**IB Physics**

**27.2 Group Quiz**

Name

**Show your work, and circle your answers and use sig figs to receive full credit.**

**Closest Approach: Ek = 1/2mv2  Q = 2e, q = Ze 1 fm = 10-15 m**

1. An alpha particle (m = 6.64x10−27 kg) going 5.36x107 m/s will get how close to a lead (Z = 82) nucleus if it hits head on? (3.97 fm)

2. A speeding alpha particle (m = 6.64x10−27 kg) hits a cobalt (Z = 27) nucleus head on. If it comes within 56.0 fm of the nucleus’ center, how fast was it going to start with? (8.19x106 m/s)

3. A 36.0 MeV alpha particle (m = 6.64x10−27 kg) can get how close to a gold nucleus (Z = 79)? (36.0 MeV is the KE)

(6.32 fm)

**Bohr Atom:  and **

4. What is the wavelength of the photon associated with an electron transition from n = 2 to n = 1 in a hydrogen atom? Is the photon being absorbed, or emitted? (122 nm – emitted)

5. What is the wavelength of the photon associated with an electron transition from n = 2 to n = 5 in a hydrogen atom? Is the photon being absorbed, or emitted? (434 nm – absorbed)

**Nuclear Radius:  Ro = 1.2 x 10-15 m (1.2 fm)**

6. What is the radius of Cl-36 nucleus? (3.96 fm)

7. What is the likely mass number of a nucleus with a radius of 7.064x10-15 m? (204)

**Heisenberg Indeterminacy:  or **

8. To effect an alpha decay, an alpha particle must “borrow” 23.0 MeV of energy. What time does it have to escape? (1.43x10-23 s)

9. A proton has an uncertainty in its velocity of ±1.20x106 m/s. What is the minimum uncertainty in its position? (13.1 fm)

**Conceptual Questions:**

I: How was Rutherford's atomic model different from Thomson's "plum pudding" model?

I: How did Rutherford discover the nucleus? What size did he determine for the atom and the nucleus?

I1: How does the density of a nucleus change with mass number? What is the density of the Uranium-235 nucleus? What is the density of the carbon-12 nucleus? Calculate both densities: (2.3x1017 kg m-3)

m = A(1.661x10-27 kg), V = 4/­3πr3, ρ = m/V

K: Specifically what phenomenon, what observed behavior of atoms was Bohr trying to explain with his quantum atomic model?

N: Energy indeterminacy accounts for nuclear decay - particles in the nucleus "borrow" energy to escape - Where does the energy come from that they "borrow", and where does it go after it has escaped?

O: What was the Einstein-Bohr debate about? What did Einstein object to in quantum mechanics?

Part A: Find the missing decay product:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | τ- → π- + πo + ??  υτ | ??→ π+ + πo +  τ+ | τ- → υτ + ?? +  e- | τ+ → + e+ + ??  υe |
| 2 | τ- → ?? + μ- +  υτ | τ+ → ?? + μ+ + υμ | ?? → e- + + υμ  μ- | μ+ → e+ + ?? +  υe |
| 3 | μ- → e- + + υμ + e+ + ??  e- | μ+ → e+ + ?? + + e+ + e-  υe | → π+ + ?? +  μ- | K+ → ?? + υμ  μ+ |

Part B: For these reactions, indicate if it is possible, or indicate every law it violates:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | p + n → K+ + ηo + Ξo  No, baryon number, Strangeness | p + n → p + +  No, charge and baryon number | n + n → Λo + Σo  No, Strangeness | n + n → Ω+ + Ω-  No, baryon number |
| 2 | p + p → Ω+ + e+ + Λo + Σo + n  No, Le, Strangeness | p + p → p + n + n + Ω+  No, Strangeness | p + p → τ+ + υτ + μ+ +  No, Baryon and Lμ | p + n → n + n + τ+ + υτ  Yes |
| 3 | p + → τ- + Λo + Ω+ +  No, Strangeness | p + → τ+ + τ-  No, charge | + n → τ+ + τ-  Yes | p + → Σ- + Ω+  No, Strangeness |
| 4 | p + p → p + p + πo  yes | p + p → p + n + π+  yes | n + n → Ξ+ + + Ω- + n + n + n  yes | π- + p → πo + n + π- + π+  yes |

Part C: Write the quark combinations that make up a proton and a neutron: p = n =

Identify the following quark combinations as either a meson, or a baryon. Determine the baryon number, strangeness, and the charge of each:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Baryon or Meson? | B = ? | S = ? | q = ? |
| 1 | s | M | 0 | 0 | 0 |
| 2 | dsc | B | +1 | -1 | 0 |
| 3 |  | B | -1 | 0 | -2 |
| 4 | s | M | 0 | -1 | -1 |
| 5 | d | M | 0 | +1 | 0 |
| 6 | sss | B | +1 | -3 | -1  Data Packet reference for decays: |
| 7 |  | B | -1 | 0 | -2 |
| 8 | u | M | 0 | +1 | +1 |
| 9 | c | M | 0 | 0 | +1 |
| 10 |  | B | -1 | +2 | 0 |
| 11 | ucc | B | +1 | 0 | +2 |
| 12 | s | M | 0 | -1 | 0 |