

Introductory Nuclear Physics (3rd Edition)

Step-by-step solution

Step 1 of 5

Write the semi-empirical mass formula:

$$B.E. = a_v A - a_s A^{2/3} - a_c \frac{Z(Z-1)}{A^{1/3}} + a_a \frac{(A-2Z)^2}{A} \pm a_p A^{-1/2}$$

Here, $B.E.$ is the binding energy, a_v is volume term, a_s is surface term, a_a is asymmetry term, a_c is the coulomb term, a_p is parity term, A is mass number, and Z is the atomic number.

The parity term is positive for even Z and even A , negative for odd Z , and odd A and zero for even Z and odd A or odd Z and even A .

The values of the terms are as follows:

$$a_v = 15.5 \text{ MeV}$$

$$a_s = 16.8 \text{ MeV}$$

$$a_c = 0.72 \text{ MeV}$$

$$a_a = 23 \text{ MeV}$$

$$a_p = 34 \text{ MeV}$$

Write the coulomb energy term,

$$E_c = a_c \frac{Z(Z-1)}{A^{1/3}}$$

Comment

Step 2 of 5

(a)

The mass number for ^{21}Ne is 21 and the atomic number is 10.

The binding energy of ^{21}Ne is as follows:

$$B.E. = a_v A - a_s A^{2/3} - a_c \frac{Z(Z-1)}{A^{1/3}} + a_a \frac{(A-2Z)^2}{A} \pm a_p A^{-1/2}$$

Substitute 21 for A and 10 for Z .

$$B.E. = \left[(15.5 \text{ MeV})(21) - (16.8 \text{ MeV})(21)^{2/3} - (0.72 \text{ MeV}) \frac{10(10-1)}{(21)^{1/3}} + (23 \text{ MeV}) \frac{(21-2(10))^2}{(21)} \pm 0 \right]$$

$$= 175.2 \text{ MeV}$$

The coulomb energy of ^{21}Ne is as follows:

$$E_c = -a_c \frac{Z(Z-1)}{A^{1/3}}$$

Substitute 21 for A and 10 for Z .

$$E_c = -(0.72 \text{ MeV}) \frac{10(10-1)}{(21)^{1/3}}$$

$$= -23.5 \text{ MeV}$$

The coulomb energy of ^{21}Ne is $[-23.5 \text{ MeV}]$.

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