2014 Answers.

1. Pb2+ + 2 I- → PbI2 (1 point. States not needed)

a ii. The potassium and nitrate ions remain in solution and do not participate in the reaction. Or, perhaps, "The net ionic equation omits the spectator ions, Na+ and NO3-

Or maybe, "the reaction occurs in solution, so all of the soluble salts are ionized."

1 point. I am not sure what they want.

b) The purpose is to make sure all of the water is driven off, or to be sure the filter paper is completely dry... 1 point

c) Since there is EXCESS lead nitrate, there must be more nitrate ions than potassium ions. (would that be enough??) The equation shows that for there to be excess lead nitrate, the amount of lead ion added would have to be more than half the number of moles of iodide. Since there are two nitrates for every lead, the amount of nitrate ion would have to be greater than the amount of iodide, and therefore greater than the amount of potassium ion. Do they need to say all that? Or is just recognizing that the lead nitrate is in excess enough. Probably 1 point.

d. 0.236 g / 461 = 5.119 x 10-4 moles. (1 point)

e. 5.119 x 10-4 moles of PbI2 )( 2 I-/PbI2)( 126.91)(100%)/0.425 g = 30.6 %

I would guess 2 points, so that 1 point could be given if the student forgets to multiply by 2, as I did at first.

f. equal, assuming all the tablets are the same. Changing the volume of water does not alter the amount of dissolved tablet in the water, and so does not affect the calculated % of I-. 1 point

g i. Yes. AgI has a very low Ksp, an 0.20 molar Ag+ with the given I- conc. would produce an ion product much greater than the Ksp. 1 point.

1 point for just saying that a precipitate would form because the Ksp is very small, or is more math required?

ii. No. The mass of AgI produced from the tablet would have to be less than 1 gram. If there are only two decimal places, there would therefore be only 2 sig figs. (1 pt)

2 a H2O is a base and H3O+ is an acid. (1)

b) pH of 2.79gives [H+] of 1.6 x 10-3. (1.6 x 10-3)2/.2 = 1.3 x 10-5 (probably 2 pts)

c) False. The product, propanoate ion, is a base. The solution would be basic.

(would credit be given for "Basic, because the base is strong while the acid is weak?)

(1 point)

ii. This is true. For example, we see that a 0.20 molar solution of propanoic acid has a pH of 2.79. To get a pH of 2.79 would require HCl to be 0.0016 molar.

(would it be sufficient just to say that you need MORE of a weak acid or less of a strong acid to get the same pH from both?) 1 point

d) 0.142 molar ( 1 point, just MV=MV)

e) No. The pKa of propanoic acid is 4.89. The acids are very similar, weak acids, and the equivalence points would occur at nearly equal pH values. (1 point)

3. Sn is being oxidized. As it is converted into Sn2+ , which dissolves, its mass decreases. Sn is losing two electrons to become Sn2+  (1 pt)

b) Its mass goes into the solution, as Sn(II) ions. (1 pt)

c) Show that the K+ is moving to the left, and the NO3- to the right. ( 1 pt)

d) "Q" in this case is [Sn2+]/[Cu2+] . If both ions are 0.50 molar, Q is still = 1, so the cell potential is still the same. ( I am sure that a Nernst explanation would get the 1 point)

ii. The nonstandard cell has fewer copper ions, so they would get used up more quickly. It would power the device for a shorter time. ( 1 pt)

e. Cu2+ + Sn → Sn2+ + Cu. Since E o is +, 0.48, delta G must be negative, so the reaction is thermodynamically favorable. Or, the Eo is +, which means that the reaction is thermodynamically favorable. Perhaps 2 points?

ii. ΔG° = -96500 x 2 x .48 = -93000 J or -93 kJ ( 2 points?)

4. n = PV/RT =0.0115 moles. ( 1 point)

b) Both experiments gave the same pressure of CO2 . If all of the solid decomposed in both, the pressure in the second one would have had to have been twice the pressure in the first. The claim is false.

c) The final pressure would be 1.04 atm. The Kp is 1.04, and does not depend on the initial concentration of CO2.

d) Yes. Since the only gas present is CO2 , the Kp = P CO2, so it is 1.04 .

5. a) ClF b) Should be 5 electron pairs around the Cl, with 2 lone pairs.

c) It is T shaped. Trigonal planar would have a symmetrical charge distribution, and a dipole moment of zero.

d) I see more than one acceptable answer.

1. Halogens may use extended octets when bonding with fluorine, resulting in several different compounds.

2. Halogens form several different fluorides, with larger halogens able to accommodate larger numbers of fluorides, because they have larger radii, and thus minimize electron-electron repulsions.

How much do they need to get the point? The fact that the prompt mentions "periodicity" might mean that the second answer is needed, or something that alludes to larger atoms being able to have more fluorides.

6. I HATE this question.

a) Assuming that the polymers are of equal length, chlorine has a larger mass than CH3 so the PVC should be denser.

b) It is one point. Both an LDF and a dipole-dipole explanation are possible.

Do they need both? I don't know. I would be tempted to describe the polarizability of the larger Cl atom as being the reason chloroethane as a higher boiling point. But it is also more highly polar than propene. Don't know what they want.

c)A lot of work for one point, so I suppose it is worth 2.

I got a value of -3860 kJ, which is releasing MORE energy.

You could also argue that the reactants in both reactions have very similar delta H of formation ( 74 vs 42) but the products in the propene combustion, with three times more water obviously have much larger, negative values than in the vinyl chloride.

7. a) At constant temperature there is a constant half life, which indicates first order.

b) 0.00693 /s c) Less, since Rate = K[cis butane] The initial rate in trial 1 is actually half the initial rate in trial 2.

d) At a higher temperature, a larger percentage of molecules can form the activated complex, which requires a certain amount of energy, the activation energy. More molecules are thus able to react, making the reaction faster.

(I don't know what they want here. )