1. C A solution is a *homegeneous mixture.* Foggy air includes a suspended mist of water droplets (water in the liquid form), so at certain points in space water is in the liquid phase, at other points in space, water is in the gaseous phase, so foggy air is a heterogenous mixture.

2. D

3. C In a saturated solution, dissolved substance is in equilibriium with undissolved substance.

4. C The rule of thumb is *like dissolves like*. Gasoline is a mixture of hydrocarbons containing 5 to 8 carbons. Dodecane is a hydrocarbon 12 carbons long and would be found in the kerosine portion of petroleum distillate.

5. A That the solubility of a gas in a liquid is proportional to the partial pressure of a gas is a statement of Henry's law, which has the matehmatical form:

$$C_A = kP_p$$

6. B Le Chatelier's principle states that any change imposed on an equilibrium system tends to shift the equilibrium to nullify the applied change. The correct formula, including energy, of A dissolving:

$$A(s) + \Delta H \rightleftharpoons A(aq)$$

Le Chatelier's principle implies that for an endothermic process of dissolving, the addition of heat (increased temperature) will tend to shift the equilibrium to the right so that heat becomes enthalpy.

7. C Because we have partial ionization of KBr (if not, the freezing point depression would be 0.37 °C, not 0.35 °C), both A nad B are false statement.

8. D All three illustrate LeChatelier's principle. See question #6 to see how statement I does so. For statement II, the common ion effect, adding to the concentration of one or more of the dissolved species will push the equilibrium to the left lowering the amount that gets dissolved. For statement III, NH_4OH is a weak base, so the addition of strong base will form NH_4OH. This will pull NH_4^+ out of the equilibrium, which will shift the equilibrium to favor dissolving of the salt by LeChatelier's principle.

9. A By more stable, it is meant that it is more energy favorable for lead hydroxide to remain undissolved in water than lead sulfate, which can be seen in the comparison of their solubility products. C is incorrect because upon mixing the solutions, lead sulfate would no longer saturate the solution (greater volume). Lead hydroxide (much lower K_{sp}) would precipitate by common ion effect.

10. A The first step is to attain the new concentrations after dilution upon mixing:
We are first concerned with Ca^{++} (our common ion). We initially had a .5 liter of 2 X 10^{-5} M solution of $CaCl_2$. Mixing with another .5 liter will produce 1 X 10^{-5} M solution. One mole of $CaCl_2$ produces one mole Ca^{++}, so that is the concentration of Ca^{++} from $CaCl_2$ (1 X 10^{-5} M).
To find the initial concentrations of Ca^{++} and CO_3^- from $CaCO_3$ in its initial saturated .5 liter solution, use K_{sp}:

$$[Ca^{++}][CO_3^-] = 4.9 \times 10^{-9}$$

so the initial concentrations of both are 7.0 X 10^{-5}. When the two .5 liter solutions are mixed, these concentrations of ions from $CaCO_3$ are halved to 3.5 X 10^{-5}.
To find whether precipitation occurs in the new solution, see if the new product of the concentrations of Ca^{++} and CO_3^- is greater than K_{sp}. It is not so no precipitation occurs.

$$[3.5 \times 10^{-5} + 1.0 \times 10^{-5}][3.5 \times 10^{-5}] < 4.9 \times 10^{-9}$$

11. D The decrease in the amount of diethyl ether lost due to evaporation is proportional to the decrease in its vapor pressure when the unknown substance is dissolved. By Rault's law, we know that the vapor pressure of the diethyl ether as solvent is proportional to its mole fraction, X_A:

$$P_A = X_A P_A^\circ$$

In going from 10 g to 9.5 g evaporated, we know that our vapor pressure decreased by 1/20.
150 g diethyl ether is almost exactly 2 moles so call it that (good MCAT math). Adding our substance brought the mole fraction of deithyl ether to 95%, so what we added must be very close to 1/10 mole (1/20 of 2: 20/21 = 95.2%) (more good MCAT math). If 1/10 mole is 9 grams then 1 mole must be 90 grams.