-law problem would be solved: it would be possible in principle to write the binding energy in terms of the atomic number Z and the mass number $A = N + Z$. Note that the mass is

$$M(Z,A) = A \cdot u + Z \cdot \Delta M_H + (A - Z) \cdot \Delta M_n - \frac{B(Z,A)}{c^2} \qquad (8c\text{-}1)$$

where u is the atomic mass unit = 931.487 MeV/c^2, ΔM_H = 7.82519 mu is the mass excess of the hydrogen atom, ΔM_n = 8.66520 mu is the neutron mass excess, and $B(Z,A)$ is the binding energy in MeV.

Even an incomplete nuclear theory can be used to predict the forms of some terms in the mass law. Weizäcker [1] pointed out that arbitrary multipliers could be used with such terms to gain insight both for the theory and the masses. His mass law, as simplified by Bethe and Bacher [2], has formed the basis for most subsequent studies. Many recent formulations and summaries are given in proceedings of topical conferences held at Vienna [3], Lysekil [4], and Winnipeg [5].

8c-2. Uses of the Mass Law. The complexity of a mass law depends on its intended use. For instance, in the calculation of nuclear kinematics, the mass number A is often a sufficient approximation, whereas for nuclear reaction theory quite sophisticated treatments are required. Uses may be classed as theoretical or experimental.

Theoretical uses include the comparison of calculated coefficients to values fitted to experimental data. Another use is an indirect determination of arbitrary constants in the theory: e.g., parameters in a proposed form of the nucleon-nucleon interaction can be found by calculating mass-law terms as functions of the interaction [6]. A third theoretical use is subtraction of the smoothly varying part of the mass law from the experimental data to isolate the small terms.

The mass law is used "experimentally" to estimate binding energies for use in other calculations or experiments. For "interpolation"—finding binding energies in the region of known data—the mass law should be discarded whenever practical in favor of tabulated experimental values. If it is necessary to use a mass law, a formula such as that of Zeldes et al. [7], which uses a large number of parameters to reproduce the experimental data as well as possible, may be used. Extrapolation to unknown masses requires the mass law. If the extrapolation is only a short distance from known data, and if only a few binding energies are needed, the values given by the mass law should be corrected by comparison of calculated and experimental data in the neighborhood, or a local extrapolation should be made. If a long extrapolation or a large number of calculations must be performed, a sophisticated

mass-law formula must be used, and it should then be used for all binding energies in the problem, including known data. Two suitable formulas are those of Myers and Swiatecki [8] and of Seeger [9]; the latter is presented below.

8c-3. Terms in the Mass Law. Mathematically, the function $B(Z,A)$ can be expanded in terms of any two functions of Z and A which remain small over the ranges of Z and A to be considered. Since the binding energy per particle is nearly constant for $A > 10$, it is convenient to expand $B(Z,A)/A$. The range of nuclear force being short compared to the nuclear radius, a convenient expansion parameter is $1/R$. Constancy of nuclear density implies that $R \sim A^{\frac{1}{3}}$, and so the usual expansion parameter is $1/A^{\frac{1}{3}}$.

The distance of Z from the line of beta stability is a possible choice for the other parameter. In deriving terms from a model of the nucleus, however, the beta-stability line is not explicitly known, and it is more natural to expand about the symmetry line $Z = A/2$; from the statistical model [2] the form is $[(A - 2Z)/A]^2$.

There are some terms in the nuclear binding energy which it is not convenient to expand. The Coulomb force, for example, does not have a short range, and the Coulomb energy can be included explicitly if the charge distribution is assumed; for a uniformly charged sphere of radius $r_0A^{\frac{1}{3}}$,

$$E_c = \frac{3Z^2e^2}{5r_0A^{\frac{1}{3}}}$$

The binding energy can be expressed quite generally as

$$B(Z,A) = A \cdot f\left[\left(\frac{A - 2Z}{A}\right)^2, A^{-\frac{1}{3}}\right] - E_c \qquad \text{(8c-2)}$$

where f is a power series in its arguments, and E_c represents Coulomb energy and any other terms which are not expanded. Although the original derivation was in terms of the liquid-drop model, the terms can be calculated analytically or numerically from any model. A calculation for infinite nuclear matter with $N = Z$ will yield the zero-order term in the expansion, the volume term αA. (Adjustable multipliers are denoted by Greek letters.) A mass law of this simple form, with one parameter determined by least-squares fit to known odd-A binding energies [10, 11] and the Coulomb energy derived from electron-scattering experiments [12], is illustrated in Fig. 8c-1*a*; it is clear from the figure that finite nuclei cannot be adequately represented by infinite nuclear matter.

The two first-order terms are the symmetry and the surface terms of the liquid drop: $-\beta(A - 2Z)^2/A - \gamma A^{\frac{2}{3}}$. These can be found for other models by calculating respectively infinite nuclear matter with $N \neq Z$ and semi-infinite matter with a plane surface. The negative signs indicate decreased binding energy. Inclusion of these terms completes the Weizsäcker formula [2]; the residual discrepancies following a least-squares fit to odd-A nuclides with $A > 40$ are shown in Fig. 8c-1*b*. The calculated binding energies are accurate to about $\frac{1}{4}$ percent; the error is greater than 1 percent for only nine of the lightest nuclides included.

Myers [6], using a nuclear force with constants determined by fitting to the four-parameter mass law above, has carried the expansion of Eq. (8c-2) to second-order terms: $A^{\frac{1}{3}}$, $(A - 2Z)^2/A^{\frac{1}{3}}$, and $(A - 2Z)^4/A^3$. The expressions become very complicated because the Coulomb force affects the density distribution of protons compared to neutrons. Only one of the second-order terms, the surface-symmetry term $\eta(A - 2Z)^2/A^{\frac{1}{3}}$, is commonly included in the mass law, and its effect is so weak that the coefficient is determined only poorly.

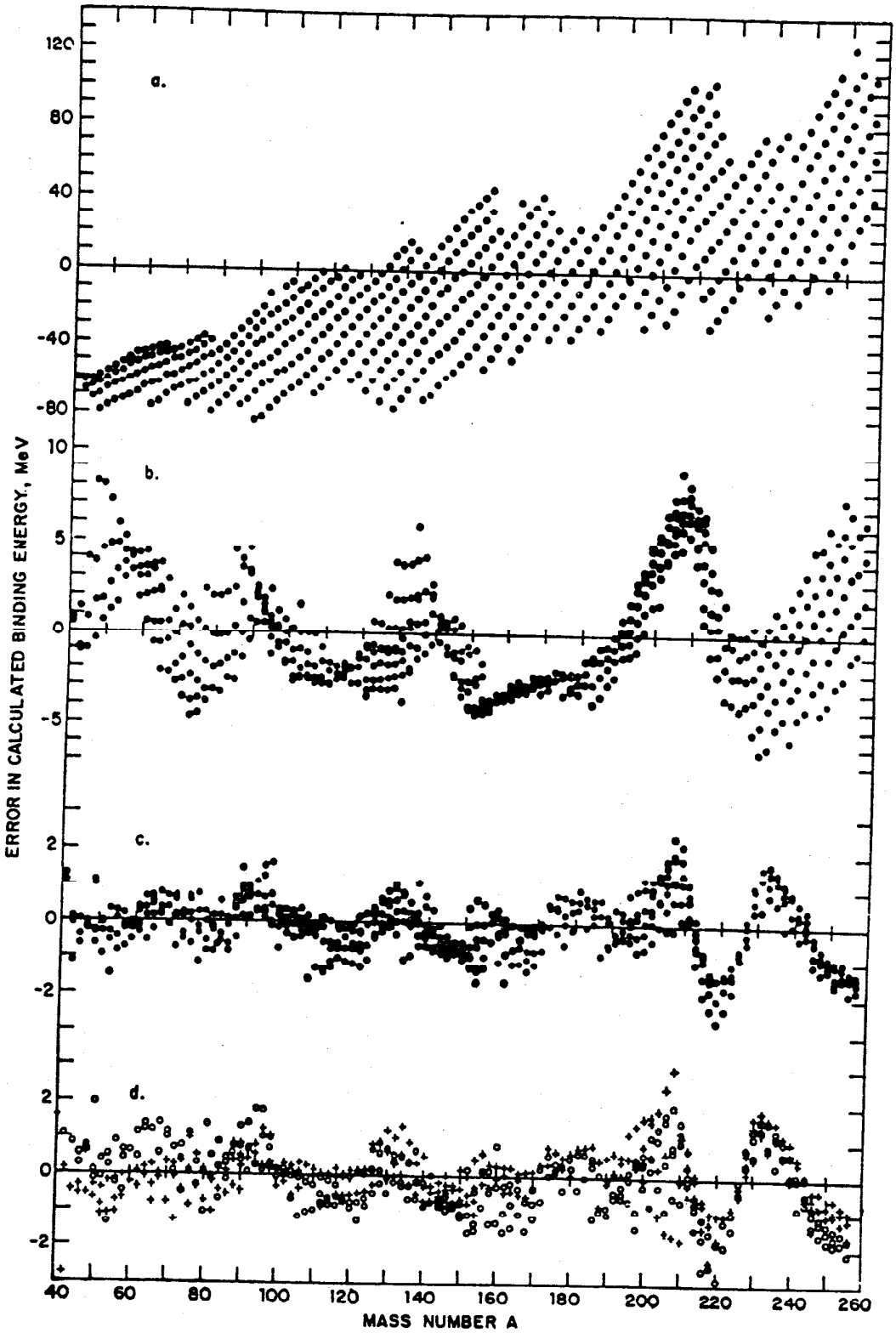

FIG. 8c-1. Errors of calculated binding energies versus mass number A: (a) for mass law with volume term and Coulomb energy only, fitted with 1 parameter to odd-A binding energies; (b) for 4-parameter liquid-drop mass law; (c) residual errors for odd-A nuclides, for Eq. (8c-3) fitted to 1,148 odd- and even-A nuclides; (d) same mass law, residual errors of even-even (+) and odd-odd (0) nuclides.

The expansion of Eq. (8c-2) is accurate only to the extent that the discrete levels occupied by nucleons can be represented by a smooth distribution, and the structure apparent in Fig. 8c-1*b* is due principally to the breaking down of this assumption. A correction term to the liquid-drop mass law can be constructed by comparing a single-particle-level diagram such as that of the Nilsson model to a smoothed average of the same levels. The method used is that of Strutinsky, extended by Tsang [13], who has shown that the results reach a limit which is independent of the details of the smoothing. The calculations [9] yield two functions $\delta U_N(N,\epsilon)$ and $\delta U_Z(Z,\epsilon)$, where ϵ is a measure of the spheroidal deformation of the nucleus. The coefficients of these functions in the mass law depend only on the radii of the neutron and proton distributions, $r_N A^{\frac{1}{3}}$ and $r_0 A^{\frac{1}{3}}$, respectively. The parameter r_N is new, but r_0 is the same radius constant which describes the proton charge distribution in the Coulomb energy.

Pairing correlation energy cannot be included in an average nuclear potential. It is calculated by applying the Bardeen-Cooper-Schrieffer (BCS) formalism to the single-particle levels, using as the average pairing matrix element $G \sim 1/A$. For a given value of the one adjustable parameter $G_N r_N^2 = G_P r_0^2$, the BCS ground-state energy for each particle number is found, and the difference in binding energy between it and the sum of the Nilsson levels is called $P_N(N,\epsilon)$ or $P_Z(Z,\epsilon)$ [9]. Since the presence of an unpaired particle decreases the binding energy of the BCS solution, the even-odd mass difference is calculated directly with no additional parameters. (A simple alternative phenomenological form for the even-odd difference is $\pm\delta/A^{\frac{1}{3}}$, where the + sign is for even-even nuclides, − for odd-odd, and the term is omitted for odd A. The least-squares determined value for δ is 10.6 ± 1.1 MeV.)

It is known that many nuclei, e.g., the rare earths and actinides, have nonspherical equilibrium shapes which are represented approximately in the Nilsson model by spheroids. The terms δU and P are explicit functions of the deformation parameter ϵ; the surface and Coulomb terms in the liquid-drop mass law can also be expanded in powers of ϵ. Then by maximizing total binding energy with respect to ϵ, the equilibrium deformation ϵ_0 is found; the results [9] agree qualitatively with experiment.

Several other small terms are included in the mass law. In the Coulomb energy there are an exchange term [2] and a correction for the diffuseness of the nuclear surface [8]. A first-order term in $(A - 2Z)/A$ seems to be required to represent extra binding of nuclei with $N - Z$; a rapidly decreasing exponential is used [8]. The binding of the atomic electrons [14] is included, although small, to prevent falsification of other terms. The complete formula is, in MeV,

$$\begin{aligned} B(Z,A) = {} & \alpha A - \frac{\beta(A-2Z)^2}{A} - \left[\gamma A^{\frac{1}{3}} - \frac{\eta(A-2Z)^2}{A^{\frac{1}{3}}}\right]\left(1 + \frac{8}{45}\epsilon_0^2 + \frac{88}{2{,}835}\epsilon_0^3\right) \\ & - \frac{3}{5}e^2\frac{Z^2}{r_0 A^{\frac{1}{3}}}\left(1 - \frac{0.76361}{Z^{\frac{1}{3}}} - \frac{2.453}{r_0^2 A^{\frac{1}{3}}} - \frac{4}{45}\epsilon_0^2 - \frac{92}{2{,}835}\epsilon_0^3\right) \\ & + 7\exp\left(-\frac{6|A-2Z|}{A}\right) + 14.33 \times 10^{-6} Z^{2.39} \\ & + \delta U_N(A-Z,\epsilon_0) + \delta U_Z(Z,\epsilon_0) + P_N(A-Z,\epsilon_0) + P_Z(Z,\epsilon_0) \end{aligned} \quad \text{(8c-3)}$$

The value used for $\frac{3}{5}e^2$ is 0.864 MeV-fm.

8c-4. Determination and Testing of Coefficients. The principal method used to determine coefficients is least-squares fitting to tables of experimentally derived binding energies. From a statistician's [15] point of view, this is not a valid procedure because there are correlations among the data of the mass table. Therefore Eq. (8c-3) has been fitted both to the mass table and to the raw experimental data. Other methods, e.g., fitting the Coulomb radius to a fission barrier [8], have also been used. In this mass law, the four parameters of the Nilsson model were chosen [9] by trial and error to reproduce known level structures as well as possible. The value for the BCS

parameter was found by solving the problem with several values of the BCS parameter, iterating to find the solution which minimized the sum of residuals.

The least-squares solution fitting the remaining six parameters to 1,148 binding energies from the 1964 [10] and 1967 [11] mass tables is given in the second column of Table 8c-1, and the solution fitted to 552 mass-spectroscopic doublets [16] and 957

TABLE 8c-1. MASS-LAW COEFFICIENTS

Parameter	Fitted to mass table	Fitted to doublets and reactions
α, MeV	15.8089 ± 0.0170	15.8570 ± 0.0322
β, MeV	30.157 ± 0.142	31.402 ± 0.168
γ, MeV	20.230 ± 0.052	20.337 ± 0.105
η, MeV	47.66 ± 0.94	53.52 ± 0.92
r_0, fm	1.18729 ± 0.00229	1.17641 ± 0.00376
r_N, fm	1.2285 ± 0.0070	1.1983 ± 0.0078
$G_p r_0^2$, MeV-fm^2	28.70	27.67
σ_1, MeV	0.805	1.916
σ_2, MeV	0.464	0.449

nuclear reaction Q values [11,16] is given in the third column. The standard deviation σ_1 is the fit to total binding energies, and σ_2 is the fit to the doublets and reaction energies.

The quoted errors in Table 8c-1 are the square roots of the diagonal elements of the error matrix adjusted to force χ^2 = degrees of freedom. For the first column they show only the relative uncertainties in the determination of the parameters; for the second column they are a more accurate estimate of statistical uncertainties. The values of the coefficients are slightly different from those in the "Winnipeg Proceedings" [9] because of the elimination of the free parameter in the Strutinsky smoothing and the addition of a neutron radius different from the proton radius. The residual errors of the calculated binding energies with the coefficients of the first column are shown for odd-A nuclides in Fig. 8c-1*c*, and for even-A in Fig. 8c-1*d*. The systematic errors remaining above $A = 200$ are due to undercorrection for the doubly closed shell at ^{208}Pb and to higher-order shapes of deformation [13]. Figure 8c-1*d* indicates systematic differences between even-even and odd-odd nuclides, demonstrating that the even-odd mass difference as calculated by BCS theory in this mass law is not accurate. Different forms for the A dependence of the pairing matrix element, e.g., $G \sim 1/A^{0.8}$, were found to give a qualitatively better fit to even-odd mass differences, but always with a considerably larger sum of residuals than the solution presented here.

The first test of a mass law is its ability to fit the known binding energies. In this case the rms deviation is 805 keV. Much better fits have been obtained, e.g., 168 keV by Zeldes [7], but generally by using a large number of phenomenological terms to represent shell, pairing, and deformation effects. Since the probability of successful extrapolation decreases with increased number of parameters, a "figure of merit" is sometimes applied which is the product of the rms deviation and the number of parameters. The mass law presented here has only 11 adjustable parameters, including all model parameters.

To test interpolation the data were placed in random order and divided into two groups of 574 binding energies each; to test extrapolation the 622 data with N less

than the stability line were placed in one group and 526 neutron-rich data in another. A separate determination of the parameters was made for each of the four groups, and the sums of residuals were compared to the sum of residuals for the mass law fitted to all the data by applying the variance-ratio or F-distribution test.[1] The respective values of F obtained for the four groups are 1.04, 0.95, 1.03, and 1.01; since the F distribution for this number of degrees of freedom is approximately normal about 1.00 with standard deviation ± 0.07, the statistical test is well satisfied both for interpolation and for extrapolation from either side of the beta-stability line to the other. There is, of course, no guarantee that the extrapolation continues accurately beyond the known nuclides.

Wing [17] has developed and used tests for comprehensive comparison of various mass formulas—based on alpha-decay energies as a function of N, neutron-pair separation energies as a function of Z, local roughness of beta-decay energies, the beta-stability line and the steepness of the valley of beta stability, separation of even and odd mass surfaces, and delayed neutron and proton precursors. No mass laws tested to date satisfy all tests.

The ultimate test is use. Two examples of problems involving extrapolation to neutron-rich isotopes which have been used to compare formulas are the r process of nucleosynthesis [18] and the study of delayed neutron emitters [19]. In both these cases the mass law presented here behaved well.

8c-5. Table of Binding Energies. Binding energies for 2,827 nuclides calculated from Eq. (8c-3) with the coefficients of the second column of Table 8c-1 are given in Table 8c-2. From 16 to 34 isotopes of each element from $Z = 20$ to $Z = 114$ are given. The isotope nearest to Green's [20] approximation of the beta-stability line, $N - Z = 0.4A^2/(A + 200)$, is indicated by a star. The four data columns give, in MeV: the spherical liquid-drop part of the binding energy [first three lines of Eq. (8c-3), with $\epsilon = 0$]; the shell correction $\delta U_N(N,\epsilon_0) + \delta U_Z(Z,\epsilon_0)$; the BCS pairing energy $P_N(N,\epsilon_0) + P_Z(Z,\epsilon_0)$; and finally the total binding energy. The deformation energy of the liquid drop is the difference between the final column and the other three columns.

Particle separation energies (binding energies of the last particles) for nucleus (Z,A) can be found as follows:

$$S_p(Z,A) = B(Z,A) - B(Z-1, A-1)$$
$$S_n(Z,A) = B(Z,A) - B(Z, A-1)$$
$$S_\alpha(Z,A) = B(Z,A) - B(Z-2, A-4) - 28.3 \text{ MeV}$$

The energy available for ground-state negative beta decay is

$$Q_\beta(Z,A) = B(Z+1, A) - B(Z,A) + 0.8 \text{ MeV}$$

and the end point of the positron energy for decay to the ground state is

$$Q_{\beta+}(Z,A) = B(Z-1, A) - B(Z,A) - 1.8 \text{ MeV}$$

References

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(*References continued on p.* 8–142.)

[1] Application of the F distribution is correctly described in report LA-3751 [9]; comments concerning it in the corresponding paper in the "Winnipeg Proceedings" are not accurate.

