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EE214000 Electromagnetics, Fall, 2020
Quiz #1, Open books, notes

1. Fill up the blanks. 1 as (atto-second) = ____ sec, 1 THz = ____ Hz, 1 keV = ____ eV, 1 μm = _____ m, 1 mg = ____ gram.

Ans: 1 as (atto-second) = 10^{-18} sec, 1 THz = 10^{12} Hz, 1 keV = 1000 eV, 1 μm = 10^{-6}m, 1 mg = 10^{-3}gram.

2. Two point charges are separated by a distance of 1 m, attracting each other with a force of *F*. What is the attractive force, if the same two charges are now separated by a distance of 3 m?

Ans: From the inverse square law of the Coulomb force, the attractive force is reduced by a factor of $3^2 = 9$. Therefore, the reduced attractive force is *F*/9.

3. In a vacuum, (1) if a stationary electron experiences a force, what could be the field(s) in the space? (2) If a moving electron experiences a force, what could be the field(s) in the space? (3) If an electron experiences a force only when it is in motion, what could be the field(s) in the space?

Ans: A magnetic force can only be experienced by a moving charge. For (1), it must be an electric field. For (2), it could be an electric field, or a magnetic field, or both. For (3), it must be a magnetic field.

4. What is the physical meaning of the arrow and the length of the arrow when you draw an electric field line?

Ans: The arrow points the direction of the electric field and the length of it denotes the strength of the field.

5. What is the integration of a flux density of something over an area?

Ans: It is a flux of something.

6. Explain how a surface charge appears on an ideal/perfect conductor?

Ans: For an ideal/perfect conductor, the volume electron density is assumed to be infinite. Therefore, multiplication of the nearly infinite volume density with nearly zero depth of a conductor surface results in a finite surface change density.

7. What are the MKSA units of an electric current, the volume current density and surface current density?

Ans: The MKSA units of an electric current is Ampere, and those of the volume current density and surface current density are A/m^2 and A/m, respectively.

8. For a magnet with north (N) and south (S) poles, how do you define the direction of the magnetic field?

Ans: The direction of a magnetic field is defined from *N* to *S*.

9. What is the SI unit of the magnetic flux density?

Ans: Tesla.

10. Write down the Lorentz force equation? Define all the symbols in the expression.

Ans: The Lorentz force equation is $\vec{F} = q(\vec{E} + \vec{u} \times \vec{B})$, where *F* is the force experienced by a charge carrying charge of *q* moving with a velocity *u* in an electric field *E* and a magnetic field *B*.