1. This graph shows how the solubility of ordinary cane sugar (sucrose) in water changes with the temperature. The solubility is expressed as the number of grams of sugar dissolved per 100 g of water in a saturated solution. An estimate of the number of grams of sugar soluble in **50 g** of water at 0° C is



(A) 80. (B) 100. (C) 104. (D) 180. (E) 204.

2) The normal boiling point of SO2 is 263.1 K and that of NH3 is 239.7 K. At –40 °C which would you predict?

(A) Ammonia has the greater vapor pressure.

(B) Sulfur dioxide has the greater vapor pressure.

(C) The vapor pressures would be equal.

(D) The vapor pressure of NH3 is 760 mmHg.

1. The relative vapor pressures are not predictable from the data given.
2. The graph shows how the vapor pressure of liquid **A** and of liquid **B** change with the temperature. Select the choice that best indicates the degree of correctness of this statement:”*The normal boiling point of liquid* ***B*** *is 78°C.”*



(A) The statement is true.

(B) The statement is probably true; additional data would be needed for a final decision.

(C) It is impossible to judge the statement because data are insufficient.

(D) The statement is probably false; additional data would be needed for a final decision.

1. The statement is false.4) The graph shows how the vapor pressure of liquid **A** and of liquid **B** change with the temperature. Select the choice that best indicates the degree of correctness of this statement: *“Liquid* ***A*** *will evaporate faster than liquid* ***B*** *under the same conditions of temperature, atmospheric pressure, and surface exposed.”*



(A) The statement is true.

(B) The statement is probably true; additional data would be needed for a final decision.

(C) It is impossible to judge the statement because data are insufficient.

(D) The statement is probably false; additional data would be needed for a final decision.

1. The statement is false.
2. According to the phase diagram for xenon, what change, if any, occurs as the pressure on a Xe sample is reduced from 760 mmHg to 1 mmHg at –l23 °C



(A) solid to gas (B) solid to liquid to gas (C) liquid to gas (D) no phase change

6) When a hypothetical ionic crystal **M**+**X**– is heated, it vaporizes to form separate **M**+*(g)* and **X**–*(g)* ions. The energy required for this vaporization (the lattice energy) will be greatest when

(A) the electron affinity of **X** is small in magnitude and the ionization potential of **M** is large in magnitude.

(B) the heat of vaporization of crystalline **M** is small.

(C) the heat of vaporization of crystalline **M** is large.

(D) the effective radii of **M**+ and **X**– are large.

(E) the effective radii of **M**+ and **X**– are small.

**2003 D Required**

For each of the following, use appropriate chemical principles to explain the observations. Include chemical equations as appropriate.

(a) In areas affected by acid rain, statues and structures made of limestone (calcium carbonate) often show signs of considerable deterioration.

(b) When table salt (NaCl) and sugar (C12H22O11) are dissolved in water, it is observed that

(i) both solution have higher boiling points than pure water, and

(ii) the boiling point of 0.10 *M* NaCl*(aq)* is higher than that of 0.10 *M* C12H22O11*(aq)*.

(c) Methane gas does not behave as an ideal gas at low temperatures and high pressures.

(d) Water droplets form on the outside of a beaker containing an ice bath.

Answer:

(a) limestone reacts with acid to produce a soluble substance, a gas, and water which wash away

CaCO3*(s)* + H+*(aq)*  Ca2+*(aq)* + CO2*(g)* + H2O*(l)*

(b) (i) a solution made from a non-volatile solute has a higher boiling point than the pure solvent because the solution has a lower vapor pressure than the water (Raoult’s Law) . the temperature of the solution has be higher to produce enough vapor pressure to equal the atmospheric pressure (i.e., boiling)

(ii) the amount of boiling point elevation depends on the number of non-volatile particles in solution. since the salt dissociates into 2 particles for every NaCl that dissolves, it will increase the boiling point more that an equal concentration of sugar (a molecular cpd) that does not dissociate or ionize.

(c) at low temperatures and high pressures, the methane molecules are slow and closer together. under these conditions, van der Waal forces become measurable and significant and creates a deviation from ideal behavior. at high pressure the volume of a real molecule is also significant.

(d) a water vapor molecules collide with the cool beaker, the molecules lose kinetic energy, slow down, attract others, and condense into a liquid

**2001 D Required**



Answer the questions below that relate to the five aqueous solutions at 25°C shown above.

(a) Which solution has the highest boiling point? Explain.

(b) Which solution has the highest pH? Explain.

(c) Identify a pair of the solutions that would produce a precipitate when mixed together. Write the formula of the precipitate.

(d) Which solution could be used to oxidize the Cl–*(aq)* ion? Identify the product of the oxidation.

(e) Which solution would be the least effective conductor of electricity? Explain.

**Answer:**

(a) solution 1, Pb(NO3)2. This compound will dissociate into three ions with the highest total particle molality. The greater the molality, the higher the boiling point. Solutions 2, 3, and 5 will produce two ions while solution 4 is molecular.

(b) solution 5, KC2H3O2. The salt of a weak acid (in this case, acetic acid) produces a basic solution, and, a higher pH.

(c) solution 1, Pb(NO3)2, and solution 2, NaCl. PbCl2

(d) solution 3, KMnO4 , ClO3–

(e) solution 4, C2H5OH. Ethyl alcohol is covalently bonded and does not form ions in water. Therefore, the solution is not a better conductor of electricity than water, which is also covalently bonded.

MC answers

1. A 2) A 3) A 4) A 5) A 6) E