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 20$: *Calcium*			
20	40	339.1	−1.3	2.6	340.4
21	41	350.0	−2.7	2.1	349.3
22	42	360.3	−3.6	5.1	361.8
23*	43	369.9	−3.5	3.4	369.9
24	44	379.1	−3.3	5.6	381.3
25	45	387.7	−2.3	3.4	388.8
26	46	395.7	−1.1	4.7	399.3
27	47	403.2	1.0	1.9	406.1
28	48	410.3	3.2	1.9	415.4
29	49	416.8	1.4	1.8	420.0
30	50	422.9	0.	4.0	426.9
31	51	428.5	−0.9	2.6	430.2
32	52	433.7	−1.3	4.3	436.6
33	53	438.5	−2.8	3.3	438.7
34	54	442.8	−4.2	6.1	444.6
35	55	446.8	−4.9	4.3	446.2
		$Z = 21$: *Scandium*			
20	41	343.2	−2.5	1.2	341.8
21	42	356.8	−3.6	0.6	353.6
22	43	367.8	−4.1	3.1	366.7
23	44	378.2	−3.7	1.3	375.7
24*	45	388.1	−3.2	3.1	387.8
25	46	397.4	−1.9	0.9	396.0
26	47	406.1	−1.3	2.5	407.2
27	48	414.4	0.3	0.4	414.9
28	49	422.1	2.0	0.5	424.6
29	50	429.3	0.5	0.4	430.1
30	51	436.1	−0.6	2.2	437.7
		$Z = 23$: *Vanadium (Continued)*			
28	51	442.6	1.2	2.1	445.9
29	52	451.2	0.2	1.4	452.7
30	53	459.3	−1.6	4.0	461.6
31	54	466.9	−2.6	2.6	467.0
32	55	474.1	−3.0	4.3	475.4
33	56	480.9	−3.4	2.4	479.6
34	57	487.1	−5.4	5.6	487.4
35	58	493.0	−5.7	3.6	490.9
36	59	498.5	−6.1	5.6	498.0
37	60	503.6	−6.6	4.0	500.9
38	61	508.3	−6.4	5.6	507.5
39	62	512.7	−6.9	4.2	509.9
40	63	516.7	−6.8	6.1	515.9
		$Z = 24$: *Chromium*			
20	44	350.2	−3.0	5.2	352.5
21	45	366.0	−3.1	3.5	366.3
22	46	381.1	−5.1	7.5	383.5
23	47	395.4	−4.4	5.3	396.3
24	48	409.1	−4.9	8.0	412.2
25	49	420.5	−3.7	5.7	422.4
26	50	431.3	−2.8	7.2	435.7
27	51	441.6	0.9	3.0	445.3
28*	52	451.3	1.5	4.4	457.2
29	53	460.6	0.7	3.4	464.6
30	54	469.4	−1.6	6.4	474.2
31	55	477.7	−2.4	4.9	480.2
32	56	485.5	−2.9	6.6	489.2
33	57	492.9	−2.9	4.2	494.0

31	52	442.4	−1.8	1.1	441.6
32	53	448.3	−2.4	3.0	448.8
33	54	453.7	−3.5	1.8	451.7
34	55	458.7	−4.2	3.9	458.2
35	56	463.3	−5.0	2.3	460.4
36	57	467.6	−5.4	4.4	466.3

Z = 22: *Titanium*

20	42	346.4	−3.3	4.8	347.9
21	43	360.7	−3.9	3.6	360.3
22	44	374.3	−5.3	7.0	376.1
23	45	385.5	−4.9	5.1	385.7
24	46	396.0	−4.9	7.4	398.5
25	47	406.0	−3.7	5.0	407.3
26*	48	415.5	−2.9	6.6	419.3
27	49	424.5	0.	3.2	427.5
28	50	432.9	1.2	4.0	438.1
29	51	440.8	0.1	3.4	444.2
30	52	448.2	−1.7	6.0	452.4
31	53	455.2	−2.6	4.5	457.1
32	54	461.7	−3.1	6.2	464.8
33	55	467.8	−3.7	4.4	468.3
34	56	473.5	−5.8	7.8	475.5
35	57	478.7	−6.2	5.8	478.3
36	58	483.6	−6.7	8.0	484.8
37	59	488.1	−6.9	6.0	487.2
38	60	492.2	−6.7	7.6	493.1

Z = 23: *Vanadium*

20	43	348.7	−3.3	2.8	348.3
21	44	363.8	−3.7	1.4	361.4
22	45	378.1	−5.1	4.8	377.9
23	46	391.8	−4.4	2.7	390.1
24	47	403.0	−4.5	5.0	403.6
25	48	413.7	−2.9	2.4	413.1
26	49	423.9	−2.6	4.4	425.7
27*	50	433.5	0.3	1.1	434.7
34	58	499.8	−5.8	8.4	502.4
35	59	506.3	−6.0	6.3	506.5
36	60	512.4	−6.7	8.6	514.3
37	61	518.1	−6.5	6.2	517.8
38	62	523.4	−6.4	7.9	524.9
39	63	528.3	−6.7	6.3	527.9
40	64	532.9	−6.4	8.0	534.5
41	65	537.2	−6.1	6.1	537.1

Z = 25: *Manganese*

20	45	350.9	−1.9	2.6	351.6
21	46	367.4	−2.1	1.0	366.2
22	47	383.2	−3.9	4.7	384.0
23	48	398.2	−3.0	2.4	397.6
24	49	412.6	−3.4	5.0	414.2
25	50	426.3	−1.7	2.2	426.8
26	51	437.8	−1.6	4.5	440.7
27	52	448.7	1.8	0.6	450.9
28	53	459.1	2.4	1.9	463.5
29	54	469.1	1.6	1.0	471.6
30*	55	478.5	−0.5	3.8	481.8
31	56	487.4	−1.4	2.4	488.4
32	57	495.8	−1.8	4.1	498.1
33	58	503.9	−1.9	1.9	503.6
34	59	511.4	−4.5	5.7	512.6
35	60	518.5	−4.6	3.5	517.4
36	61	525.2	−5.1	5.6	525.7
37	62	531.5	−5.4	3.8	529.8
38	63	537.4	−5.2	5.4	537.5
39	64	543.0	−5.7	3.9	541.2
40	65	548.1	−5.4	5.7	548.3
41	66	552.9	−5.2	3.9	551.5
42	67	557.4	−5.3	6.0	558.1
43	68	561.5	−4.9	4.4	561.0

Z = 26: *Iron*

21	47	368.0	−0.9	2.3	369.4
22	48	384.5	−2.6	6.1	387.9

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 26: *Iron (Continued)*			
23	49	400.2	−2.3	4.2	402.2
24	50	415.3	−2.5	6.6	419.4
25	51	429.6	−1.5	4 5	432.7
26	52	443.4	−0.4	5.8	448.8
27	53	455.0	2.9	1.9	459.6
28	54	466.0	3.8	3.1	472.9
29	55	476.6	2.8	2.3	481.5
30	56	486.6	0.7	5.1	492.4
31*	57	496.2	−0.1	3.6	499.7
32	58	505.2	−0.6	5.3	510.0
33	59	513.9	−1.0	3.2	516.0
34	60	522.0	−3.5	7.1	525.7
35	61	529.8	−4.0	5.2	531.0
36	62	537.1	−4.6	7.4	539.9
37	63	544.0	−4.4	5.1	544.7
38	64	550.4	−4.3	6.8	552.9
39	65	556.6	−4.6	5.1	557.1
40	66	562.3	−4.4	6.9	564.8
41	67	567.7	−4.1	5.1	568.6
42	68	572.7	−4.5	7.6	575.7
43	69	577.4	−4.1	5.8	579.1
44	70	581.7	−3.6	7.6	585.7
		Z = 27: *Cobalt*			
22	49	385.0	0.4	2.1	387.3
23	50	401.4	0.7	0.5	402.3
24	51	417.1	1.2	2.1	420.2
25	52	432.2	2.2	0.1	434.2
26	53	446.6	3.0	1.5	450.8
		Z = 28: *Nickel (Continued)*			
39	67	580.8	−0.7	2.4	582.5
40	68	587.7	−0.6	4.2	591.3
41	69	594.2	−0.9	2.8	596.1
42	70	600.3	−0.9	5.0	604.4
43	71	606.1	−0.5	3.3	608.9
44	72	611.5	0.	4.9	616.5
45	73	616.6	0.9	3.2	620.7
46	74	621.4	2.1	4.2	627.7
47	75	625.9	3.9	1.7	631.5
48	76	630.0	5.5	2.5	638.0
		Z = 29: *Copper*			
24	53	418.6	0.8	2.1	421.3
25	54	434.9	1.8	0.2	436.6
26	55	450.6	2.5	1.6	454.6
27	56	465.6	4.0	−0.3	469.0
28	57	480.0	5.5	−0.2	485.4
29	58	493.9	4.1	−0.3	497.5
30	59	505.8	3.0	1.4	510.1
31	60	517.1	1.9	0.3	519.3
32	61	528.0	1.3	2.2	531.4
33	62	538.4	0.2	1.0	539.4
34	63	548.4	−0.6	3.1	550.7
35*	64	557.9	−1.4	1.6	557.9
36	65	566.9	−1.7	3.6	568.6
37	66	575.6	−2.4	2.1	575.1
38	67	583.8	−2.6	4.0	585.1
39	68	591.6	−3.0	2.7	591.0
40	69	599.0	−3.1	4.6	600.3

27	54	460.4	4.3	−0.4	464.1
28	55	472.0	5.8	−0.2	477.6
29	56	483.2	4.5	−0.4	487.1
30	57	493.9	3.4	1.4	498.5
31	58	504.0	2.2	0.3	506.4
32*	59	513.7	1.5	2.3	517.4
33	60	523.0	0.5	1.0	524.2
34	61	531.7	−0.2	3.1	534.3
35	62	540.1	−1.0	1.5	540.3
36	63	548.0	−1.4	3.5	549.8
37	64	555.4	−2.1	2.0	555.1
38	65	562.5	−2.4	4.2	564.0
39	66	569.2	−2.8	2.8	568.8
40	67	575.5	−2.8	4.7	577.1
41	68	581.4	−2.6	2.9	581.4
42	69	587.0	−2.2	4.5	589.1
43	70	592.2	−1.5	2.4	593.0
44	71	597.1	−0.4	3.6	600.1
45	72	601.7	0.5	1.7	603.7

Z = 28: *Nickel*

23	51	401.8	1.6	1.5	404.9
24	52	418.2	1.7	3.5	423.5
25	53	433.9	2.6	1.6	438.1
26	54	449.0	3.8	2.7	455.5
27	55	463.4	5.9	−0.2	469.0
28	56	477.2	7.9	0.	485.1
29	57	489.0	6.2	−0.2	495.0
30	58	500.2	4.8	2.1	507.1
31	59	511.0	3.9	0.7	515.6
32	60	521.3	3.5	2.3	527.1
33	61	531.1	2.0	1.2	534.3
34*	62	540.5	0.6	4.1	545.2
35	63	549.4	−0.2	2.5	551.8
36	64	557.9	−0.7	4.6	561.8
37	65	565.9	−0.7	2.5	567.7
38	66	573.6	−0.5	4.0	577.1
41	70	606.1	−2.9	2.9	605.8
42	71	612.7	−2.5	4.5	614.5
43	72	619.0	−1.8	2.5	619.6
44	73	625.0	−0.8	3.7	627.7
45	74	630.6	0.	1.9	632.4
46	75	635.9	1.2	2.9	639.9
47	76	640.9	2.7	0.9	644.3
48	77	645.5	3.9	1.8	651.2
49	78	649.9	5.9	−0.3	655.4

Z = 30: *Zinc*

26	56	451.4	−0.6	5.9	456.7
27	57	467.1	2.3	2.3	471.6
28	58	482.1	3.4	3.2	488.7
29	59	496.6	2.2	2.6	501.4
30	60	510.5	0.4	5.2	516.1
31	61	522.4	−0.4	3.8	525.8
32	62	533.9	−0.9	5.4	538.4
33	63	544.9	−1.5	3.6	546.9
34	64	555.4	−3.7	7.1	558.9
35	65	565.5	−4.2	5.4	566.7
36	66	575.1	−4.7	7.5	577.8
37*	67	584.3	−4.6	5.3	584.9
38	68	593.1	−4.5	6.9	595.4
39	69	601.4	−4.8	5.3	601.9
40	70	609.4	−4.6	7.0	611.8
41	71	617.0	−4.5	5.4	617.8
42	72	624.2	−4.8	7.7	627.1
43	73	631.0	−4.3	6.0	632.7
44	74	637.5	−3.9	7.7	641.3
45	75	643.7	−3.2	6.1	646.6
46	76	649.5	−1.9	7.1	654.6
47	77	654.9	0.2	4.4	659.5
48	78	660.1	1.4	5.4	667.0
49	79	665.0	4.2	2.4	671.5
50	80	669.5	5.9	2.9	678.3
51	81	673.8	4.6	2.5	680.8

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 31: *Gallium*			
27	58	467.9	1.1	1.0	469.7
28	59	483.5	1.9	2.0	487.4
29	60	498.5	1.0	1.3	500.7
30	61	513.0	−0.9	3.8	515.9
31	62	526.9	−1.7	2.5	527.6
32	63	539.0	−2.2	4.1	540.8
33	64	550.5	−2.5	2.2	550.0
34	65	561.6	−4.5	5.4	562.5
35	66	572.3	−4.8	3.5	570.8
36	67	582.4	−5.2	5.5	582.6
37	68	592.2	−5.7	3.9	590.3
38*	69	601.5	−5.5	5.4	601.3
39	70	610.4	−6.0	4.0	608.4
40	71	618.9	−5.9	5.9	618.8
41	72	627.1	−5.7	4.2	625.4
42	73	634.8	−5.6	6.1	635.2
43	74	642.2	−5.3	4.5	641.3
44	75	649.2	−4.7	6.0	650.5
45	76	655.8	−4.3	4.7	656.2
46	77	662.1	−3.0	5.6	664.8
47	78	668.1	−0.9	3.0	670.2
48	79	673.8	0.2	4.2	678.1
49	80	679.1	3.0	1.2	683.2
50	81	684.2	4.5	1.8	690.5
51	82	688.9	3.3	1.4	693.5
52	83	693.4	1.5	3.4	698.3
		Z = 32: *Germanium*			
29	61	499.8	0.	3.6	503.2
30	62	514.8	−2.3	6.5	519.0
		Z = 33: *Arsenic (Continued)*			
41*	74	644.7	−5.2	3.4	641.9
42	75	653.4	−7.9	7.1	652.6
43	76	661.8	−7.4	5.4	659.8
44	77	669.8	−7.0	7.1	670.0
45	78	677.5	−6.3	5.5	676.8
46	79	684.8	−5.0	6.5	686.3
47	80	691.8	−2.9	3.8	692.7
48	81	698.5	−1.7	4.9	701.6
49	82	704.8	1.0	2.0	707.7
50	83	710.8	2.7	2.4	715.9
51	84	716.5	1.4	2.1	719.9
52	85	721.9	−0.3	4.0	725.6
53	86	727.0	−1.3	3.2	728.9
54	87	731.8	−2.2	4.4	734.0
55	88	736.4	−2.6	2.9	736.6
56	89	740.6	−3.1	3.9	741.4
		Z = 34: *Selenium*			
30	64	516.3	−3.2	6.0	519.1
31	65	531.9	−4.0	4.7	532.6
32	66	547.0	−4.5	6.6	548.8
33	67	561.5	−4.4	4.7	561.1
34	68	575.5	−4.8	6.4	576.4
35	69	587.8	−5.8	5.0	586.5
36	70	599.6	−5.9	6.9	599.8
37	71	611.0	−5.8	5.2	609.2
38	72	622.0	−6.0	7.0	621.9
39	73	632.5	−5.0	4.8	630.6
40	74	642.6	−5.9	6.9	642.5

31	63	529.3	−3.0	5.0	531.3
32	64	543.2	−3.5	6.7	546.4
33	65	555.4	−3.3	4.4	556.1
34	66	567.0	−6.3	8.4	569.1
35	67	578.2	−5.6	5.6	578.1
36	68	588.9	−6.0	7.6	590.3
37	69	599.2	−6.8	6.2	598.6
38	70	609.1	−6.4	7.6	610.2
39	71	618.6	−6.2	5.9	617.8
40*	72	627.6	−6.8	8.1	628.7
41	73	636.3	−6.6	6.4	635.8
42	74	644.5	−6.7	8.3	646.1
43	75	652.4	−6.4	6.8	652.8
44	76	659.9	−6.1	8.7	662.5
45	77	667.1	−5.6	7.3	668.7
46	78	673.9	−4.4	8.3	677.8
47	79	680.4	−2.0	5.3	683.6
48	80	686.5	−1.0	6.6	692.1
49	81	692.4	2.0	3.4	697.7
50	82	697.9	3.4	4.1	705.4
51	83	703.1	2.3	3.5	708.9
52	84	708.1	0.3	5.7	714.1
53	85	712.7	−0.6	4.8	716.9
54	86	717.1	−1.5	6.1	721.6

Z = 33: *Arsenic*

29	62	500.3	−1.2	2.1	501.1
30	63	515.9	−3.0	4.6	517.5
31	64	530.9	−3.7	3.2	530.4
32	65	545.4	−4.2	4.8	546.1
33	66	559.5	−3.8	2.7	557.7
34	67	571.6	−6.9	6.5	571.2
35	68	583.4	−5.1	3.1	580.7
36	69	594.7	−5.3	5.1	593.6
37	70	605.6	−5.4	3.5	602.5
38	71	616.0	−5.8	5.3	614.6
39	72	626.0	−5.2	3.3	622.8
40	73	635.5	−5.7	5.3	634.2
41	75	652.3	−5.5	5.1	650.7
42*	76	661.5	−6.3	7.3	661.9
43	77	670.4	−5.5	5.4	669.6
44	78	678.9	−6.3	7.8	680.3
45	79	687.1	−6.5	7.0	687.5
46	80	694.9	−5.3	7.9	697.6
47	81	702.4	−3.0	5.1	704.4
48	82	709.5	−2.0	6.3	713.8
49	83	716.3	0.4	3.8	720.4
50	84	722.8	2.4	3.8	729.0
51	85	729.0	0.9	3.7	733.5
52	86	734.8	−0.6	5.4	739.7
53	87	740.4	−1.6	4.6	743.4
54	88	745.7	−2.4	5.8	749.0
55	89	750.7	−2.9	4.4	752.1
56	90	755.4	−3.4	5.3	757.3
57	91	759.9	−4.5	4.9	759.8

Z = 35: *Bromine*

32	67	547.8	−4.8	4.7	547.3
33	68	562.9	−4.2	2.8	560.2
34	69	577.5	−4.3	4.4	576.1
35	70	591.6	−4.4	2.9	588.1
36	71	603.9	−4.7	4.6	601.9
37	72	615.9	−3.4	2.3	612.0
38	73	627.3	−4.5	4.5	625.1
39	74	638.4	−3.3	2.2	634.5
40	75	648.9	−4.2	4.1	646.8
41	76	659.1	−4.0	2.5	655.5
42	77	668.9	−4.8	4.6	667.1
43	78	678.3	−4.4	2.9	675.3
44*	79	687.2	−6.3	5.7	686.4
45	80	695.9	−5.7	4.0	694.1
46	81	704.2	−4.8	5.3	704.6
47	82	712.2	−3.2	3.2	712.0
48	83	719.8	−2.4	4.5	721.9
49	84	727.1	−0.1	2.1	729.0
50	85	734.0	1.7	2.3	738.0

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 35: Bromine (Continued)			
51	86	740.6	0.4	2.1	743.0
52	87	747.0	−1.1	3.8	749.6
53	88	753.0	−1.9	2.8	753.8
54	89	758.7	−2.7	3.9	759.9
55	90	764.2	−3.4	2.8	763.5
56	91	769.4	−4.2	4.1	769.2
57	92	774.4	−2.6	2.2	772.1
58	93	779.0	−3.1	3.6	777.7
59	94	783.5	−1.9	.9	780.7
		Z = 36: Krypton			
33	69	563.6	−5.0	4.9	562.4
34	70	578.7	−4.8	6.2	578.8
35	71	593.3	−4.1	4.2	591.3
36	72	607.4	−4.3	5.8	606.8
37	73	619.9	−2.9	3.4	617.4
38	74	631.8	−3.3	5.0	631.0
39	75	643.4	−2.8	3.3	640.9
40	76	654.4	−3.7	5.2	653.7
41	77	665.2	−3.5	3.6	662.9
42	78	675.4	−5.8	6.7	675.0
43	79	685.3	−6.0	5.4	683.7
44	80	694.8	−6.2	7.1	695.2
45*	81	703.9	−6.2	5.9	703.5
46	82	712.7	−5.9	7.6	714.5
47	83	721.1	−3.5	4.8	722.3
48	84	729.2	−3.0	6.4	732.7
49	85	737.0	−0.2	3.6	740.2
50	86	744.4	1.3	4.0	749.7

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 37: Rubidium (Continued)			
61	98	821.2	0.1	0.6	818.2
62	99	825.7	0.1	1.7	823.8
		Z = 38: Strontium			
35	73	594.9	−1.9	2.6	592.6
36	74	610.0	−1.6	3.9	609.1
37	75	624.6	−0.8	1.8	622.0
38	76	638.7	−0.4	2.9	637.7
39	77	651.3	−0.8	1.8	648.6
40	78	663.3	−1.7	3.7	662.3
41	79	675.0	−1.8	2.3	672.5
42	80	686.2	−4.1	5.2	685.5
43	81	697.1	−3.9	3.8	695.1
44	82	707.5	−6.4	7.1	707.6
45	83	717.6	−6.1	5.5	716.7
46	84	727.3	−5.5	6.9	728.7
47	85	736.7	−3.7	4.6	737.5
48*	86	745.8	−2.7	5.8	748.8
49	87	754.5	−0.6	3.6	757.3
50	88	762.8	1.5	3.4	767.7
51	89	770.8	−0.1	3.4	774.1
52	90	778.5	−1.4	5.0	782.1
53	91	785.9	−2.3	4.1	787.7
54	92	793.0	−3.1	5.2	795.1
55	93	799.8	−3.8	4.0	800.0
56	94	806.3	−4.9	5.9	807.0
57	95	812.6	−2.6	3.2	811.3
58	96	818.5	−2.7	4.4	818.2
59	97	824.3	−0.5	1.9	822.6

51	87	751.5	0.2	3.6	755.2
52	88	758.3	−1.6	5.6	762.3
53	89	764.8	−2.4	4.6	766.9
54	90	771.0	−3.3	5.8	773.5
55	91	776.8	−3.7	4.4	777.4
56	92	782.5	−4.2	5.4	783.6
57	93	787.8	−5.4	5.1	787.0
58	94	793.0	−3.5	5.1	793.0
59	95	797.9	−1.5	2.9	796.4
60	96	802.4	−1.1	3.7	802.0

Z = 37: *Rubidium*

35	72	594.5	−2.8	1.9	590.7
36	73	609.0	−2.5	3.1	606.7
37	74	623.2	−1.8	1.2	619.1
38	75	635.6	−1.5	2.4	633.1
39	76	647.7	−1.9	1.2	643.6
40	77	659.3	−2.4	2.9	656.8
41	78	670.5	−2.4	1.4	666.6
42	79	681.2	−3.6	3.5	679.0
43	80	691.6	−3.7	2.3	688.2
44	81	701.5	−6.0	5.3	700.1
45	82	711.1	−6.8	4.4	708.7
46	83	720.4	−5.7	5.6	720.2
47*	84	729.3	−3.9	3.2	728.6
48	85	737.9	−2.9	4.4	739.4
49	86	746.1	−0.6	2.0	747.4
50	87	754.0	1.2	2.2	757.4
51	88	761.6	−0.1	2.0	763.4
52	89	768.8	−1.6	3.7	770.9
53	90	775.7	−2.5	2.8	776.0
54	91	782.4	−3.3	3.9	783.0
55	92	788.7	−3.9	2.7	787.4
56	93	794.8	−4.4	4.3	794.0
57	94	800.7	−2.5	1.9	798.0
58	95	806.2	−2.4	2.9	804.5
59	96	811.5	−0.9	1.0	808.5
60	97	816.5	−0.3	1.7	814.5
60	98	829.7	0.3	2.5	829.0
61	99	834.9	0.9	1.3	833.2
62	100	839.8	0.9	2.3	839.1
63	101	844.4	1.2	1.2	842.7
64	102	848.8	1.2	2.0	848.1

