List of most of the types of problems from 441 – Spring 2025

1. How to do integrals and derivatives of scalar and vector functions
2. How to use and/or prove gradient theorem, divergence theorem, curl theorem
3. How to draw electric field lines or make other field-related plots
4. How to use Coulomb's law to find **E** from charges or charge densities ("script r method")
5. How to use Gauss's law to find **E** for high symmetry situations of spherical, cylindrical, and planar charge densities
6. How to find **E** from V (negative gradient); and V from **E** (negative line integral)
7. How to find V from charges or charge densities ("script r")
8. How to calculate energy stored in field/work done to assemble charges
9. How to conceptually or numerically solve Laplace's equation using relaxation
10. How to solve boundary value problems using separation of variables: for both rectangular and spherical coordinates, esp. using Fourier's trick and Colton's trick
11. How to solve image problems
12. How to find electric dipole moments, dipole potentials, and dipole fields
13. How to find electric quadrupole moments and quadrupole potentials
14. How to use Gauss's law for **D** to find **D** for high symmetry situations
15. How to find field given **P** (via bound charge densities or Gauss's law for **D**)
16. How to find capacitance for a given geometry (including with possible dielectrics)
17. How to use Biot-Savart law to calculate magnetic field from currents or current densities ("script r")
18. How to use Ampere's law to find B for high symmetry situations of cylindrical, solenoidal, planar, and toroidal current densities
19. How to find **B** from **A** (curl)
20. How to find **A** from currents or current densities ("script r")
21. How to calculate energy stored in field/work done to assemble currents
22. How to find magnetic dipole moments, dipole potentials, and dipole fields
23. How to use Ampere's law for **H** to find **H** for high symmetry situations
24. How to find field given **M** (via bound current densities or Ampere's law for **H**)
25. How to find EMF (including motional EMF, and Faraday's flux rule)
26. How to find **E** for a changing **B** (the "Faraday current")
27. How to find **B** for a changing **E** (the "displacement current")
28. How to use boundary conditions for all fields and potentials (**E**, V, **D**, **B**, **A**, **H**) to relate quantities in one region of space to another; including distinctions between parallel and perpendicular when applicable
29. How to find properties of isolated charges or dipoles (electric or magnetic) in both types of fields: force, torque, energy