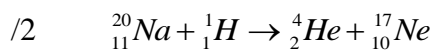


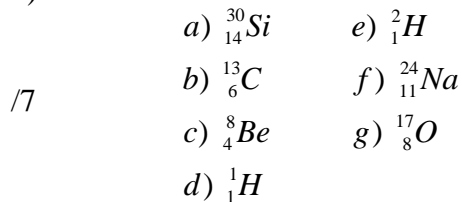
Physics 30 – Lesson 35
Nuclear Physics

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1)



2)



3)

$$F_E = F_m$$

$$q|\vec{E}| = qvB_{\perp}$$

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$$\frac{V}{d} = vB_{\perp}$$

$$V = dvB_{\perp}$$

$$V = 0.0150m(4.20 \times 10^5 \text{ m/s})(4.00 \times 10^{-2} T)$$

$$\boxed{V = 252V}$$

4)

$$B_{\perp} = 0.250T$$

$$E = 7000V / m$$

$$r = 8.12 \times 10^3 m$$

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$$q = 1.60 \times 10^{-19} C$$

a) $F_E = F_m$

$$q|\vec{E}| = qvB_{\perp}$$

$$v = \frac{|\vec{E}|}{B_{\perp}}$$

$$v = \frac{7000 \frac{V}{m}}{0.250T}$$

$$v = 28000 \text{ m/s}$$

b) $F_m = F_c$

$$qvB_{\perp} = \frac{mv^2}{r}$$

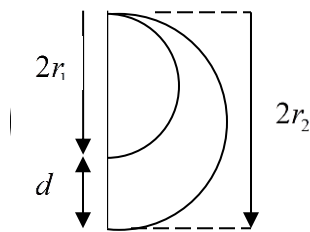
$$m = \frac{qB_{\perp}r}{v}$$

$$m = \frac{(1.60 \times 10^{-19} C)(0.250T)(8.12 \times 10^3 m)}{28000 \text{ m/s}}$$

$$\boxed{m = 1.16 \times 10^{-26} kg}$$



5)



The difference (d) is the difference in the **diameters** ($2r$).

$$d = 2r_2 - 2r_1$$

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$$m_1 = 23.98504 \times 1.660540 \times 10^{-27} \text{ kg}$$

$$m_2 = 24.98584 \times 1.660540 \times 10^{-27} \text{ kg}$$

$$q_1 = q_2 = 3.20 \times 10^{-19} \text{ C}$$

$$B_{\perp} = 0.250 \text{ T}$$

$$F_E = F_m$$

$$q|\vec{E}| = qvB_{\perp}$$

$$v = \frac{|\vec{E}|}{B_{\perp}}$$

$$v = \frac{4.60 \times 10^5 \frac{\text{V}}{\text{m}}}{0.850 \text{ T}}$$

$$v = 5.412 \times 10^5 \text{ m/s}$$

$$F_m = F_c$$

$$qvB_{\perp} = \frac{mv^2}{r}$$

$$r = \frac{mv}{qB_{\perp}}$$

$$r_1 = \frac{(23.98504 \text{ u} \times 1.660539 \times 10^{-27} \frac{\text{kg}}{\text{u}})(5.412 \times 10^5 \text{ m/s})}{(3.20 \times 10^{-19} \text{ C})(0.250 \text{ T})}$$

$$r_1 = 0.2694 \text{ m}$$

$$r_2 = \frac{(28.98584 \text{ u} \times 1.660539 \times 10^{-27} \frac{\text{kg}}{\text{u}})(5.412 \times 10^5 \text{ m/s})}{(3.20 \times 10^{-19} \text{ C})(0.250 \text{ T})}$$

$$r_2 = 0.2807 \text{ m}$$

$$d = 2(0.2807 \text{ m}) - 2(0.2694 \text{ m})$$

$$\boxed{d = 0.0226 \text{ m}}$$

6)

$$q = 1.60 \times 10^{-19} \text{ C}$$

$$r = 0.113 \text{ m}$$

$$|\vec{E}| = 7.50 \times 10^4 \frac{\text{N}}{\text{C}}$$

$$B_{\perp} = 0.300 \text{ T}$$

$$m = ?$$

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speed

$$F_E = F_m$$

$$q|\vec{E}| = qvB_{\perp}$$

$$v = \frac{|\vec{E}|}{B_{\perp}}$$

$$v = \frac{7.50 \times 10^4 \frac{\text{N}}{\text{C}}}{0.300 \text{ T}}$$

$$v = 2.5 \times 10^5 \text{ m/s}$$

$$F_m = F_c$$

$$qvB_{\perp} = \frac{mv^2}{r}$$

$$m = \frac{qB_{\perp}r}{v}$$

$$m = \frac{1.60 \times 10^{-19} \text{ C}(0.300 \text{ T})(0.113 \text{ m})}{2.5 \times 10^5 \text{ m/s}}$$

$$m = 2.1696 \times 10^{-26} \text{ kg}$$

$$\# = \frac{2.1696 \times 10^{-26} \text{ kg}}{1.660539 \times 10^{-27} \frac{\text{kg}}{\text{u}}} = \boxed{13}$$

