

## Chemistry Lab - Test Exchange

School: \_\_\_\_\_

Team #: \_\_\_\_\_

Time: 50 minutes

Instructions:

MARK ALL WORK AND ANSWERS IN THIS BOOKLET CLEARLY FOR FULL CREDIT

Answers are to be rounded to 3 significant figures, if not stated otherwise in the question.

Appropriate units are required for full credit.

Scientific and non-programmable calculators are allowed; use of programmable or graphing calculators is grounds for disqualification.

Separate pages from staple if necessary, but be mindful to staple all pages back together before submission of your exam.

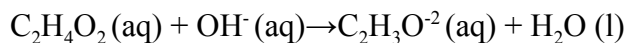
Constants, but not formulas, will be given to you in the problem.

**BEGINNING OF EXAM****Free Response**

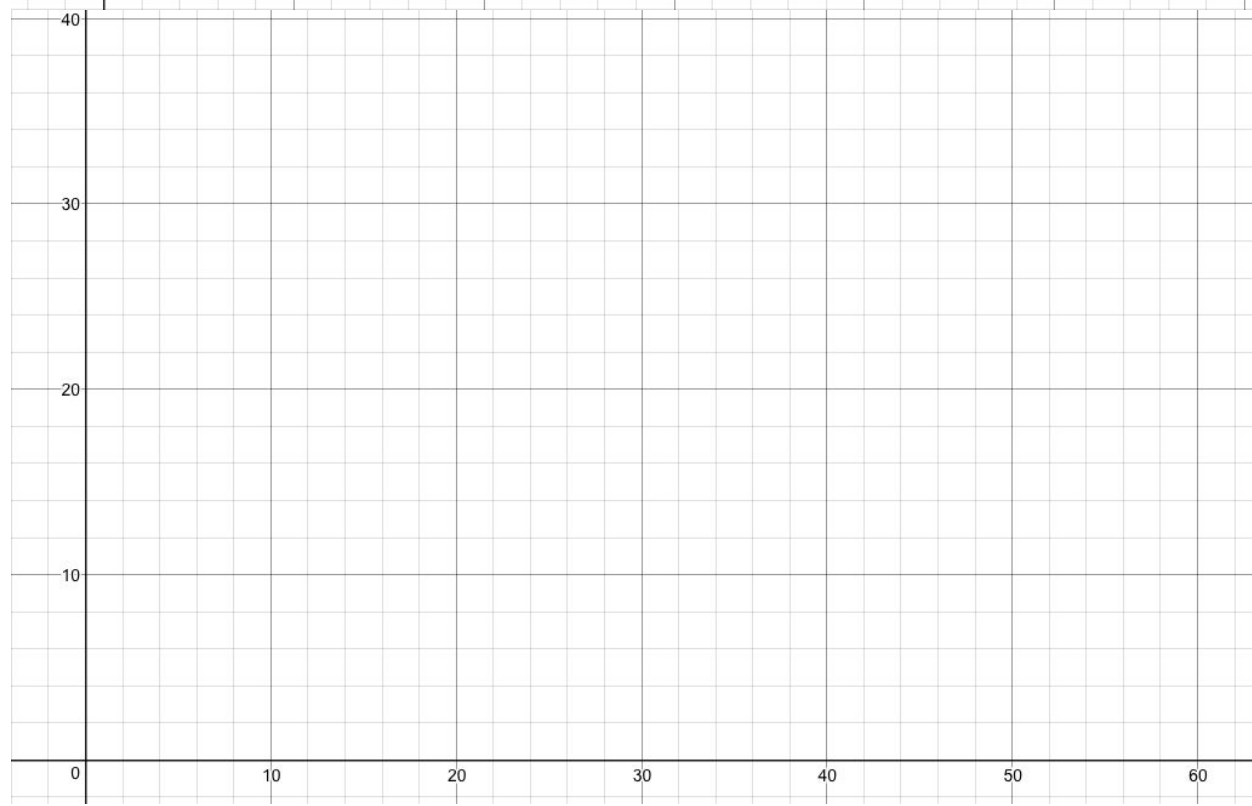
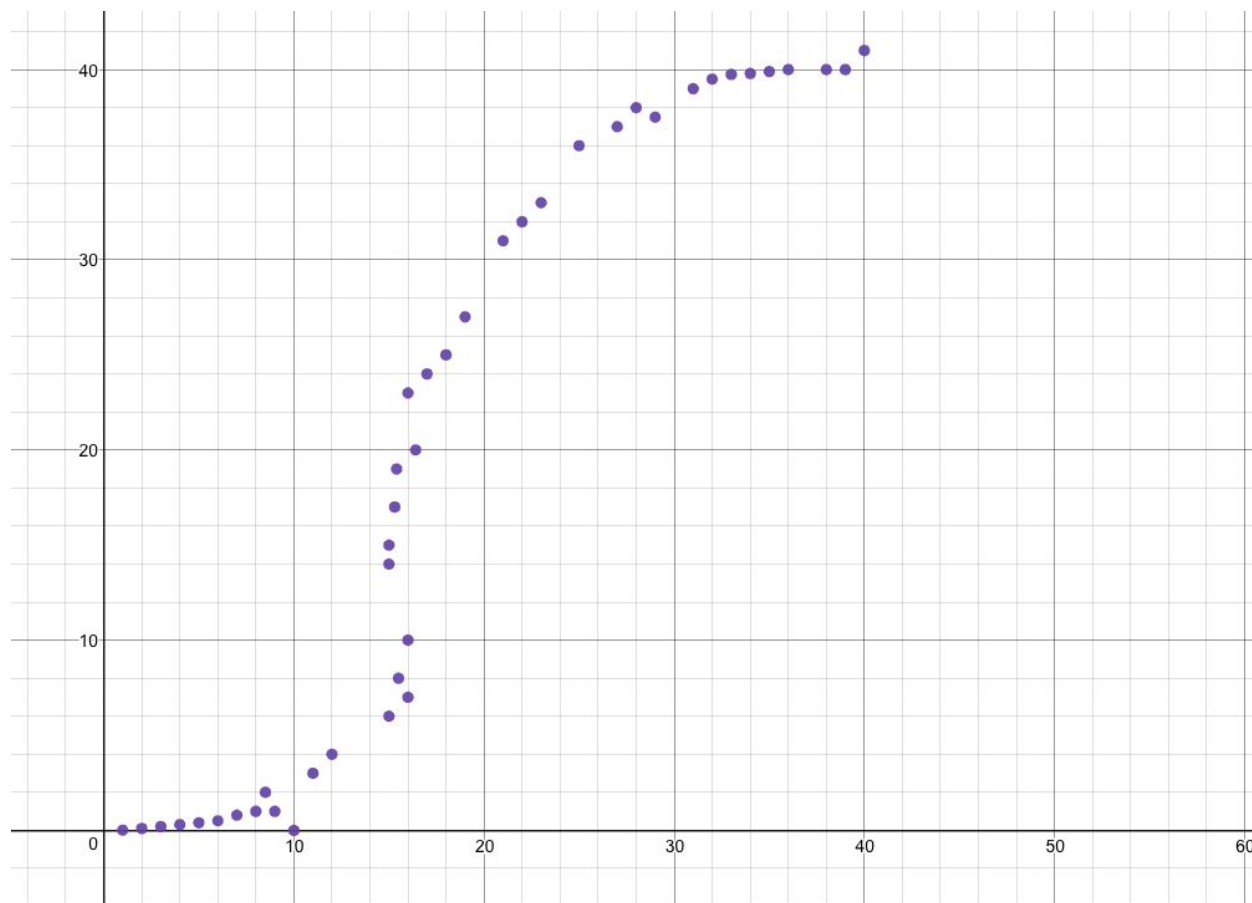
1. A 5th period element is burned under a bunsen burner and a vibrant red-violet flame is produced. It is seen to also violently react with water. What is the element? [3 points]

