SQ1: The outer electron in Na is well screened from nucleus, so Na is easily ionized and physically bigger. It is also more chemically reactive and has net angular momentum.

SQ2: In $n=1$ & $n=2$ there are $2+2+6 = 10$ electrons. Subtracting one gives 9 e^- shielding the nucleus.

predict $E_{La} = -13.6\,(z-9)^2\left(\frac{1}{2^2}-\frac{1}{3^2}\right)$

$= -13.6\,(z-9)^2\left(\frac{1}{4}-\frac{1}{9}\right)$

empirical value is

$-13.6\,(z-7.4)^2\left(\frac{1}{4}-\frac{1}{9}\right)$

SQ 3:

$$E_N = (N + \tfrac{1}{2})\hbar\omega$$
$$= (N + \tfrac{1}{2})\hbar\sqrt{k/\mu}$$

$$E_L = \frac{L(L+1)\hbar^2}{2\mu R^2}$$

$$\mu = \frac{m_1 m_2}{m_1 + m_2} \sim m_1 \quad \text{if} \quad m_1 << m_2$$

So $\mu_D \sim 2\mu_H$

E_L drops by 2
E_N drops by $\sqrt{2}$

SQ 4: a. 2000 & 1109

b.

2000	1100
0200	1010
0020	1001
0002	0110
	0101
	0011
= 4	= 6

check $\binom{4+2-1}{2} = \binom{5}{2} = 10$

c. $\rho = 1/4 - 4/10 = 1/10$

d. $\rho = 1/4 \cdot 1/2 = 1/8$