This print-out should have 10 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

How many milliliters of 0.010 M HNO_3 will neutralize 20 mL of 0.0050 M $Ba(OH)_2$?

1. 40 mL

2. 20 mL **correct**

3. 10 mL

4. 5.0 mL

Explanation:

$[HNO_3] = 0.010$ M $\quad V_{Ba(OH)_2} = 20$ mL

$[Ba(OH)_2] = 0.0050$ M

The balanced equation for this neutralization reaction is

$$2\,HNO_3 + Ba(OH)_2 \rightarrow Ba(NO_3)_2 + 2\,H_2O$$

We determine the moles of $Ba(OH)_2$ present:

$$\begin{aligned} ?\text{ mol } Ba(OH)_2 &= 0.020\text{ L soln} \\ &\quad \times \frac{0.0050\text{ mol } Ba(OH)_2}{1\text{ L soln}} \\ &= 0.00010\text{ mol } Ba(OH)_2 \end{aligned}$$

Using the mole ratio from the balanced chemical equation we calculate the moles of HNO_3 needed to react with this amount of $Ba(OH)_2$:

$$\begin{aligned} ?\text{ mol } HNO_3 &= 0.00010\text{ mol } Ba(OH)_2 \\ &\quad \times \frac{2\text{ mol } HNO_3}{1\text{ mol } Ba(OH)_2} \\ &= 0.00020\text{ mol } HNO_3 \end{aligned}$$

We use the molarity of HNO_3 solution to convert from moles to volume of HNO_3:

$$\begin{aligned} ?\text{ mL } HNO_3 &= 0.00020\text{ mol } HNO_3 \\ &\quad \times \frac{1000\text{ mL soln}}{0.010\text{ mol } HNO_3} \\ &= 20\text{ mL } HNO_3 \end{aligned}$$

002 10.0 points

For gases that do not react chemically with water, the solubility of the gas in water generally (decreases, increases) with an increase in the pressure of the gas and (decreases, increases) with increasing temperature.

1. decreases; increases

2. decreases; decreases

3. increases; decreases **correct**

4. increases; increases

Explanation:

An increase in pressure means that you have increased the concentration of gas above the solvent surface, thereby increasing the concentration of the gas in the solvent. Increasing the temperature will decrease the solubility of the gas.

003 10.0 points

C_6H_{12} will most likely dissolve in which solvent?

1. H_2O

2. $BaCl_2$

3. CCl_4 **correct**

4. HF

5. NCl_3

Explanation:

C_6H_{12} is a nonpolar molecule. Like dissolves like, so the solvent most likely to dissolve C_6H_{12} will be nonpolar. CCl_4 is nonpolar.

004 10.0 points

Several interesting observations from the world around you are listed below. Which of these is NOT explained by a colligative property?

1. A lobster will die when placed in fresh water.

2. At high altitude it takes longer to cook spaghetti. **correct**

3. Water boils at a higher temperature when salt is added.

4. The freezing point of water is lowered when salt is added.

5. Antifreeze is added to a car radiator to keep the car from overheating.

Explanation:
Colligative properties of a solution depend on the number of solute particles in solution, not the type. Boiling point variations due to pressure changes have nothing to do with solutions and colligative properties (boiling point variations due to particles in solution, etc.).

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005 10.0 points

Consider two liquids A and B. The vapor pressure of pure A (molecular weight = 50 g/mol) is 225 torr at 25°C and the vapor pressure of pure B (molecular weight = 75 g/mol) is 90 torr at the same temperature. What is the total vapor pressure at 25°C of a solution that is 70% A and 30% B by weight?

1. 108 torr

2. 335 torr

3. 195 torr **correct**

4. 76 torr

5. 115 torr

6. 124 torr

7. 225 torr

8. 203 torr

9. 135 torr

Explanation:
For A,
$P^0 = 255$ torr MW = 50 g/mol
For B,
$P^0 = 90$ torr MW = 75 g/mol
The mole fractions are $\frac{7}{9}$ for A and $\frac{2}{9}$ for B.

$$\left(\frac{7}{9}\right)(225) + \left(\frac{2}{9}\right)(90) = 175 + 20 = 195 \text{ torr}$$

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006 10.0 points

A solution initially contains 1 M Ag^+ and 0.1 M Pb^{2+}. If NaCl is added to the solution, which cation will precipitate first, and how many orders of magnitude separate the concentrations of Cl^- ions at which the precipitations start?
AgCl: $K_{sp} \approx 10^{-10}$
$PbCl_2$: $K_{sp} \approx 10^{-5}$

1. Pb^{2+}; 6

2. Both will precipitate at the same time.

3. Ag^+; 8 **correct**

4. Pb^{2+}; 8

5. Ag^+; 6

Explanation:
For AgCl,

$$\begin{aligned} K_{sp} &= [Ag^+]\,[Cl^-] \\ 10^{-10} &= (1\text{ M})\,[Cl^-] \\ [Cl^-] &= 10^{-10} \end{aligned}$$

For $PbCl_2$,

$$\begin{aligned} K_{sp} &= [Pb^{2+}]\,[Cl^-]^2 \\ 10^{-5} &= (0.1\text{ M})\,[Cl^-]^2 \\ [Cl^-] &= 10^{-2} \end{aligned}$$

So Ag^+ precipitates first, and 8 orders of magnitude separate the concentrations which cause precipitation.

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007 10.0 points

In basic solution MnO_4^- oxidizes NO_2^- to NO_3^-

and is reduced to MnO_2. Calculate the volume of 0.10 M $KMnO_4$ solution that would be required to oxidize 30 mL of 0.10 M $NaNO_2$.

1. 45 mL

2. 20 mL **correct**

3. 10 mL

4. 30 mL

5. 90 mL

Explanation:

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008 10.0 points

Arrange the compounds

I)	CuS	$K_{sp} = 1.3 \times 10^{-36}$
II)	$PbCl_2$	$K_{sp} = 1.6 \times 10^{-5}$
III)	FeS	$K_{sp} = 6.3 \times 10^{-18}$
IV)	Hg_2Cl_2	$K_{sp} = 2.6 \times 10^{-18}$
V)	Cu_2S	$K_{sp} = 2.0 \times 10^{-47}$

in increasing order of molar solubility.

1. II, IV, III, V, I

2. V, I, IV, III, II

3. I, II, III, IV, V

4. I, V, III, IV, II **correct**

5. II, III, IV, I, V

Explanation:

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009 10.0 points

What is the molar solubility of Ag_2S? The K_{sp} is 6.3×10^{-51}.

1. 1.16×10^{-17} **correct**

2. 5.8×10^{-18}

3. 6.37×10^{-15}

4. 7.94×10^{-26}

5. 2.82×10^{-13}

Explanation:

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010 10.0 points

What is the molar solubility of CuBr in 0.5 M NaBr? The K_{sp} is 4.2×10^{-8}.

1. 2.05×10^{-4}

2. 3.48×10^{-3}

3. 8.40×10^{-8} **correct**

4. 4.20×10^{-7}

5. 4.20×10^{-8}

Explanation: