Here's some comments about a few questions I was asked about during the review or in office hours today concerning the "Practice Final" (1210 ACS PracFinal).

#15) This might be a little confusing because Na_2CO_3 is given as a solid in the problem. Na_2CO_3 is soluble. However, it's quite possible there's not enough water around to dissolve it all (like putting too much sugar or salt in water and it won't all dissolve) or HCl(aq) was added to solid Na_2CO_3 but not enough was added to react with it all or dissolve it all. That's why the answer is "C". You would need to leave the Na_2CO_3 as a solid in the ionic and net ionic eqn.

Na_2CO_3 (s) + 2 HCl (aq) ---> 2 NaCl (aq) + H_2O (ℓ) + CO_2 (g) molecular eqn

Na_2CO_3 (s) + 2 H^+ (aq) + 2 Cl^- (aq) ---> 2 Na^+ (aq) + 2 Cl^- (aq) + H_2O (ℓ) + CO_2 (g) ionic eqn

Na_2CO_3 (s) + 2 H^+ (aq) ---> 2 Na^+ (aq) + H_2O (ℓ) + CO_2 (g) net ionic eqn
(cancel spectator Cl^- ions)

This can first be treated as an exchange reaction to give carbonic acid, H_2CO_3 (aq).

Na_2CO_3 (s) + 2 HCl (aq) ---> 2 NaCl (aq) + H_2CO_3 (aq)

The H_2CO_3 (aq) is unstable and breaks down to H_2O (ℓ) + CO_2 (g).

In exchange reactions solids, liquids, nonelectrolytes and weak electrolytes stay in molecular form in the molecular and ionic equations.

Remember, one type of exchange rxn gives a gas (need to remove the ions from solution in order for the reaction to occur, either form a precipitate, gas, nonelectrolyte or weak electrolyte).

This is one of the gas forming exchange reactions.

Carbonates (CO_3^{2-}) and Bicarbonates (HCO_3^-) react w. acids to give a salt, H_2O (ℓ) and CO_2 (g).

Sulfites (SO_3^{2-}) and Bisulfites (HSO_3^-) react w. acids to give a salt, H_2O (ℓ) and SO_2 (g).

Sulfides (S^{2-}) react w. acids to give a salt and H_2S (g).

What would the eqns look like if the Na_2CO_3 was listed as (aq):

Na_2CO_3 (aq) + 2 HCl (aq) ---> 2 NaCl (aq) + H_2O (ℓ) + CO_2 (g) molecular eqn

2 Na^+ (aq) + CO_3^{2-} (aq) + 2 H^+ (aq) + 2 Cl^- (aq) ---> 2 Na^+ (aq) + 2 Cl^- (aq) + H_2O (ℓ) + CO_2 (g) ionic eqn

CO_3^{2-} (aq) + 2 H^+ (aq) ---> H_2O (ℓ) + CO_2 (g) net ionic eqn

#23) This question deals with ionization and ionization energy (IE). It is one of the properties and periodic trends we discussed in chapter 7. People did seem to have some problems with questions on midterm 2 covering chapter 7 material.

It takes more energy to pull an electron off a cation (positively charged ion) than a neutral atom. This because there's already a positive charge (more protons than electrons) for the cation which gives a large effective nuclear charge (Z_{eff}), which pulls the orbitals and electrons in closer and results in a stronger attraction for the electron by the nucleus. Each time another electron is pulled off more energy is required.

#22) This is also about periodic trends. The ions given are an isoelectronic series, same number of electrons and same electron configuration (in this case they all have the same electron config. of Ne). In this case the ion gets smaller as the number of protons increases (Z_{eff} inc.). The larger Z_{eff} pulls the orbitals and electrons in closer. #46 is also about size, of neutral atoms.

#65) This is about periodic properties and electronegativity (EN). Electronegativity is not a measurable property. It's a combination of other properties, generally ionization energy and electron affinity.

IE energy required to pull an electron of a neutral atom or ion

EA energy associated with adding an electron to a neutral atom or ion (generally energy released, negative, but can be positive, as it is for the noble gases, N, Be, and Mg).

EA generally is more negative as one moves left to right across a row and bottom to top in a group (column). There is an exception moving up the group when going from row 3 to row 2. The energy released for the 2nd row elements is less negative than for 3rd row (in general). Slightly less energy is given off when an electron is added to F than Cl. That's because F is so small the extra negative charge can't be effectively spread out like it can on Cl so not as much energy is released.

Based just on EA one might expect Cl to be more electronegative than F. However, EN also depends on IE. The IE for F is much larger than for Cl. This means F holds onto the electrons more strongly than Cl. When this is taken into account along with the EA the EN of F is greater than that of Cl.

So an element with a high EN would be expected to have a large negative EA and a high IE.

#29) This is a stoichiometry problem involving collecting a gas over water, Dalton's Law of partial pressures and the ideal gas law (IGL).

You're after the volume of H_2 (g) produced by the complete reaction of 1.566 g Zn with excess HCl according to the following rxn,

$$Zn(s) + 2\ HCl(aq) \longrightarrow H_2(g) + ZnCl_2(aq)$$

First determine the moles of H_2 produced by doing a gram-to-mole stoichiometry problem.

$$?\ mol\ H_2 = 1.566\ g\ Zn \times \frac{1\ mol\ Zn}{65.38\ g\ Zn} \times \frac{1\ mol\ H_2}{1\ mol\ Zn} = 0.023952\ mol\ H_2$$

You need to use this in the IGL eqn to get the volume of H2. However, you first need the pressure of the H2. It is NOT the 752 mm Hg given in the problem. That's the TOTAL pressure, which one gets by reading it off the barometer. The gas was collected over water so it's "wet". You have to account for the water vapor. You have two gases, a gas mixture. Think Dalton's Law of Partial Pressures, the total pressure of a mixture is the sum of the partial pressures of the gases.

$$P_{tot} = P_{H2} + P_{H2O}$$

$$P_{H2} = P_{tot} - P_{H2O} = 752\ mm\ Hg - 18.65\ mm\ Hg = 73\underline{\mathbf{3}}.35\ mm\ Hg$$

Need this pressure in atm for the IGL,

$$?\ atm = 73\underline{\mathbf{3}}.35\ mm\ Hg \times \frac{1\ atm}{760\ mm\ Hg} = 0.96493\ atm$$

Now you can calculate the volume of the H_2 using the IGL.

Need Temp in kelvin, 21.0 °C + 273.15 = 294.15 K.

$$V = \frac{n\,R\,T}{P} = \frac{(0.023952\ mol)\ (0.0821\ L{*}atm/mol{*}K)\ (294.15\ K)}{0.96493\ atm} = 0.5\underline{\mathbf{9}}946\ L$$

#32) Since the gas in the 3 cylinders all have the same P and V you simply need to figure out the temperatures in each cylinder and realize the T and n are inversely proportional. The higher the T the smaller the moles (and thus mass since they all contain the same gas). You can see this from the IGL.

PV = nRT

Since n and T are on the same side of the equality the are inversely related, if one increases the other has to decrease (since both are to the first power if one increases by some factor the other decreases by the same factor, i.e. if one doubles the other has to be cut in half).

Thus the one with the smallest T has to have the largest n (moles) and thus the largest mass.

Note, you need to know the formulas for converting temperatures.

A: - 20 C (253K) B: -26.1 C (247 K) C: 260 K

So the moles of O_2 (and mass) would be the largest in cylinder B.