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Question: 1

Place the following in the correct order of increasing acidity.

a. HCl < HF < HI < HBr
b. HCl < HBr < HI < HF
c. HI < HBr < HCl < HF
d. HF < HCl < HBr < HI

Answer: D

Explanation:
Acidity increases as we travel down the periodic table with regard to the halogens. Even though fluorine is the most electronegative element and would be expected to stabilize a negative charge well, it is such a small atom that it is poorly able to stabilize the negative charge and therefore will have a stronger bond to the hydrogen. As the atoms get larger, moving from fluorine to iodine, the ability to stabilize a negative charge becomes greater and the bond with the hydrogen is weaker. A stronger bond with the between the halogen and the hydrogen will result in less acidity, since fewer hydrogen ions will be produced.

Question: 2

Place the following in the correct order of increasing solubility in water.

a. Butanol < ethanol < octane < NaCl
b. Ethanol < NaCl < octane < butanol
c. NaCl < octane < butanol < ethanol
d. Octane < butanol < ethanol < NaCl

Answer: D

Explanation:
Octane is a nonpolar hydrocarbon with little or no water solubility. Butanol is an alcohol with a small amount of solubility due to its polar —OH group. Ethanol is a smaller, more polar alcohol that is very soluble in water. NaCl is an ionic salt that is highly soluble in water.

Question: 3

50 grams of acetic acid $C_2H_4O_2$ are dissolved in 200 g of water. Calculate the weight % and mole fraction of the acetic acid in the solution.

a. 20%, 0.069
b. 0.069%, 0.20
c. 25%, 0.075
d. 20%, 0.075

Answer: A

Explanation:

The weight % of the acetic acid is the mass of acetic acid divided by the mass of the acetic acid plus the water. So $\frac{50\ g}{(50\ g+200\ g)} = 0.2$, or 20%. The mole fraction is the moles of acetic acid divided by the total number of moles of the solution. So 50 g of acetic acid (MW = 60) is $\frac{50\ g}{\frac{60\ g}{mol}} =$ 0.83 moles. 200 g of water = 11.11 moles. Therefore, $\frac{0.83\ mol}{(0.83\ mol+11.11\ mol)} = 0.069$.

Question: 4

Ammonium Phosphate $(NH_4)_3PO_4$ is a strong electrolyte. What will be the concentration of all the ions in a 0.9 M solution of ammonium phosphate?

a. $[NH_4^+] = 0.9$ M, $[PO_4^{3-}] = 0.9$ M
b. $[NH_4^+] = 0.3$ M, $[PO_4^{3-}] = 0.9$ M
c. $[NH_4^+] = 2.7$ M, $[PO_4^{3-}] = 0.9$ M
d. $[NH_4^+] = 2.7$ M, $[PO_4^{3-}] = 2.7$ M

Answer: C

Explanation:

Since there are three moles of NH_4^+ per mole of salt and 1 mole of PO_4^{3-} per mole of salt, the total ionic concentrations must be 2.7 M of NH_4^+, and 0.9 M of PO_4^{3-}.

Question: 5

Which of the following represents the correct increasing order of acidity?

a. $CH_3COOH < CH_3OH < CH_3CH_3 < HCl$
b. $CH_3CH_3 < CH_3OH < CH_3COOH < HCl$
c. $CH_3CH_3 < CH_3COOH < CH_3OH < HCl$
d. $CH_3OH < CH_3CH_3 < HCl < CH_3COOH$

Answer: B

Explanation:

Ethane is an alkane and only very weakly acidic. Methanol, an alcohol, has a slightly acidic proton attached to the oxygen. Acetic acid is much more acidic than methanol with the acidic proton attached to the carboxyl group. Hydrochloric acid is highly acidic and completely dissociates in water.

Question: 6

One liter of a 0.02 M solution of methanol in water is prepared. What is the mass of methanol in the solution, and what is the approximate molality of methanol?

a. 0.64 g, 0.02 m
b. 0.32 g, 0.01 m
c. 0.64 g, 0.03 m
d. 0.32 g, 0.02 m

Answer: A

Explanation:

Since we have 1 liter of the solution, then 0.02 M represents 0.02 moles of methanol. The mass of methanol can then be found by 0.02 mol × MW of $CH_3OH(32) = 0.64$ g. Molality is the moles of solute (methanol) divided by the number of kilograms of solvent, in this case, it is essentially 1 kg. This is assumed since the solvent is water and the density of water is 1 g/mL. So 0.02 mol/1 kg = 0.02 m.

Question: 7

A 1 M solution of NaCl (A) and a 0.5 M solution of NaCl (B) are joined together by a semi permeable membrane. What, if anything, is likely to happen between the two solutions?

A. No change, the solvents and solutes are the same in each
B. Water will migrate from A to B
C. NaCl will migrate from A to B and water will migrate from B to A.
D. Water will migrate from B to A.

Answer: D

Explanation:
During osmosis, solvent flows from the lowest to the highest concentration of solute, in this case B to A. The membrane is semi-permeable and only allows the solvent to move, not the solute.

Question: 8

Which of the following radioactive emissions results in an increase in atomic number?

A. Alpha
B. Negative Beta
C. Positive Beta
D. Gamma

Answer: B

Explanation:
Negative beta emission represents the spontaneous decay of a neutron into a proton with the release of an electron. Therefore, the resulting nucleus will have one more proton than it did before the reaction, and protons represent the atomic number of an atom. Alpha decay results in the emission of a helium nucleus. The resulting nucleus of an alpha decay would lose two protons and two neutrons, causing a decrease in both the atomic number and the mass number. Gamma decay does not affect the numbers of protons or neutrons in the nucleus. It is an emission of a photon, or packet of energy.

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