Name:
Score: 0 / 20 points (0%)

Chapter 4 Review Quiz

Multiple Choice

Identify the choice that best completes the statement or answers the question.

____ 1. The bonding present between water molecules is:

a. covalent.
b. dipole–dipole.
c. dispersion.
d. hydrogen.

ANSWER: D
There is a large difference in electronegativity between hydrogen atoms and oxygen atoms in water molecules, so the water molecule is polar. Due to the large difference in electronegativity, there is hydrogen bonding between water molecules.
POINTS: 0 / 1
FEEDBACK:
REF: 83

____ 2. A student performed an investigation to determine the formula for the hydrated salt for zinc sulfate. The student collected the following data:
Mass of empty evaporating basin = 42.56 g
Mass of evaporating basin with hydrated salt = 48.06 g
Mass of evaporating basin with anhydrous salt = 45.66 g

What is the formula for the hydrated salt of zinc sulfate?

a. $ZnSO_4.6H_2O$
b. $ZnSO_4.7H_2O$
c. $ZnSO_3.8H_2O$
d. $ZnSO_4.8H_2O$

ANSWER: B
General formula for hydrated salt of zinc sulfate is $ZnSO_4.xH_2O$. Hence, need to find *x*.
Mass of hydrated salt = 48.06 – 42.56 = 5.50 g
Mass of anhydrous salt = 45.66 – 42.56 = 3.10 g
Mass of water = 5.50 – 3.10 = 2.40 g

	$ZnSO_4$	H_2O
mass	3.10	2.40
molar mass	161.44	18.016
number of moles	0.0192	0.133
mole ratio	1	6.93 i.e. ~7

POINTS: 0 / 1
FEEDBACK:
REF: 83

___ 3. When an ionic compound dissolves:

a. the negative part of the water is attracted to the anion. This only occurs if the energy required to separate the ions is less than the energy released when the ions are hydrated.
b. the negative part of the water is attracted to the anion. This only occurs if the energy required to separate the ions is more than the energy released when the ions are hydrated.
c. the negative part of the water is attracted to the cation. This only occurs if the energy required to separate the ions is less than the energy released when the ions are hydrated.
d. the negative part of the water is attracted to the cation. This only occurs if the energy required to separate the ions is more than the energy released when the ions are hydrated.

ANSWER: C
The energy required to separate the ions must be less than the energy released when the ions are hydrated otherwise there is not sufficient energy present for the process to continue. Cations are positively charged ions, so they are attracted to the negative part of the water molecule.
POINTS: 0 / 1
FEEDBACK:
REF: 85

___ 4. The solubility of a solute is:

a. the mass of solute dissolved in an unsaturated solution.
b. the mass of solute dissolved in a saturated solution.
c. the mass of solute dissolved in a supersaturated solution.
d. the mass of solute that precipitates when a supersaturated solution is bumped.

ANSWER: A
POINTS: 0 / 1
FEEDBACK:
REF: 87

___ 5. How much potassium dichromate would dissolve at 50°C in 50 mL of water?

a. 72 g
b. 36 g
c. 30 g
d. 15 g

ANSWER: D
The solubility of potassium dichromate ($K_2Cr_2O_7$) at 50 ^{o}C is 30 g / 100 mL. Since there is only 50 mL of water, then only half this mass will dissolve (15 g).
POINTS: 0 / 1
FEEDBACK:
REF: 87

___ 6. Which salt has a solubility closest to 25 g / 50 mL water at 30^{o}C?

a. NaCl
b. KCl
c. KNO_3
d. $Pb(NO_3)_2$

ANSWER: C

25 g / 50 mL is equivalent to 50 g / 100 mL. At 30°C, KNO_3 has a solubility of 45 g / 100 mL, while $Pb(NO_3)_2$ has a solubility of 65 g / 100 mL. Hence, solubility of KNO_3 is closest to 50 g / 100 mL.

