Set #7

20. Use the following property:

$$[\hat{A}, \hat{B}\hat{C}] = [\hat{A}, \hat{B}]\hat{C} + \hat{B}[\hat{A}, \hat{C}]$$

to show that $[L_x, L_y] = i\hbar L_z$ e that $[L^2, L_x] = 0$.

21. Quantum numbers for macroscopic systems (*Bohr's Correspondence Principle: classical physics is recovered in the limit of large quantum #s*).

a. Estimate the angular momentum quantum number "n" for a Ferries wheel using the Bohr condition for the quantisation of the angular momentum. (Use your own parameters set for the estimate.)

b. The energy of a harmonic oscillator (i.e. mass and spring) are quantised via

$$E_n = \hbar\omega_o(n + \frac{1}{2})$$

where $\omega = \sqrt{k/m}$ is the natural frequency of oscillation. If you push down the back end of a car, it will spring back. Estimate the quantum number associated with this classical motion. (Use your own parameters set for the estimate).

22. How many possible orientations may the angular momentum of a rotating wheel (m=10 g, r=50 cm, T=1 sec) take?

How many possible angular momentum states do we span when turning the wheel's hub by 10 degrees. Compare with the above exercise (22) and briefly explain.

23. Show all possible orientations of the electron orbital angular momentum in the energy level n=3 (l=0,1,2). Give all the angles the orbital magnetic moment μ forms about a given direction (z).