Chem Lab C - Chem Lab Pearl City Invitational 2020 - Pearl City Invitational - 12-12-2020

Please select the best possible answer for all questions. The tie breakers ARE NOT noted on the test, so make sure you answer all the questions.

The answer sections do not provide the options for subscripts or superscripts so I have done my best here to explain how they will be represented.

Assume that any number in the front of a chemical formula is a coefficient and any number that comes at the end or the middle of a chemical formula is a subscript.

Ex: $2H_2O_2$ = 2H2O2

If a number has a + or - sign in front it indicates a charged ion. If it is a polyatomic ion the charge will be indicated outside a parenthesis for more clarity.

Ex: $2H^+$ = 2 H+

Al^{+3} = Al+3

NO_3^- = (NO3)-

If there are powers they will be indicated with a ^, which will be used for equilibrium expressions.

Ex: $[NO_3^-]^3$ = [(NO3)-]^3

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1. (1.00 pts)   For the equilibrium that exists in an aqueous solution of nitrous acid (HNO_2, weak acid) the equilibrium constant expression is:

○ A) Ka = [H+][(NO2)-] / [HNO2]

○ B) Ka = [H+][N+3][O-2]^2 / [HNO2]

○ C) Ka = [H+][(NO2)-]

○ D) Ka = [H+]^2[(NO2)-] / [HNO2]

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2. (2.00 pts)   Which of the following are a conjugate acid/base pair?

○ A) HCl / OCl-

○ B) H2SO4 / (SO4)-2

○ C) (NH4)+ / NH3

○ D) (H3O)+ / OH-

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3. (1.00 pts)   What is the [H+] in a solution with a pH of 9.88?

○ A) 4.1 M

○ B) 9.9 M

○ C) 7.6 x 10^-5 M

○ D) 1.3 x 10^-10 M

○ E) None of these

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4. (2.00 pts)   For Nitrous acid, HNO_2, K_a = 4.0 x 10^{-4}. Calculate the pH of 0.27M HNO_2.

○ A) 1.98

○ B) 0.57

○ C) 3.97

○ D) 12.02

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5. (1.00 pts)   An aqueous solution of sodium carbonate (Na2CO3) is _____ in nature.

○ A) Acidic

○ B) Basic

○ C) Neutral Salt

○ D) cannot be determined

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6. (2.00 pts)   Calculate the pH of a 5.7 M solution of aniline. ($C_6H_5NH_2$; $K_b = 3.8 \times 10^{-10}$)

○ A) 4.33

○ B) 9.67

○ C) 5.34

○ D) 8.66

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7. (1.00 pts)   What is the pOH of a solution with a pH of 4?

○ A) 10

○ B) 4

○ C) 3

○ D) 1

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8. (1.00 pts)   Calculate the pH of a 2.28 M solution of NaOH.

○ A) 0.358

○ B) 13.6

○ C) 14.4

○ D) 2.28

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9. (2.00 pts)   If an acid, HA, is 14.7% dissociated in a 1.0 M solution, what is the Ka for this acid?

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10. (5.00 pts)
A solution of 0.100 M HCl and a solution of 0.100 M NaOH are prepared. A 40.0 mL sample of one of the solutions is added to a beaker and then titrated with the other solution. A pH electrode is used to obtain the data that are plotted in the titration curve shown. Answer a-c below. Make sure you label your answers.

Volume of Titrant Added (mL)
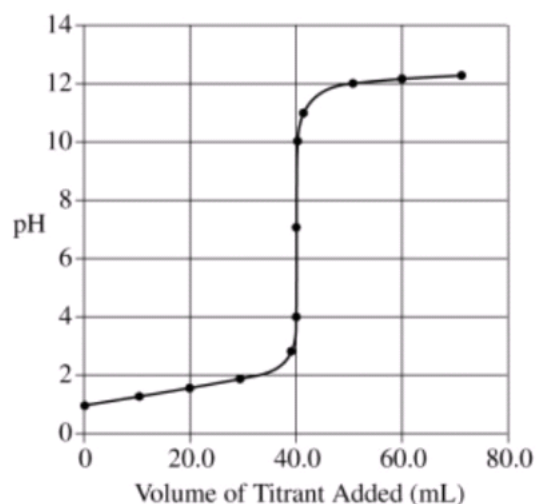
Indicator	pH Range of Color Change
Methyl violet	0 – 1.6
Methyl red	4 – 6
Alizarin yellow	10 – 12

(a) (2pt.) Identify the solution that was initially added to the beaker. Explain your reasoning.

(b) (1pt.) At the equivalence point, how many moles of titrant have been added?

(c) (2pts.) The same titration is to be performed again, this time using an indicator. Use the information in the table to select the best indicator for the titration and Explain you choice.

