College Admission

IB-Chemistry

IB Chemistry (SL and HL) Examination

Latest Version: 6.0

Question: 1

100 mL of a 0.1 M solution of NaOH is neutralized to pH 7 with H_2SO_4. How many grams of H_2SO_4 are required to achieve this neutralization?

A. 4.9 g
B. 0.98 g
C. 9.8 g
D. 0.49 g

Answer: D

Explanation:
100 mL of a 0.1 M solution of NaOH contains 0.01 moles of NaOH. That means 0.01 moles of acid are required to completely neutralize the solution. The MW of sulfuric acid is 98, so 0.98 g of sulfuric acid is 0.01 mole. But since sulfuric acid has two equivalents of acid per mole, only 0.005 mole of the acid is required or 0.49 g.

Question: 2

Comparing pure water and a 1 M aqueous solution of NaCl, both at 1 atm of pressure, which of the following statements is most accurate?

A. The pure water will boil at a higher temperature, and be less conductive
B. The pure water will boil at a lower temperature and be less conductive
C. The pure water will boil at a lower temperature and be more conductive
D. The pure water boil at the same temperature and be more conductive

Answer: B

Explanation:
Pure water boils at 100̊C. Water that has salts dissolved in it will boil at a slightly higher temperature, and will conduct electricity much better than pure water.

Question: 3

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: 4

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 < NACI

Answer: D

Explanation:
Octane is a no polar 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: 5

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: 6

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: 7

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: 8

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, 0.01m
C. 0.64 g, 0.03 m
D. 0.323 0.02m

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.

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