107060013 電資22 王昱淳

Prof. Yen-Chieh Huang
Dept of Electrical Engineering
National Tsing-Hua University

office: Delta 856
ext: 62340, 62214
email:ychuang@ee.nthu.edu.tw

EE214000 Electromagnetics, Fall 2020

Sep. 14, 2020

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Quiz #1, Open books, notes

1. Fill up the blanks. 1 as (atto-second) = 10^{-18} sec, 1 THz = 10^{12} Hz, 1 keV = 10^{3} 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?

$F = \frac{q_1 q_2}{4\pi\varepsilon R^2}\hat{a}_R \propto \frac{1}{R^2} \Rightarrow F_{new} = \frac{1}{3^2}\cdot F = \frac{1}{9}F$ #

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?

① Electric Field ② Electric Field or Magnetic Field ③ Magnetic Field #

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

Arrow : direction of force
Length : strength of force #

($\vec{E} \propto \frac{1}{R^2}\hat{a}_R$)

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

Total flux (Source) $\phi = \int_s \vec{D}\cdot ds$ #

($\vec{D} = \varepsilon\vec{E} = \frac{q}{4\pi R^2}\hat{a}_R$)

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

For an ideal/perfect conductor, the volume charge density ($\rho_v \to \infty$) multiplying a zero thickness ($dw \to 0$) results in a finite surface charge density.

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

① Electric Current : Ampere ② Volume Current Density : A/m^2 ③ Surface Current Density : A/m #

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

We define the direction of the magnetic field goes from N to S. #

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

B : magnetic flux density ⇒ Tesla = Weber/m^2

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

$\vec{F} = q(\vec{E} + \vec{u}\times\vec{B})$. $\vec{F}$ is the force driven by charge q.
$\vec{u}$: the velocity of charge q. $\vec{E}$: electric field $\vec{B}$: magnetic field
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