11. (2.00 pts) What is the pH of a 1.5 x 10^{-2} M solution ammonia? (K_b = 1.8 x 10^{-5} (M))

- A) 3.3
- B) 4.4
- C) 11.3
- D) 10.7
- E) 13
- F) 12.6

12. (3.00 pts) A 0.0322 M solution of an organic weak base had a pH of 11.82. What is the K_b for the base?

- A) 4.7 x 10^{-6}
- B) 1.7 x 10^{-3}
- C) 1.8 x 10^{-2}
- D) 2.1 x 10^{-1}
- E) 3.4 x 10^{-8}
- F) 5.6 x 10^{-3}

13. (2.00 pts) A solution of HF has a pH of 3.66. What is its concentration? The K_a for HF is 6.8 x 10^{-4}.

○ A) 1.7 x 10^{-3}

○ B) 6.6 x 10^{-3} M

○ C) 3.4 x 10^{-10} M

○ D) 7.1 x 10^{-5} M

○ E) 2.9 x 10^{-4} M

○ F) 6.0 x 10^{-2} M

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14. (2.00 pts)   What is the mole fraction of ethanol when 67 g of ethanol is mixed with 80 g of water?

○ A) 1

○ B) 0.75

○ C) 0.5

○ D) 0.25

○ E) 0.125

○ F) 0

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15. (2.00 pts)   What is the concentration (M) of HCl in a solution prepared by dissolving 10 g of HCl in 400 g of C2H6O if the density of the solution is 0.79 g/mL?

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16. (1.00 pts)   What mass of lithium phosphate would you mass to make 2.5 liter of 1.06 M lithium phosphate solution?

○ A) 307 grams

○ B) 407 grams

○ C) 152 grams

○ D) 45 grams

○ E) 2.65 grams

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17. (1.00 pts)   Identify which one of the following 0.100 M solutions will have the lowest vapor pressure. Sucrose, Ca(ClO4)$_2$, NaCl, Al(ClO4)$_3$, KClO$_4$

○ A) Sucrose

○ B) Ca(ClO4)2

○ C) Al(ClO4)3

○ D) KClO4

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18. (1.00 pts)   Complete the following sentence correctly. An unsaturated solution is one that _____.

○ A) has no double bonds.

○ B) has a concentration lower than the solubility.

○ C) contains no solute.

○ D) contains the maximum concentration of solute possible.

○ E) contains more dissolved solute than the solubility allows.

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19. (2.00 pts)   Which one of the following occurs when adding more solute to an aqueous solution?

○ A) The boiling point goes down.

○ B) The freezing point goes down.

○ C) The vapor pressure increases.

○ D) The osmotic pressure decreases.

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20. (1.00 pts)   A solution with a concentration higher than the solubility is _____.

○ A) not possible

○ B) saturated

○ C) supercritical

○ D) supersaturated

○ E) unsaturated

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21. (1.00 pts)   Molality is defined as the _____.

○ A) moles solute / moles solvent

○ B) moles solute / Liters solution

○ C) moles solute / kg solvent

○ D) moles solute / kg solution

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22. (1.00 pts)   What is the molarity of a solution with 4 moles of NaCl in 2 Liters?

○ A) 1M

○ B) 2M

○ C) 3M

○ D) 4M

○ E) 5M

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23. (1.00 pts)   How many mL of a 5 M solution of NaCl are needed to make 500 mL of a 0.01M solution?

○ A) 1mL

○ B) 10mL

○ C) 100mL

○ D) 1000mL

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24. (2.00 pts)   How many grams of NaCl are in 25 mL of a 2M solution?

○ A) 2 grams

○ B) 2.5 grams

○ C) 2.9 grams

○ D) 3.2 grams

25. (1.00 pts) When HNO_3 dissociates in water, what ions are formed?

○ A) H+ , N3+, (O3)^-4

○ B) H3+, (O3)^-3

○ C) H+ , (NO3)^-1

○ D) H+ , (NO3)^-4

26. (1.00 pts) A solution of KI is added to another unknown solution. A yellow precipitate comes out of solution. What is the possible identity of the unknown solution?

