1. Describe briefly the differences between Fermions and Bosons.
Fermions have half integer spins, mostly $S = \frac{1}{2} \hbar$ and sometimes $S = \frac{3}{2} \hbar$. With these spins Fermions must obey the Pauli Principle, which states that no two Fermions can have exactly the same quantum numbers in a quantum system. Electrons and quarks are examples of Fermions. 
On the other hand, Bosons have integer spin: $0 \hbar; 1 \hbar; 2 \hbar$ etc. Bosons do not have to obey the Pauli Principle and an infinite number of them can have the same quantum numbers. An example is the photon, with spin $S = 1 \hbar$. In a laser a huge number of photons occupy exactly the same quantum state. The Gauge Bosons $Z_0$ and $W^\pm$ are other examples.

2. Explain what Gauge symmetry stipulates.
The principle of Gauge symmetry states that the principal predictions of a theory and the measurements of the results in different locations should not depend on the scales and gauges used to describe the result.

3. By whom, when and where was the mechanism invented that can give mass to the elementary particles?
Professor Peter Higgs at Edinburgh University introduced a field called the Higgs field that fills all of space with a sticky goop that provides mass to elementary particles, notably the Gauge Bosons $Z_0$ and $W^\pm$. The ripple in this goop manifests itself as the Higgs particle (or particles), the lowest of which has a predicted mass of $\sim 115$ GeV.

4. What particles does the Large Hadron Collider (LHC) accelerate and to what energy. Where is it being built?
The Large Hadron Collider is being constructed at the European Research Center CERN in Geneva Switzerland. The collider accelerates two beams of protons to a top energy of 7 TeV (=7,000 GeV) each, then colliding them. This produces collision energy of 14 TeV.

5. Give at least one scientific goal for the LHC.
This energy is sufficient to create the predicted Higgs Particle or particles and expected new super-symmetric particles with masses up to 1,000 GeV.

6. What are the super-symmetric partners of quarks and gluons?
The super-symmetric partners to quarks carry the names of squarks, those of gluons a called gluinos. Since the quarks have half integer spins the squarks must have integer spins, since the gluons carry integer spins, the gluinos have half integer spins.