1. A metal sphere of radius r is placed in a uniform electric field. Assuming the field is uniform at distances much larger than the radius and at the sphere it is slightly perturbed . Write down the potential for this problem. Discuss an analogous problem for non turbulent water flow past a sphere.

2. A LCR circuit is connected in series. Find the resonant frequency f_0 the quality factor Q in terms of R,L,C.

3. In free space Plane waves are solutions of Maxwell's equations. Assume the propagation is along Z axis with the fields along x and y axis. Show that $E_x = cB_y$

4. In-terms of ϵ_0, μ_0 and$\epsilon\mu$ write down an expression for refractive index of light in a dielectric medium.

5. Assume a source of light of frequency ν in a rest frame. If an observer is moving with speed $v = 0.2C$ towards the light source. From relativistic considerations arrive at the frequency or wavelength of light for the source moving towards and awy from the observer.

6. Write down the relation between $\mathbf{B}, \mathbf{H}, \mathbf{M}$ and find out the units of these quantities. Write down Maxwell's equations in a medium in-terms of $, \mathbf{E}, \mathbf{D}, \mathbf{P}, \mathbf{B}, \mathbf{H}, \mathbf{M}$

7. Solve Maxwell's equations for a electromagnetic waves in a metal. Assume μ, ϵ as permeability and permittivity of the medium. You can also assume $\mathbf{J} = \sigma\mathbf{E}$ (σ is the conductivity of the metal) and $\nabla.\mathbf{E} = 0$ inside the metal. Your solution must have an oscillatory as well as a damped term. Find ou what is skin depth i.e, the depth to which high frequency signals propagate in a metal. This is related to the damped part of the solution

8. Consider a charge moving at relativistic speeds. We solved for the electric field of a moving capacitor and concluded the field lines are more intense if the direction of motion is perpendicular to the field. Use this fact to show how the electric field changes.

9. Discuss the working of a betatron. (cf Feynamn Vol 2)

10. Discuss how the Hall effect can be discussed as a consequence if relativity.

11. Arrive at the Poynting vector formula for the electromagnetic field. A cylindrical conductor of radius r carries a current I and has a resistance R. Find the Poynting vector in this case. Feynman describes a thought experiment in the chapter on induction. This leads to a paradox. Can you resolve the paradox with the concept of Poynting vector.

12. Find the self inductance of a cylindrical wire of radius r.