Z = 39: *Yttrium*

37	76	625.5	0.3	0.3	621.6
38	77	640.1	0.8	1.2	637.7
39	78	654.3	0.8	0.1	650.4
40	79	666.8	−0.6	2.1	664.3
41	80	678.9	−0.7	0.7	675.1
42	81	690.6	−1.7	2.3	688.3
43	82	701.9	−3.3	1.9	698.4
44	83	712.8	−5.6	5.0	711.2
45	84	723.4	−4.1	2.7	720.9
46	85	733.6	−4.8	4.7	733.2
47	86	743.4	−3.6	3.0	742.5
48	87	752.9	−2.6	4.0	754.2
49	88	762.1	−0.9	2.2	763.2
50*	89	770.9	0.9	2.2	774.0
51	90	779.3	−0.4	2.1	781.0
52	91	787.5	−1.6	3.4	789.3
53	92	795.3	−2.3	2.6	795.4
54	93	802.9	−3.0	3.6	803.3
55	94	810.1	−4.1	2.8	808.6
56	95	817.0	−5.1	4.8	816.1
57	96	823.8	−2.4	1.7	821.0
58	97	830.1	−2.1	2.7	828.4
59	98	836.3	0.1	0.5	833.3
60	99	842.2	1.0	1.0	840.2
61	100	847.8	1.2	0.2	844.8
62	101	853.0	1.2	1.3	851.1
63	102	858.1	1.4	0.2	855.2
64	103	862.9	1.6	0.9	861.0
65	104	867.4	1.2	0.2	864.5
66	105	871.7	0.9	1.2	869.7

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 40$: *Zirconium*			
38	78	640.5	−0.8	3.1	639.5
39	79	655.2	−1.3	2.0	652.6
40	80	669.3	−2.1	4.0	668.3
41	81	681.9	−2.1	2.5	679.5
42	82	694.1	−4.1	5.2	693.4
43	83	705.9	−3.8	3.7	704.0
44	84	717.3	−5.9	6.7	717.4
45	85	728.3	−6.0	5.4	727.5
46	86	739.0	−5.9	7.3	740.4
47	87	749.4	−3.9	4.8	750.2
48	88	759.3	−3.6	6.6	762.3
49	89	768.9	−0.8	3.8	771.7
50	90	778.2	0.6	4.3	783.1
51*	91	787.1	−0.4	3.8	790.4
52	92	795.7	−2.2	5.8	799.3
53	93	804.0	−2.9	4.7	805.8
54	94	811.9	−3.7	5.9	814.1
55	95	819.6	−4.3	4.5	819.8
56	96	827.0	−4.7	5.7	827.7
57	97	834.1	−2.5	3.1	832.9
58	98	840.9	−3.0	4.5	840.6
59	99	847.5	−0.9	2.2	845.8
60	100	853.8	−0.3	2.8	853.0
61	101	859.8	0.6	1.5	858.0
62	102	865.5	0.5	2.5	864.7
63	103	870.9	0.9	1.4	869.1
64	104	876.1	0.9	2.2	875.3
65	105	881.0	0.7	1.4	879.2
66	106	885.7	0.3	2.5	884.8
67	107	890.2	−0.1	1.7	888.2
		$Z = 42$: *Molybdenum* (*Continued*)			
46	88	747.9	−5.5	7.4	749.7
47	89	759.1	−3.2	4.6	760.4
48	90	770.0	−3.3	6.8	773.5
49	91	780.5	0.1	3.4	783.8
50	92	790.7	0.8	4.5	796.0
51	93	800.5	0.2	3.6	804.2
52	94	810.0	−1.9	6.0	814.0
53	95	819.1	−2.5	4.8	821.3
54	96	827.9	−3.4	6.0	830.5
55*	97	836.5	−3.7	4.4	837.2
56	98	844.7	−3.9	5.2	845.9
57	99	852.6	−4.4	4.2	851.9
58	100	860.3	−3.7	5.1	860.3
59	101	867.7	−1.4	2.3	866.1
60	102	874.8	−1.4	3.3	874.2
61	103	881.6	−0.2	1.7	879.8
62	104	888.1	−0.3	2.7	887.3
63	105	894.4	0.2	1.6	892.5
64	106	900.3	−0.1	2.6	899.5
65	107	906.1	0.	1.6	904.2
66	108	911.5	−0.3	2.6	910.6
67	109	916.7	−0.5	1.7	914.8
68	110	921.7	−1.0	2.9	920.9
69	111	926.5	−1.2	2.1	924.7
70	112	931.0	−1.4	3.0	930.3
71	113	935.3	−1.4	1.9	933.7
		$Z = 43$: *Technetium*			
42	85	699.8	−3.3	3.6	698.6
43	86	714.0	−3.0	1.9	711.6

$Z = 41$: *Niobium*

40	81	670.2	−1.8	2.6	668.0
41	82	684.4	−1.9	1.1	680.8
42	83	697.0	−3.4	3.4	695.1
43	84	709.3	−3.4	2.1	706.2
44	85	721.2	−4.4	4.3	720.0
45	86	732.7	−3.4	2.3	730.6
46	87	743.8	−4.8	5.0	743.9
47	88	754.6	−3.4	3.1	754.1
48	89	765.0	−3.1	4.8	766.7
49	90	775.1	−0.5	2.1	776.6
50	91	784.8	0.6	2.9	788.3
51	92	794.2	−0.2	2.3	796.2
52	93	803.2	−1.9	4.2	805.4
53*	94	811.9	−2.4	3.0	812.4
54	95	820.3	−3.2	4.1	821.1
55	96	828.4	−4.0	3.0	827.3
56	97	836.2	−4.4	4.1	835.6
57	98	843.8	−2.2	1.6	841.4
58	99	851.0	−2.6	3.0	849.5
59	100	858.0	−0.7	0.9	855.1
60	101	864.7	−0.3	1.7	862.8
61	102	871.1	0.3	0.5	868.1
62	103	877.2	0.3	1.5	875.2
63	104	883.0	0.6	0.5	880.1
64	105	888.6	0.5	1.3	886.6
65	106	893.9	0.4	0.5	891.0
66	107	899.0	0.1	1.5	897.0
67	108	903.8	−0.3	0.7	900.8
68	109	908.4	−0.7	1.8	906.4
69	110	912.8	−1.0	1.0	909.8

$Z = 42$: *Molybdenum*

42	84	699.2	−4.9	5.8	698.9
43	85	711.9	−4.8	4.4	710.5
44	86	724.3	−5.0	6.1	724.9
45	87	736.3	−5.1	5.0	736.0
44	87	726.8	−4.3	4.4	726.4
45	88	739.2	−4.3	3.2	737.9
46	89	751.3	−6.1	7.0	752.2
47	90	763.0	−2.6	3.0	763.3
48	91	774.3	−2.9	5.4	776.8
49	92	786.3	0.7	1.7	787.6
50	93	795.9	1.4	3.0	800.2
51	94	806.1	0.9	2.0	808.9
52	95	816.0	−1.5	4.6	819.1
53	96	825.6	−2.2	3.4	826.9
54	97	834.9	−3.1	4.8	836.5
55	98	843.8	−3.1	2.9	843.6
56*	99	852.4	−3.4	3.7	852.7
57	100	860.8	−3.6	2.5	859.1
58	101	868.9	−2.3	2.9	868.0
59	102	876.7	−1.4	1.2	874.2
60	103	884.2	−1.5	2.4	882.7
61	104	891.4	−0.6	0.8	888.7
62	105	898.3	−0.7	1.8	896.6
63	106	905.0	−0.3	0.7	902.1
64	107	911.3	−0.6	1.8	909.5
65	108	917.4	−0.4	0.7	914.6
66	109	923.3	−0.6	1.6	921.5
67	110	928.9	−0.7	0.8	926.1
68	111	934.3	−1.1	1.9	932.5
69	112	939.4	−1.2	1.0	936.7
70	113	944.3	−1.2	1.9	942.7
71	114	949.0	−1.0	0.6	946.5
72	115	953.4	−0.8	1.3	952.1
73	116	957.7	−1.3	0.8	955.6

$Z = 44$: *Ruthenium*

44	88	728.6	−4.6	6.3	730.1
45	89	741.5	−6.4	7.1	742.2
46	90	754.0	−5.1	7.9	756.8
47	91	766.2	−2.2	4.5	768.4
48	92	777.9	−2.0	6.4	782.4
49	93	789.3	1.6	2.7	793.5

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 44: *Ruthenium* (*Continued*)			
50	94	800.4	2.2	4.0	806.6
51	95	811.1	1.7	3.0	815.7
52	96	821.4	−0.6	5.6	826.4
53	97	831.4	−1.4	4.5	834.6
54	98	841.1	−2.3	5.8	844.6
55	99	850.5	−2.3	4.0	852.1
56	100	859.5	−3.1	5.2	861.6
57	101	868.3	−2.8	3.3	868.4
58*	102	876.8	−3.0	4.5	877.6
59	103	885.0	−2.6	3.0	884.0
60	104	892.8	−2.5	4.1	892.8
61	105	900.5	−1.1	2.0	899.0
62	106	907.8	−1.2	3.0	907.3
63	107	914.8	−0.6	1.7	913.2
64	108	921.6	−1.0	2.9	921.0
65	109	928.1	−0.6	1.6	926.4
66	110	934.3	−0.7	2.6	933.7
67	111	940.3	−0.8	1.7	938.7
68	112	946.1	−1.2	2.9	945.6
69	113	951.6	−1.0	1.8	950.2
70	114	956.9	−1.0	2.6	956.6
71	115	961.9	−0.8	1.4	960.8
72	116	966.7	−0.7	2.3	966.8
73	117	971.3	−0.9	1.6	970.7
74	118	975.7	−1.2	2.9	976.4
75	119	979.9	−1.2	2.1	980.1
		Z = 45: *Rhodium*			
45	90	743.2	−2.8	2.9	743.2
46	91	756.1	−2.3	4.5	758.3

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 46: *Palladium* (*Continued*)			
52	98	830.2	1.9	4.4	836.5
53	99	841.0	1.0	3.5	845.5
54	100	851.6	0.1	4.7	856.4
55	101	861.8	−0.1	3.1	864.7
56	102	871.6	−0.8	4.2	875.1
57	103	881.2	−1.1	2.7	882.5
58	104	890.5	−4.0	6.2	892.6
59	105	899.4	−2.7	3.2	899.6
60	106	908.1	−3.3	4.7	909.1
61*	107	916.5	−2.5	3.0	915.8
62	108	924.6	−2.6	4.1	925.0
63	109	932.5	−1.6	2.1	931.4
64	110	940.0	−1.6	3.2	940.0
65	111	947.3	−1.1	1.7	946.1
66	112	954.3	−1.2	2.9	954.3
67	113	961.1	−1.0	1.7	960.0
68	114	967.6	−1.3	3.0	967.7
69	115	973.9	−0.8	1.6	973.0
70	116	979.9	−0.8	2.6	980.3
71	117	985.6	−0.5	1.4	985.2
72	118	991.2	−0.6	2.5	992.1
73	119	996.5	−0.3	1.5	996.8
74	120	1001.6	−0.7	3.0	1003.3
75	121	1006.5	−0.4	2.1	1007.7
76	122	1011.2	−1.5	4.6	1014.1
77	123	1015.7	−0.3	3.1	1018.4
78	124	1020.0	−0.1	4.7	1024 6
		Z = 47: *Silver*			
48	95	785.0	3.1	2.4	790.4
49	96	797.7	4.9	0.4	802.9

47	92	768.7	−0.6	2.2	770.3
48	93	780.9	−0.3	4.0	784.7
49	94	792.8	2.6	1.0	796.3
50	95	804.2	3.5	2.1	809.8
51	96	815.4	2.8	1.3	819.4
52	97	826.1	0.9	3.4	830.4
53	98	836.6	0.3	2.2	839.1
54	99	846.7	−0.5	3.3	849.5
55	100	856.5	−1.1	2.1	857.4
56	101	865.9	−1.4	3.0	867.4
57	102	875.1	−1.9	1.9	874.6
58	103	884.0	−2.2	3.2	884.2
59*	104	892.6	−2.4	2.1	891.0
60	105	900.8	−2.6	3.3	900.3
61	106	908.9	−1.6	1.4	906.8
62	107	916.6	−1.6	2.4	915.5
63	108	924.0	−1.1	1.0	921.7
64	109	931.1	−1.4	2.3	929.9
65	110	938.1	−0.9	0.9	935.7
66	111	944.7	−1.0	1.8	943.4
67	112	951.1	−0.9	0.8	948.8
68	113	957.2	−1.2	2.1	956.0
69	114	963.1	−0.9	0.9	961.0
70	115	968.7	−0.9	1.7	967.8
71	116	974.1	−0.6	0.5	972.4
72	117	979.3	−0.5	1.4	978.8
73	118	984.3	−0.5	0.6	983.1
74	119	989.0	−0.7	1.8	989.2
75	120	993.6	−0.5	0.9	993.2
76	121	997.9	−0.9	2.4	999.1

Z = 46: *Palladium*

47	93	770.6	−0.3	4.0	774.2
48	94	783.3	0.6	5.2	789.0
49	95	795.5	3.6	2.0	801.0
50	96	807.4	4.8	2.8	815.0
51	97	819.0	3.8	2.2	825.0

50	97	810.0	6.6	0.6	817.2
51	98	822.0	5.3	0.5	827.7
52	99	833.6	4.1	1.9	839.5
53	100	844.9	3.2	1.0	849.1
54	101	855.8	2.5	2.1	860.3
55	102	866.4	1.6	1.1	869.1
56	103	876.7	1.0	2.2	879.9
57	104	886.7	−0.2	1.6	887.8
58	105	896.3	−1.4	3.4	898.2
59	106	905.7	−2.0	2.3	905.6
60	107	914.8	−2.8	3.9	915.6
61	108	923.6	−2.5	2.3	922.6
62*	109	932.0	−3.0	3.8	932.1
63	110	940.3	−2.3	2.0	938.8
64	111	948.2	−2.2	3.0	947.9
65	112	955.9	−1.6	1.4	954.3
66	113	963.3	−1.9	2.7	962.9
67	114	970.4	−1.5	1.4	968.9
68	115	977.3	−1.6	2.6	977.0
69	116	983.9	−1.1	1.2	982.7
70	117	990.3	−1.0	2.2	990.4
71	118	996.5	−0.6	0.9	995.7
72	119	1002.4	−0.8	2.2	1003.0
73	120	1008.1	−0.2	1.0	1008.0
74	121	1013.5	−0.5	2.5	1015.0
75	122	1018.8	0.	1.4	1019.8
76	123	1023.8	0.1	2.8	1026.5
77	124	1028.6	0.9	1.7	1031.2
78	125	1033.3	1.7	2.7	1037.6
79	126	1037.7	3.0	1.4	1042.1

Z = 48: *Cadmium*

49	97	799.2	6.3	0.9	806.4
50	98	811.9	8.3	1.0	821.3
51	99	824.3	6.8	0.9	832.1
52	100	836.4	5.4	2.6	844.4
53	101	848.1	4.4	1.9	854.3

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 48$: *Cadmium* (*Continued*)			
54	102	859.4	3.6	3.0	866.0
55	103	870.4	3.1	1.7	875.2
56	104	881.1	2.7	2.5	886.3
57	105	891.5	1.1	2.0	894.5
58	106	901.5	−0.6	4.5	905.5
59	107	911.3	−1.5	3.4	913.1
60	108	920.7	−2.9	5.6	923.5
61	109	929.9	−3.7	4.6	930.8
62	110	938.8	−4.1	5.9	940.6
63	111	947.4	−4.6	4.7	947.5
64*	112	955.7	−4.4	5.9	956.9
65	113	963.8	−3.4	3.7	963.5
66	114	971.5	−3.5	5.0	972.5
67	115	979.1	−2.5	3.0	978.8
68	116	986.3	−2.7	4.5	987.4
69	117	993.3	−1.8	2.6	993.4
70	118	1000.1	−2.1	4.2	1001.6
71	119	1006.6	−1.3	2.6	1007.2
72	120	1012.9	−1.8	4.3	1015.0
73	121	1018.9	−0.8	2.6	1020.3
74	122	1024.7	−1.3	4.6	1027.9
75	123	1030.3	0.	2.9	1033.0
76	124	1035.7	0.	4.6	1040.3
77	125	1040.9	1.9	2.5	1045.2
78	126	1045.9	3.1	3.2	1052.2
79	127	1050.6	4.5	1.9	1057.0
80	128	1055.2	6.0	2.3	1063.5
81	129	1059.5	7.8	0.9	1068.2
82	130	1063.7	9.6	1.0	1074.3
		$Z = 50$: *Tin* (*Continued*)			
54	104	864.7	6.7	2.0	873.5
55	105	876.6	6.2	0.7	883.4
56	106	888.0	5.8	1.5	895.4
57	107	899.2	4.2	0.9	904.3
58	108	910.1	2.6	3.5	916.1
59	109	920.6	1.5	2.5	924.6
60	110	930.8	0.3	4.6	935.8
61	111	940.8	−0.5	3.5	943.8
62	112	950.4	−1.1	5.0	954.4
63	113	959.8	−1.5	3.7	962.0
64	114	968.8	−1.6	5.0	972.2
65	115	977.6	−2.2	3.9	979.3
66	116	986.1	−2.7	5.7	989.2
67*	117	994.4	−2.8	4.4	996.0
68	118	1002.4	−3.1	6.2	1005.4
69	119	1010.1	−2.7	4.6	1012.0
70	120	1017.6	−2.7	6.2	1021.0
71	121	1024.9	−2.3	4.7	1027.3
72	122	1031.9	−1.5	5.7	1036.0
73	123	1038.6	−0.6	4.0	1042.0
74	124	1045.2	0.4	4.8	1050.4
75	125	1051.5	1.9	2.8	1056.1
76	126	1057.5	2.9	3.7	1064.1
77	127	1063.4	4.6	1.7	1069.7
78	128	1069.0	6.1	2.2	1077.4
79	129	1074.5	7.4	1.0	1082.9
80	130	1079.7	9.0	1.3	1090.0
81	131	1084.7	10.7	−0.1	1095.3

$Z = 49$: *Indium*

51	100	826.1	8.3	−0.2	834.1
52	101	838.5	6.9	1.5	846.9
53	102	850.6	5.9	0.8	857.2
54	103	862.4	5.0	1.9	869.3
55	104	873.8	4.5	0.6	878.9
56	105	884.9	4.1	1.4	890.5
57	106	895.7	2.5	0.9	899.0
58	107	906.1	0.9	3.4	910.4
59	108	916.3	−0.2	2.4	918.5
60	109	926.1	−1.4	4.5	929.2
61	110	935.7	−2.2	3.4	936.9
62	111	944.9	−2.7	4.9	947.1
63	112	953.9	−3.2	3.6	954.4
64	113	962.6	−3.3	4.9	964.2
65	114	971.0	−3.8	3.9	971.0
66*	115	979.1	−4.3	5.6	980.4
67	116	987.0	−3.8	3.9	986.9
68	117	994.7	−3.9	5.4	996.0
69	118	1002.0	−3.1	3.5	1002.2
70	119	1009.2	−3.2	5.0	1010.9
71	120	1016.0	−2.6	3.5	1016.8
72	121	1022.7	−2.6	5.0	1025.1
73	122	1029.1	−1.6	3.4	1030.8
74	123	1035.3	−1.1	4.6	1038.8
75	124	1041.2	0.6	2.4	1044.2
76	125	1047.0	1.3	3.6	1051.9
77	126	1052.5	3.1	1.5	1057.1
78	127	1057.8	4.5	2.1	1064.4
79	128	1062.9	5.9	0.9	1069.6
80	129	1067.8	7.4	1.2	1076.4
81	130	1072.5	9.1	−0.2	1081.4
82	131	1077.0	10.9	−0.1	1087.8
83	132	1081.3	9.6	−0.2	1090.8
84	133	1085.4	8.4	1.0	1094.8

$Z = 50$: *Tin*

52	102	840.1	8.6	1.6	850.2
53	103	852.6	7.6	0.9	861.0
82	132	1089.6	12.5	0.	1102.1
83	133	1094.2	11.2	−0.1	1105.3
84	134	1098.6	10.0	1.1	1109.7
85	135	1102.9	9.1	0.6	1112.6

$Z = 51$: *Antimony*

54	105	866.5	5.0	1.6	873.1
55	106	878.7	4.3	0.5	883.5
56	107	890.6	3.8	1.5	895.8
57	108	902.2	2.3	0.9	905.3
58	109	913.4	1.0	3.0	917.4
59	110	924.3	0.	2.0	926.3
60	111	935.0	−0.9	3.8	937.8
61	112	945.3	−1.7	2.8	946.2
62	113	955.3	−2.2	4.3	957.3
63	114	965.0	−2.5	3.1	965.3
64	115	974.5	−3.1	4.8	975.9
65	116	983.7	−2.8	3.1	983.6
66	117	992.5	−3.0	4.5	993.7
67	118	1001.2	−2.4	2.8	1001.1
68	119	1009.5	−2.6	4.2	1010.8
69*	120	1017.6	−1.8	2.4	1017.8
70	121	1025.5	−1.8	3.8	1027.1
71	122	1033.1	−0.8	2.0	1033.8
72	123	1040.4	−0.9	3.4	1042.7
73	124	1047.5	0.	1.9	1049.1
74	125	1054.4	0.4	3.1	1057.7
75	126	1061.0	1.4	1.6	1063.9
76	127	1067.5	1.9	2.8	1072.1
77	128	1073.7	3.1	1.4	1078.1
78	129	1079.6	4.3	2.1	1086.0
79	130	1085.4	5.6	0.8	1091.8
80	131	1091.0	7.2	1.1	1099.3
81	132	1096.3	8.8	−0.2	1105.0
82	133	1101.5	10.6	−0.1	1112.0
83	134	1106.4	9.4	−0.1	1115.6
84	135	1111.2	8.3	0.8	1120.3
85	136	1115.8	7.4	0.3	1123.5

