Class 12 Physics · Chapter 13: Nuclei

Worksheet · 20 marks · about 40 minutes · based on NCERT

Name _____ Class and section _____ Date _____

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1. The radius of a nucleus is about 10^{-4} times the radius of its atom. The fraction of the atom's volume occupied by the nucleus is about [1]

(a) 10^{-12} (b) 10^{-16}
(c) 10^{-4} (d) 10^{-8}

2. The binding energy of the ${}^{4}_{2}\mathrm{He}$ nucleus is 28.3 MeV. Its mass defect is (take 1 u = 931.5 MeV/c^2) [1]

(a) 0.304 u (b) 0.0304 u
(c) 0.0152 u (d) 0.0076 u

3. When beryllium was bombarded with α-particles, it gave out a neutral radiation that could knock protons out of light nuclei. Chadwick concluded that this radiation was not made of photons because [1]

(a) photons able to do this would need far more energy than the bombardment could supply (b) photons are always absorbed by protons without ejecting them
(c) photons cannot travel through beryllium (d) photons carry electric charge

4. Of the following nuclei, the one in which a nucleon is, on average, most tightly bound is [1]

(a) ${}^{4}_{2}\mathrm{He}$ (b) ${}^{12}_{6}\mathrm{C}$
(c) ${}^{238}_{92}\mathrm{U}$ (d) ${}^{56}_{26}\mathrm{Fe}$

5. Which of the following nuclides is an isotone of ${}^{14}_{6}\mathrm{C}$? [1]

(a) ${}^{13}_{6}\mathrm{C}$ (b) ${}^{14}_{7}\mathrm{N}$
(c) ${}^{15}_{8}\mathrm{O}$ (d) ${}^{16}_{8}\mathrm{O}$

6. State whether each pair is a pair of isotopes, isobars or isotones: (i) ${}^{40}_{18}\mathrm{Ar}$ and ${}^{40}_{20}\mathrm{Ca}$ (ii) ${}^{13}_{6}\mathrm{C}$ and ${}^{14}_{7}\mathrm{N}$ (iii) ${}^{35}_{17}\mathrm{Cl}$ and ${}^{37}_{17}\mathrm{Cl}$ (iv) ${}^{2}\mathrm{H}$ and ${}^{3}\mathrm{H}$. [2]

7. How much energy is needed to remove one neutron from a ${}^{13}_{6}\mathrm{C}$ nucleus, leaving ${}^{12}_{6}\mathrm{C}$? Given the atomic masses m(${}^{13}_{6}\mathrm{C}$) = 13.003355 u, m(${}^{12}_{6}\mathrm{C}$) = 12.000000 u, m_n = 1.008665 u and 1 u = 931.5 MeV/c^2. [2]

8. The fission of 1 kg of uranium gives about 10^{14} J, and burning 1 kg of coal gives about 10^{7} J. What mass of coal must be burnt to give the energy released by the fission of 1 g of uranium? What does the comparison show about nuclear and chemical energies? [2]

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9. The binding energies of ${}^{7}_{3}\mathrm{Li}$, ${}^{4}_{2}\mathrm{He}$ and ${}^{3}_{1}\mathrm{H}$ are 39.25 MeV, 28.30 MeV and 8.48 MeV. (a) Find the minimum energy needed to split a ${}^{7}_{3}\mathrm{Li}$ nucleus into a ${}^{4}_{2}\mathrm{He}$ nucleus and a ${}^{3}_{1}\mathrm{H}$ nucleus. (b) Find the binding energy per nucleon of ${}^{7}_{3}\mathrm{Li}$ and of ${}^{4}_{2}\mathrm{He}$. (c) Why does ${}^{7}_{3}\mathrm{Li}$, though heavier, have a lower binding energy per nucleon than ${}^{4}_{2}$ He? [3]

10. A nuclear reactor produces heat at 500 MW from the fission of ${}^{235}_{92}\mathrm{U}$, each fission giving 200 MeV. Find (a) the number of fissions per second, and (b) the mass of ${}^{235}\mathrm{U}$ used up in one day. Take 1 MeV = 1.6×10^{-13} J and $N_A = 6.02 \times 10^{23}$ mol^{-1}. [3]

11. A ${}^{238}_{92}\mathrm{U}$ nucleus emits an α-particle, and the product then emits two β^- particles, one after the other. Write the three steps, and state how the final nucleus is related to the original. [3]

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