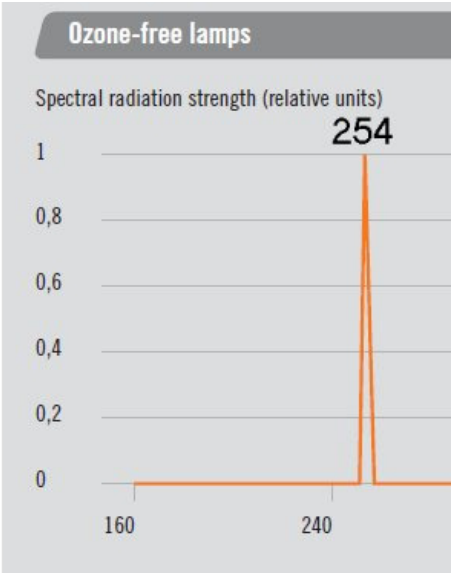
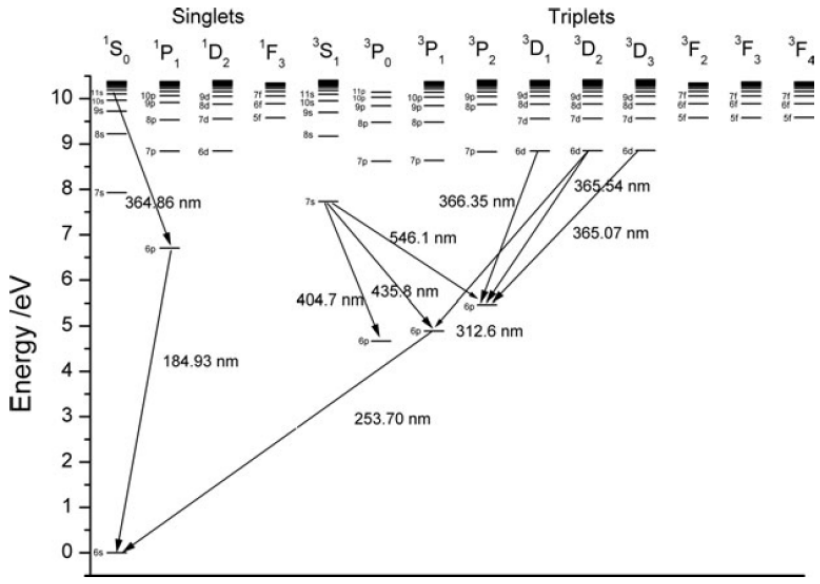


Low pressure mercury lamps present the spectra shown above with a sharp peak at 254 nm (a peak at 185 nm is also produced but blocked by the glass material).

a) A 50 Watt lamp has a 30% efficiency. Calculate the number of photons emitted in 15s operation.
b) If you use the lamp above to irradiate a sodium cathode what would be the maximum kinetic energy of the ejected electrons? (W_o(Na) = 2.28 eV)
c) In PES (Photo-Electron Spectroscopy) it's possible to calculate the ionization energy of an atom or molecule, by measuring the kinetic energy of the electrons ejected when a gas phase of the given element is irradiated with UV light. Calculate the ionization energy of the rubidium atom knowing that light from the above lamp generates electrons with a maximum speed of 498 km.s^{-1}.
d) What would be the associated wavelength of the electrons ejected in the previous experiments?
e) What differences would be observed in the previous experiments if the lamp used was rated at 100 W?
f) The Grotrian diagram for mercury is given bellow. What kind of angular momentum coupling scheme should be used to explain a transition between a singlet and a triplet state?



g) The lifetime of the $^3P_1$ state is 122ns. Calculate the natural width of the band.

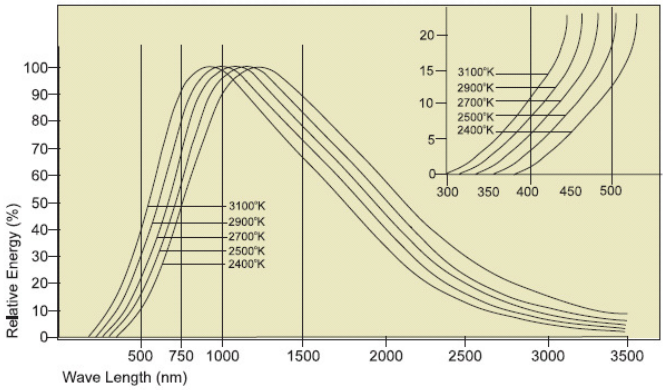
h) Estimate the width of the peak for a lamp operating in a 30^{o}C environment.

i) What kind of lineshape would better represent the experimental spectrum shown above?

j) How many microstates could be seen in the fine structure of the spectra if the lamp was operating under a sufficiently strong magnetic field?

k) Consider the following spectra of a tungsten lamp.

Figure 2: Spectral Radiation Output for Tungsten Filament Lamps (Including Halogen Lamps & Technical Lamps).



Explain the blue shift observed as a function of temperature.

l) Compare the total radiative energy of a lamp operating at 2400 K and 3100K.