1, 10% Give two experimental facts that support Einstein's special relativity.

2, 10% In quantum mechanics we used to use operators to represent physical observables. What properties should the operators have? What are the eigenvalues of the operator related to physical measurement? What does the expectation value mean?

3, 10% It is a typical X-ray spectrum shown in the figure. Explain the origin of each part of the spectrum.
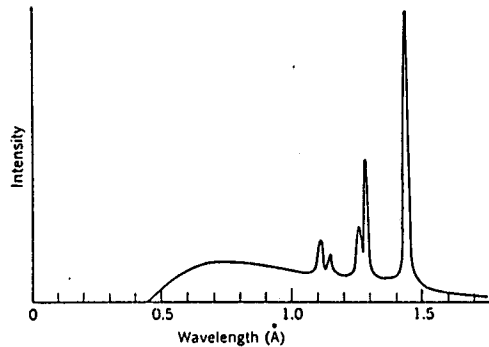
4, 10% If an atom has two optical electrons. They are two 3d electrons. If the coupling is L-S coupling. What are the possible energy states of the atoms? Draw a diagram to illustrate the energy levels. (First draw the energy levels without fine structure. Than draw the splittings.) Give reasons of the order of the levels.

5, 10% How do we decide whether a substance can be used as a Laser source? (Hint: First state the properties of laser light. Than see if the atomic or molecular energy levels have these properties.)

6, 10% Sketch qualitatively how you get the alpha particle decay rate.

CHOOSE ANY FOUR OUT OF THE PROBLEMS 7,8,9,10,11,12

7, 10% Discuss the energy levels of a diatomic molecule.

8, 10% Discuss nuclear fusion and nuclear fission. What are the problems in utilizing nuclear energy in these two kinds of processes.

9, 10% What is the theory of conductors, superconductors? Is the theory for ordinary superconductor applicable to high T_c. superconductor?

10, 10% What is the importance of found the top quark?

11, 10% What are the fundamental forces in the universe? When are they applicable?

12, 10% What is Zeeman effect and anomalous Zeeman effect?