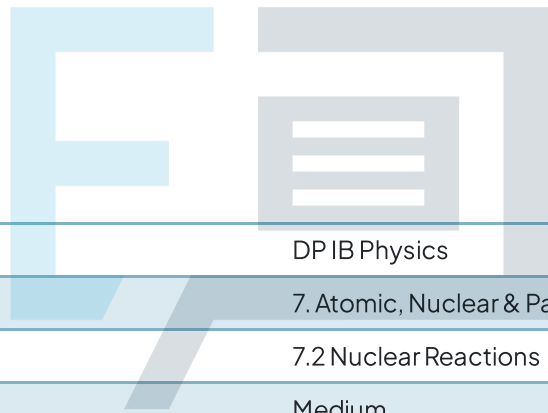




7.2 Nuclear Reactions

Question Paper



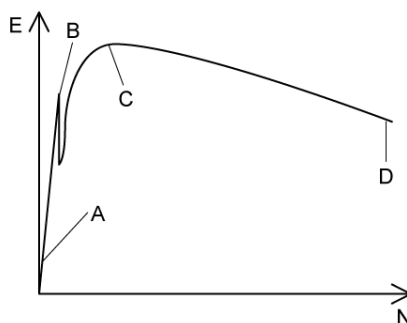
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|------------|---------------------------------------|
| Course | DP IB Physics |
| Section | 7. Atomic, Nuclear & Particle Physics |
| Topic | 7.2 Nuclear Reactions |
| Difficulty | Medium |

Exam Papers Practice

To be used by all students preparing for DP IB Physics HL
Students of other boards may also find this useful

Question 1

The image below shows a simplified version of the binding energy per nucleon E of nuclei versus the nucleon number N . Which of the following positions represents nuclei that are the most stable?



[1 mark]

Question 2

The rest mass of a nucleus of Boron-11 (${}^{11}_5\text{B}$) can be considered as m_B . The rest-masses of a neutron and proton can be considered as m_N and m_P respectively. Which of the following equations is the correct representation for the binding energy of Boron-11?

- A. $(5m_P + 6m_N - m_B)c^2$
- B. $(5m_P + 6m_N + m_B)c^2$
- C. $(5m_P + 11m_N - m_B)c^2$
- D. $(6m_P + 5m_N - m_B)c^2$

[1 mark]

Question 3

Which statement about nuclear binding energy is correct?

- A. It is the energy equivalent of the mass of the neutrons in a nucleus
- B. It is the energy required to separate nucleons in a nucleus
- C. It is the energy required to overcome the electrostatic force between nucleons in the nucleus
- D. It is the energy required to remove a single nucleon from a nucleus

[1 mark]

Question 4

The binding energy per nucleon is 7.98 MeV for an atom of ${}^{16}_8\text{O}$. Approximately how much energy would be needed to completely separate the nucleons of this atom?

- A. 33.2 MeV
- B. 63.9 MeV
- C. 88.5 MeV
- D. 127.7 MeV

[1 mark]

Question 5

The mass defect for Helium-4 is 5.04×10^{-29} kg. What is the binding energy of Helium-4 closest to?

- A. 0.02 MeV
- B. 28 MeV
- C. 190 MeV
- D. 1225 MeV

[1 mark]

Question 6

Which of the following isotopes releases the least amount of potential energy during nuclear fission?

- A. Uranium-235
- B. Thorium-231
- C. Radon-222
- D. Osmium-190

[1 mark]

Question 7

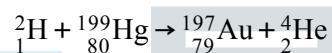
Two identical nuclei of mass m fuse to form a single heavier nucleus (with no other products) with mass M . Which of the following statements is correct?

- A. $m = M$
- B. $2m = M$
- C. $2m > M$
- D. $2m < M$

[1 mark]

Question 8

Alchemists investigated the process of transmutation of mercury into gold. This can be represented by the following equation:



The sum of the rest masses of deuterium and mercury is 202.60 u and the sum of the rest masses of gold and helium are 200.97 u.

Take the energy equivalent of 0.001 u to be 1 MeV.

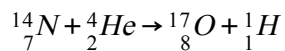
Which of the following can be determined from the information provided?

- A. Energy of approximately 2000 MeV has been converted to a mass of 2 u
- B. The kinetic energy of the products exceeds the kinetic energy of the reactants by 2000 MeV
- C. The number of nuclei of gold is not equal to the number of nuclei of mercury
- D. The kinetic energy of the deuterium nucleus was 2000 MeV

[1 mark]

Question 9

Nitrogen-14 can be transformed into Oxygen-17 by bombardment with high energy alpha particles, as described in the nuclear reaction equation below:



The total rest mass of the reactants is 18.006 u and total rest mass of the products is 18.007 u.

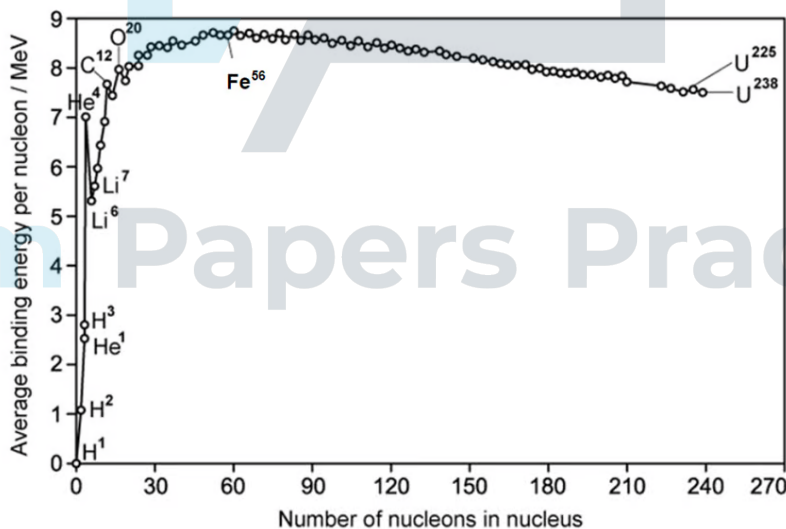
Which of the following statements about this reaction is **correct**?

- A. A mass of 0.001 u has been converted to about 1 MeV of energy
- B. The kinetic energy of the products exceeds the kinetic energy of the reactants by about 1 MeV
- C. The kinetic energy of the reactants exceeds the kinetic energy of the products by about 1 MeV
- D. The mass defect of this reaction is 0.002 u

[1 mark]

Question 10

The graph below shows how the average binding energy per nucleon varies with nucleon number for stable nuclei.



Approximately how much energy is released when the nucleus ${}_{70}^{181}\text{X}$ forms?

- A. 7.90 MeV
- B. 1430 MeV
- C. 533 MeV
- D. 888 MeV

[1 mark]