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INCORRECT SIG FIGS | INCORRECT UNITS

# Unit 11
# Free Response Practice #1

## Pre-AP Chemistry
## Section II
## Constructed-Response Questions

**Directions:** The suggested time is about 15 minutes for answering the constructed response section of the chemistry test. The parts within a question may not have equal weight. For calculations, show all your work in the spaces provided after each part. Pay particular attention to the proper use of units. Be sure your final answer is rounded to the correct number of significant figures. Make sure your work is legible. Illegible work will receive a grade of zero.

**Question 1 [10 POINTS]**

Known concentration ⇒ titrant

Unknown concentration ⇒ analyte

A solution of 0.10 M nitric acid is prepared to determine the concentration of 10.0 mL of a magnesium hydroxide solution. The 10.0 mL of magnesium hydroxide solution is placed in an Erlenmeyer flask. A pH probe is used to obtain pH readings throughout the titration experiment. To reach the equivalence point, 30.0 mL of nitric acid is added to the Erlenmeyer flask.

**A.** Write the balanced equation for the neutralization reaction described by the titration. **[2 POINTS]**

$$1\,Mg(OH)_{2(aq)} + 2\,HNO_{3(aq)} \rightarrow 2\,H_2O_{(l)} + 1\,Mg(NO_3)_{2(aq)}$$

**B.** Write the balanced net ionic equation for the reaction above. **[1 POINT]**

$$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$$

**C.** Using the information provided above:

i. Calculate the concentration of the initial magnesium hydroxide solution. **[2 POINTS]**

$$M_a V_a = M_{OH^-} V_b$$

$$(0.10M)(30.0mL) = M_{OH^-}(10.0mL)$$

$$M_{OH^-} = \frac{30.0 \times 0.10}{10.0} = 0.30M\ OH^- \times \frac{1\ Ca(OH)_2}{2\ OH^-} = \boxed{0.15\ M\ Ca(OH)_2}$$

ii. Calculate the number of moles of magnesium hydroxide in the 10.0 mL sample. **[1 POINT]**

$$mol = 0.15M \times 0.0100L = \boxed{0.0015\ mol\ Mg(OH)_2}$$

(or $1.5 \times 10^{-3}$)

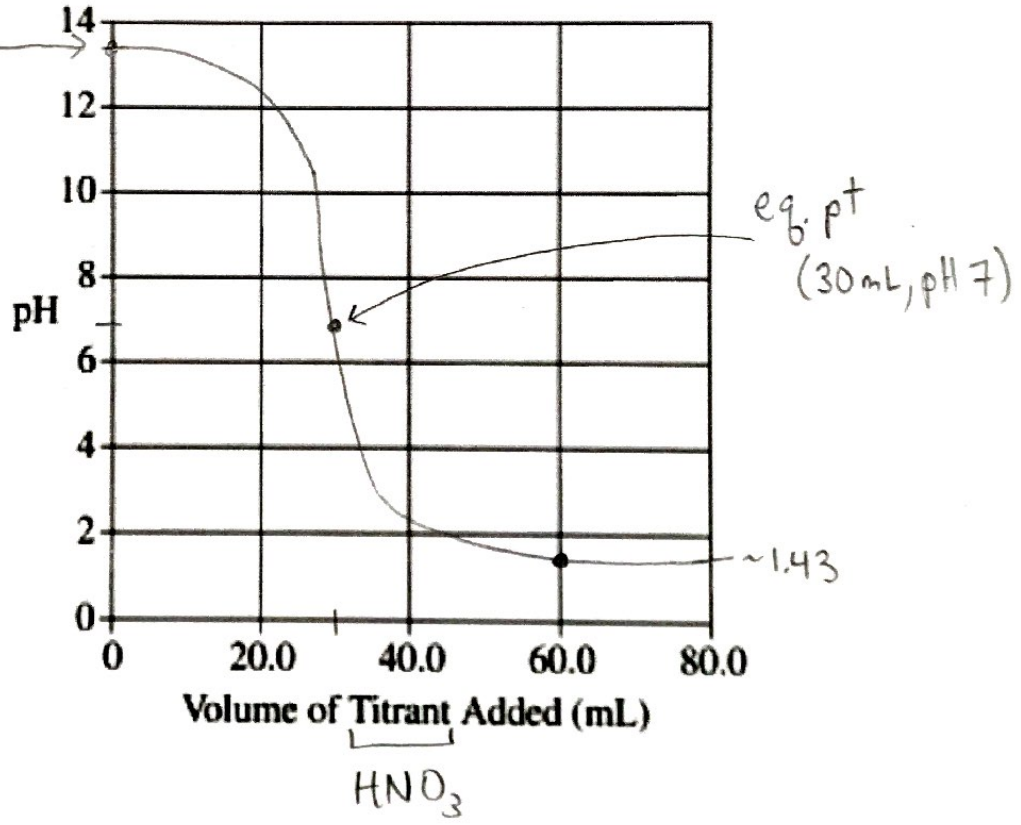
iii. Show a numerical setup and calculate the pH of the initial magnesium hydroxide solution. **[2 POINTS]**

$pOH = -\log[OH^-] = -\log(0.30) = 0.52$

$\Rightarrow pH = 14 - 0.52 = \boxed{13.48}$

**D.** When the student has added 60.0 mL of the nitric acid to the Erlenmeyer flask, the pH is determined to be 1.43. On the axis below:

i. Plot the points at which 0.00 mL, 30.0 mL, and 60.0 mL of titrant have been added to the Erlenmeyer flask and sketch the general shape of the titration curve. **[2 POINTS]**




Note: to get full credit, curve shape must show:

- steepest part @ eq. pt
- curve starting / ending almost flat