4. REVIEW QUESTIONS

1. State the postulates of the electric field, in light of Helmholtz's theorem. Are both postulates absolutely necessary? Explain.

2. For a field to be an electrostatic field its curl and divergence must be (mark correct answer):

(a) Both zero.

(b) Both nonzero.

(c) The curl must be zero and the divergence must be nonzero.

(d) The curl must be zero and the divergence can be zero or nonzero.

3. Can the divergence of an electrostatic field be zero in one portion of space and nonzero in another? Explain.

4. State Gauss's law. What is the relation of Gauss's law to the postulates?

5. Explain the superposition in Gauss's law. Why is this important?

6. Define electric potential and discuss its physical meaning.

7. Potential difference in the electrostatic fields is independent of path *T/F*. Explain.

8. Discuss the idea of a conductor in the electrostatic field. How does this differ from circuits?

9. Charges in a conductor will redistribute themselves on the outer surface of the conductor because this leads to a minimum energy state *T/F*.

10. A cylindrical conductor is on the z axis and is at a potential of 50 V. This value represents the potential difference between its surface and its center *T/F*. If false, what does it represent?

11. Both the electric field intensity and the potential inside a conductor are constant, nonzero values *T/F*.

12. The direction of the electric field intensity is in the direction of decreasing potential *T/F*.

13. The electric field intensity at the surface of a conductor must be perpendicular to the surface. Why is this condition necessary?

14. Work done by an external source against an electric field represents positive work *T/F*. Explain.

15. What is polarization of charges? Does it occur in all materials? Explain.

16. Polarization is proportional to the external electric field intensity applied on the material and reduces the internal electric field intensity in the material *T/F*.

17. What are the polarization charge densities that exist in a material? Define them.

18. Define the conditions under which there can be nonzero polarization charge densities:

(a) On the surface of a dielectric in an electric field.

(b) In the volume of a dielectric.

19. Polarization is independent of the permittivity of the material *T/F*.

20. If a medium has a greater number of free charges, the medium will have a larger polarization *T/F*. Explain.

21. Define linearity, homogeneity, and isotropy of materials in relation to the electric field.

22. Give a simple, intuitive definition of dielectric strength.

23. What are the uses and implications of dielectric strength of materials?

24. Lightning cannot occur in vacuum. Why not?

25. Observation of a lightning storm on distant planets tells us that these planets must have an atmosphere *T/F*. Explain the implications.

26. Can we tell something about what the atmosphere of planets is made of from observations on lightning?

27. The potential across the interfaces between different media must be continuous or the electric field intensity would become infinite *T/F*.

28. The tangential component of the electric field intensity at the interface between two dielectrics is (mark correct answer):

(a) Always continuous.

(b) Continuous if there are no charges on the interface.

(c) Always discontinuous.

29. The discontinuity of the normal component of the electric flux density is related to the change in permittivity at the interface *T/F*.

30. Explain why there is refraction of the electric field at the interface between two materials.

31. What is the relation between the angles of the electric field intensities on the two sides of an interface?

32. The tangential components of the electric flux density are always continuous across the interface between two dielectrics *T/F*.

33. The electric flux density outside a conductor is equal to the surface charge density on the conductor's surface. Explain why this must be so.

34. Define capacitance in the most general terms.

35. A point charge cannot be related to any capacitance even though it produces a potential. Explain why not.

36. If the energy in a capacitor is stored in the dielectric, why are the plates necessary?

37. In a parallel plate capacitor having a multilayer arrangement of perfect dielectrics with boundaries parallel to the plates, the resulting capacitance can be determined by treating the layered arrangement as capacitors in:

(a) series or

(b) parallel.

38. Explain why capacitance is independent of the total charge and potential.

39. The energy needed to assemble a finite charge into a point must be infinite. Explain why this is so.

40. Equipotential lines and surfaces are parallel to the direction of the electric field intensity *T/F*.

41. In all discussion so far, we only considered potential energy. Why do you think we never considered kinetic energy?