isotope is carbon-13

7)

theoretical mass

$$\text{protons } 27 \times 1.007276 \text{ u}$$

$$\text{neutrons } 32 \times 1.008665 \text{ u}$$

$$59.473732 \text{ u}$$

/4

$$\Delta m = m_{\text{measured}} - m_{\text{theoretical}}$$

$$\Delta m = 58.9332 \text{ u} - 59.473732 \text{ u}$$

$$\boxed{\Delta m = -0.540532 \mu}$$

$$\Delta m = -0.540532 \text{ u} \times 1.660539 \times 10^{-27} \frac{\text{kg}}{\text{u}}$$

$$\boxed{\Delta m = -8.976 \times 10^{-28} \text{ kg}}$$

8)

$$M_{AVG} = 0.7577(34.96885) + 0.2423(36.96590)$$

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$$M_{AVG} = 35.45$$

9)

theoretical mass

$$\Delta m = 7.0160u - 7.056488u$$

protons $3 \times 1.007276u$

$$\Delta m = -0.040488u$$

neutrons $4 \times 1.008665u$

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$$7.056488u$$

$$E = \Delta mc^2$$

$$E = (-0.040488u \times 1.660539 \times 10^{-27} \frac{kg}{u})(3.0 \times 10^8 \frac{m}{s})^2$$

$$E = -6.050875 \times 10^{-12} J$$

$$E = \frac{-6.050875 \times 10^{-12} J}{1.60 \times 10^{-19} \frac{J}{eV}}$$

$$E = -37.818 MeV$$

10)

theoretical mass

$$\Delta m = 226.0254u - 227.836058u$$

protons $88 \times 1.007276u$

$$\Delta m = -1.810658u$$

neutrons $138 \times 1.008665u$

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$$227.836058u$$

$$E = \Delta mc^2$$

$$E = (-1.810658u \times 1.660539 \times 10^{-27} \frac{kg}{u})(3.0 \times 10^8 \frac{m}{s})^2$$

$$E = -2.706003 \times 10^{-10} J$$

$$E = \frac{-2.706003 \times 10^{-10} J}{1.60 \times 10^{-19} \frac{J}{eV}}$$

$$E = -1691.25 MeV$$

$$E_{nucleon} = \frac{-1691.25 MeV}{226}$$

$$E_{nucleon} = -7.48342 \frac{MeV}{nucleon}$$

11)

$$m = \frac{E}{c^2}$$

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$$m = \frac{4.0 \times 10^{26} J}{(3.0 \times 10^8 \frac{m}{s})^2}$$

$$m = 4.4 \times 10^9 kg / s$$



12)

$$E_{atom} = 3.2 \times 10^{-8} \text{ J / atom}$$

$$n = \frac{E_T}{E_{atom}}$$

$$m = \frac{E}{c^2}$$

/4

$$E_T = 8.0 \times 10^{13} \text{ J}$$

$$n = \frac{8.0 \times 10^{13} \text{ J}}{3.2 \times 10^{-8} \text{ J / atom}}$$

$$m = \frac{8.0 \times 10^{13} \text{ J}}{(3.0 \times 10^8 \text{ m/s})^2}$$

$$\boxed{n = 2.5 \times 10^{21} \text{ atoms}}$$

$$\boxed{m = 8.9 \times 10^{-4} \text{ kg}}$$

13)

a)

$$\Delta m = (235.043925u + 1.00867u) - (139.92161u + 93.915367u + 2 \times 1.00867u)$$

$$\Delta m = -0.19781u \times 1.660540 \times 10^{-27} \frac{\text{kg}}{u}$$

$$\Delta m = -3.28 \times 10^{-28} \text{ kg}$$

/4

$$E = \Delta mc^2$$

$$E = (-3.28 \times 10^{-28} \text{ kg})(3.0 \times 10^8 \text{ m/s})^2$$

$$\boxed{E = -2.96 \times 10^{-11} \text{ J}}$$

b)

$$\Delta m = [4.00260u + 2(1.00728u)] - [3.01603u + 3.01603u]$$

$$\Delta m = -0.01490u \times 1.660540 \times 10^{-27} \frac{\text{kg}}{u}$$

$$\Delta m = -2.47 \times 10^{-29} \text{ kg}$$

/4

$$E = \Delta mc^2$$

$$E = (-2.474 \times 10^{-29} \text{ kg})(3.00 \times 10^8 \text{ m/s})^2$$

$$\boxed{E = -2.23 \times 10^{-12} \text{ J}}$$

14)

$$P = 3.0 \times 10^9 \text{ W}$$

$$E = Pt$$

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$$E = ?$$

$$E = (3.0 \times 10^9 \text{ W})(3.1536 \times 10^7 \text{ s})$$

$$t = 365 \text{ days} \times 24 \times 3600$$

$$E = 9.461 \times 10^{16} \text{ J}$$

$$t = 3.1536 \times 10^7 \text{ s}$$

$$m = \frac{E}{c^2}$$

$$m = \frac{9.461 \times 10^{16} \text{ J}}{(3.0 \times 10^8 \text{ m/s})^2}$$

$$\boxed{m = 1.1 \text{ kg}}$$