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 51$: *Antimony (Continued)*			
86	137	1120.2	6.7	1.1	1127.9
87	138	1124.4	6.0	0.4	1130.8
		$Z = 52$: *Tellurium*			
56	108	892.5	1.9	3.3	897.8
57	109	904.5	0.7	2.4	907.5
58	110	916.1	−1.3	5.3	920.1
59	111	927.4	−2.1	4.0	929.3
60	112	938.4	−3.5	6.3	941.3
61	113	949.1	−4.4	5.3	950.1
62	114	959.5	−4.6	6.6	961.5
63	115	969.6	−5.3	5.5	969.8
64	116	979.5	−5.2	6.5	980.8
65	117	989.0	−3.8	4.0	988.8
66	118	998.3	−4.1	5.5	999.3
67	119	1007.3	−2.9	3.3	1007.1
68	120	1016.0	−3.3	4.9	1017.1
69	121	1024.5	−2.2	2.9	1024.5
70	122	1032.7	−2.7	4.6	1034.2
71*	123	1040.6	−1.6	2.8	1041.2
72	124	1048.3	−2.3	4.7	1050.5
73	125	1055.8	−1.6	3.3	1057.2
74	126	1063.0	−2.3	5.6	1066.2
75	127	1070.0	−0.6	3.4	1072.7
76	128	1076.7	−0.6	5.2	1081.4
77	129	1083.3	1.4	3.0	1087.6
78	130	1089.6	2.4	3.9	1095.9
79	131	1095.7	3.7	2.7	1102.1
80	132	1101.6	5.3	3.0	1109.9
		$Z = 53$: *Iodine (Continued)*			
84	137	1134.4	5.0	2.1	1141.6
85	138	1139.6	4.3	1.6	1145.4
86	139	1144.6	3.4	2.5	1150.5
87	140	1149.4	2.9	1.7	1153.9
88	141	1154.1	2.3	2.3	1158.7
89	142	1158.5	2.0	1.2	1161.7
90	143	1162.8	1.6	1.7	1166.1
		$Z = 54$: *Xenon*			
59	113	931.9	−3.4	3.6	931.9
60	114	943.6	−4.3	5.4	944.5
61	115	955.2	−3.2	3.3	954.3
62	116	966.3	−3.4	4.5	966.5
63	117	977.2	−2.6	2.7	975.9
64	118	987.8	−2.6	3.7	987.6
65	119	998.1	−2.1	2.3	996.6
66	120	1008.1	−2.3	3.4	1007.8
67	121	1017.8	−2.0	2.3	1016.4
68	122	1027.2	−2.2	3.5	1027.0
69	123	1036.4	−1.8	2.1	1035.2
70	124	1045.3	−1.7	3.1	1045.4
71	125	1053.9	−1.4	1.9	1053.2
72	126	1062.3	−1.6	3.1	1063.0
73	127	1070.4	−1.1	2.0	1070.4
74*	128	1078.3	−1.5	3.5	1079.8
75	129	1086.0	−1.0	2.5	1087.0
76	130	1093.4	−2.2	5.1	1096.2
77	131	1100.6	−0.7	3.3	1103.2

81	133	1107.3	7.1	1.5	1115.9
82	134	1112.8	8.8	1.7	1123.3
83	135	1118.0	7.7	1.5	1127.2
84	136	1123.1	6.3	2.8	1132.2
85	137	1128.0	5.5	2.2	1135.8
86	138	1132.7	4.5	3.2	1140.5
87	139	1137.2	3.9	2.5	1143.6
88	140	1141.6	3.4	3.1	1148.1
89	141	1145.7	3.3	1.7	1150.8

Z = 53: *Iodine*

57	110	906.2	−0.5	1.7	907.3
58	111	918.2	−2.2	4.2	920.2
59	112	930.0	−2.6	2.7	929.9
60	113	941.3	−3.6	4.5	942.2
61	114	952.5	−2.9	2.5	951.4
62	115	963.2	−4.0	4.4	963.2
63	116	973.7	−3.1	2.4	972.2
64	117	983.9	−3.3	3.6	983.5
65	118	993.9	−2.5	1.8	992.1
66	119	1003.5	−2.8	3.2	1002.9
67	120	1012.9	−2.2	1.7	1011.1
68	121	1021.9	−2.4	2.9	1021.4
69	122	1030.7	−1.8	1.5	1029.3
70	123	1039.3	−1.8	2.6	1039.2
71	124	1047.6	−1.3	1.3	1046.6
72*	125	1055.6	−1.7	2.8	1056.1
73	126	1063.4	−0.7	1.3	1063.2
74	127	1071.0	−1.2	2.9	1072.4
75	128	1078.3	−0.5	1.7	1079.2
76	129	1085.4	−0.9	3.6	1088.1
77	130	1092.3	0.4	2.2	1094.7
78	131	1098.9	1.1	3.3	1103.3
79	132	1105.4	2.2	2.2	1109.8
80	133	1111.6	3.9	2.4	1117.9
81	134	1117.6	5.7	1.0	1124.3
82	135	1123.4	7.3	1.2	1132.0
83	136	1129.0	6.3	1.0	1136.2

78	132	1107.6	−0.3	4.8	1112.1
79	133	1114.4	0.9	3.6	1118.9
80	134	1120.9	2.5	3.9	1127.4
81	135	1127.3	4.4	2.4	1134.1
82	136	1133.4	6.0	2.6	1142.1
83	137	1139.3	5.1	2.3	1146.7
84	138	1145.0	3.6	3.6	1152.3
85	139	1150.6	2.9	3.0	1156.5
86	140	1155.9	1.9	4.1	1161.8
87	141	1161.0	1.3	3.3	1165.6
88	142	1166.0	0.8	3.9	1170.7
89	143	1170.7	0.8	2.5	1174.0
90	144	1175.3	0.2	3.2	1178.8
91	145	1179.7	−0.8	2.5	1181.3
92	146	1183.9	−3.0	5.2	1186.1

Z = 55: *Cesium*

61	116	957.4	−2.2	1.8	955.0
62	117	968.9	−2.3	2.8	967.5
63	118	980.2	−1.7	1.4	977.5
64	119	991.1	−2.1	2.7	989.5
65	120	1001.7	−1.6	1.3	999.0
66	121	1012.1	−1.8	2.3	1010.4
67	122	1022.1	−1.7	1.3	1019.5
68	123	1031.9	−2.0	2.5	1030.4
69	124	1041.4	−1.8	1.3	1039.0
70	125	1050.7	−1.7	2.2	1049.4
71	126	1059.7	−1.5	1.0	1057.6
72	127	1068.4	−1.4	1.9	1067.5
73	128	1076.9	−1.4	1.1	1075.3
74	129	1085.1	−1.5	2.2	1084.9
75	130	1093.1	−1.3	1.4	1092.4
76*	131	1100.8	−2.4	3.5	1101.8
77	132	1108.4	−1.6	2.5	1109.1
78	133	1115.7	−1.3	4.0	1118.3
79	134	1122.8	−0.1	2.8	1125.5
80	135	1129.7	1.5	3.1	1134.3
81	136	1136.3	3.4	1.6	1141.3
82	137	1142.8	4.9	1.9	1149.6

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 55: Cesium (Continued)			
83	138	1149.0	4.0	1.5	1154.5
84	139	1155.1	2.6	2.9	1160.5
85	140	1160.9	1.9	2.2	1165.0
86	141	1166.5	0.8	3.3	1170.7
87	142	1172.0	0.3	2.5	1174.8
88	143	1177.2	−0.3	3.2	1180.1
89	144	1182.3	−0.2	1.7	1183.8
90	145	1187.2	−0.8	2.4	1188.8
91	146	1191.9	−1.8	1.8	1191.7
92	147	1196.4	−4.1	4.5	1196.8
93	148	1200.9	−1.8	1.7	1199.6
94	149	1205.1	−1.5	2.3	1204.4
		Z = 56: Barium			
62	118	970.9	−1.7	3.3	970.2
63	119	982.5	−1.2	2.0	980.6
64	120	993.7	−1.6	3.3	992.9
65	121	1004.8	−1.2	2.0	1002.8
66	122	1015.4	−1.5	3.0	1014.5
67	123	1025.9	−1.5	2.1	1023.9
68	124	1036.0	−2.0	3.3	1035.1
69	125	1045.9	−1.8	2.3	1044.1
70	126	1055.4	−1.9	3.2	1054.8
71	127	1064.8	−1.7	2.0	1063.3
72	128	1073.8	−1.6	2.9	1073.5
73	129	1082.7	−1.8	2.2	1081.7
74	130	1091.2	−2.1	3.4	1091.5
75	131	1099.6	−2.0	2.6	1099.3
76	132	1107.6	−2.4	4.1	1108.9
		Z = 57: Lanthanum (Continued)			
81	138	1152.6	1.8	1.7	1156.1
82	139	1159.7	3.5	1.8	1165.0
83	140	1166 6	2.4	1.7	1170.6
84	141	1173.2	1.1	2.8	1177.2
85	142	1179.7	0.4	2.3	1182.4
86	143	1186.0	−0.5	3.2	1188.6
87	144	1192.0	−1.0	2.4	1193.4
88	145	1197.9	−1.6	3.1	1199.4
89	146	1203.6	−1.8	1.9	1203.7
90	147	1209.1	−2.2	2.4	1209.3
91	148	1214.5	−2.4	2.0	1213.0
92	149	1219.6	−2.3	2.7	1218.6
93	150	1224.6	−1.7	1.6	1222.6
94	151	1229.4	−1.3	2.2	1228.2
95	152	1234.1	−0.5	1.1	1232.1
96	153	1238.5	−0.2	1.6	1237.3
97	154	1242.8	0.4	0.6	1241.0
		Z = 58: Cerium			
66	124	1020.5	−0.1	2.3	1019.5
67	125	1031.6	−0.3	1.6	1029.7
68	126	1042.5	−0.7	2.6	1041.4
69	127	1053.0	−0.9	1.8	1051.1
70	128	1063.3	−1.1	2.7	1062.3
71	129	1073.3	−1.0	1.5	1071.4
72	130	1083.0	−0.8	2.2	1082.3
73	131	1092.5	−1.5	1.8	1091.0
74	132	1101.8	−2.0	3.0	1101.3
75	133	1110.7	−2.3	2.4	1109.7

77*	133	1115.5	−2.0	3.3	1116.6
78	134	1123.1	−2.1	5.0	1126.0
79	135	1130.6	−1.0	3.9	1133.5
80	136	1137.8	0.7	4.2	1142.6
81	137	1144.8	2.5	2.7	1150.0
82	138	1151.5	4.1	3.0	1158.6
83	139	1158.1	3.2	2.6	1163.9
84	140	1164.4	1.8	3.9	1170.1
85	141	1170.6	1.1	3.3	1175.0
86	142	1176.6	0.1	4.3	1180.9
87	143	1182.3	−0.4	3.4	1185.4
88	144	1187.9	−1.0	4.2	1191.0
89	145	1193.2	−1.0	2.8	1195.0
90	146	1198.4	−1.6	3.5	1200.3
91	147	1203.5	−2.7	3.1	1203.6
92	148	1208.3	−4.7	5.4	1208.9
93	149	1213.0	−2.0	2.7	1212.2
94	150	1217.5	−1.7	3.2	1217.4
95	151	1221.9	−0.9	2.1	1220.9

$Z = 57$: *Lanthanum*

64	121	995.9	−0.6	1.9	994.1
65	122	1007.2	−0.5	0.9	1004.4
66	123	1018.3	−0.8	1.8	1016.4
67	124	1029.1	−1.0	1.0	1026.2
68	125	1039.5	−1.3	2.1	1037.7
69	126	1049.7	−1.4	1.3	1047.0
70	127	1059.7	−1.5	2.1	1057.9
71	128	1069.3	−1.4	1.0	1066.7
72	129	1078.7	−1.2	1.6	1077.2
73	130	1087.9	−1.7	1.1	1085.7
74	131	1096.8	−1.9	2.2	1095.7
75	132	1105.5	−2.0	1.5	1103.8
76	133	1113.9	−2.6	2.9	1113.5
77	134	1122.1	−2.2	2.1	1121.5
78	135	1130.0	−2.8	4.0	1131.2
79*	136	1137.7	−1.6	2.8	1139.0
80	137	1145.3	0.	3.1	1148.4

76	134	1119.5	−2.8	3.9	1119.7
77	135	1128.0	−2.8	3.2	1127.9
78	136	1136.3	−3.3	5.0	1137.9
79	137	1144.3	−2.0	3.7	1146.1
80	138	1152.2	−0.4	4.0	1155.8
81*	139	1159.8	1.2	2.7	1163.8
82	140	1167.2	3.1	2.7	1173.0
83	141	1174.4	1.8	2.7	1178.9
84	142	1181.4	0.7	3.7	1185.8
85	143	1188.2	−0.1	3.2	1191.3
86	144	1194.8	−1.0	4.1	1197.9
87	145	1201.1	−1.4	3.3	1203.0
88	146	1207.3	−2.1	4.0	1209.2
89	147	1213.3	−2.4	3.0	1213.9
90	148	1219.1	−2.6	3.3	1219.8
91	149	1224.8	−2.7	2.9	1223.9
92	150	1230.3	−2.3	3.5	1229.9
93	151	1235.6	−1.3	2.1	1234.2
94	152	1240.7	−0.8	2.6	1240.1
95	153	1245.6	−0.1	1.6	1244.4
96	154	1250.3	0.2	2.2	1249.9
97	155	1254.9	0.9	1.2	1253.9
98	156	1259.3	1.4	1.6	1259.1
99	157	1263.5	1.4	1.1	1262.8

$Z = 59$: *Praseodymium*

67	126	1033.7	0.4	0.5	1031.0
68	127	1044.8	0.1	1.5	1043.1
69	128	1055.7	−0.2	0.7	1053.1
70	129	1066.4	−0.3	1.6	1064.6
71	130	1076.7	−0.2	0.4	1074.0
72	131	1086.8	−0.2	1.0	1085.1
73	132	1096.6	−1.1	0.7	1094.0
74	133	1106.2	−1.4	1.8	1104.6
75	134	1115.5	−1.9	1.2	1113.2
76	135	1124.5	−2.4	2.4	1123.5
77	136	1133.4	−2.7	2.0	1131.9
78	137	1142.0	−3.9	4.0	1142.0

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 59$: *Praseodymium* (*Continued*)			
79	138	1150.4	−2.7	2.8	1150.4
80	139	1158.5	−1.2	3.2	1160.4
81	140	1166.5	0.3	2.0	1168.7
82*	141	1174.2	2.1	2.0	1178.3
83	142	1181.7	0.9	2.0	1184.6
84	143	1189.0	−0.1	2.8	1191.8
85	144	1196.1	−0.7	2.3	1197.6
86	145	1203.0	−1.4	2.9	1204.5
87	146	1209.7	−1.9	2.3	1209.9
88	147	1216.2	−2.5	2.9	1216.5
89	148	1222.4	−3.2	2.3	1221.4
90	149	1228.6	−3.0	3.0	1227.7
91	150	1234.6	−2.0	1.6	1232.5
92	151	1240.4	−1.3	1.9	1238.9
93	152	1246.0	−0.5	0.8	1243.7
94	153	1251.3	0.	1.4	1249.9
95	154	1256.5	0.5	0.5	1254.5
96	155	1261.6	0.9	1.1	1260.4
97	156	1266.4	1.5	0.2	1264.7
98	157	1271.1	1.9	0.6	1270.2
99	158	1275.6	1.9	0.1	1274.2
100	159	1279.9	1.9	0.8	1279.2
		$Z = 60$: *Neodymium*			
69	129	1057.9	0.7	0.9	1056.2
70	130	1068.8	0.5	1.8	1068.0
71	131	1079.6	0.6	0.7	1077.8
72	132	1090.0	0.5	1.4	1089.1
73	133	1100.1	−0.7	1.2	1098.3
74	134	1110.0	−1.1	2.4	1109.2

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 61$: *Promethium* (*Continued*)			
79	140	1160.7	−3.1	2.8	1160.0
80	141	1169.4	−2.7	3.9	1170.6
81	142	1178.0	−0.9	2.5	1179.6
82	143	1186.4	0.7	2.7	1189.8
83	144	1194.5	−0.3	2.4	1196.7
84	145	1202.5	−1.6	3.6	1204.5
85	146	1210.2	−1.7	2.6	1210.9
86*	147	1217.7	−2.5	3.3	1218.4
87	148	1225.0	−2.6	2.5	1224.5
88	149	1232.1	−2.6	2.7	1231.7
89	150	1239.0	−2.5	1.8	1237.3
90	151	1245.8	−1.7	2.1	1244.5
91	152	1252.4	−0.7	0.8	1250.1
92	153	1258.7	0.1	1.2	1257.3
93	154	1264.9	0.7	0.3	1262.8
94	155	1270.9	1.2	1.0	1269.7
95	156	1276.7	1.6	0.3	1274.9
96	157	1282.3	2.1	0.7	1281.4
97	158	1287.7	2.6	0.	1286.4
98	159	1292.9	2.9	0.4	1292.4
99	160	1298.0	2.9	0.	1297.0
100	161	1302.8	3.0	0.6	1302.5
101	162	1307.6	3.1	0.1	1306.8
102	163	1312.1	3.2	0.5	1311.9
103	164	1316.5	3.4	−0.1	1315.9
104	165	1320.7	3.5	0.1	1320.5
		$Z = 62$: *Samarium*			
73	135	1105.4	0.2	1.0	1103.7
74	136	1116.0	−0.6	2.4	1115.2

75	135	1119.6	−1.7	1.9	1118.1
76	136	1129.0	−2.4	3.2	1128.7
77	137	1138.2	−2.8	2.8	1137.4
78	138	1147.1	−4.0	5.0	1147.8
79	139	1155.8	−3.8	4.6	1156.6
80	140	1164.3	−2.2	4.9	1166.9
81	141	1172.5	−0.4	3.4	1175.5
82	142	1180.6	1.2	3.6	1185.4
83	143	1188.4	0.3	3.3	1192.0
84*	144	1196.0	−1.1	4.6	1199.5
85	145	1203.4	−1.5	3.8	1205.6
86	146	1210.6	−2.8	5.0	1212.8
87	147	1217.6	−2.4	3.5	1218.5
88	148	1224.4	−4.0	5.0	1225.4
89	149	1231.0	−3.8	3.5	1230.6
90	150	1237.5	−3.0	3.8	1237.2
91	151	1243.8	−1.6	2.1	1242.4
92	152	1249.8	−0.8	2.3	1249.1
93	153	1255.7	0.1	1.1	1254.3
94	154	1261.4	0.6	1.7	1260.8
95	155	1266.9	1.2	0.9	1265.7
96	156	1272.2	1.6	1.4	1271.9
97	157	1277.3	2.2	0.5	1276.5
98	158	1282.3	2.6	0.9	1282.2
99	159	1287.0	2.6	0.5	1286.5
100	160	1291.6	2.6	1.1	1291.8
101	161	1296.1	2.8	0.5	1295.8
102	162	1300.4	2.9	1.0	1300.7

$Z = 61$: *Promethium*

71	132	1081.9	1.1	0.2	1079.5
72	133	1092.6	1.1	0.7	1091.1
73	134	1103.2	0.6	0.2	1100.6
74	135	1113.3	−0.6	1.6	1111.7
75	136	1123.2	−1.2	0.8	1120.8
76	137	1133.0	−1.5	1.7	1131.5
77	138	1142.4	−2.2	1.4	1140.5
78	139	1151.6	−3.0	2.9	1151.0
75	137	1126.3	−1.1	1.6	1124.7
76	138	1136.3	−1.4	2.4	1135.7
77	139	1146.1	−2.0	2.1	1145.0
78	140	1155.6	−3.0	3.8	1155.8
79	141	1165.0	−3.4	3.9	1165.1
80	142	1174.1	−3.1	5.2	1176.1
81	143	1183.0	−1.3	3.7	1185.3
82	144	1191.6	0.3	4.0	1195.9
83	145	1200.1	−0.6	3.6	1203.1
84	146	1208.3	−2.0	4.9	1211.2
85	147	1216.4	−2.1	3.8	1218.0
86	148	1224.2	−2.8	4.5	1225.8
87	149	1231.8	−2.9	3.5	1232.1
88*	150	1239.2	−2.8	3.7	1239.6
89	151	1246.4	−2.3	2.5	1245.5
90	152	1253.5	−1.5	2.7	1253.0
91	153	1260.4	−0.7	1.6	1258.9
92	154	1267.0	0.	2.0	1266.4
93	155	1273.5	0.7	1.1	1272.2
94	156	1279.7	1.1	1.6	1279.3
95	157	1285.8	1.6	0.9	1284.8
96	158	1291.7	2.0	1.4	1291.5
97	159	1297.4	2.6	0.5	1296.8
98	160	1302.9	3.0	0.9	1303.1
99	161	1308.2	3.0	0.5	1308.0
100	162	1313.4	3.0	1.1	1313.8
101	163	1318.4	3.1	0.6	1318.3
102	164	1323.3	3.3	1.0	1323.7
103	165	1327.9	3.5	0.4	1327.9
104	166	1332.4	3.5	0.7	1332.9
105	167	1336.7	2.8	0.5	1336.5
106	168	1340.9	2.5	1.2	1341.1

$Z = 63$: *Europium*

74	137	1118.2	0.1	1.5	1116.8
75	138	1128.8	−0.7	0.8	1126.5
76	139	1139.1	−0.8	1.4	1137.8
77	140	1149.2	−1.5	0.9	1147.2

