Name ___________________KEY________________________ IB Physics.
Atomic and Nuclear. Review.

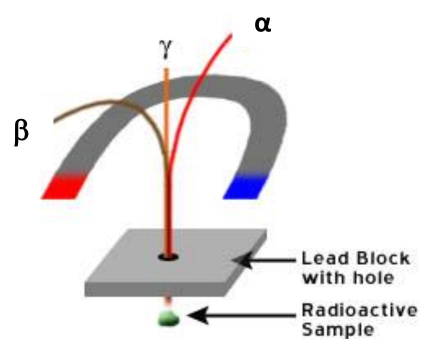
Part I: Matching. Accomplishments of each scientist.

_____ 1. Henri Becquerel
_____ 2. Marie Curie
_____ 3. Cockcroft & Walton
_____ 4. E. O. Lawrence
_____ 5. Albert Einstein
_____ 6. Lene Vestergaard
_____ 7. Sau Lan Wu
_____ 8. Lisa Randall
_____ 9. Davis & Koshiba
_____ 10. Ernest Rutherford

A. Most cited theoretical physicist in last 5 years.
B. Derived the equation for converting mass to energy.
C. Nobel Prize, 2002, for discovering neutrinos.
D. "Mysterious rock" fogged his photographic plates.
E. Found the "J/Psi" particle, and the gluon.
F. Two Nobel prizes, and discovered several radioactive elements.
G. Slowed light down to 17m/s in ultra-cold gas.
H. Gold-foil experiment, bombarded with alpha.
I. Built the first Linear Accelerator.
J. Built the first Cyclotron. Element named after him.

Part II: Problem-solving. Show all work to get full credit.

1. Which Is Alpha, Beta, and Gamma?
Label the diagram.



Solution: Use Right-hand Rule.

2. What is the missing nucleus from this equation?

$^{235}U_{92}$ ---> __________ + $^{4}He_{2}$

$^{231}Th_{90}$

3. Calculate the mass defect for Tritium, $(^{3}_{1}H)$ a radioactive isotope of hydrogen.
Assume:
m_p = 1.007825 u
m_n = 1.008665 u
m_T = 3.01605 u

Solution: 1.007825 + 2(1.008665) - 3.01605

.009105 u

4. Calculate the binding energy in MeV for the Tritium, in #3.

Solution: .009105 x 931.5 **8.481 MeV**

5. Calculate the binding energy per nucleon (MeV/nucleon) for Tritium, in #3 and #4.

Solution: 8.481/3 nucleons 2.8271 MeV/nucleon

6. An alpha particle is emitted from a radioactive source with an energy of 10.0 MeV. How fast is it moving (in m/s)?

Solution: $v = \sqrt{((2 \cdot 10 \times 10^6 \times 1.6 \times 10^{-19})/(4 \cdot 1.67 \times 10^{-27}))}$ 2.2×10^7 m/s

7. An isotope has a half-life of 15.3 years. Assume we have 15 kg of the substance. How much will be left after 40 years?

Solution: $A = 15\ \text{kg}/2^{(40/15.3)}$

2.45 kg

8. What value of *Z* (atomic number) and *A* (mass number) result in the following nuclear decay equation?

$${}^{238}_{92}\text{U} \rightarrow \_\_\_\_\_ + \alpha + \alpha + \beta$$

${}^{230}\text{Ac}_{89}$

9. How much Nitrogen-13 is left from an original radioactive amount of 25 g after 45 minutes? The activity constant for this isotope is 1.16×10^{-6} /s.

Solution: $A = 25\ \text{g} \cdot e^{(-1.16\text{x}10\text{EE-}6 \times 45 \times 60)}$

24.92 g

10. Based on the data given in #9, what Is the half-life of Nitrogen-13 in minutes?

$T_{½} = .693/1.16 \times 10^{-6}$

9959 min.

11. Name the 5 Particle Detectors. Draw one of them below.

_____in your notes________________ (Make sure you can draw one.)

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12. Which one of the following statements is true concerning the proton? _____

(a) The proton cannot be further subdivided.

(b) The proton is composed of two up quarks and a down quark.

(c) The proton is composed of two down quarks and an up quark.

(d) The proton is composed of a down quark and an up quark.

(e) The proton is composed of an up quark and a down quark.

13. Which one of the following statements is the best explanation as to why *nuclear fusion* is not at present used to generate electric power? _________

(a) Fusion produces too much radiation. (b) Fusion requires isotopes that are scarce.

(c) Fusion processes can result in nuclear explosions. (d) Fusion results in large amounts of radioactive waste.

(e) Fusion requires very high temperatures that are difficult to contain.