POINTS: 0 / 1
FEEDBACK:
REF: 87

___ 7. Which of the following salts is least soluble when the temperature is less than 90°C?

a. Potassium chlorate
b. Potassium chloride
c. Potassium chromate
d. Potassium nitrate

ANSWER: A
Less soluble means the graph that is lowest on the graph. The $KClO_3$ line is below the other named lines for all temperatures less than 90°C.
POINTS: 0 / 1
FEEDBACK:
REF: 87

___ 8. Australia's first peoples used a variety of ways to process food. Complex processing is commonly associated with which of the following types of processing?

a. cutting
b. cooking
c. leaching
d. pounding

ANSWER: C
Complex processing refers to processes that take over half a day to complete. Leaching usually takes between several hours and several days to complete.
POINTS: 0 / 1
FEEDBACK:
REF: 91

___ 9. What criteria is required for the removal of a substance by leaching?

a. The substance must have a high solubility in water.
b. The substance must have a high molar mass.
c. There must be a flowing creek nearby.
d. The substance must have a large surface area.

ANSWER: A
Leaching is the removal of a substance because it dissolves in water. The greater its solubility, the more substance that will dissolve in water and be removed.
POINTS: 0 / 1
FEEDBACK:
REF: 91

___ 10. Sparingly soluble refers to compounds whose solubility is:

a. < 0.1 g/L.
b. 0.1 – 5 g/L.
c. 1 – 10 g/L.
d. > 10 g/L.

ANSWER: C

Sparingly soluble means that it dissolves between 1 g/L and 10 g/L.

POINTS: 0 / 1
FEEDBACK:
REF: 94

____ 11. When a sodium chloride solution is added to a silver nitrate solution, a precipitate forms. Which of the following represents the net ionic equation for this reaction?

a. Ag^{+} (aq) + Cl^{-} (aq) $\rightarrow$ AgCl (s)
b. Na^{+} (aq) + NO_3^{-} (aq) $\rightarrow$ $NaNO_3$ (s)
c. NaCl (aq) + $AgNO_3$ (aq) $\rightarrow$ $NaNO_3$ (s) + AgCl (aq)
d. NaCl (aq) + $AgNO_3$ (aq) $\rightarrow$ $NaNO_3$ (aq) + AgCl (s)

ANSWER: A
Net ionic equation only shows the species that react; it does not include the spectator ions. All sodium salts and all nitrate salts are soluble; hence, precipitate is AgCl.

POINTS: 0 / 1
FEEDBACK:
REF: 94

____ 12. $MgCO_3$ (s) ƒ Mg^{2+} (aq) + CO_3^{2-} (aq)
The equilibrium expression for magnesium carbonate is written as:

a. $\dfrac{\left[Mg^{2+}\right]\left[Co_3^{2-}\right]}{\left[MgCO_3\right]}$

b. $[Mg^{2+}][CO_3^{2-}]$

c. $\dfrac{\left[Mg^{2+}\right]\left[Co_3^{2-}\right]}{\left[MgCO_3\right]}$

d. $[\,[Mg^{2+}][CO_3^{2-}]\,]^{-1}$

ANSWER: B
Since it is a heterogeneous system, only the ions are included in the equilibrium expression. Equilibrium expressions are always products over reactants, which is why magnesium ions and carbonate ions are in the numerator.

POINTS: 0 / 1
FEEDBACK:
REF: 100

____ 13. Write the equilibrium expression for the insoluble salt, magnesium phosphate.

a. $[Mg^{2+}][PO_4^{3-}]$
b. $[\,[Mg^{2+}][PO_4^{3-}]\,]^6$
c. $[Mg^{2+}]^2[PO_4^{3-}]^3$
d. $[Mg^{2+}]^3[PO_4^{3-}]^2$

ANSWER: D
Equation is: $Mg_3(PO_4)_2$ ƒ $3Mg^{2+}$ (aq) + $2PO_4^{3-}$ (aq)
Equilibrium expression is the product of the concentrations of the ions raised to the power of the coefficient in the equation. Since coefficient of Mg^{2+} is 3,

the concentration of Mg^{2+} is raised to the power of 3, ie. $[Mg^{2+}]^3$. Similarly, for the phosphate ion.

