Assess Quizzes from the o-book – Explanations for the answers.

Chapter 13 Review – Support

Q	Reason
1	By definition, an antiparticle has same mass and opposite charge of the ordinary particle. A proton has a positive change, so the antiproton has a negative charge, similar to the electron.
2	By definition. See NCPQ U3&4 page 361.
3	See the values in Table 1 on page 360. You need to learn this order.
4	See Table 2 page 361.
5	See bottom of page 358.
6	Quarks and leptons are the fundamental matter particles. The gluons are the fundamental gauge bosons that hold the quarks together via the strong nuclear force.
7	The option about there being equal numbers of matter and antimatter particles at the time of the Big Bang is **not true** as there was more matter than antimatter. See top of page 366. The option about antimatter and matter annihilating each other is true. For example, in the electron-positron annihilation (see page 385 for the Feynman diagram that you have to learn) an electron and a positron come together and annihilate (destroy) each other form photons. You should also be aware that an electron and a positron do not <u>always</u> annihilate; sometimes they can come together and bounce off each other (called Bhabha scattering). This is another interaction you have to learn (see top of page 385). The other options are also true (antimatter has the same mass but opposite charge to the matter equivalent).
8	Definition of a meson (quark and antiquark). See top of page 355. The other options are wrong.
9	A baryon has three quarks, or three antiquarks. A meson has a quark and an antiquark.
10	Only quarks and antiquarks carry fractional charge. Quarks are either +2/3e or -1/3e, whereas antiquarks are either -2/3e or +1/3e. See Table 1 page 354. Leptons are either -1 or 0 (neutrinos), and the antileptons are either +1e or 0.

Chapter 13 Review – Consolidate

Q	Reason
1	The answer has to be *quark*. An atom and meson are not fundamental (elementary) as they are made up of quarks (and antiquarks in the case of the meson). A neutrino is fundamental (elementary) but is not as common as quarks as far as scientists know.
2	By definition, they are mediating particles that carry the force between quarks and/or leptons. The other options are wrong: a composite particle containing an odd number of quarks is a baryon (if the

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	odd number is 3). For all other combinations of quarks we would call them exotic hadrons (but you don't have to learn that). The particle that carries the Higgs force is the Higgs boson. The smallest indivisible particles of matter (elementary particles of matter) are quarks and leptons. If one of the options was "the smallest indivisible mediating particle of matter" then it would be 'gauge boson'.
3	$ucd, u\bar{d}, c\bar{d}, d\bar{d}$
4	(+2/3) + (+2/3) + (–1/3) = +1
5	Gluons are the mediating force carriers between quarks and quark composites such as mesons, protons and neutrons. They make up the strong nuclear force so are found in the nucleus. The lepton (for example, the electron) would be found orbiting the nucleus.

Chapter 13 Review – Extend

Q	Reason
1	Uncharged leptons are the neutrinos such as electron neutrino, muon neutrino and tau neutrino. The other leptons (electron, muons, tauons) have a -1e charge. The force between the uncharged leptons is the weak nuclear force. As a matter of interest, the force between charged leptons would be weak nuclear force and the electromagnetic force (and I suppose the gravitational force, but that would be extremely weak).
2	All quarks have fractional charge but leptons could have charge (leptons are -1e and antileptons are +1e), or they could be uncharged (that is, the neutrinos).
3	The combinations allowable are made up of 3 quarks (a baryon), 3 antiquarks (antibaryon), or a quark-antiquark composite (meson). It is true that all quarks and antiquarks have fractional charge but that none are 0..
4	Mesons are a quark-antiquark composite. Any pair that is made of two quarks, or two antiquarks is not a meson. Any composite with three particles is also wrong.
5	The two antineutrinos have the same zero charge. The baryon $\bar{s}\bar{s}\bar{s}$ is -1/3, -1/3, -1/3 = -1. An e+ is +1. The baryon uud is -1, udd is 0. The meson $\bar{c}s$ is +1, whereas the antineutrino $\bar{\nu}_e$ is uncharged (0).