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 63$: *Europium (Continued)*			
78	141	1159.1	−2.0	2.1	1158.2
79	142	1168.7	−3.0	2.4	1167.8
80	143	1178.1	−3.5	4.3	1178.9
81	144	1187.3	−1.6	2.8	1188.5
82	145	1196.3	0.	2.9	1199.3
83	146	1205.1	−0.9	2.7	1206.8
84	147	1213.6	−2.4	4.0	1215.3
85	148	1222.0	−1.8	2.5	1222.4
86	149	1230.1	−2.1	2.8	1230.5
87	150	1238.0	−2.5	2.1	1237.2
88	151	1245.8	−1.8	2.1	1245.1
89*	152	1253.3	−1.3	1.0	1251.5
90	153	1260.7	−0.7	1.5	1259.4
91	154	1267.8	0.	0.5	1265.7
92	155	1274.8	0.7	1.0	1273.5
93	156	1281.5	1.2	0.3	1279.7
94	157	1288.1	1.5	0.9	1287.1
95	158	1294.4	1.9	0.3	1293.0
96	159	1300.6	2.4	0.7	1300.0
97	160	1306.5	2.8	0.	1305.5
98	161	1312.3	3.2	0.4	1312.1
99	162	1317.9	3.2	0.	1317.2
100	163	1323.4	3.2	0.6	1323.4
101	164	1328.7	3.3	0.1	1328.2
102	165	1333.7	3.5	0.5	1333.8
103	166	1338.7	3.6	−0.1	1338.3
104	167	1343.4	3.7	0.1	1343.5
105	168	1348.0	3.0	0.	1347.4
106	169	1352.5	2.7	0.7	1352.3
107	170	1356.8	2.3	0.2	1355.8

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 65$: *Terbium (Continued)*			
80	145	1184.6	−3.3	4.1	1185.3
81	146	1194.4	−1.7	2.9	1195.6
82	147	1204.1	−0.2	3.1	1206.9
83	148	1213.4	−1.0	2.7	1215.1
84	149	1222.6	−2.2	3.8	1224.2
85	150	1231.6	−1.0	1.9	1232.0
86	151	1240.3	−1.2	2.1	1240.7
87	152	1248.8	−1.9	1.7	1248.1
88	153	1257.2	−1.0	1.5	1256.6
89	154	1265.3	−0.3	0.6	1263.7
90	155	1273.3	0.	1.2	1272.3
91	156	1281.0	0.4	0.4	1279.2
92	157	1288.5	1.0	0.9	1287.5
93*	158	1295.8	1.3	0.3	1294.3
94	159	1302.9	1.7	0.9	1302.2
95	160	1309.8	2.0	0.3	1308.7
96	161	1316.6	2.4	0.8	1316.2
97	162	1323.1	2.9	0.	1322.3
98	163	1329.5	3.2	0.4	1329.4
99	164	1335.6	3.2	0.	1335.2
100	165	1341.6	3.3	0.6	1341.8
101	166	1347.4	3.4	0.	1347.2
102	167	1353.1	3.5	0.5	1353.4
103	168	1358.6	3.7	−0.	1358.4
104	169	1363.9	3.8	0.1	1364.2
105	170	1369.0	3.1	−0.1	1368.6
106	171	1374.0	2.8	0.6	1374.0
107	172	1378.8	2.4	0.2	1378.0
108	173	1383.5	2.2	0.7	1383.1
109	174	1387.9	1.6	0.3	1386.8

$Z = 64$: *Gadolinium*

76	140	1141.4	−0.6	1.9	1140.9
77	141	1151.8	−1.4	1.6	1150.7
78	142	1162.0	−2.2	3.1	1162.1
79	143	1171.9	−3.0	3.4	1171.9
80	144	1181.6	−3.5	5.2	1183.4
81	145	1191.2	−1.8	4.0	1193.3
82	146	1200.5	0.	3.9	1204.4
83	147	1209.5	−1.1	3.9	1212.2
84	148	1218.4	−2.3	4.9	1221.0
85	149	1227.0	−1.8	3.4	1228.4
86	150	1235.5	−2.1	3.8	1236.8
87	151	1243.7	−2.5	3.0	1243.9
88	152	1251.7	−2.0	3.1	1252.0
89	153	1259.6	−1.4	1.9	1258.6
90	154	1267.2	−0.5	2.1	1266.8
91*	155	1274.7	0.1	1.0	1273.4
92	156	1281.9	0.7	1.5	1281.4
93	157	1288.9	1.2	0.7	1287.8
94	158	1295.8	1.6	1.4	1295.5
95	159	1302.4	2.0	0.7	1301.6
96	160	1308.8	2.4	1.2	1308.9
97	161	1315.1	2.9	0.4	1314.7
98	162	1321.2	3.3	0.8	1321.6
99	163	1327.1	3.3	0.4	1327.0
100	164	1332.8	3.3	1.0	1333.4
101	165	1338.3	3.4	0.5	1338.5
102	166	1343.7	3.6	0.9	1344.4
103	167	1348.9	3.7	0.3	1349.2
104	168	1353.9	3.8	0.5	1354.6
105	169	1358.8	3.1	0.3	1358.8
106	170	1363.5	2.8	1.0	1363.9
107	171	1368.1	2.4	0.6	1367.7
108	172	1372.4	2.1	1.1	1372.5
109	173	1376.7	1.5	0.7	1376.0

$Z = 65$: *Terbium*

78	143	1164.4	−1.1	1.5	1163.6
79	144	1174.6	−2.3	2.0	1173.7
110	175	1392.3	1.3	0.9	1391.6
111	176	1396.5	0.9	0.4	1395.0

$Z = 66$: *Dysprosium*

80	146	1187.0	−3.4	5.3	1188.9
81	147	1197.2	−1.6	3.8	1199.4
82	148	1207.1	−0.1	4.2	1211.1
83	149	1216.8	−0.8	3.7	1219.6
84	150	1226.3	−2.3	5.0	1228.9
85	151	1235.5	−0.9	2.7	1237.0
86	152	1244.6	−1.0	2.9	1246.1
87	153	1253.4	−1.7	2.5	1253.7
88	154	1262.0	−1.2	2.6	1262.5
89	155	1270.4	−0.7	1.4	1269.7
90	156	1278.7	−0.1	1.9	1278.5
91	157	1286.7	0.4	0.9	1285.7
92	158	1294.6	0.9	1.5	1294.3
93	159	1302.1	1.3	0.7	1301.2
94	160	1309.5	1.7	1.4	1309.5
95*	161	1316.7	2.0	0.7	1316.2
96	162	1323.7	2.4	1.2	1324.0
97	163	1330.6	2.9	0.4	1330.3
98	164	1337.2	3.3	0.8	1337.7
99	165	1343.6	3.3	0.4	1343.7
100	166	1349.9	3.3	1.0	1350.7
101	167	1356.0	3.4	0.5	1356.3
102	168	1361.9	3.5	0.9	1362.8
103	169	1367.7	3.7	0.3	1368.0
104	170	1373.2	3.8	0.5	1374.1
105	171	1378.6	3.2	0.3	1378.8
106	172	1383.9	2.9	1.0	1384.4
107	173	1388.9	2.5	0.5	1388.8
108	174	1393.9	2.2	1.0	1394.1
109	175	1398.6	1.7	0.6	1398.1
110	176	1403.2	1.4	1.3	1403.2
111	177	1407.7	0.9	0.8	1406.8
112	178	1412.0	0.6	1.4	1411.6
113	179	1416.2	0.3	0.9	1415.1

$Z = 67$: *Holmium*

81	148	1199.4	−1.1	2.6	1200.9
82	149	1209.6	0.1	3.2	1212.9

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 67: *Holmium* (*Continued*)			
83	150	1219.6	−0.2	2.3	1221.7
84	151	1229.4	−2.0	3.9	1231.3
85	152	1239.0	−0.2	1.3	1239.7
86	153	1248.3	0.	1.3	1249.1
87	154	1257.4	−0.9	1.1	1257.0
88	155	1266.4	−0.6	1.6	1266.2
89	156	1275.1	−0.2	0.6	1273.8
90	157	1283.6	0.2	1.2	1283.0
91	158	1291.9	0.7	0.3	1290.5
92	159	1300.0	1.1	0.9	1299.4
93	160	1307.9	1.5	0.2	1306.6
94	161	1315.6	1.8	0.9	1315.2
95	162	1323.1	2.1	0.2	1322.1
96*	163	1330.4	2.5	0.8	1330.3
97	164	1337.5	2.9	0.	1336.9
98	165	1344.4	3.3	0.3	1344.6
99	166	1351.1	3.3	0.	1350.8
100	167	1357.7	3.3	0.6	1358.0
101	168	1364.0	3.4	0.1	1363.9
102	169	1370.2	3.5	0.5	1370.7
103	170	1376.2	3.7	−0.1	1376.2
104	171	1382.1	3.8	0.1	1382.5
105	172	1387.7	3.2	−0.1	1387.5
106	173	1393.2	2.9	0.6	1393.4
107	174	1398.6	2.5	0.1	1398.0
108	175	1403.8	2.3	0.6	1403.6
109	176	1408.8	1.8	0.2	1407.8
110	177	1413.6	1.5	0.8	1413.2
111	178	1418.4	1.0	0.3	1417.1
112	179	1422.9	0.8	1.0	1422.1
113	180	1427.3	0.4	0.4	1425.8
114	181	1431.6	0.2	1.0	1430.6

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 69: *Thulium* (*Continued*)			
87	156	1263.9	0.	0.7	1264.2
88	157	1273.4	−0.2	1.4	1273.8
89	158	1282.7	−0.3	0.8	1281.9
90	159	1291.8	−0.1	1.4	1291.5
91	160	1300.7	0.2	0.6	1299.5
92	161	1309.4	0.4	1.2	1308.8
93	162	1317.8	0.8	0.4	1316.6
94	163	1326.1	1.1	1.1	1325.6
95	164	1334.1	1.4	0.4	1333.1
96	165	1342.0	1.7	0.9	1341.7
97	166	1349.7	2.2	0.	1348.8
98	167	1357.1	2.6	0.4	1357.1
99	168	1364.4	2.6	0.	1363.8
100*	169	1371.5	2.6	0.7	1371.6
101	170	1378.4	2.7	0.1	1378.0
102	171	1385.1	2.8	0.6	1385.3
103	172	1391.7	3.0	−0.1	1391.4
104	173	1398.0	3.1	0.2	1398.3
105	174	1404.2	2.7	−0.1	1403.9
106	175	1410.3	2.4	0.5	1410.3
107	176	1416.1	2.1	0.	1415.5
108	177	1421.8	1.9	0.6	1421.6
109	178	1427.3	1.4	0.1	1426.5
110	179	1432.7	1.2	0.7	1432.3
111	180	1438.0	0.9	0.2	1436.8
112	181	1443.0	0.7	0.8	1442.4
113	182	1448.0	0.3	0.3	1446.6
114	183	1452.7	0.	1.0	1452.0
115	184	1457.3	−0.2	0.4	1456.0
116	185	1461.8	−0.2	0.9	1461.1
117	186	1466.1	−0.3	0.3	1464.9
118	187	1470.3	−0.4	0.8	1469.9

$Z = 68$: *Erbium*

83	151	1221.9	0.2	3.2	1225.2
84	152	1232.0	−1.5	4.6	1235.2
85	153	1241.9	0.2	2.1	1243.9
86	154	1251.5	0.	2.3	1253.5
87	155	1260.9	−0.6	1.8	1261.7
88	156	1270.1	−0.7	2.4	1271.0
89	157	1279.1	−0.8	1.7	1278.8
90	158	1287.9	−0.3	2.0	1288.1
91	159	1296.6	0.4	0.9	1295.8
92	160	1304.9	0.9	1.4	1304.9
93	161	1313.1	1.4	0.6	1312.4
94	162	1321.1	1.7	1.2	1321.2
95	163	1328.9	2.1	0.5	1328.4
96	164	1336.5	2.5	1.0	1336.8
97	165	1343.9	3.0	0.2	1343.7
98*	166	1351.0	3.4	0.5	1351.6
99	167	1358.0	3.4	0.1	1358.1
100	168	1364.8	3.4	0.8	1365.6
101	169	1371.5	3.5	0.2	1371.8
102	170	1377.9	3.6	0.7	1378.8
103	171	1384.2	3.8	0.	1384.6
104	172	1390.3	3.9	0.3	1391.2
105	173	1396.3	3.3	0.1	1396.5
106	174	1402.0	3.0	0.7	1402.6
107	175	1407.6	2.6	0.3	1407.5
108	176	1413.1	2.3	0.8	1413.4
109	177	1418.3	1.8	0.4	1417.9
110	178	1423.5	1.5	1.1	1423.5
111	179	1428.4	1.1	0.6	1427.8
112	180	1433.2	0.9	1.2	1433.1
113	181	1437.9	0.4	0.7	1437.0
114	182	1442.4	0.	1.5	1442.1
115	183	1446.8	−0.3	1.0	1445.8
116	184	1451.0	−0.6	1.7	1450.7

$Z = 69$: *Thulium*

85	154	1244.3	1.0	0.9	1245.7
86	155	1254.2	0.8	1.1	1255.7

$Z = 70$: *Ytterbium*

87	157	1266.3	0.4	1.5	1267.9
88	158	1276.1	0.2	1.9	1277.8
89	159	1285.7	−0.2	1.3	1286.0
90	160	1295.1	−0.4	2.1	1295.7
91	161	1304.3	−0.3	1.3	1303.8
92	162	1313.2	0.	2.0	1313.4
93	163	1322.0	0.4	1.1	1321.3
94	164	1330.5	0.7	1.7	1330.6
95	165	1338.9	1.1	1.0	1338.3
96	166	1347.0	1.3	1.5	1347.2
97	167	1355.0	1.8	0.7	1354.6
98	168	1362.7	2.3	1.0	1363.1
99	169	1370.2	2.2	0.7	1370.1
100	170	1377.6	2.2	1.3	1378.1
101	171	1384.8	2.3	0.8	1384.8
102*	172	1391.8	2.4	1.3	1392.4
103	173	1398.6	2.6	0.6	1398.7
104	174	1405.2	2.7	0.8	1405.9
105	175	1411.7	2.4	0.5	1411.7
106	176	1418.0	2.2	1.0	1418.5
107	177	1424.1	1.8	0.6	1423.9
108	178	1430.0	1.6	1.1	1430.4
109	179	1435.8	1.3	0.6	1435.5
110	180	1441.5	1.1	1.1	1441.6
111	181	1447.0	0.8	0.6	1446.4
112	182	1452.3	0.6	1.2	1452.3
113	183	1457.4	0.2	0.8	1456.8
114	184	1462.5	0.	1.5	1462.5
115	185	1467.3	−0.1	0.9	1466.8
116	186	1472.1	−0.2	1.5	1472.3
117	187	1476.6	−0.1	0.8	1476.4
118	188	1481.1	0.	1.4	1481.7
119	189	1485.4	0.	1.0	1485.9
120	190	1489.5	0.	1.8	1491.0

$Z = 71$: *Lutetium*

89	160	1288.2	0.	0.8	1288.3
90	161	1297.9	−0.4	1.7	1298.3
91	162	1307.3	−0.5	1.0	1306.5

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 71: *Lutetium* (*Continued*)			
92	163	1316.6	−0.5	1.8	1316.3
93	164	1325.6	−0.2	0.9	1324.4
94	165	1334.4	0.	1.5	1334.0
95	166	1343.1	0.5	0.6	1341.9
96	167	1351.5	0.8	1.2	1351.0
97	168	1359.7	1.3	0.3	1358.6
98	169	1367.7	1.7	0.7	1367.4
99	170	1375.6	1.8	0.3	1374.7
100	171	1383.2	1.7	1.0	1383.0
101	172	1390.6	1.8	0.4	1389.9
102	173	1397.9	1.9	0.9	1397.8
103	174	1405.0	2.2	0.2	1404.4
104*	175	1411.9	2.2	0.5	1411.8
105	176	1418.6	1.9	0.1	1418.0
106	177	1425.2	1.7	0.6	1425.0
107	178	1431.5	1.4	0.2	1430.8
108	179	1437.7	1.2	0.7	1437.5
109	180	1443.8	0.9	0.2	1442.9
110	181	1449.7	0.9	0.7	1449.4
111	182	1455.4	0.6	0.3	1454.5
112	183	1461.0	0.4	0.9	1460.6
113	184	1466.4	0.	0.5	1465.4
114	185	1471.7	−0.2	1.2	1471.4
115	186	1476.8	−0.2	0.6	1476.0
116	187	1481.8	−0.2	1.1	1481.7
117	188	1486.6	0.	0.4	1486.1
118	189	1491.3	0.2	0.9	1491.7
119	190	1495.8	0.4	0.4	1496.1
120	191	1500.2	0.7	0.8	1501.5
121	192	1504.5	1.0	0.6	1505.9
122	193	1508.6	1.1	1.3	1510.8

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 73: *Tantalum* (*Continued*)			
94	167	1340.7	−0.4	1.8	1340.7
95	168	1349.9	0.	0.9	1349.0
96	169	1358.9	0.3	1.3	1358.7
97	170	1367.7	0.7	0.5	1366.7
98	171	1376.2	1.0	0.9	1376.0
99	172	1384.6	1.1	0.4	1383.8
100	173	1392.8	1.0	1.2	1392.6
101	174	1400.8	1.1	0.6	1400.1
102	175	1408.6	1.1	1.2	1408.5
103	176	1416.2	1.4	0.3	1415.5
104	177	1423.6	1.5	0.7	1423.6
105	178	1430.9	1.4	0.3	1430.3
106	179	1437.9	1.3	0.8	1437.9
107*	180	1444.9	1.1	0.3	1444.3
108	181	1451.6	0.9	0.9	1451.6
109	182	1458.2	0.8	0.4	1457.6
110	183	1464.6	0.8	0.8	1464.6
111	184	1470.8	0.6	0.4	1470.2
112	185	1476.9	0.4	1.0	1477.0
113	186	1482.8	0.2	0.6	1482.3
114	187	1488.6	0.1	1.3	1488.9
115	188	1494.2	0.1	0.7	1494.0
116	189	1499.6	0.2	1.2	1500.3
117	190	1505.0	0.6	0.4	1505.3
118	191	1510.1	1.0	0.9	1511.5
119	192	1515.2	1.6	0.1	1516.5
120	193	1520.0	2.1	0.6	1522.5
121	194	1524.8	2.5	0.2	1527.4
122	195	1529.4	2.8	0.8	1532.9
123	196	1533.9	3.3	0.5	1537.6
124	197	1538.2	3.7	1.1	1542.9
125	198	1542.4	4.1	1.0	1547.5

$Z = 72$: *Hafnium*

90	162	1300.1	−0.6	2.6	1301.6
91	163	1309.9	−0.5	1.7	1310.0
92	164	1319.4	−0.7	2.5	1320.0
93	165	1328.7	−0.5	1.6	1328.3
94	166	1337.8	−0.2	2.2	1338.1
95	167	1346.8	0.2	1.3	1346.2
96	168	1355.4	0.5	1.8	1355.6
97	169	1363.9	0.9	1.0	1363.5
98	170	1372.2	1.3	1.4	1372.5
99	171	1380.4	1.4	0.9	1380.0
100	172	1388.2	1.3	1.7	1388.6
101	173	1396.0	1.4	1.1	1395.8
102	174	1403.5	1.4	1.6	1404.0
103	175	1410.9	1.7	0.8	1410.7
104	176	1418.0	1.8	1.2	1418.5
105*	177	1425.0	1.6	0.8	1425.0
106	178	1431.8	1.5	1.2	1432.3
107	179	1438.5	1.2	0.8	1438.3
108	180	1444.9	1.0	1.4	1445.3
109	181	1451.2	0.8	0.9	1451.0
110	182	1457.4	0.8	1.3	1457.8
111	183	1463.4	0.5	0.9	1463.1
112	184	1469.2	0.3	1.6	1469.6
113	185	1474.9	0.	1.1	1474.7
114	186	1480.4	−0.2	1.9	1480.9
115	187	1485.8	−0.2	1.3	1485.8
116	188	1491.0	−0.2	1.9	1491.8
117	189	1496.0	0.1	1.1	1496.5
118	190	1501.0	0.4	1.6	1502.5
119	191	1505.8	0.9	0.9	1507.1
120	192	1510.4	1.2	1.5	1512.9
121	193	1514.9	1.6	1.2	1517.5
122	194	1519.3	1.8	1.9	1522.9
123	195	1523.5	2.3	1.6	1527.3

$Z = 73$: *Tantalum*

92	165	1321.7	−0.6	1.9	1322.2
93	166	1331.4	−0.5	1.2	1330.7

$Z = 74$: *Tungsten*

94	168	1343.1	−0.4	2.3	1343.9
95	169	1352.6	0.	1.3	1352.4
96	170	1361.8	0.3	1.8	1362.3
97	171	1370.9	0.6	1.0	1370.6
98	172	1379.7	0.9	1.4	1380.2
99	173	1388.4	1.0	0.9	1388.1
100	174	1396.8	0.9	1.7	1397.3
101	175	1405.1	1.1	1.0	1405.0
102	176	1413.2	1.0	1.7	1413.7
103	177	1421.1	1.3	0.8	1420.9
104	178	1428.7	1.4	1.3	1429.3
105	179	1436.3	1.4	0.7	1436.3
106	180	1443.6	1.3	1.2	1444.2
107	181	1450.8	1.2	0.7	1450.8
108	182	1457.7	1.0	1.3	1458.4
109*	183	1464.6	1.0	0.7	1464.7
110	184	1471.2	1.0	1.2	1472.0
111	185	1477.7	0.8	0.7	1477.9
112	186	1484.0	0.7	1.4	1484.9
113	187	1490.2	0.5	0.9	1490.6
114	188	1496.2	0.4	1.6	1497.4
115	189	1502.1	0.6	1.0	1502.9
116	190	1507.8	0.8	1.5	1509.5
117	191	1513.3	1.0	0.9	1514.8
118	192	1518.8	1.3	1.6	1521.4
119	193	1524.0	1.8	0.9	1526.6
120	194	1529.2	2.6	1.2	1532.9
121	195	1534.2	3.3	0.7	1538.1
122	196	1539.0	3.3	1.7	1544.0
123	197	1543.7	4.3	1.0	1548.9
124	198	1548.3	4.7	1.5	1554.5
125	199	1552.7	5.3	1.3	1559.4
126	200	1557.1	5.9	1.4	1564.4
127	201	1561.2	5.3	1.2	1567.7

$Z = 75$: *Rhenium*

96	171	1364.3	0.2	1.4	1364.6
97	172	1373.6	0.6	0.4	1373.0
98	173	1382.7	0.8	1.0	1382.9

