Chapter 15

Quantifying Magnets

15.1 (a) 9.8 N/kg, (b) 1.6×10^{-23} N/kg

15.2 Zero

15.3 (b) 3.46×10^{6} N/C in a direction away from the center of the square, (c) zero

15.4 200 N/C (i.e., each Coulomb of charge would feel a force of 200 N)

15.5 (a) The one with the lower capacitance (a larger voltage across the same gap distance means a larger electric field), (b) The force on the protons and electrons are so different that they "break apart".

15.6 Tesla

15.7 3.6 mm

15.8 10^{-2} T

15.9 7.1×10^{8} A (note: this is a huge current, even compared to that in a lightning strike)[1]

[1]By the way, the assumption made in the question is that the field at the center of the earth would be the same as that at the poles. This would not be the case for a single loop. Indeed, the field decreases as one gets further from the center of the loop (on the axis of the loop). The actual current required to produce a field of 7.0×10^{-5} T at the poles would be much more (about 20×10^{8} A).

15.10 The box has four sides. The only side for which the magnetic field is parallel to the side and non-zero is the side (of length L) that is inside the solenoid. Consequently, that is the only part we use for the "circulation" and and so the left-hand side would be BL.