○ A) sodium nitrate

○ B) calcium nitrate

○ C) aluminum nitrate

○ D) lead nitrate

27. (1.00 pts) What is the general rule in chemistry that describes the relationship between solvent and solute of soluble substances?
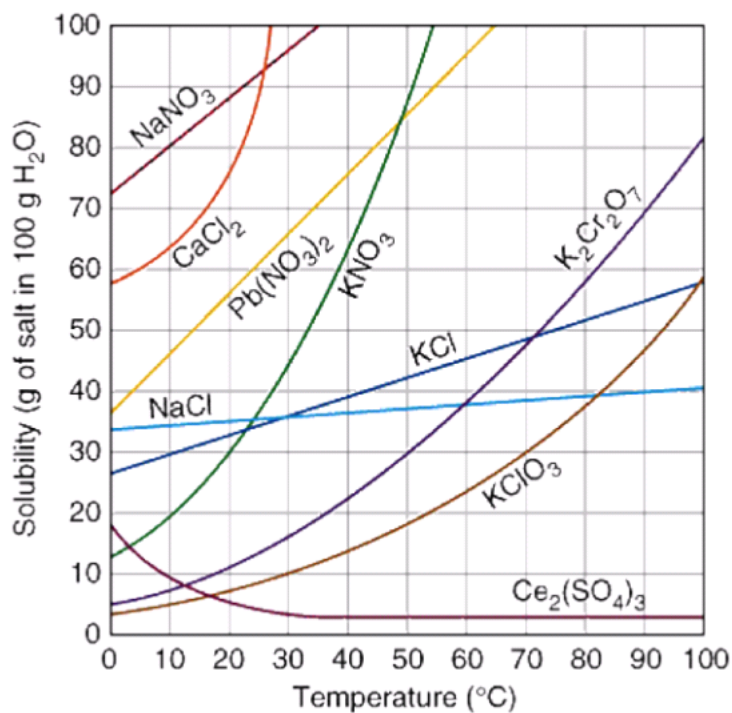
○ A) Like dissolves like.

○ B) Like does not dissolve like.

○ C) Unlike dissolves unlike.

○ D) Unlike dissolves like.

28. (2.00 pts) Use the graph to determine how much $K_2Cr_2O_7$ can be dissolved in 35 grams of water at 50ºC.
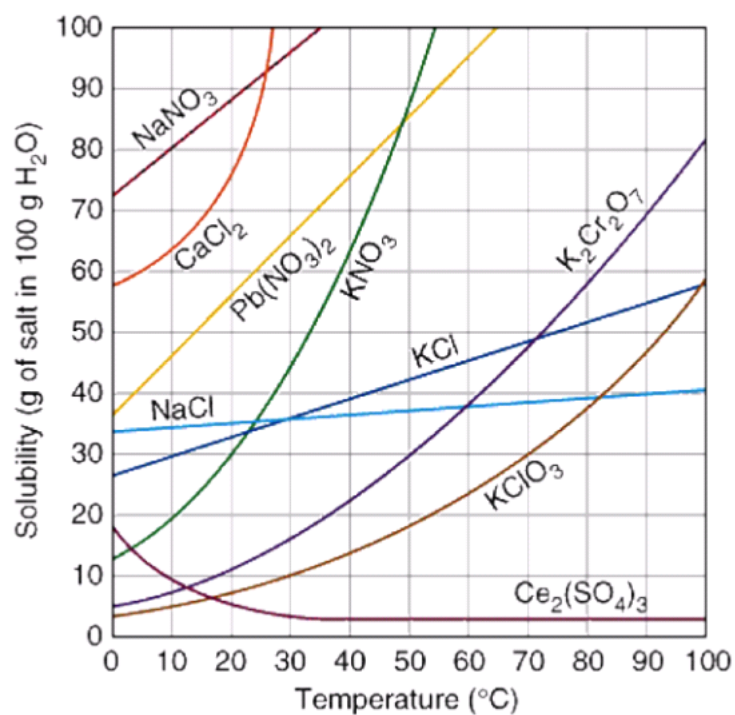
- A) 30 grams
- B) 3.0 grams
- C) 10.5 grams
- D) 15 grams
- E) 35 grams

29. (1.00 pts) Use the graph to determine the MINIMUM mass of water needed to dissolve 14g of $NaNO_3$ at 10°C.
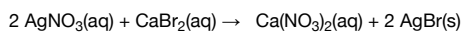
- A) 10 grams
- B) 100 grams
- C) 80 grams
- D) 17.5 grams
- E) 20.5 grams
- F) 12.5 grams

30. (2.00 pts) How many grams of silver chromate will precipitate when 250. mL of 0.500 M silver nitrate are added to 300. mL of 0.400 M potassium chromate?

$2\ AgNO_3(aq) + K_2CrO_4(aq) \rightarrow\ Ag_2CrO_4(s) + 2\ KNO_3(aq)$
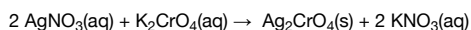
31. (2.00 pts) What volume of 0.550 M silver nitrate will be required to precipitate, as silver bromide, all the bromide ion in 35.0 mL of 0.100 M calcium bromide?

$2\ AgNO_3(aq) + CaBr_2(aq) \rightarrow\ Ca(NO_3)_2(aq) + 2\ AgBr(s)$

- A) 0.00555 L
- B) 0.00636 L
- C) 0.0127 L
- D) 0.00777 L

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