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 75: *Rhenium* (*Continued*)			
99	174	1391.7	1.0	0.3	1391.0
100	175	1400.4	0.7	1.2	1400.5
101	176	1408.9	0.9	0.5	1408.3
102	177	1417.2	0.8	1.2	1417.4
103	178	1425.4	1.2	0.3	1424.9
104	179	1433.3	1.2	0.8	1433.6
105	180	1441.1	1.5	0.1	1440.8
106	181	1448.7	1.4	0.6	1449.1
107	182	1456.1	1.3	0.1	1455.9
108	183	1463.4	1.1	0.8	1463.8
109	184	1470.5	1.2	0.2	1470.4
110	185	1477.4	1.2	0.7	1478.0
111*	186	1484.1	1.0	0.2	1484.2
112	187	1490.7	0.8	1.1	1491.5
113	188	1497.1	0.7	0.6	1497.4
114	189	1503.4	0.4	1.4	1504.5
115	190	1509.5	0.6	0.7	1510.3
116	191	1515.4	0.9	1.4	1517.3
117	192	1521.2	1.3	0.7	1523.0
118	193	1526.9	2.1	1.0	1529.8
119	194	1532.4	2.9	0.1	1535.3
120	195	1537.8	3.8	0.4	1541.8
121	196	1543.0	4.4	−0.1	1547.2
122	197	1548.1	5.0	0.2	1553.3
123	198	1553.1	5.5	−0.1	1558.4
124	199	1557.9	6.3	0.1	1564.2
125	200	1562.5	6.8	−0.1	1569.2
126	201	1567.1	7.5	−0.1	1574.5
127	202	1571.5	6.7	−0.1	1578.0
128	203	1575.8	6.0	0.5	1582.2
129	204	1579.9	5.5	0.2	1585.5
		Z = 77: *Iridium* (*Continued*)			
101	178	1415.0	0.4	0.9	1414.9
102	179	1423.9	0.3	1.6	1424.5
103	180	1432.5	0.6	0.7	1432.5
104	181	1441.0	0.7	1.3	1441.8
105	182	1449.3	1.2	0.3	1449.4
106	183	1457.4	1.4	0.7	1458.4
107	184	1465.4	1.4	0.2	1465.7
108	185	1473.2	1.3	1.0	1474.2
109	186	1480.8	1.4	0.2	1481.3
110	187	1488.2	1.6	0.8	1489.5
111	188	1495.4	1.4	0.3	1496.2
112	189	1502.5	0.7	1.5	1504.1
113	190	1509.4	0.9	0.9	1510.6
114*	191	1516.2	1.1	1.5	1518.4
115	192	1522.8	1.5	0.8	1524.7
116	193	1529.2	1.9	1.5	1532.4
117	194	1535.5	2.6	0.6	1538.5
118	195	1541.7	3.5	0.8	1545.9
119	196	1547.7	4.2	0.1	1551.9
120	197	1553.5	5.0	0.4	1558.9
121	198	1559.2	5.7	0.	1564.8
122	199	1564.8	6.2	0.4	1571.3
123	200	1570.2	6.9	−0.1	1577.0
124	201	1575.5	7.7	0.1	1583.2
125	202	1580.6	8.3	−0.1	1588.8
126	203	1585.6	8.9	−0.1	1594.5
127	204	1590.5	8.1	−0.1	1598.5
128	205	1595.2	7.3	0.6	1603.1
129	206	1599.8	6.8	0.3	1606.8
130	207	1604.3	6.3	0.8	1611.3
131	208	1608.6	5.9	0.3	1614.8
132	209	1612.8	5.5	0.7	1619.0

$Z = 76$: *Osmium*

98	174	1385.2	1.0	1.3	1386.0
99	175	1394.5	1.2	0.5	1394.4
100	176	1403.4	0.9	1.5	1404.1
101	177	1412.2	1.1	0.7	1412.3
102	178	1420.8	1.0	1.4	1421.6
103	179	1429.2	1.3	0.5	1429.3
104	180	1437.4	1.4	1.1	1438.3
105	181	1445.5	1.8	0.2	1445.8
106	182	1453.3	1.8	0.7	1454.3
107	183	1461.0	1.7	0.2	1461.4
108	184	1468.5	1.5	1.0	1469.6
109	185	1475.9	1.6	0.3	1476.4
110	186	1483.0	1.5	0.9	1484.3
111	187	1490.0	1.3	0.5	1490.7
112	188	1496.8	0.8	1.6	1498.4
113*	189	1503.5	0.7	1.2	1504.6
114	190	1510.0	0.8	1.8	1512.0
115	191	1516.4	1.1	1.0	1518.1
116	192	1522.5	1.5	1.5	1525.5
117	193	1528.6	2.4	0.4	1531.4
118	194	1534.5	3.5	0.6	1538.6
119	195	1540.3	4.0	0.2	1544.5
120	196	1545.9	4.6	0.8	1551.3
121	197	1551.4	5.3	0.2	1556.9
122	198	1556.7	6.0	0.6	1563.3
123	199	1561.9	6.8	0.	1568.7
124	200	1566.9	7.7	0.1	1574.8
125	201	1571.8	8.3	0.	1580.1
126	202	1576.6	9.0	0.	1585.6
127	203	1581.2	8.1	0.	1589.3
128	204	1585.7	7.3	0.7	1593.7
129	205	1590.1	6.6	0.4	1597.2
130	206	1594.4	6.0	1.1	1601.4
131	207	1598.5	5.5	0.7	1604.7

$Z = 77$: *Iridium*

99	176	1396.7	0.4	0.8	1396.6
100	177	1405.9	0.1	1.8	1406.6

$Z = 78$: *Platinum*

101	179	1417.3	−0.1	1.3	1417.6
102	180	1426.4	0.	2.1	1427.6
103	181	1435.4	0.2	1.1	1435.7
104	182	1444.1	0.4	1.8	1445.3
105	183	1452.7	0.9	0.6	1453.2
106	184	1461.1	1.2	1.1	1462.4
107	185	1469.3	1.3	0.5	1470.0
108	186	1477.3	1.2	1.3	1478.9
109	187	1485.1	1.5	0.4	1486.2
110	188	1492.8	1.7	1.0	1494.7
111	189	1500.3	1.5	0.6	1501.7
112	190	1507.7	1.4	1.6	1510.0
113	191	1514.8	1.6	0.9	1516.7
114	192	1521.8	1.8	1.6	1524.7
115	193	1528.7	2.2	0.8	1531.3
116*	194	1535.4	2.5	1.5	1539.1
117	195	1541.9	3.1	0.7	1545.4
118	196	1548.3	3.8	1.1	1553.0
119	197	1554.5	4.6	0.2	1559.2
120	198	1560.6	5.4	0.5	1566.5
121	199	1566.6	6.0	0.1	1572.6
122	200	1572.4	6.3	0.7	1579.4
123	201	1578.0	7.1	0.1	1585.2
124	202	1583.5	7.8	0.4	1591.8
125	203	1588.9	8.3	0.3	1597.5
126	204	1594.1	9.0	0.4	1603.5
127	205	1599.2	8.2	0.2	1607.7
128	206	1604.2	7.3	1.1	1612.6
129	207	1609.0	6.8	0.7	1616.5
130	208	1613.7	6.1	1.3	1621.2
131	209	1618.3	5.7	0.9	1624.9
132	210	1622.7	5.2	1.4	1629.4
133	211	1627.0	5.2	0.6	1632.8
134	212	1631.2	4.7	1.2	1637.1

$Z = 79$: *Gold*

103	182	1437.7	−0.7	1.2	1437.5
104	183	1446.7	−0.6	1.9	1447.4

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	LCS pairing energy	Total binding energy
		$Z = 79$: *Gold (Continued)*			
105	184	1455.6	−0.2	0.8	1455.4
106	185	1464.2	0.1	1.4	1465.0
107	186	1472.7	0.3	0.6	1472.8
108	187	1480.9	0.3	1.5	1482.0
109	188	1489.1	0.6	0.5	1489.5
110	189	1497.0	0.8	1.2	1498.4
111	190	1504.7	0.8	0.7	1505.6
112	191	1512.3	0.7	1.7	1514.2
113	192	1519.7	1.0	0.9	1521.3
114	193	1527.0	1.4	1.6	1529.6
115	194	1534.1	1.8	0.9	1536.4
116	195	1541.0	2.3	1.5	1544.5
117	196	1547.8	2.9	0.6	1551.2
118*	197	1554.4	3.9	0.8	1559.0
119	198	1560.9	4.6	0.1	1565.5
120	199	1567.2	5.4	0.4	1573.0
121	200	1573.4	6.0	0.	1579.3
122	201	1579.5	6.6	0.4	1586.4
123	202	1585.3	7.3	−0.1	1592.5
124	203	1591.1	8.0	0.1	1599.2
125	204	1596.7	8.6	−0.1	1605.2
126	205	1602.1	9.3	0.	1611.4
127	206	1607.5	8.4	−0.1	1615.8
128	207	1612.6	7.6	0.6	1620.9
129	208	1617.7	7.1	0.3	1625.1
130	209	1622.6	6.5	0.8	1630.0
131	210	1627.4	6.2	0.3	1633.9
132	211	1632.1	5.8	0.8	1638.6
133	212	1636.6	5.5	0.2	1642.3
134	213	1641.0	5.2	0.6	1646.8
135	214	1645.2	5.0	−0.1	1650.2
136	215	1649.4	4.9	0.1	1654.4

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 81$: *Thallium (Continued)*			
109	190	1495.4	−0.9	1.2	1495.5
110	191	1503.8	−1.2	2.6	1505.0
111	192	1512.1	−0.6	1.4	1512.7
112	193	1520.2	−0.8	2.8	1522.0
113	194	1528.1	0.	1.5	1529.5
114	195	1535.8	0.4	2.4	1538.6
115	196	1543.4	1.3	1.2	1545.9
116	197	1550.9	2.3	1.5	1554.7
117	198	1558.1	3.3	0.3	1561.8
118	199	1565.3	4.4	0.6	1570.2
119	200	1572.2	4.9	0.1	1577.2
120	201	1579.0	5.5	0.7	1585.2
121	202	1585.7	6.1	0.2	1592.0
122*	203	1592.2	6.8	0.6	1599.6
123	204	1598.5	7.7	−0.1	1606.1
124	205	1604.7	8.5	0.1	1613.3
125	206	1610.8	9.1	−0.1	1619.8
126	207	1616.7	9.8	−0.1	1626.5
127	208	1622.5	8.9	−0.1	1631.3
128	209	1628.1	8.1	0.7	1636.9
129	210	1633.6	7.5	0.4	1641.5
130	211	1639.0	6.9	1.0	1646.8
131	212	1644.2	6.4	0.6	1651.2
132	213	1649.3	6.0	1.1	1656.4
133	214	1654.3	5.8	0.4	1660.5
134	215	1659.1	5.5	0.8	1665.4
135	216	1663.8	5.5	−0.1	1669.2
136	217	1668.4	5.4	0.1	1673.9
137	218	1672.9	4.1	0.	1676.9
138	219	1677.2	2.7	1.7	1681.6
139	220	1681.4	1.8	1.3	1684.5
140	221	1685.5	0.5	2.9	1688.9

$Z = 80$: *Mercury*

105	185	1458.0	−0.6	1.2	1457.9
106	186	1466.9	−0.4	1.8	1467.7
107	187	1475.6	−0.1	1.0	1475.8
108	188	1484.1	−0.2	1.9	1485.2
109	189	1492.5	0.2	0.9	1493.0
110	190	1500.7	0.2	1.7	1502.1
111	191	1508.7	0.3	1.1	1509.6
112	192	1516.5	0.2	2.1	1518.5
113	193	1524.2	0.7	1.2	1525.8
114	194	1531.7	1.0	2.0	1534.5
115	195	1539.0	1.6	1.1	1541.6
116	196	1546.2	2.3	1.6	1550.0
117	197	1553.2	3.1	0.6	1556.9
118	198	1560.1	4.2	0.8	1565.1
119	199	1566.8	4.7	0.3	1571.8
120*	200	1573.4	5.3	0.9	1579.6
121	201	1579.8	6.0	0.3	1586.1
122	202	1586.0	6.7	0.8	1593.5
123	203	1592.2	7.5	0.1	1599.8
124	204	1598.1	8.3	0.3	1606.8
125	205	1604.0	8.9	0.1	1613.0
126	206	1609.7	9.6	0.2	1619.4
127	207	1615.2	8.7	0.1	1624.0
128	208	1620.6	7.9	0.9	1629.4
129	209	1625.9	7.3	0.6	1633.8
130	210	1631.0	6.7	1.2	1638.9
131	211	1636.0	6.2	0.8	1643.1
132	212	1640.9	5.8	1.3	1648.0
133	213	1645.7	5.6	0.6	1651.9
134	214	1650.3	5.3	1.0	1656.6
135	215	1654.8	5.3	0.1	1660.2
136	216	1659.1	5.2	0.3	1664.6
137	217	1663.4	3.9	0.2	1667.4
138	218	1667.5	2.5	1.9	1672.0

$Z = 81$: *Thallium*

107	188	1478.0	−1.4	1.4	1477.7
108	189	1486.8	−1.7	2.7	1487.5

$Z = 82$: *Lead*

109	191	1497.9	−2.5	2.9	1498.1
110	192	1506.6	−3.0	4.5	1508.1
111	193	1515.1	−1.7	2.6	1516.0
112	194	1523.4	−1.3	3.6	1525.6
113	195	1531.6	−0.2	1.9	1533.3
114	196	1539.6	0.8	2.4	1542.7
115	197	1547.4	1.6	1.2	1550.3
116	198	1555.1	2.6	1.6	1559.3
117	199	1562.6	3.6	0.4	1566.6
118	200	1569.9	4.8	0.6	1575.3
119	201	1577.1	5.2	0.2	1582.6
120	202	1584.2	5.7	0.8	1590.8
121	203	1591.1	6.4	0.3	1597.8
122	204	1597.8	7.1	0.7	1605.6
123	205	1604.4	8.0	0.	1612.4
124*	206	1610.8	8.9	0.1	1619.8
125	207	1617.1	9.5	0.	1626.5
126	208	1623.3	10.2	0.	1633.4
127	209	1 29.3	9.3	0.	1638.5
128	210	1635.1	8.4	0.7	1644.3
129	211	1640.8	7.8	0.5	1649.1
130	212	1646.4	7.2	1.1	1654.7
131	213	1651.9	6.7	0.7	1659.3
132	214	1657.2	6.3	1.2	1664.7
133	215	1662.4	6.0	0.6	1669.0
134	216	1667.4	5.8	0.9	1674.2
135	217	1672.4	5.8	0.	1678.2
136	218	1677.2	5.8	0.1	1683.1
137	219	1681.8	4.4	0.	1686.3
138	220	1686.4	3.1	1.8	1691.3
139	221	1690.8	2.1	1.4	1694.3
140	222	1695.1	0.8	3.0	1698.9
141	223	1699.3	0.1	2.4	1701.8
142	224	1703.4	−1.0	3.8	1706.2

$Z = 83$: *Bismuth*

111	194	1517.7	−1.3	1.3	1517.3
112	195	1526.2	−1.4	2.4	1527.0

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 83: *Bismuth (Continued)*			
113	196	1534.6	−0.6	1.2	1535.0
114	197	1542.9	−0.3	2.1	1544.6
115	198	1550.9	0.6	1.0	1552.4
116	199	1558.8	1.4	1.4	1561.5
117	200	1566.6	2.2	0.4	1569.1
118	201	1574.2	3.3	0.6	1578.0
119	202	1581.6	3.8	0.1	1585.5
120	203	1588.9	4.5	0.6	1593.9
121	204	1596.0	5.1	0.1	1601.2
122	205	1603.0	5.8	0.5	1609.2
123	206	1609.8	6.6	−0.1	1616.3
124	207	1616.4	7.4	0.1	1623.9
125	208	1623.0	8.0	−0.1	1630.8
126*	209	1629.3	8.7	0.	1637.9
127	210	1635.6	7.8	−0.1	1643.3
128	211	1641.7	7.0	0.6	1649.3
129	212	1647.6	6.5	0.3	1654.4
130	213	1653.4	5.9	0.8	1660.1
131	214	1659.1	5.5	0.4	1665.0
132	215	1664.6	5.1	0.9	1670.6
133	216	1670.0	4.8	0.3	1675.1
134	217	1675.3	4.5	0.7	1680.5
135	218	1680.4	4.4	−0.1	1684.8
136	219	1685.5	4.3	0.1	1689.8
137	220	1690.3	3.0	0.	1693.3
138	221	1695.1	1.8	1.6	1698.5
139	222	1699.7	0.8	1.3	1701.8
140	223	1704.3	−0.3	2.6	1706.6
141	224	1708.6	−0.9	2.0	1709.7
142	225	1712.9	−1.7	3.1	1714.3
143	226	1717.1	−2.0	2.3	1717.4
144	227	1721.1	−2.5	3.3	1721.8
		Z = 85: *Astatine (Continued)*			
116	201	1564.9	−0.7	1.9	1566.0
117	202	1573.2	0.1	1.0	1574.1
118	203	1581.2	0.9	1.3	1583.4
119	204	1589.1	1.5	0.8	1591.4
120	205	1596.8	2.1	1.3	1600.3
121	206	1604.4	2.8	0.8	1608.0
122	207	1611.9	3.4	1.3	1616.5
123	208	1619.1	4.2	0.7	1624.0
124	209	1626.3	4.9	1.0	1632.1
125	210	1633.2	5.4	0.8	1639.5
126	211	1640.1	6.1	0.9	1647.1
127	212	1646.8	5.3	0.8	1652.8
128	213	1653.3	4.5	1.5	1659.3
129*	214	1659.7	4.0	1.2	1664.8
130	215	1665.9	3.4	1.8	1671.1
131	216	1672.1	3.0	1.3	1676.3
132	217	1678.0	2.5	1.8	1682.4
133	218	1683.9	2.4	1.2	1687.4
134	219	1689.6	2.0	1.6	1693.2
135	220	1695.2	2.0	0.7	1697.9
136	221	1700.6	1.8	1.0	1703.4
137	222	1705.9	0.6	0.8	1707.3
138	223	1711.1	−0.8	2.6	1712.9
139	224	1716.2	−1.5	2.0	1716.6
140	225	1721.1	−2.7	3.4	1721.9
141	226	1725.9	−3.0	2.6	1725.5
142	227	1730.6	−3.8	3.7	1730.5
143	228	1735.2	−3.6	2.5	1734.0
144	229	1739.7	−3.6	3.0	1738.8
145	230	1744.1	−1.9	0.9	1742.4
146	231	1748.3	−1.6	1.3	1747.2
147	232	1752.5	−1.4	1.0	1750.8

$Z = 84$: *Polonium*

112	196	1528.5	−1.9	2.7	1529.1
113	197	1537.2	−1.3	1.7	1537.4
114	198	1545.6	−1.5	3.1	1547.1
115	199	1554.0	−0.5	1.8	1555.1
116	200	1562.1	−0.1	2.6	1564.6
117	201	1570.1	1.0	1.4	1572.4
118	202	1577.9	1.9	1.8	1581.6
119	203	1585.6	2.5	1.2	1589.3
120	204	1593.1	2.9	1.9	1598.0
121	205	1600.4	3.6	1.4	1605.5
122	206	1607.6	4.3	1.8	1613.7
123	207	1614.7	5.3	1.0	1621.0
124	208	1621.6	6.0	1.3	1628.9
125	209	1628.3	6.6	1.1	1636.1
126	210	1634.9	7.3	1.2	1643.4
127*	211	1641.4	6.5	1.1	1648.9
128	212	1647.7	5.6	1.9	1655.2
129	213	1653.9	5.0	1.6	1660.5
130	214	1659.9	4.3	2.3	1666.5
131	215	1665.8	3.9	1.9	1671.5
132	216	1671.6	3.4	2.4	1677.4
133	217	1677.2	3.3	1.7	1682.1
134	218	1682.7	3.0	2.1	1687.7
135	219	1688.0	3.1	1.0	1692.2
136	220	1693.3	2.9	1.3	1697.5
137	221	1698.4	1.7	1.1	1701.2
138	222	1703.3	0.2	3.0	1706.6
139	223	1708.2	−0.6	2.4	1710.0
140	224	1712.9	−2.0	4.1	1715.1
141	225	1717.5	−2.4	3.3	1718.4
142	226	1722.0	−3.5	4.8	1723.2
143	227	1726.4	−3.5	3.6	1726.4
144	228	1730.6	−4.3	4.8	1731.1
145	229	1734.7	−3.2	2.8	1734.2

$Z = 85$: *Astatine*

114	199	1548.0	−1.5	2.0	1548.2
115	200	1556.6	−1.1	1.3	1556.5

$Z = 86$: *Radon*

117	203	1575.8	−0.7	1.7	1576.6
118	204	1584.0	0.	2.2	1586.2
119	205	1592.2	0.5	1.7	1594.4
120	206	1600.1	0.9	2.4	1603.5
121	207	1608.0	1.7	1.8	1611.4
122	208	1615.6	2.1	2.4	1620.2
123	209	1623.1	3.1	1.6	1627.9
124	210	1630.5	3.7	2.1	1636.3
125	211	1637.7	4.3	1.9	1643.9
126	212	1644.7	4.9	2.0	1651.7
127	213	1651.6	4.2	1.8	1657.6
128	214	1658.4	3.3	2.7	1664.4
129	215	1665.0	2.8	2.3	1670.1
130	216	1671.5	2.1	3.0	1676.6
131*	217	1677.8	1.7	2.6	1682.0
132	218	1684.0	1.2	3.1	1688.3
133	219	1690.1	1.1	2.3	1693.5
134	220	1696.0	0.7	2.8	1699.6
135	221	1701.8	1.0	1.7	1704.5
136	222	1707.5	0.6	2.1	1710.2
137	223	1713.0	−0.4	1.7	1714.3
138	224	1718.4	−2.1	3.8	1720.1
139	225	1723.7	−2.6	3.0	1724.1
140	226	1728.8	−4.1	4.8	1729.5
141	227	1733.9	−4.0	3.5	1733.3
142	228	1738.7	−5.0	4.8	1738.5
143	229	1743.6	−4.0	2.9	1742.3
144	230	1748.3	−2.2	2.1	1747.4
145	231	1752.9	−1.9	1.5	1751.4
146	232	1757.4	−1.7	2.0	1756.5
147	233	1761.7	−1.5	1.8	1760.5
148	234	1765.9	−1.2	2.2	1765.3

