Worksheet Solution

(Chapter 2 Binding Energy)

Ans. 1: (c)

Solution: Mass defect, $\Delta m = m_p + m_e - m_n$

$$\Delta m = \left(1.6725\times10^{-27}\right)+\left(9\times10^{-31}\right)-\left(1.6725\times10^{-27}\right)kg$$

$$\Delta m = 9\times10^{-31}kg$$

Energy released $= \Delta mc^2$

Energy released $= \left(9\times10^{31}\right)\times\left(3\times10^{8}\right)^2 J$

Energy released $= \left[\left(9\times10^{-31}\right)\times\left(9\times10^{16}\right)\right]/\left[1.6\times10^{-13}\right]MeV = 0.51\,MeV$

Ans. 2: (a)

Ans. 3: (d)

Ans. 4: (b) and (c)

Ans. 5: (b)

Ans. 6: (b)

Solution: $E_n\left({}^4_2He\right):E_n\left({}^{12}_6C\right) \quad \Rightarrow A_{He}^{-1}:A_c^{-1} \qquad \Rightarrow 4^{-1}:12^{-1}=3$

Ans. 7: (c)

Solution: $B = a_v A - a_s A^{2/3} - \dfrac{a_c z(z-1)}{A^{1/3}} - \dfrac{a_n (A-2z)^2}{A} \pm \dfrac{a_p}{A^{3/4}}$

$a_v = 0, a_s = 0, a_c = 0$ and $a_p = 0$, then

$$B = \frac{a_n (A-2z)^2}{A}, \frac{\partial B}{\partial Z} = \frac{2a_n}{A}(A-2z)(-2) = 0$$

$$\frac{2a_n}{A}(A-2z) = 0 \Rightarrow 2a_n \frac{A}{A} - \frac{4a_n z}{A} = 0$$

$$a_n = 2a_n \frac{Z}{A} \Rightarrow Z = \frac{A}{2} \Rightarrow \frac{Z}{A} = \frac{1}{2}$$

Ans. 8: (a)

Solution: $B \approx \dfrac{a_c\left(z^2 - z\right)}{A^{1/3}} \Rightarrow \dfrac{\partial B}{\partial Z} = \dfrac{a_c(2Z-1)}{A^{1/3}} = 0$

$$\frac{2a_c z}{A^{1/3}} = \frac{a_c}{A^{1/3}} \Rightarrow z = \frac{1}{2}$$

Ans. 9: (b)

Ans. 10: (c)

Ans. 11: (d)

Ans. 12: (b)

Solution: $B = \dfrac{a_n (A-2z)^2}{A}$

$$\frac{\partial B}{\partial Z} = 0 \Rightarrow 2a_n \frac{(A-2z)}{A} = 0$$

$$\frac{2a_n A}{A} = \frac{4a_n z}{A} \Rightarrow 1 = \frac{2z}{A} \Rightarrow \left[Z = \frac{A}{2} \right]$$

Ans. 13: (c)

Ans. 14: (a)

Ans. 15: (a)

Solution: $Z_0 = \dfrac{64}{2 + 0.015A^{2/3}} = \dfrac{64}{2 + 0.015(64)^{2/3}}$

$$Z_0 = \frac{64}{2 + 0.015 \times 16} = \frac{64}{2 + 0.240} = \frac{64}{2.24}$$

$$Z_0 = 28.57$$

Ans. 16: (a)

Solution: $\dfrac{\partial B}{\partial Z} = -\dfrac{2a_c z}{A^{1/3}} - \dfrac{2a_n (A-2z)}{A}(-2) = 0$

$$\frac{2a_c}{A^{1/3}} = \frac{4a_n (A-2z)}{A} \Rightarrow \frac{2a_c z}{A^{1/3}} = 4a_n - \frac{8a_n z}{A}$$

$$4a_n = z\left[\frac{2a_c}{A^{1/3}} + \frac{8a_n}{A} \right]$$

$$Z\left[\frac{2a_c A + 8a_n A^{1/3}}{A^{4/3}} \right] = 4a_n$$

$$Z\left[\frac{2a_c A + 4a_n A^{1/3}}{A^{4/3}} \right] = 2a_n$$

$$Z = \frac{2a_n A, A^{1/3}}{a_c A + 4a_n A^{1/3}} = \frac{2a_n A}{4a_n + a_c A^{2/3}}$$

But value of a_n and a_c

$$Z = \frac{2 \times 9MeVA}{4 \times 19MeV + 0.595MeV \times A^{2/3}}$$

$$Z = \frac{38A}{76 + 0.595A^{2/3}}$$

$$Z = \frac{A}{2 + 0.015A^{2/3}} \text{ [divided by 38]}$$

Ans. 17: (a)

Solution: By the formula

$$B(A,Z) = a_v A - a_s A^{2/3} - \frac{a_c z(z \cdot 1)}{A^{1/3}} - \frac{a_n (A-2z)^2}{A} \pm \frac{a_p}{A^{3/4}}$$

volume term (a_v) is positive.

Ans. 18: (b)

Solution: $\alpha = 14.1MeV$, $\delta = 33.5MeV$ (for even-even n)

$$\beta = 13.0MeV, Y = 0.595MeV, \xi = 19MeV$$

Ans. 19: (c)

Ans. 20: (d)

Ans. 21: (a)

Ans. 22: (b)

Ans. 23: (d)