

11. REVIEW QUESTIONS

1. Discuss the continuity equation. How does it state the continuity of charge?
2. In a certain system, the current density \mathbf{J} is conservative. What can you say about the continuity equation in this system?
3. Define displacement current.
4. Displacement current does not require conducting media. Is it then a current in the same sense as conduction and convection current? Explain.
5. Does displacement current obey Ohm's law? Explain.
6. How would you measure displacement current?
7. Displacement current does not require conductivity to exist. Can it then exist in conductors? Explain.
8. Can a displacement current exist under dc conditions? Explain.
9. Write side-by-side Maxwell's equations and the electromagnetic field equations that existed before Maxwell. Discuss the differences between the two sets and the implications from these differences.
10. What constitutes a complete set of electromagnetic field equations?
11. Why is the Lorentz force equation included in the complete set?
12. Do potentials have to have physical meaning? Explain.
13. State the necessary conditions to define
 - (a) An electric scalar potential.
 - (b) A magnetic scalar potential.
 - (c) An electric vector potential.
 - (d) A magnetic vector potential.
14. Convince yourself that only the two curl equations or only the two divergence equations are independent by deriving one set from the other.
15. Define the general interface conditions for the electric field. Compare these with the interface conditions in **Chapter 4**.
16. Define the general interface conditions for the magnetic field. Compare these with the interface conditions in **Chapter 9**.
17. A surface current density must always exist at the interface between a conducting material and air *T/F*. Explain
18. A surface current density must always exist at the interface between a superconductor and a dielectric. Should there also be a surface charge density at the interface? Explain.
19. How can the time-harmonic representation of fields be used with nonsinusoidal fields?
20. State explicitly the conditions under which the time-harmonic form of Maxwell's equations is valid.
21. Convince yourself that by neglecting all time dependent quantities in Maxwell's equations you get:

(a) The electrostatic field equations.

(b) The magnetostatic field equations.

(c) That the two sets in **(a)** and **(b)** are independent of each other.

22. What do you understand by “source-free” equations? Specifically, discuss the sources of “source-free” Maxwell’s equations.

23. How many variables (equations) are necessary for electrostatic field solutions?

24. How many variables (equations) are necessary for magnetostatic field solutions?

25. How many variables (equations) are necessary for time-dependent field solutions which include displacement currents?