

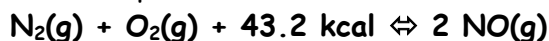
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Last KeyFirst Answer

Question 1 Consider the following system at equilibrium at 298 K:

8 Points



The production of NO(g) is favored by:

Indicate True or False for each of the following:

- | | |
|--|---|
| <input type="checkbox"/> Increasing the temperature. True | <input type="checkbox"/> Adding NO. False |
| <input type="checkbox"/> Increasing the volume. False | <input type="checkbox"/> Removing O ₂ . False |

Question 2 Consider the following system at equilibrium at 346 K:

8 Points

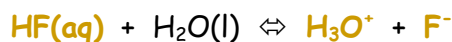
The production of COBr₂(g) is favored by:

Indicate True or False for each of the following:

- | | |
|--|---|
| <input type="checkbox"/> Decreasing the temperature. True | <input type="checkbox"/> Adding Br ₂ . True |
| <input type="checkbox"/> Decreasing the pressure. False | <input type="checkbox"/> Removing COBr ₂ . True |

Question 3 Write a net ionic equation to show that hydrofluoric acid, HF, behaves as an acid in water.

4 Points



Question 4 Assign each species on the left to a category on the right.

8 Points

- | | | |
|--|----------|----------------|
| a. C ₂ H ₅ NH ₂ | 4 | 1. Strong Acid |
| b. HF | 2 | 2. Weak Acid |
| c. NH ₃ | 4 | 3. Strong Base |
| d. Ba(OH) ₂ | 3 | 4. Weak Base |

Question 5 The hydroxide concentration in an aqueous solution is 4.47×10⁻⁴ M @ 25°C

6 Points

- | | |
|--|--------------------------------|
| a. The hydronium ion concentration is: | 2.24×10⁻¹¹ M |
| b. The pH of this solution is: | 10.65 |
| c. The pOH is: | 3.35 |

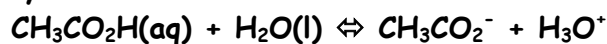
Question 6 Arrange the following solutions in order of increasing acidity:

6 Points

1 = least acidic ; 3 = most acidic

- | | |
|--|----------|
| 1. [H ₃ O ⁺] = 1×10 ⁻⁶ M | 2 |
| 2. pOH = 3 | 1 |
| 3. [OH ⁻] = 1×10 ⁻⁹ M | 3 |

Question 7 In the following net ionic equation, identify each reactant as either a Bronsted-Lowry acid or a Bronsted-Lowry base:
8 Points



Bronsted-Lowry acid: BLA

Bronsted-Lowry base: BLB

- | | | | |
|-------------------------------------|-----|-------------------------------|-----|
| 1. $\text{CH}_3\text{CO}_2\text{H}$ | BLA | 3. CH_3CO_2^- | BLB |
| 2. H_2O | BLB | 4. H_3O^+ | BLA |

Question 8 Give the formula for:
6 Points

- The conjugate acid of H_2PO_4^- H_3PO_4
- The conjugate base of H_2PO_4^- HPO_4^{2-}

Question 9 Which of the following aqueous solutions are buffer solutions?
4 Points

- | | |
|---|--|
| <input type="checkbox"/> 0.19 M KOH + 0.25 M KCl | <input checked="" type="checkbox"/> 0.17M CH_3COOH +0.17M CH_3COOK |
| <input checked="" type="checkbox"/> 0.34 M NH_4Br + 0.38 M NH_3 | <input type="checkbox"/> 0.22 M HI + 0.19 M NaI |
| <input type="checkbox"/> 0.34 M $\text{Ba}(\text{ClO}_4)_2$ + 0.23 M $\text{Ba}(\text{NO}_3)_2$ | |

Question 10 A buffer solution that is 0.354 M in HNO_2 and 0.354 M in NaNO_2 has a pH of 3.35.
4 Points

Addition of which of the following would increase the capacity of the buffer for added H_3O^+ ?

