Exercises, Ch 3,4 (Lederman and Schram)

1. A cloud chamber experiment revealed a positive electron (positron). Its path was curved due to: (a) the curvature of the Earth (b) the curvature of space (c) a magnetic field (d) droplets in the chamber.

2. Compared to a book at rest on a table top, a book held 2 m above the table top (a) has greater kinetic energy (b) has greater potential energy (c) has the same potential energy (d) has greater momentum.

3. A neutrino is (a) like a neutron only heavier (b) produced in beta decay (c) inside all electrons (d) charged with 1/3 of an electron charge (e) the mediator of the strong force.

4. Neutrons were difficult to detect because (a) they are accelerated so strongly by electric fields (b) are accelerated so strongly by magnetic fields (c) don’t leave tracks in cloud chambers (d) always travel in circles (e) orbit nuclei of atoms.

5. Generally speaking (a) molecules are more strongly bound than nuclei (b) atoms are more strongly bound than nuclei (c) nuclei are less strongly bound than proteins (d) nuclei are less strongly bound than nucleons.

6. A nucleon is (a) the same as a neutrino (b) a collective name for the constituents of nuclei (c) a modern name for muons (d) one of the valence electrons of an atom (e) none of these.

7. Deuterium (\( _1^2 \text{H} \)) has (a) more binding energy per nucleon than (\( _2^4 \text{He} \)) (b) the same energy per nucleon as (\( _2^4 \text{He} \)) (c) less binding energy per nucleon than (\( _2^4 \text{He} \)) (d) a currently unknown binding energy.

8. If a nucleus of A=240 splits apart into two product nuclei, each with A=120, (a) the process requires a great deal of energy (b) several MeV of energy is released (c) several eV of energy is released (d) the process is fusion.

9. The weak interaction (force) (a) is involved with beta decay (b) in everyday life is as strong as electromagnetic forces (c) actually dominates strong forces between nucleons (d) is the force of repulsion between two electrons in an atom.

10. If a collection of N radioactive nuclei with half life 1 year is prepared, then after 3 years there will be how many remaining (undecayed) radioactive nuclei? (a) N/2 (b) N/3 (c) N/4 (d) N/8 (e) none of these.

11. In particle accelerators, quite generally, charged particles are speeded up by (a) electric fields (b) magnetic fields (c) kinetic energy (d) targets.
12. The radius of the orbit of a charged particle in a magnetic field (a) depends on the momentum of the particle (b) depends on the strangeness of the particle (c) depends on whether the particle is involved in strong interactions (d) depends on whether the particle undergoes weak interactions.

13. Neutrinos (a) interact via strong interactions with nucleons (b) barely interact at all with nucleons.

14. Gell-Mann first proposed to describe known strongly interacting particles using (a) three types of quarks (b) one type of quark and its antiparticle (c) quarks with charge the same as the electron charge in magnitude (d) 92 different quarks for the elements of the periodic table.

15. In Gell-Mann’s quark picture the mesons are composed of (a) three quarks (b) two quarks (c) a quark and an antiquark (d) two nucleons.

16. In the current (by the mid 1990’s) version of the “standard model” to characterize all known particles and mesons one needs (a) six quarks in six generations (b) 12 quarks (c) six quarks in three generations (d) a number of quarks equal to the known number of particles is required.

17. The forces binding quarks together to form nucleons, for example, is, according to the standard model, mediated by (a) gluons (b) pions (c) muons (d) photons (e) photonites.

18. The term “electroweak” interaction is used to describe the unification of (a) photons and protons (b) weak forces and electromagnetism (c) electrons and positrons (d) neutrons and coulomb attraction.