POINTS: 0 / 1
FEEDBACK:
REF: 100

____ 14. Which of the following hydroxides is most soluble?

a. $Cd(OH)_2$ $K_{sp} = 7.2 \times 10^{-15}$
b. $Ca(OH)_2$ $K_{sp} = 5.02 \times 10^{-6}$
c. $Pb(OH)_2$ $K_{sp} = 1.43 \times 10^{-20}$
d. $Mg(OH)_2$ $K_{sp} = 5.6 \times 10^{-12}$

ANSWER: B
The larger the K_{sp}, the more ions are produced; hence, the more soluble the salt.

POINTS: 0 / 1
FEEDBACK:
REF: 100

____ 15. The K_{sp} for lithium phosphate is 2.37×10^{-11} at 298K. Calculate the solubility of lithium phosphate in g/L.

a. 1.27×10^{-3} g/L
b. 2.21×10^{-3} g/L
c. 0.147 g/L
d. 0.256 g/L

ANSWER: C

Li_3PO_4 (s) f $3Li^+$ (aq) + PO_4^{3-} (aq)

$[PO_4^{3-}] = s$

$[Li^+] = 3s$

$K_{sp} = [Li^+]^3[PO_4^{3-}]$

$2.37 \times 10^{-11} = [3s]^3[s]$

$9s^4 = 2.37 \times 10^{-11}$

$$s^4 = \frac{2.37 \times 10^{-11}}{9} = 2.63 \times 10^{-12}$$

$$s = \sqrt[4]{2.63 \times 10^{-12}} = 1.27 \times 10^{-3}\,\text{molL}^{-1}$$

Molar mass of Li_3PO_4 = 115.79 g

Solubility (g/L) = solubility (mol/L) × molar mass = $1.27 \times 10^{-3} \times 115.79 = 0.147$ g/L

POINTS: 0 / 1
FEEDBACK:
REF: 101

____ 16. In a saturated solution of nickel(II) hydroxide at 298 K, the concentration of nickel ions is 5.16×10^{-6} mol/L. What is the K_{sp} for nickel(II) hydroxide?

a. 1.06×10^{-10}
b. 1.88×10^{-17}

c. 2.66×10^{-11}
d. 5.50×10^{-16}

ANSWER: D

$Ni(OH)_2$ (s) f Ni^{2+} (aq) + $2OH^-$ (aq)

$[Ni^{2+}] = s = 5.16 \times 10^{-6}$

$[OH^-] = 2s = 2 \times 5.16 \times 10^{-6} = 1.03 \times 10^{-5}$

$K_{sp} = [Ni^{2+}][OH^-]^2 = [5.16 \times 10^{-6}] \times [1.03 \times 10^{-5}]^2 = 5.50 \times 10^{-16}$

POINTS: 0 / 1
FEEDBACK:
REF: 102

___ 17. A student added 100 mL of 0.050 mol/L $Pb(NO_3)_2$ to 40 mL of a 0.020 mol/L NaCl solution. The K_{sp} for lead chloride is 1.70×10^{-5} at 298 K. Justify whether a precipitate of lead chloride will form in this investigation.

a. A precipitate will form because $Q_{sp} < K_{sp}$.
b. A precipitate will form because $Q_{sp} > K_{sp}$.
c. A precipitate will not form because $Q_{sp} < K_{sp}$.
d. A precipitate will not form because $Q_{sp} > K_{sp}$.

ANSWER: C

Number of moles of Pb^{2+} = $C_{Pb^{2+}} \times V_{Pb^{2+}} = 0.050 \times 0.100 = 0.0050$ mol

$[Pb^{2+}]$ in reaction = $\frac{n_{Pb^{2+}}}{v_{total}} = \frac{0.0050}{0.140} = 0.0357 \text{ mol L}^{-1}$

Number of moles of Cl^- = $C_{Cl^-} \times V_{Cl^-} = 0.020 \times 0.040 = 0.00080$ mol

$[Cl^-]$ in reaction = $\frac{n_{Cl^-}}{V_{total}} = \frac{0.00080}{0.0140} = 0.00571 \text{ molL}^{-1}$

$Q_{sp} = [Pb^{2+}][Cl^-]^2 = [0.0357] \times [0.00571]^2 = 1.17 \times 10^{-6}$

$Q_{sp} < K_{sp}$; therefore, no precipitate forms.