- | | |
|---|---|
| <input checked="" type="checkbox"/> NaNO_2 | <input checked="" type="checkbox"/> both HNO_2 and NaNO_2 |
| <input type="checkbox"/> pure water | <input type="checkbox"/> None of the these |
| <input type="checkbox"/> HNO_2 | |

Question 11 A buffer solution is 0.422 M in HCN and 0.273 M in KCN. If K_a for HCN is 4.0×10^{-10} , what is the pH of this buffer solution?
5 Points

$$\text{pH} = \text{p}K_a - \log_{10} \frac{[\text{CN}^-]}{[\text{HCN}]}$$

$$\text{pH} = -\log_{10}(4.0 \times 10^{-10}) - \log_{10} \frac{0.273}{0.422}$$

$$\text{pH} = 9.21$$

Question 12 A small amount of strong base is added to a buffer made from HNO_2 and NaNO_2 . What changes if any will occur to the solution?
8 Points

- Circle the appropriate answer

- | | | | |
|----------------------|----------|----------|-----------|
| a. pH | Increase | Decrease | Unchanged |
| b. $[\text{NO}_2^-]$ | Increase | Decrease | Unchanged |
| c. $[\text{HNO}_2]$ | Increase | Decrease | Unchanged |
| d. $[\text{OH}^-]$ | Increase | Decrease | Unchanged |

- Question 13 How many grams of copper(II) chloride are there in **48.9 mL** of an aqueous solution that has a concentration of **0.196 M** ?
6 Points
Must show work

$$\text{CuCl}_2: 63.55 + 2(33.45) = 134.45 \text{ g}\cdot\text{mol}^{-1}$$

$$\# \text{mol CuCl}_2 = 0.196 \times 0.0489 = 9.58 \times 10^{-3} \text{ mol CuCl}_2$$

$$\frac{9.58 \times 10^{-3} \text{ mol CuCl}_2}{1} \left| \frac{134.45 \text{ g}}{1 \text{ mol}} \right. = 1.29 \text{ g}$$

1.29 g

- Question 14 You wish to make a **0.233 M nitric acid** solution from a stock solution of **6.00 M nitric acid**. How much concentrated acid must you add to obtain a total volume of **75.0 mL** of the dilute solution ?
6 Points
Must show work

$$\# \text{mol HNO}_3 = 0.233 \times 0.075 = 1.75 \times 10^{-2} \text{ mol HNO}_3$$

$$M = \frac{\# \text{ mol HNO}_3}{V(\text{l})}$$

$$6.00 = \frac{1.75 \times 10^{-2} \text{ mol HNO}_3}{V(\text{l})}$$

$$V = 0.00291 \text{ L}$$

2.91 mL

- Question 15 According to the following reaction, how many moles of **bromine trifluoride** are necessary to form **0.162 moles fluorine gas**? **bromine trifluoride (g) = bromine (g) + fluorine (g)**
5 Points
Must show work and include a balanced chemical equation.



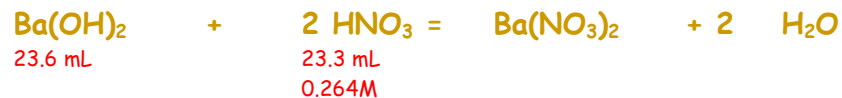
$$\frac{0.162 \text{ mol F}_2}{1} \left| \frac{2 \text{ BrF}_3}{3 \text{ F}_2} \right. = 0.108 \text{ mol BrF}_3$$

0.108 mol

Question 16 An aqueous solution of **barium hydroxide** is standardized by titration with a **0.264 M** solution of **nitric acid**.
8 Points

If **23.6 mL** of base are required to neutralize **23.3 mL** of the acid, what is the molarity of the **barium hydroxide** solution?

Must show work and include a balanced chemical equation.



$$\# \text{ mol HNO}_3 = 0.264 \times 0.0233 = 6.15 \times 10^{-3} \text{ mol HNO}_3$$

$$\frac{6.15 \times 10^{-3} \text{ mol HNO}_3}{2 \text{ HNO}_3} \left| \frac{1 \text{ Ba(OH)}_2}{2 \text{ HNO}_3} \right. = 3.07 \times 10^{-3} \text{ mol Ba(OH)}_2$$

$$M = \frac{3.07 \times 10^{-3} \text{ mol Ba(OH)}_2}{0.0236} = 0.130$$

0.130 M

Exam III Score