1) a) This diagram is **allowed**, and the configuration, in shorthand, is: $1s^22s^22p^6$.

b) This configuration is **not allowed**. The best corrected diagram would be:

$$\begin{align*}
(\uparrow\downarrow) & \quad (\uparrow\downarrow) & \quad (\uparrow\downarrow)(\uparrow)(\uparrow) \\
1s & \quad 2s & \quad 2p
\end{align*}$$

This one is “best” because it obeys **all** the rules for electron filling. (aufbau, Pauli, Hund’s)

A second, acceptable (although not as good) diagram would be:

$$\begin{align*}
(\uparrow\downarrow) & \quad (\uparrow\downarrow) & \quad (\uparrow\downarrow)(\uparrow\downarrow)(\uparrow) \\
1s & \quad 2s & \quad 2p
\end{align*}$$

Not as good, because it does not follow Hund’s Rule.

c) This configuration is also **not allowed**. A corrected diagram would be:

$$\begin{align*}
(\uparrow\downarrow) & \quad (\uparrow\downarrow) & \quad (\uparrow)(\uparrow\downarrow)(\uparrow) \\
1s & \quad 2s & \quad 2p
\end{align*}$$

d) This configuration is **allowed**, and the configuration is: $1s^22s^22p^3$.

(If you said ‘not allowed’ because the 2p electrons were all spin down, that’s fine, since I said that it is spin up by convention.)

2) The equation, which is the easier to do, is:

$$\text{Sr}_{(s)} + 2\text{H}_2\text{O} \rightarrow \text{Sr(OH)}_{2(aq)} + \text{H}_2(g)$$
since Strontium is a Group II metal.

Now we can move to the stoichiometry part of the question: We have 53.2 mL of $\text{H}_2$ gas at 22.5°C and 788 mm Hg (= 1.037 atm) From the ideal gas law, we get:

$$n = \frac{(1.037 \text{ atm})(0.0532L)}{(0.08206L \cdot \text{ atm} / \text{ K} \cdot \text{ mol})(295.65K)} = 2.272 \times 10^{-3} \text{ mole } \text{H}_2; \text{ this gives us}$$

the same amount of strontium. Thus, we have: $(2.272 \times 10^{-3} \text{ moles francium})(87.62 \text{ g/mol strontium}) = 0.199 \text{ g Sr}$.

3) We can use the equation $\Delta E = E_f - E_i$ with the energies substituted as per the given equation. Doing so yields $\Delta E = -R_{Z}Z^{2}\left(\frac{1}{n^2_{f}} - \frac{1}{n^2_{i}}\right)$; in this case, $n_{f} = \infty$ and $n_{i} = 1$, so we
end up getting \( \Delta E = R_H Z^2 \) (since the parentheses yield 0 – 1 or -1). Substituting, we get 
\[
\Delta E = 2.179 \times 10^{18} \text{ J/electron}(2^2) = 8.716 \times 10^{18} \text{ J/electron} = 5249 \text{ kJ/mol}
\] (in good agreement with the textbook value of 5250 kJ/mol).

4) This is just a glorified Hess’ Law of Heat Summation, here called the Born-Haber Cycle. If we ionize the cesium atoms, add an electron to the fluorine atoms and then let those come together to form the solid CsF, releasing the lattice energy, we will get the overall equation we are after. If the lattice energy is the energy required to break an ionic solid into the separated gas phase ions, it follows that the lattice energy is released when the gas phase ions come together to form the ionic solid.

We need to set up the Hess’s Law equations, which are:

\[
\text{Cs}_\text{(g)} \rightarrow \text{Cs}^+ + e^- \quad \Delta H = 589.8 \text{ kJ/mole} \quad \text{(This is the ionization energy)}
\]

\[
\text{F}_\text{(g)} + e^- \rightarrow \text{F}^- \quad \Delta H = -328 \text{ kJ/mole} \quad \text{(This is the electron affinity)}
\]

\[
\text{Cs}^+ + \text{F}^- \rightarrow \text{CsF}_\text{(s)} \quad \Delta H = -740 \text{ kJ/mole} \quad \text{(This is the reverse of the lattice energy)}
\]

The overall \( \Delta H \) is, therefore: 589.8+(-328) + (-740) = \textbf{-478.2 kJ/mole}.

5) The electron configuration of H is 1s\(^1\). This is just one electron away from the nearest noble gas, He; therefore, it seems probably that H could accept an electron, becoming hydride (H\(^-\)). Taking on one electron to obtain the noble gas configuration is a property of the group 17 elements. We also know that hydrogen loses one electron, to be come H\(^+\); loss of the lone valence electron is a property of the group 1 (alkali) metals. Therefore, hydrogen is justifiable placed in both Groups 1 and 17.