Physics 102 – Fall 2009 – Recitation 8

(1)

u ≡ up quark, charge = $+2/3$

d ≡ down quark, charge = $-1/3$

s ≡ strange quark, charge = $-1/3$

Suppose only 3 quarks (u, d, s) existed.

How many baryons with what charges can you make from these quarks?

How many mesons with what charges can you make from these quarks?

(2) Identify the fundamental force of nature responsible for the following particle interactions –

$$e^- + p \rightarrow n + \nu_e$$

$$\gamma + Ne \rightarrow Ne^* \longrightarrow Ne + \gamma$$

(excited STATE)

$$\Delta \longrightarrow p + \pi^0$$

↑
Sort of an excited STATE of a proton called the "Delta"

$$\mu^- \longrightarrow e^- + \bar{\nu}_e$$

(3) (See p.411 in Hobson)

In the United STATES the annual energy consumption is approximately 10^{18} Joules.

Suppose you were able to find a source of antimatter and perfected the design of a matter-Antimatter power reactor (a la STar Trek warp engines) . . .

What mass of matter/antimatter would it take to supply the energy needs of the United STATES for 1 year?

(4)

Suppose you were immortal . . . with no breaks . — No need to sleep or eat ——

how long would it take you to run a distance of one light year?

(5) What is the Higgs particle ... or should I say, what role does it play in modern physics?

Why is it important to you that we understand what it is that does what the Higgs does?

(6)

Ernest Rutherford's experiments in which he (or his students) observed the scattering of alpha particles as they passed through a thin metal foil demonstrated that

a) light is a wave.
b) Light is made of particles
c) The atom has a tiny positive nucleus containing most of the atom's mass.
d) Electrons exist.
e) Neutrons exist.

(7)

A neutral atom's "atomic number" represents the

a) number of protons in the nucleus.
b) the number of neutrons in the nucleus.
c) the number of electrons orbiting the nucleus of the atom.
d) the number of quantum mechanical energy levels in the atom.
e) the number of protons and neutrons in the nucleus.
f) both (a) and (c).

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The sun's energy comes from

a) nuclear decay.
b) nuclear fusion.
c) excessive amounts of jolt cola.
d) nuclear fission.
e) chemical reactions.

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If two atoms are the same and are bound together in a molecule (such as H_2 or O_2) the chemical bond between them is

a) a quantum entanglement.
b) a covalent bond.
c) an example of the photoelectric effect.
d) an ionic bond.
e) all of the above

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A neutron makes a much more effective "nuclear bullet" for fissioning a nucleus, e.g., in a chain reaction, than does a proton. Why?