$Z = 87$: *Francium*

119	206	1594.8	−0.2	1.1	1595.6
120	207	1603.0	0.5	1.5	1605.0
121	208	1611.0	1.2	1.0	1613.2
122	209	1618.9	1.4	1.8	1622.1

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 87$: *Francium (Continued)*			
123	210	1626.7	2.3	1.1	1630.1
124	211	1634.2	2.8	1.6	1638.6
125	212	1641.7	3.3	1.5	1646.5
126	213	1648.9	4.0	1.6	1654.5
127	214	1656.1	3.3	1.3	1660.7
128	215	1663.1	2.4	2.2	1667.6
129	216	1669.9	1.9	1.8	1673.6
130	217	1676.6	1.2	2.5	1680.3
131	218	1683.2	0.9	2.0	1686.0
132	219	1689.6	0.4	2.5	1692.5
133*	220	1695.9	0.3	1.7	1697.9
134	221	1702.0	−0.1	2.3	1704.2
135	222	1708.0	0.1	1.2	1709.3
136	223	1713.9	−0.3	1.7	1715.3
137	224	1719.6	−1.3	1.3	1719.6
138	225	1725.2	−2.9	3.3	1725.6
139	226	1730.7	−3.3	2.4	1729.8
140	227	1736.1	−4.7	4.1	1735 4
141	228	1741.3	−4.4	2.7	1739.5
142	229	1746.4	−4.7	3.3	1744.9
143	230	1751.6	−2.4	1.0	1749.2
144	231	1756.5	−2.1	1.4	1754.7
145	232	1761.3	−2.0	1.1	1759.0
146	233	1765.9	−1.8	1.6	1764.3
147	234	1770.5	−1.6	1.3	1768.5
148	235	1774.9	−1.2	1.6	1773.5
149	236	1779.2	−0.4	0.8	1777.6
150	237	1783.3	−0.2	1.0	1782.3
		$Z = 88$: *Radium*			
121	209	1613.6	0.5	1.7	1615.9
122	210	1621.8	0.6	2.7	1625.0

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 89$: *Actinium (Continued)*			
129	218	1678.3	0.4	2.0	1680.8
130	219	1685.4	−0.3	2.8	1687.9
131	220	1692.4	−0.7	2.3	1694.1
132	221	1699.3	−1.2	2.9	1701.0
133	222	1706.0	−1.2	2.0	1706.9
134	223	1712.6	−1.7	2.7	1713.5
135	224	1719.0	−1.4	1.5	1719.1
136	225	1725.3	−1.8	2.0	1725.5
137*	226	1731.5	−2.7	1.5	1730.3
138	227	1737.5	−4.5	3.6	1736.7
139	228	1743.4	−4.7	2.6	1741.3
140	229	1749.2	−6.2	4.4	1747.4
141	230	1755.0	−3.2	1.3	1752.3
142	231	1760.6	−2.5	1.5	1758.4
143	232	1766.0	−2.2	0.9	1763.4
144	233	1771.3	−2.1	1.6	1769.4
145	234	1776.6	−1.8	1.2	1774.2
146	235	1781.6	−1.5	1.6	1779.9
147	236	1786.6	−0.9	0.9	1784.6
148	237	1791.3	−0.6	1.2	1790.1
149	238	1796.1	0.	0.7	1794.6
150	239	1800.6	0.2	0.9	1799.7
151	240	1805.0	0.3	0.7	1804.0
152	241	1809.3	0.3	0.8	1808.6
153	242	1813.6	0.1	0.7	1812.5
154	243	1817.6	−0.1	1.0	1816.9
		$Z = 90$: *Thorium*			
125	215	1650.9	1.3	2.5	1654.6
126	216	1658.8	1.9	2.6	1663.3

123	211	1629.7	1.5	2.0	1633.2
124	212	1637.5	2.0	2.5	1642.0
125	213	1645.2	2.5	2.4	1650.0
126	214	1652.7	3.1	2.5	1658.3
127	215	1660.1	2.5	2.2	1664.7
128	216	1667.3	1.5	3.1	1671.9
129	217	1674.3	1.1	2.6	1678.1
130	218	1681.2	0.4	3.4	1685.0
131	219	1688.0	0.	2.9	1690.9
132	220	1694.7	−0.5	3.5	1697.6
133	221	1701.2	−0.5	2.6	1703.3
134	222	1707.5	−1.0	3.3	1709.7
135*	223	1713.7	−0.7	2.1	1715.1
136	224	1719.8	−1.1	2.6	1721.3
137	225	1725.8	−2.0	2.1	1725.8
138	226	1731.6	−3.8	4.2	1732.0
139	227	1737.3	−4.0	3.1	1736.4
140	228	1742.9	−5.6	5.0	1742.3
141	229	1748.4	−4.5	3.0	1746.6
142	230	1753.8	−3.1	2.5	1752.4
143	231	1759.0	−2.3	1.5	1757.1
144	232	1764.1	−2.1	2.1	1762.8
145	233	1769.1	−2.0	1.8	1767.4
146	234	1774.0	−1.8	2.3	1772.9
147	235	1778.7	−1.4	1.8	1777.4
148	236	1783.3	−1.0	2.1	1782.6
149	237	1787.9	−0.3	1.4	1786.9
150	238	1792.2	−0.1	1.6	1791.8
151	239	1796.4	0.	1.4	1796.0
152	240	1800.5	0.1	1.6	1800.4

Z = 89: *Actinium*

123	212	1632.3	0.8	1.4	1634.5
124	213	1640.4	1.3	1.9	1643.5
125	214	1648.3	1.8	1.8	1651.8
126	215	1656.0	2.4	1.9	1660.3
127	216	1663.6	1.8	1.6	1667.0
128	217	1671.0	0.8	2.5	1674.4

127	217	1666.6	1.2	2.4	1670.2
128	218	1674.3	0.3	3.2	1677.8
129	219	1681.8	−0.1	2.7	1684.5
130	220	1689.2	−0.8	3.4	1691.8
131	221	1696.4	−1.0	2.8	1698.2
132	222	1703.5	−1.6	3.5	1705.3
133	223	1710.4	−1.5	2.6	1711.4
134	224	1717.2	−2.2	3.4	1718.3
135	225	1723.8	−2.0	2.3	1724.1
136	226	1730.3	−2.3	2.7	1730.7
137	227	1736.7	−3.3	2.3	1735.7
138	228	1743.0	−5.0	4.4	1742.3
139*	229	1749.1	−5.1	3.3	1747.2
140	230	1755.2	−3.6	2.8	1753.6
141	231	1761.2	−2.7	1.6	1758.9
142	232	1766.9	−2.0	1.8	1765.3
143	233	1772.6	−1.9	1.4	1770.6
144	234	1778.1	−1.7	2.0	1776.8
145	235	1783.5	−1.4	1.5	1781.8
146	236	1788.8	−1.0	1.9	1787.8
147	237	1793.9	−0.5	1.3	1792.7
148	238	1798.9	−0.2	1.6	1798.3
149	239	1803.8	0.3	1.1	1803.1
150	240	1808.5	0.6	1.2	1808.3
151	241	1813.2	0.6	1.1	1812.9
152	242	1817.7	0.7	1.2	1817.7
153	243	1822.1	0.5	1.1	1821.8
154	244	1826.4	0.3	1.4	1826.3
155	245	1830.6	−0.1	1.3	1829.9
156	246	1834.6	−0.5	1.9	1834.4

Z = 91: *Protactinium*

128	219	1677.1	−0.2	2.6	1679.5
129	220	1684.9	−0.7	2.1	1686.4
130	221	1692.5	−1.4	2.9	1693.9
131	222	1699.9	−2.0	2.6	1700.5
132	223	1707.2	−2.3	3.0	1707.9
133	224	1714.3	−2.0	1.9	1714.2

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 91$: *Protactinium (Continued)*			
134	225	1721.3	−2.7	2.7	1721.3
135	226	1728.2	−2.6	1.7	1727.3
136	227	1734.9	−2.7	1.9	1734.2
137	228	1741.5	−4.0	1.8	1739.4
138	229	1748.0	−5.4	3.6	1746.2
139	230	1754.5	−3.5	1.5	1751.6
140	231	1760.7	−2.9	1.7	1758.4
141*	232	1766.9	−2.3	0.8	1764.0
142	233	1772.8	−1.7	1.0	1770.7
143	234	1778.7	−1.4	0.7	1776.2
144	235	1784.4	−1.2	1.2	1782.6
145	236	1790.0	−0.9	0.8	1787.9
146	237	1795.5	−0.6	1.1	1794.0
147	238	1800.8	−0.2	0.6	1799.2
148	239	1806.0	0.2	0.9	1805.0
149	240	1811.1	0.6	0.5	1810.0
150	241	1816.0	0.8	0.6	1815.4
151	242	1820.8	0.9	0.5	1820.2
152	243	1825.6	1.0	0.6	1825.2
153	244	1830.2	0.8	0.5	1829.4
154	245	1834.6	0.6	0.8	1834.1
155	246	1839.0	0.3	0.6	1838.0
156	247	1843.3	−0.1	1.2	1842.6
157	248	1847.4	−0.4	0.8	1846.3
		$Z = 92$: *Uranium*			
130	222	1695.3	−1.6	3.4	1697.1
131	223	1703.0	−1.6	2.7	1704.0
132	224	1710.5	−2.3	3.3	1711.5
		$Z = 93$: *Neptunium (Continued)*			
141	234	1776.9	−1.4	0.5	1774.4
142	235	1783.3	−0.8	0.8	1781.5
143	236	1789.5	−0.7	0.5	1787.5
144	237	1795.6	−0.4	1.0	1794.3
145*	238	1801.6	−0.2	0.6	1800.1
146	239	1807.5	0.2	0.9	1806.6
147	240	1813.2	0.6	0.4	1812.1
148	241	1818.8	1.0	0.6	1818.4
149	242	1824.3	1.3	0.3	1823.7
150	243	1829.6	1.6	0.4	1829.6
151	244	1834.9	1.6	0.3	1834.7
152	245	1840.0	1.7	0.4	1840.1
153	246	1845.0	1.5	0.3	1844.7
154	247	1849.8	1.3	0.6	1849.8
155	248	1854.6	1.0	0.4	1854.1
156	249	1859.2	0.7	0.9	1859.0
157	250	1863.8	0.4	0.6	1863.1
158	251	1868.2	0.2	1.1	1867.8
159	252	1872.5	0.1	0.7	1871.7
160	253	1876.7	0.1	1.0	1876.2
161	254	1880.8	0.1	0.4	1879.9
		$Z = 94$: *Plutonium*			
134	228	1731.2	−3.8	3.5	1730.9
135	229	1738.7	−4.0	2.9	1737.6
136	230	1746.0	−4.3	3.3	1745.0
137	231	1753.4	−3.0	1.7	1751.4
138	232	1760.6	−2.3	1.9	1759.0
139	233	1767.7	−2.0	1.4	1765.6

133	225	1717.8	−2.4	2.7	1718.1
134	226	1725.0	−2.9	3.3	1725.4
135	227	1732.1	−3.1	2.6	1731.6
136	228	1739.1	−3.0	2.6	1738.6
137	229	1745.9	−4.7	3.0	1744.1
138	230	1752.7	−3.9	3.0	1751.1
139	231	1759.3	−2.9	1.6	1757.0
140	232	1765.8	−2.3	1.9	1764.1
141	233	1772.1	−1.8	1.1	1769.9
142	234	1778.3	−1.1	1.3	1776.9
143*	235	1784.3	−1.0	1.0	1782.6
144	236	1790.2	−0.8	1.6	1789.2
145	237	1796.0	−0.5	1.2	1794.7
146	238	1801.7	−0.2	1.5	1801.0
147	239	1807.2	0.2	1.0	1806.4
148	240	1812.6	0.6	1.3	1812.4
149	241	1817.9	0.9	0.9	1817.6
150	242	1823.0	1.2	1.0	1823.2
151	243	1828.1	1.2	0.9	1828.2
152	244	1833.0	1.3	1.0	1833.4
153	245	1837.8	1.1	0.9	1837.8
154	246	1842.5	1.0	1.2	1842.7
155	247	1847.0	0.7	0.9	1846.8
156	248	1851.5	0.3	1.5	1851.6
157	249	1855.8	0.1	1.2	1855.4
158	250	1860.0	−0.1	1.6	1860.0
159	251	1864.2	−0.2	1.2	1863.7

Z = 93: *Neptunium*

132	225	1713.3	−2.2	2.3	1713.3
133	226	1720.9	−2.6	1.9	1720.1
134	227	1728.3	−3.1	2.4	1727.5
135	228	1735.6	−3.6	2.0	1734.0
136	229	1742.8	−3.8	2.2	1741.2
137	230	1749.9	−3.6	1.6	1747.3
138	231	1756.9	−2.7	1.6	1754.7
139	232	1763.7	−2.4	0.9	1760.9
140	233	1770.4	−1.9	1.3	1768.3
140	234	1774.5	−1.4	1.7	1773.2
141	235	1781.3	−0.9	0.9	1779.5
142	236	1787.8	−0.3	1.2	1786.9
143	237	1794.3	−0.2	0.8	1793.0
144	238	1800.6	0.	1.3	1800.0
145	239	1806.8	0.3	0.9	1806.0
146	240	1812.8	0.7	1.2	1812.7
147*	241	1818.7	1.0	0.7	1818.5
148	242	1824.5	1.4	1.0	1824.9
149	243	1830.2	1.7	0.6	1830.5
150	244	1835.8	2.0	0.7	1836.5
151	245	1841.2	2.0	0.6	1841.8
152	246	1846.5	2.2	0.7	1847.4
153	247	1851.7	1.9	0.6	1852.3
154	248	1856.8	1.8	0.9	1857.5
155	249	1861.7	1.5	0.7	1862.0
156	250	1866.6	1.2	1.2	1867.1
157	251	1871.3	0.8	0.9	1871.3
158	252	1875.9	0.6	1.4	1876.3
159	253	1880.4	0.5	1.0	1880.3
160	254	1884.8	0.4	1.4	1885.1
161	255	1889.1	0.5	0.8	1888.9
162	256	1893.3	0.6	1.0	1893.4
163	257	1897.3	0.3	0.8	1897.1

Z = 95: *Americium*

135	230	1741.3	−4.2	2.2	1739.2
136	231	1749.0	−2.7	1.6	1747.1
137	232	1756.6	−2.2	0.8	1754.0
138	233	1764.0	−1.8	1.5	1762.1
139	234	1771.2	−1.4	0.7	1768.8
140	235	1778.3	−0.8	1.1	1776.7
141	236	1785.2	−0.4	0.3	1783.2
142	237	1791.9	0.1	0.6	1790.8
143	238	1798.6	0.3	0.2	1797.2
144	239	1805.1	0.5	0.8	1804.4
145	240	1811.5	0.8	0.3	1810.6
146	241	1817.7	1.2	0.6	1817.5

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MEV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 95$: *Americium (Continued)*			
147	242	1823.8	1.5	0.1	1823.4
148*	243	1829.8	1.9	0.4	1830.1
149	244	1835.7	2.2	0.	1835.8
150	245	1841.5	2.5	0.2	1842.1
151	246	1847.1	2.5	0.	1847.6
152	247	1852.6	2.6	0.1	1853.4
153	248	1858.0	2.3	0.	1858.4
154	249	1863.2	2.2	0.3	1863.9
155	250	1868.4	1.9	0.1	1868.5
156	251	1873.4	1.7	0.6	1873.8
157	252	1878.4	1.3	0.3	1878.2
158	253	1883.2	1.1	0.8	1883.3
159	254	1887.9	0.9	0.4	1887.6
160	255	1892.5	0.9	0.8	1892.5
161	256	1896.9	0.9	0.2	1896.5
162	257	1901.3	1.0	0.4	1901.2
163	258	1905.6	0.7	0.1	1905.0
164	259	1909.8	0.5	0.6	1909.4
		$Z = 96$: *Curium*			
138	234	1766.9	−1.2	1.8	1765.7
139	235	1774.3	−0.7	0.9	1772.7
140	236	1781.5	−0.2	1.3	1780.7
141	237	1788.6	0.2	0.5	1787.5
142	238	1795.6	0.7	0.8	1795.3
143	239	1802.4	0.8	0.5	1801.8
144	240	1809.1	1.1	1.0	1809.3
145	241	1815.7	1.3	0.5	1815.6
146	242	1822.2	1.7	0.8	1822.8
		$Z = 97$: *Berkelium (Continued)*			
157	254	1891.2	2.2	0.2	1891.8
158	255	1896.4	1.9	0.8	1897.3
159	256	1901.5	1.7	0.4	1901.8
160	257	1906.4	1.6	0.8	1907.1
161	258	1911.3	1.5	0.3	1911.5
162	259	1916.0	1.7	0.4	1916.6
163	260	1920.7	1.5	0.1	1920.7
164	261	1925.2	1.4	0.4	1925.5
165	262	1929.7	1.2	0.1	1929.4
166	263	1934.0	1.1	0.4	1934.0
167	264	1938.2	0.8	0.1	1937.6
		$Z = 98$: *Californium*			
142	240	1801.6	1.3	0.9	1802.0
143	241	1808.9	1.4	0.6	1809.0
144	242	1816.0	1.6	1.1	1816.8
145	243	1823.0	1.9	0.6	1823.6
146	244	1829.8	2.3	0.9	1831.1
147	245	1836.6	2.7	0.4	1837.6
148	246	1843.2	3.1	0.6	1844.9
149	247	1849.6	3.3	0.3	1851.2
150	248	1856.0	3.6	0.4	1858.0
151	249	1862.2	3.6	0.3	1864.1
152	250	1868.3	3.7	0.4	1870.5
153	251	1874.2	3.5	0.3	1876.1
154*	252	1880.1	3.3	0.6	1882.2
155	253	1885.8	3.0	0.4	1887.4
156	254	1891.4	2.8	0.8	1893.3
157	255	1896.9	2.5	0.6	1898.2

147	243	1828.5	2.1	0.3	1828.9
148	244	1834.7	2.5	0.6	1835.7
149	245	1840.8	2.7	0.2	1841.7
150*	246	1846.7	3.0	0.4	1848.1
151	247	1852.5	3.0	0.2	1853.8
152	248	1858.2	3.1	0.3	1859.8
153	249	1863.8	2.9	0.2	1865.0
154	250	1869.3	2.8	0.5	1870.7
155	251	1874.6	2.5	0.3	1875.6
156	252	1879.9	2.2	0.8	1881.0
157	253	1885.0	1.9	0.5	1885.6
158	254	1890.0	1.7	1.0	1890.9
159	255	1894.9	1.4	0.7	1895.3
160	256	1899.6	1.4	1.0	1900.4
161	257	1904.3	1.4	0.4	1904.6
162	258	1908.9	1.6	0.6	1909.5
163	259	1913.3	1.2	0.4	1913.5
164	260	1917.7	1.1	0.8	1918.1
165	261	1921.9	0.9	0.4	1921.8

Z = 97: *Berkelium*

140	237	1784.4	0.1	1.0	1783.5
141	238	1791.7	0.5	0.3	1790.5
142	239	1798.8	0.9	0.6	1798.5
143	240	1805.9	1.1	0.2	1805.2
144	241	1812.8	1.3	0.7	1812.9
145	242	1819.6	1.6	0.2	1819.4
146	243	1826.2	2.0	0.6	1826.8
147	244	1832.8	2.3	0.1	1833.1
148	245	1839.1	2.7	0.3	1840.2
149	246	1845.4	3.0	0.	1846.3
150	247	1851.6	3.2	0.1	1853.0
151	248	1857.6	3.3	0.	1858.9
152*	249	1863.5	3.4	0.1	1865.0
153	250	1869.2	3.1	0.	1870.4
154	251	1874.9	3.0	0.3	1876.3
155	252	1880.5	2.7	0.1	1881.3
156	253	1885.9	2.5	0.5	1887.0
157	254	1891.3	2.3	0.2	1892.0
158	255	1896.6	2.1	0.6	1897.3
159	256	1902.0	2.0	0.1	1902.9
160	257	1907.3	1.8	0.4	1908.1
161	258	1912.5	1.8	0.1	1913.2
162	259	1917.7	1.7	0.3	1918.3
163	260	1922.8	1.7	0.1	1923.4
164	261	1927.9	1.6	0.3	1928.4
165	262	1932.9	1.6	0.1	1933.4
166	263	1937.9	1.5	0.3	1938.3
167	264	1942.8	1.5	0.1	1943.2
168	265	1947.7	1.4	0.3	1948.0
169	266	1952.5	1.4	0.1	1952.8

Z = 98: *Californium*

144	242	1812.8	1.3	0.7	1812.9
145	243	1819.6	1.6	0.2	1819.4
146	244	1826.2	2.0	0.6	1826.8
147	245	1832.8	2.3	0.1	1833.1
148	246	1839.1	2.7	0.3	1840.2
149	247	1845.4	3.0	0.	1846.3
150	248	1851.6	3.2	0.1	1853.0
151	249	1857.6	3.3	0.	1858.9
152*	250	1863.5	3.4	0.1	1865.0
153	251	1869.2	3.1	0.	1870.4
154	252	1874.9	3.0	0.3	1876.3
155	253	1880.5	2.7	0.1	1881.3
156	254	1885.9	2.5	0.5	1887.0
157	255	1891.3	2.3	0.2	1892.0
158	256	1896.6	2.1	0.6	1897.3
159	257	1902.0	2.0	0.1	1902.9
160	258	1907.3	1.8	0.4	1908.1
161	259	1912.5	1.8	0.1	1913.2
162	260	1917.7	1.7	0.3	1918.3
163	261	1922.8	1.7	0.1	1923.4
164	262	1927.9	1.6	0.3	1928.4
165	263	1932.9	1.6	0.1	1933.4
166	264	1937.9	1.5	0.3	1938.3
167	265	1942.8	1.5	0.1	1943.2
168	266	1947.7	1.4	0.3	1948.0
169	267	1952.5	1.4	0.1	1952.8