POINTS: 0 / 1
FEEDBACK:
REF: 106

___ 18. PbI_2 (s) f Pb^{2+} (aq) + $2I^-$ (aq)

Compare the solubility of lead(II) iodide in water with its solubility in a solution containing 0.1 mol/L potassium iodide.

a. Solubility of lead iodide is less in the potassium iodide solution because the forward reaction is favoured.
b. Solubility of lead iodide is less in the potassium iodide solution because the reverse reaction is favoured.
c. Solubility of lead iodide is greater in the potassium iodide solution because the forward reaction is favoured.
d. Solubility of lead iodide is greater in the potassium iodide solution because the reverse reaction is favoured.

ANSWER: D

Since the $[I^-]$ is greater in the potassium iodide solution than in water, the reverse reaction is favoured to minimise the increase in $[I^-]$ (Le Chatelier's

Principle), thereby favouring the formation of PbI_2 and decreasing the solubility of PbI_2.

POINTS: 0 / 1
FEEDBACK:
REF: 107

___ 19. The K_{sp} for AgCl is 1.77×10^{-10} at 298 K. Calculate the solubility of Ag+ in a 0.100 mol/L solution of NaCl.

a. 1.77×10^{-9} mol/L
b. 1.77×10^{-10} mol/L
c. 1.33×10^{-5} mol/L
d. 1.33×10^{-6} mol/L

ANSWER: A

In water, $K_{sp} = [Ag^+]\,[Cl^-]$ where $[Ag^+] = [Cl^-] = s$

$1.77 \times 10^{-10} = s^2$

$s = \sqrt{1.77 \times 10^{-10}}\ 1.33 \times 10^{-5} \mathrm{molL^{-1}}$

In NaCl, $[Cl^-] = 0.100 + s \approx 0.100$ mol/L

$[Ag^+] = s$

$K_{sp} = [Ag^+]\,[Cl^-]$

$1.77 \times 10^{-10} = s \times 0.100$

$s = \frac{1.77 \times 10^{-10}}{0.100} = 1.77 \times 10^{-9} \mathrm{molL^{-1}}$

POINTS: 0 / 1
FEEDBACK:
REF: 107

___ 20. The K_{sp} for $NiCO_3$ is 1.42×10^{-7} at 298 K. Determine how much less soluble $NiCO_3$ is in a 0.050 mol/L solution of Na_2CO_3 than it is in water.

a. 53 000
b. 133
c. 3.77×10^{-4}
d. 7.53×10^{-3}

ANSWER: B

In water, $K_{sp} = [Ni^{2+}]\,[CO_3^{2-}]$ where $[Ni^{2+}] = [CO_3^{2-}] = s$

$s = \sqrt{1.42 \times 10^{-7}} = 3.77 \times 10^{-4} \mathrm{molL^{-1}}$

In $NiCO_3$, $[CO_3^{2-}] = 0.050 + s \approx 0.050$ mol/L

$[Ni^{2+}] = s$

$K_{sp} = [Ni^{2+}]\,[CO_3^{2-}]$

$1.42 \times 10^{-7} = s \times 0.050$

$s = \frac{1.42 \times 10^{-7}}{0.050} = 2.84 \times 10^{-6} \mathrm{molL^{-1}}$

solubility of $NiCO_3$ in water is $3.77 \times 10^{-4} \mathrm{molL^{-1}}$

solubility of $NiCO_3$ in 0.050 mol/L solution of Na_2CO_3 is $2.84 \times 10^{-6} \mathrm{molL^{-1}}$

$$\frac{3.77 \times 10^{-4}}{2.84 \times 10^{-6}} = 133$$

Therefore, $NiCO_3$ is 133 times less soluble in 0.050 mol/L solution of Na_2CO_3 than it is in water.

POINTS: 0 / 1
FEEDBACK:
REF: 107

Retake