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Nucleus Formulas

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List of 11 Nucleus Formulas

Nucleus 🔗

1) Average Life 🔗

Open Calculator 🔗

fx $t_{avg} = \dfrac{1}{\lambda}$

ex $2.5s = \dfrac{1}{0.4Hz}$

2) Binding Energy 🔗

Open Calculator 🔗

fx $BE = (Z \cdot m_p + (A - Z) \cdot m_n - m_{atom}) \cdot [c]^2$

ex $2E\char`^10eV = (17 \cdot 1.00728u + (37 - 17) \cdot 1.00866u - 16u) \cdot [c]^2$

3) Change in Mass in Nuclear Reaction 🔗

Open Calculator 🔗

fx $\Delta m = m_{reactant} - m$

ex $3E\char`^27u = 60kg - 55kg$

4) Decay Rate 🔗

Open Calculator 🔗

fx $D = -\lambda \cdot N$

ex $-26 = -0.4Hz \cdot 65$

5) Energy Released in Nuclear Reaction ↗

Open Calculator ↗

fx $E = \Delta m \cdot [c]^2$

ex $1.2E\text{\textasciicircum}-10J = 0.8u \cdot [c]^2$

6) Half Life for Nuclear Decay ↗

Open Calculator ↗

fx $t_{0.5} = \dfrac{0.693}{\lambda}$

ex $1.7325s = \dfrac{0.693}{0.4Hz}$

7) Mass Defect ↗

Open Calculator ↗

fx $\Delta m = Z \cdot m_p + (A - Z) \cdot m_n - m_{atom}$

ex $21.29696u = 17 \cdot 1.00728u + (37 - 17) \cdot 1.00866u - 16u$

8) Nuclear Radius ↗

Open Calculator ↗

fx $r = r_0 \cdot A^{\frac{1}{3}}$

ex $4.165277f = 1.25f \cdot (37)^{\frac{1}{3}}$

9) Population after N Half Lives ⤴

fx $$N_t = \frac{N_o}{2^n}$$

Open Calculator ⤴

ex $$1.5625 = \frac{50}{2^5}$$

10) Population at Time t ⤴

fx $$N_t = N_o \cdot e^{-\frac{\lambda \cdot t}{3.156 \cdot 10^7}}$$

Open Calculator ⤴

ex $$49.99998 = 50 \cdot e^{-\frac{0.4Hz \cdot 25s}{3.156 \cdot 10^7}}$$

11) Q-Value ⤴

fx $$Q = U_i - U_f$$

Open Calculator ⤴

ex $$10J = 20J - 10J$$

Variables Used

- Δm Mass Defect *(Atomic Mass Unit)*
- A Mass Number
- BE Binding Energy *(Electron-Volt)*
- D Decay Rate
- E Energy *(Joule)*
- m Mass Product *(Kilogram)*
- m_{atom} Mass of Atom *(Atomic Mass Unit)*
- m_n Mass of Neutron *(Atomic Mass Unit)*
- m_p Mass of Proton *(Atomic Mass Unit)*
- $m_{reactant}$ Mass Reactant *(Kilogram)*
- n Number of Half Lives
- N Total Number of Particles in Sample
- N_o Number of Particles in Sample Initially
- N_t Number of Particles at Time t
- Q Q Value *(Joule)*
- r Nuclear Radius *(Fermi)*
- r_0 Radius of Nucleon *(Fermi)*
- t Time *(Second)*
- $t_{0.5}$ Half Life Period *(Second)*
- t_{avg} Average Life *(Second)*
- U_f Final Energy *(Joule)*
- U_i Initial Energy *(Joule)*

- **Z** Atomic Number
- **λ** Decay Constant *(Hertz)*

Constants, Functions, Measurements used

- Constant: **[c]**, 299792458.0 Meter/Second
  Light speed in vacuum
- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Measurement: **Length** in Fermi (f)
  Length Unit Conversion ⬀
- Measurement: **Weight** in Atomic Mass Unit (u), Kilogram (kg)
  Weight Unit Conversion ⬀
- Measurement: **Time** in Second (s)
  Time Unit Conversion ⬀
- Measurement: **Energy** in Electron-Volt (eV), Joule (J)
  Energy Unit Conversion ⬀
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion ⬀

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- **Atom Formulas** ⤴
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