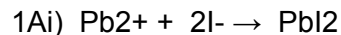


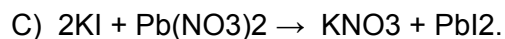
2014 AP Chem FRQ

Link to exam: http://media.collegeboard.com/digitalServices/pdf/ap/ap14_frq_chemistry.pdf



ii) Since the NO_3^- and K^+ ions don't react in any way, it isn't necessary to put them in the equation (spectators). The only species that react are the Pb^{2+} and I^- ions.

B) To make sure all the water has been dried from the ppt. When the mass stops decreasing we know the precipitate is dry.



$[\text{NO}_3^-]$ is greater than $[\text{K}^+]$, Since the $\text{Pb}(\text{NO}_3)_2$ is the excess, and due to the ratio of KI and NO_3^- ions being 1:1, we know NO_3^- must be greater.

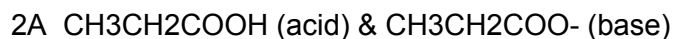
d) $1.698 - 1.462 = .236$ of $\text{PbI}_2 \times (1/461.02 \text{ g}) = 5.12 \times 10^{-4} \text{ mol PbI}_2$

E) $253.82/461.02 \times 100 = 55.06\% \text{ I} \times .236 \text{ g} = .130 \text{ g I}$
 $.130/.425 \times 100 = 30.6\% \text{ I}^-$

F) Equal to, the amount of water won't appreciably affect the amount of PbI_2 that precipitates, therefore no effect on the calculations. Note: There would be a very slight increase in the solubility of the PbI_2 due to the larger volume of water but the amount would be negligible due to its very small K_{sp} .

Gi) Yes, AgI would precipitate out. Its very low K_{sp} value means only a small amount would dissolve, basically making it insoluble.

ii) No, during the subtraction step (as seen in part D), if the two values went out to only the hundredths, the resulting mass would only go out to the hundredths, giving it only 2 sig figs. Note: this assumes similar masses to the original experiment.



B) $K_a = (1.62 \times 10^{-3})^2 / .198 = 1.3 \times 10^{-5}$

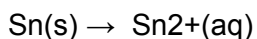
Ci) False, since propanoic acid is a weak acid, its conjugate base (propanoate) is strong enough to affect the pH. The pH would be greater than 7.

ii) True, since HCl is a strong acid, equal concentrations of HCl and propanoic would yield a larger number of H⁺ ions in the HCl solution, giving it a lower pH. To have equal H⁺ in both solutions, one would need to increase the concentration of the weak acid.

$$\begin{aligned} \text{D) } (M_a)(V_a) &= (M_b)(V_b) \\ (M_a)(25\text{ml}) &= (.173)(20.52\text{mL}) \\ M_a &= .142 \text{ M} \end{aligned}$$

E) No, the pK_a for propanoic (4.88) is very similar to butanoic and therefore could use the same indicator

3A) Sn electrode is where oxidation is occurring. Solid Sn is oxidizing into Sn²⁺ ions.



Mass decrease tells me this is the oxidation half.

B) The Sn²⁺ ions are released into the solution that the Sn electrode is sitting in.

C) Basically you need to draw K⁺ ions going towards the Cu cathode and NO₃⁻ ions going towards the Sn anode.

Di) Equal to, since there is no change in the ratio of Cu²⁺ to Sn²⁺ ions, there would be no shift in the RXN. This results in no change to voltage.

ii) Shorter time, there are less Cu²⁺ ions that can be reduced, when these run out the reaction would stop.

Ei) $\text{Sn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Sn}^{2+}(\text{aq}) + \text{Cu(s)}$ (you must choose the half reactions with Cu²⁺ and Sn(s), due to what the problem says)

$$E_{\text{cell}} = .34 - -.14$$

$$E_{\text{cell}} = .48 \text{ V (this is the only possible answer)}$$

a + voltage means the RXN is thermodynamically favorable. If it has a + voltage the delta G will be negative

$$\begin{aligned} \text{ii) } \Delta G &= -(2)(96,500)(.48) \\ &= -92,000 \text{ J/mol or } -92 \text{ kJ/mol} \end{aligned}$$

$$4a) PV = nRT$$

$$(1.04 \text{ atm})(1.00\text{L}) = (n)(.0821)(1100\text{K})$$

$$n = .012 \text{ mol}$$

B) No, if 50 g (.50 mol) of CaCO_3 decomposed, we would expect .5 mol of CO_2 to form (ratio from balanced equation). According to our results from part A only .012 mol formed. This means it didn't completely decompose.

C) Equal to. Since $K_p = (P_{\text{CO}_2})$ the equilibrium position must have a pressure of 1.04 atmospheres.

D) Yes, $K_p = P_{\text{CO}_2}$, so $K_p = 1.04$

5A) ClF

B) Chlorine in middle with 3 single bonds and 2 pairs of unshared e-

C) T-shaped, due to the arrangement of atoms around the central atom due to the unshared e-, the dipoles do not cancel. If it was trigonal planar, the dipoles would cancel and it would be nonpolar.

D) Not sure what they're looking for here. When extra energy level is added it adds a new fluorine/halogen combination. The number of F must be odd when attached to a different halogen. ClF , ClF_3

6A) PVC will sink, the Cl atoms will cause the PVC to be more dense (Cl vs CH_3 molecular weight)

B) The vinyl chloride is polar, so it exhibits dipole-dipole forces. Propene is nonpolar and therefore only exhibits dispersion forces. Since dipole-dipole forces are stronger, its B.P. is higher.

c) $\Delta H = [6(-394) + 6(-242)] - [2(21)]$

_____ $\Delta H = -3858 \text{ kJ/mol}$

Releases more energy.

7A) Since Trial 1 and 2 have the same half-life, it's 1st order.

B) $t_{1/2} = 0.693/k$ $k = .00693 \text{ s}^{-1}$

C) Less than, more moles of gas must react in trial 2 in the same amount of time. This means its rate must be faster.

D) Since the average kinetic energy is greater, more molecules can break the activation energy barrier, thus the rate of the reaction is increased, shortening the half-life.