Z = 99: *Einsteinium*

144	243	1818.8	2.0	0.7	1819.6
145	244	1826.0	2.3	0.2	1826.6
146	245	1833.0	2.8	0.5	1834.3
147	246	1840.0	3.1	0.	1841.1
148	247	1846.7	3.5	0.2	1848.5
149	248	1853.4	3.7	−0.1	1855.1
150	249	1859.9	4.0	0.1	1862.1
151	250	1866.3	4.0	−0.1	1868.4
152	251	1872.6	4.1	0.	1874.9
153	252	1878.8	3.9	−0.1	1880.7
154	253	1884.9	3.7	0.3	1887.0
155	254	1890.8	3.4	0.	1892.4
156*	255	1896.6	3.2	0.5	1898.4
157	256	1902.3	2.9	0.2	1903.6
158	257	1907.9	2.7	0.7	1909.5
159	258	1913.3	2.5	0.3	1914.4
160	259	1918.7	2.4	0.8	1920.0
161	260	1923.9	2.3	0.3	1924.7
162	261	1929.0	2.3	0.6	1930.2
163	262	1934.1	2.3	0.	1934.7
164	263	1939.0	2.4	0.2	1939.9
165	264	1943.8	2.1	0.	1944.2
166	265	1948.5	1.8	0.4	1949.1
167	266	1953.1	1.5	0.1	1953.1
168	267	1957.7	1.3	0.4	1957.8
169	268	1962.2	1.2	0.1	1962.3

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		Z = 99: *Einsteinium* (*Continued*)			
168	267	1957.6	1.4	0.5	1957.8
169	268	1961.9	0.9	0.2	1961.5
170	269	1966.3	0.7	0.7	1966.1
171	270	1971.0	1.7	0.	1969.6
		Z = 100: *Fermium*			
146	246	1835.8	3.3	0.5	1837.7
147	247	1842.9	3.6	0.1	1844.7
148	248	1849.9	4.0	0.3	1852.3
149	249	1856.8	4.2	0.	1859.0
150	250	1863.5	4.5	0.1	1866.2
151	251	1870.1	4.5	0.	1872.7
152	252	1876.6	4.6	0.1	1879.4
153	253	1882.9	4.4	0.	1885.4
154	254	1889.2	4.2	0.3	1891.9
155	255	1895.3	3.9	0.1	1897.5
156	256	1901.3	3.7	0.5	1903.7
157	257	1907.2	3.4	0.2	1909.1
158*	258	1913.0	3.2	0.7	1915.1
159	259	1918.6	3.0	0.4	1920.2
160	260	1924.2	2.8	0.8	1926.1
161	261	1929.6	2.7	0.4	1931.0
162	262	1934.9	2.7	0.6	1936.6
163	263	1940.1	2.7	0.1	1941.3
164	264	1945.2	2.8	0.3	1946.7
165	265	1950.2	2.5	0.1	1951.1
166	266	1955.1	2.3	0.5	1956.2
167	267	1959.8	2.0	0.2	1960.4
168	268	1964.5	1.8	0.6	1965.3
		Z = 102: *Nobelium* (*Continued*)			
153	255	1889.9	4.4	0.1	1892.7
154	256	1896.5	4.2	0.4	1899.5
155	257	1903.0	3.9	0.2	1905.5
156	258	1909.4	3.7	0.6	1912.2
157	259	1915.7	3.4	0.4	1917.9
158	260	1921.8	3.2	0.9	1924.3
159	261	1927.8	3.0	0.5	1929.8
160	262	1933.8	2.9	0.9	1936.1
161	263	1939.6	3.0	0.3	1941.4
162*	264	1945.2	3.1	0.5	1947.4
163	265	1950.8	2.8	0.2	1952.4
164	266	1956.3	2.7	0.6	1958.2
165	267	1961.6	2.5	0.2	1963.0
166	268	1966.9	2.5	0.5	1968.5
167	269	1972.0	2.1	0.2	1973.0
168	270	1977.0	1.9	0.6	1978.3
169	271	1982.0	1.5	0.3	1982.6
170	272	1986.8	1.3	0.8	1987.6
171	273	1991.5	1.1	0.4	1991.7
172	274	1996.1	0.9	0.7	1996.6
173	275	2000.4	−0.1	0.7	2000.6
174	276	2004.8	0.1	0.9	2005.5
175	277	2009.1	−0.6	1.2	2009.5
176	278	2013.3	−0.5	1.4	2013.9
		Z = 103: *Lawrencium*			
153	256	1892.8	4.3	−0.1	1895.5
154	257	1899.6	4.2	0.2	1902.5
155	258	1906.3	3.9	0.	1908.7

169	269	1969.0	1.3	0.3	1969.2
170	270	1973.5	1.1	0.8	1973.9
171	271	1978.5	2.2	0.1	1977.8
172	272	1982.7	2.3	0.4	1982.5
173	273	1987.0	2.2	0.1	1986.2

Z = 101: *Mendelevium*

149	250	1859.7	4.1	−0.1	1861.9
150	251	1866.6	4.4	0.1	1869.3
151	252	1873.4	4.4	−0.1	1876.0
152	253	1880.1	4.6	0.	1882.9
153	254	1886.6	4.3	−0.1	1889.1
154	255	1893.1	4.2	0.3	1895.7
155	256	1899.4	3.9	0	1901.5
156	257	1905.6	3.7	0.5	1908.0
157	258	1911.7	3.4	0.2	1913.5
158	259	1917.6	3.1	0.7	1919.8
159	260	1923.4	2.9	0.4	1925.1
160*	261	1929.2	2.8	0.8	1931.1
161	262	1934.8	2.7	0.3	1936.2
162	263	1940.3	2.8	0.5	1942.0
163	264	1945.7	2.7	0.	1946.9
164	265	1951.0	2.8	0.2	1952.5
165	266	1956.1	2.5	0.	1957.1
166	267	1961.2	2.3	0.4	1962.4
167	268	1966.2	2.0	0.1	1966.8
168	269	1971.0	1.8	0.5	1971.8
169	270	1975.7	1.4	0.2	1975.9
170	271	1980.4	1.2	0.7	1980.8
171	272	1984.9	0.9	0.2	1984.7
172	273	1989.4	0.8	0.6	1989.4
173	274	1994.3	1.7	0.1	1993.2
174	275	1998.5	1.5	0.7	1997.9

Z = 102: *Nobelium*

151	253	1876.3	4.5	0.1	1879.2
152	254	1883.2	4.6	0.2	1886.3
156	259	1912.9	3.7	0.5	1915.5
157	260	1919.3	3.4	0.2	1921.4
158	261	1925.6	3.1	0.7	1928.0
159	262	1931.8	3.0	0.3	1933.8
160	263	1937.9	3.0	0.7	1940.2
161	264	1943.9	3.0	0.1	1945.7
162	265	1949.8	3.1	0.3	1951.9
163	266	1955.5	2.9	0.	1957.1
164*	267	1961.2	2.7	0.4	1963.0
165	268	1966.7	2.5	0.1	1968.1
166	269	1972.2	2.5	0.3	1973.7
167	270	1977.5	2.1	0.1	1978.5
168	271	1982.7	1.9	0.5	1983.9
169	272	1987.8	1.6	0.2	1988.4
170	273	1992.8	1.3	0.6	1993.6
171	274	1997.7	1.1	0.2	1997.9
172	275	2002.5	0.9	0.6	2002.9
173	276	2007.0	0.4	0.1	2007.0
174	277	2011.5	0.5	0.4	2012.0
175	278	2016.0	0.	0.4	2016.2
176	279	2020.4	0.	0.8	2020.8
177	280	2024.7	−0.4	0.7	2024.8
178	281	2028.9	−0.2	0.8	2029.2

Z = 104

155	259	1909.1	4.0	0.2	1911.8
156	260	1915.9	3.8	0.6	1918.8
157	261	1922.5	3.4	0.4	1924.9
158	262	1929.0	3.3	0.8	1931.8
159	263	1935.4	3.1	0.5	1937.7
160	264	1941.7	3.1	0.8	1944.3
161	265	1947.9	3.1	0.2	1950.0
162	266	1953.9	3.3	0.4	1956.4
163	267	1959.9	3.0	0.1	1961.8
164	268	1965.7	2.8	0.6	1967.9
165	269	1971.4	2.6	0.2	1973.1
166*	270	1977.0	2.6	0.5	1978.9
167	271	1982.5	2.2	0.2	1983.9

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 104$ (*Continued*)			
168	272	1987.9	2.0	0.6	1989.5
169	273	1993.2	1.7	0.3	1994.2
170	274	1998.4	1.5	0.8	1999.6
171	275	2003.4	1.0	0.5	2004.0
172	276	2008.3	0.7	0.9	2009.4
173	277	2013.1	0.5	0.8	2014.0
174	278	2017.8	0.7	0.9	2019.1
175	279	2022.5	0.2	1.1	2023.5
176	280	2027.1	0.1	1.4	2028.3
177	281	2031.5	−0.1	1.3	2032.5
178	282	2035.9	0.	1.4	2037.1
179	283	2040.1	−0.7	1.7	2041.0
180	284	2044.3	−0.8	1.9	2045.4
		$Z = 105$			
157	262	1925.3	3.3	0.3	1927.6
158	263	1932.0	3.2	0.7	1934.6
159	264	1938.6	3.1	0.3	1940.7
160	265	1945.1	3.1	0.6	1947.5
161	266	1951.4	3.1	0.	1953.4
162	267	1957.7	3.3	0.2	1960.0
163	268	1963.8	3.0	0.	1965.7
164	269	1969.8	2.8	0.4	1971.9
165	270	1975.7	2.6	0.	1977.3
166	271	1981.5	2.6	0.3	1983.3
167	272	1987.2	2.3	0.1	1988.5
168*	273	1992.8	2.0	0.5	1994.3
169	274	1998.2	1.7	0.2	1999.1
170	275	2003.6	1.5	0.6	2004.7
		$Z = 107$			
162	269	1963.9	3.1	0.2	1966.3
163	270	1970.4	2.9	−0.1	1972.4
164	271	1976.8	2.9	0.2	1979.0
165	272	1983.0	2.6	0.	1984.8
166	273	1989.2	2.5	0.3	1991.2
167	274	1995.2	2.2	0.1	1996.7
168	275	2001.1	1.9	0.6	2002.9
169	276	2006.9	1.6	0.3	2008.2
170	277	2012.6	1.5	0.7	2014.3
171	278	2018.2	1.6	0.2	2019.6
172*	279	2023.7	1.6	0.5	2025.5
173	280	2029.0	1.7	0.2	2030.7
174	281	2034.3	2.1	0.2	2036.4
175	282	2039.5	1.8	0.3	2041.4
176	283	2044.6	1.8	0.5	2046.7
177	284	2049.6	1.6	0.3	2051.4
178	285	2054.5	1.6	0.5	2056.5
179	286	2059.3	1.1	0.7	2061.0
180	287	2063.9	1.1	0.9	2065.9
181	288	2068.5	0.2	1.5	2070.1
182	289	2073.0	−0.4	2.1	2074.8
183	290	2077.4	−0.4	1.8	2078.8
184	291	2081.7	−0.4	1.9	2083.2
185	292	2085.9	−0.7	1.6	2086.8
		$Z = 108$			
164	272	1979.6	2.9	0.5	1982.2
165	273	1986.1	2.7	0.2	1988.3
166	274	1992.4	2.7	0.4	1994.9

171	276	2008.8	1.1	0.3	2009.4
172	277	2013.8	1.0	0.6	2014.9
173	278	2018.8	0.9	0.3	2019.6
174	279	2023.8	1.1	0.4	2025.0
175	280	2028.6	0.7	0.4	2029.5
176	281	2033.3	0.6	0.8	2034.5
177	282	2038.0	0.5	0.5	2038.8
178	283	2042.5	0.6	0.7	2043.6
179	284	2046.9	0.	0.9	2047.6
180	285	2051.3	−0.1	1.1	2052.2
181	286	2055.5	−1.2	1.8	2056.1
182	287	2059.7	−1.4	2.0	2060.3

$Z = 106$

160	266	1948.0	3.2	0.7	1950.8
161	267	1954.6	3.2	0.1	1956.8
162	268	1961.0	3.4	0.3	1963.6
163	269	1967.3	3.1	0.1	1969.5
164	270	1973.5	3.1	0.4	1975.9
165	271	1979.6	2.8	0.1	1981.5
166	272	1985.5	2.6	0.5	1987.7
167	273	1991.4	2.3	0.2	1993.0
168	274	1997.1	2.1	0.6	1999.0
169	275	2002.7	1.7	0.4	2004.1
170*	276	2008.2	1.3	1.0	2009.9
171	277	2013.6	1.1	0.6	2015.0
172	278	2018.9	1.2	1.0	2020.8
173	279	2024.1	1.2	0.7	2025.8
174	280	2029.2	1.5	0.8	2031.3
175	281	2034.2	1.2	0.8	2036.1
176	282	2039.2	1.2	1.1	2041.3
177	283	2044.0	1.0	0.9	2045.8
178	284	2048.7	1.0	1.2	2050.7
179	285	2053.3	0.4	1.4	2055.1
180	286	2057.8	0.3	1.7	2059.8
181	287	2062.2	−0.6	2.3	2063.9
182	288	2066.5	−0.9	2.7	2068.3
183	289	2070.8	−1.1	2.5	2072.2

167	275	1998.6	2.4	0.2	2000.6
168	276	2004.7	2.1	0.8	2007.0
169	277	2010.7	2.0	0.4	2012.7
170	278	2016.5	2.0	0.8	2019.0
171	279	2022.3	2.1	0.4	2024.5
172	280	2028.0	2.2	0.8	2030.7
173	281	2033.5	2.3	0.5	2036.2
174*	282	2039.0	2.6	0.6	2042.0
175	283	2044.4	2.4	0.6	2047.2
176	284	2049.6	2.3	0.9	2052.7
177	285	2054.8	2.2	0.8	2057.6
178	286	2059.8	2.0	1.2	2062.9
179	287	2064.8	1.6	1.3	2067.7
180	288	2069.7	1.3	1.8	2072.7
181	289	2074.4	1.0	1.8	2077.2
182	290	2079.1	0.6	2.4	2082.0
183	291	2083.7	0.4	2.1	2086.2
184	292	2088.1	0.4	2.3	2090.8
185	293	2092.5	0.1	2.0	2094.6
186	294	2096.8	−0.6	3.0	2099.1
187	295	2101.0	−0.6	2.3	2102.8

$Z = 109$

166	275	1995.2	2.9	0.1	1997.7
167	276	2001.6	2.6	0.	2003.7
168	277	2007.9	2.5	0.4	2010.3
169	278	2014.1	2.4	0.1	2016.2
170	279	2020.1	2.5	0.4	2022.7
171	280	2026.1	2.6	0.	2028.4
172	281	2031.9	2.8	0.3	2034.8
173	282	2037.6	3.0	0.	2040.4
174	283	2043.3	3.3	0.1	2046.5
175	284	2048.8	3.1	0.1	2051.8
176*	285	2054.3	3.1	0.3	2057.5
177	286	2059.6	3.0	0.1	2062.6
178	287	2064.8	2.8	0.5	2068.0
179	288	2070.0	2.5	0.6	2072.9
180	289	2075.0	2.2	1.0	2078.2

TABLE 8c-2. CALCULATED BINDING ENERGIES IN MeV (*Continued*)

Number of neutrons N	Mass number A	Liquid drop	Shell correction	BCS pairing energy	Total binding energy
		$Z = 109$ (*Continued*)			
181	290	2079.9	1.9	1.1	2082.8
182	291	2084.7	1.5	1.6	2087.8
183	292	2089.5	1.3	1.3	2092.2
184	293	2094.1	1.3	1.5	2096.9
185	294	2098.7	1.0	1.2	2100.9
186	295	2103.1	0.3	2.2	2105.6
187	296	2107.5	0.3	1.6	2109.4
188	297	2111.8	−0.1	2.2	2113.8
189	298	2115.9	0.1	1.5	2117.5
		$Z = 110$			
168	278	2010.7	2.9	0.5	2013.7
169	279	2017.0	2.9	0.2	2019.8
170	280	2023.2	3.2	0.4	2026.6
171	281	2029.4	3.1	0.3	2032.6
172	282	2035.4	3.4	0.5	2039.2
173	283	2041.3	3.6	0.3	2045.1
174	284	2047.2	3.9	0.4	2051.3
175	285	2052.9	3.7	0.4	2056.9
176	286	2058.5	3.7	0.7	2062.8
177	287	2064.0	3.5	0.6	2068.1
178*	288	2069.4	3.4	1.1	2073.8
179	289	2074.7	2.8	1.4	2078.9
180	290	2079.9	3.0	1.4	2084.3
181	291	2085.0	2.8	1.4	2089.2
182	292	2090.0	2.5	1.8	2094.3
183	293	2094.9	2.4	1.6	2098.9
184	294	2099.7	2.4	1.7	2103.8
185	295	2104.4	2.0	1.5	2107.9
177	289	2071.6	5.1	0.5	2077.2
178	290	2077.4	5.0	0.9	2083.3
179	291	2083.0	5.0	0.8	2088.8
180	292	2088.6	5.3	0.8	2094.6
181	293	2094.0	5.1	0.7	2099.8
182*	294	2099.3	4.8	1.1	2105.3
183	295	2104.6	4.7	0.8	2110.2
184	296	2109.7	4.7	1.0	2115.4
185	297	2114.8	4.3	0.8	2119.9
186	298	2119.7	3.7	1.7	2125.1
187	299	2124.6	3.5	1.3	2129.4
188	300	2129.4	3.1	1.9	2134.3
189	301	2134.0	3.0	1.4	2138.5
190	302	2138.6	2.8	1.9	2143.3
191	303	2143.1	2.7	1.4	2147.2
192	304	2147.5	2.6	1.8	2151.9
193	305	2151.8	2.8	1.2	2155.7
194	306	2156.0	2.6	1.6	2160.2
		$Z = 113$			
175	288	2062.7	6.1	−0.1	2068.6
176	289	2068.8	6.2	0.1	2075.1
177	290	2074.8	6.2	0.	2080.9
178	291	2080.8	6.3	0.2	2087.2
179	292	2086.6	6.4	−0.1	2092.9
180	293	2092.3	6.6	0.	2098.8
181	294	2097.9	6.4	−0.1	2104.2
182	295	2103.4	6.2	0.2	2109.8
183	296	2108.8	6.1	−0.1	2114.8

186	296	2109.1	1.3	2.4	2112.8
187	297	2113.6	1.2	1.9	2116.7
188	298	2118.0	0.8	2.6	2121.4
189	299	2122.4	0.8	2.0	2125.2
190	300	2126.6	0.6	2.4	2129.6
191	301	2130.8	0.6	1.9	2133.3

$Z = 111$

171	282	2032.3	3.6	0.1	2035.9
172	283	2038.5	4.0	0.3	2042.7
173	284	2044.6	4.2	0.	2048.7
174	285	2050.6	4.4	0.2	2055.1
175	286	2056.5	4.4	0.1	2060.9
176	287	2062.3	4.4	0.3	2066.9
177	288	2068.0	4.3	0.2	2072.4
178	289	2073.6	4.3	0.5	2078.3
179	290	2079.1	4.1	0.4	2083.5
180*	291	2084.4	4.2	0.5	2089.1
181	292	2089.7	4.0	0.5	2094.2
182	293	2094.9	3.6	0.9	2099.5
183	294	2100.0	3.5	0.7	2104.2
184	295	2104.9	3.5	0.9	2109.3
185	296	2109.8	3.1	0.6	2113.5
186	297	2114.6	2.4	1.5	2118.6
187	298	2119.3	2.4	1.0	2122.7
188	299	2123.9	2.0	1.6	2127.5
189	300	2128.4	2.0	1.0	2131.5
190	301	2132.8	1.9	1.4	2136.1
191	302	2137.1	1.9	0.9	2139.9
192	303	2141.3	1.6	1.4	2144.4

$Z = 112$

173	285	2047.5	4.8	0.4	2052.7
174	286	2053.7	5.0	0.6	2059.3
175	287	2059.8	5.1	0.4	2065.2
176	288	2065.8	5.1	0.7	2071.5

184*	297	2114.2	6.0	0.1	2120.3
185	298	2119.4	5.5	0.	2124.9
186	299	2124.5	5.2	0.6	2130.3
187	300	2129.5	4.9	0.3	2134.7
188	301	2134.4	4.7	0.8	2139.9
189	302	2139.3	4.5	0.4	2144.2
190	303	2144.0	4.4	0.8	2149.1
191	304	2148.7	4.3	0.3	2153.3
192	305	2153.2	4.2	0.7	2158.1
193	306	2157.7	4.2	0.2	2162.1
194	307	2162.0	4.2	0.5	2166.7
195	308	2166.3	4.2	−0.1	2170.5
196	309	2170.5	4.4	0.	2174.9

$Z = 114$

177	291	2077.7	7.4	0.	2085.1
178	292	2083.7	7.7	0.1	2091.6
179	293	2089.7	7.7	0.	2097.5
180	294	2095.6	7.9	0.	2103.6
181	295	2101.4	7.7	0.	2109.1
182	296	2107.1	7.5	0.3	2114.9
183	297	2112.7	7.4	0.	2120.1
184	298	2118.2	7.5	0.1	2125.7
185	299	2123.6	6.9	0.	2130.5
186*	300	2128.8	6.4	0.8	2136.0
187	301	2134.0	6.1	0.5	2140.6
188	302	2139.1	5.8	1.1	2145.9
189	303	2144.1	5.6	0.7	2150.4
190	304	2149.0	5.4	1.1	2155.5
191	305	2153.8	5.3	0.7	2159.8
192	306	2158.5	5.2	1.0	2164.8
193	307	2163.2	5.3	0.4	2168.9
194	308	2167.7	5.3	0.7	2173.7
195	309	2172.1	5.5	0.	2177.6
196	310	2176.5	5.8	0.	2182.3
197	311	2180.7	4.9	0.	2185.6
198	312	2184.9	4.1	1.2	2190.1

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