2. A student decides to titrate  $\text{H}_3\text{PO}_4$ , a triprotic acid, with a solution of NaOH. The experiment was completed with 100 mL of a 1.5 M  $\text{H}_3\text{PO}_4$  solution and 2.0 M NaOH. Calculate the pH of the solution when 200 mL of NaOH is added. ( $K_{a1} = 7.5 \times 10^{-3}$ ,  $K_{a2} = 6.2 \times 10^{-8}$ ,  $K_{a3} = 4.8 \times 10^{-13}$ ) [5 points]

3. The reaction of a weak acid and a strong base is given. Given that you titrate 200 mL of a 2.0 M solution of the weak acid with a 100 mL 1.5 M solution of the strong base, calculate the pH. The strong base is added to the acid from a buret. ( $K_a = 1.8 \times 10^{-5}$ ) [5 points]



4. A student titrates a solution of HCl and NaOH in a lab. Label the axes of the given appropriately, with units, and draw a line of best fit. Add an appropriate title. Label the plot with approximate (half)-equivalence points. Then, sketch in the blank plot the complementary graph of the titration with the same corresponding features. Exact points are not needed. [10 points]



5. Phenolphthalein,  $C_{20}H_{14}O_4$  or “phph” for shorthand, is a common acid-base indicator that turns colorless under acidic conditions and pink under basic conditions. A student uses phph as an indicator for a titration with an acetic acid solution and a solution of NaOH. If some acid is spilled during the transfer of solutions, how will the percent error change in respects to the percentage of acetic acid in vinegar? What will the resulting color be? [5 points]

6. List the following acids from least to greatest according to strength. Explain your reasoning. [5 points]

**HCl,  $H_2SO_4$ ,  $H_3O^+$ , HF,  $CH_3COOH$ ,  $H_2$ , and  $H_2S$**

7. An element is a solid at room temperature but soft enough to be cut with an ordinary knife. It reacts violently with water. What is the element? [3 points]

**Multiple Choice**

- 1) What is the pH of a 0.01M benzoic acid solution given benzoic acid  $K_a = 6.5 \times 10^{-5}$ ?
- 7.20
  - 2.92
  - 3.11
  - 6.23
- 2) Which of the following pH values will change blue litmus paper into a red color?
- 13.2
  - 9.5
  - 6.3
  - 2.2
- 3) Which of the following answer choices is a reaction that will result in a precipitate?
- $3\text{KBr} + \text{AlPO}_4 \rightarrow \text{K}_3\text{PO}_4 + \text{AlBr}$
  - $\text{Na}_2\text{CO}_3 + \text{CaCl}_2 \rightarrow \text{CaCO}_3 + 2\text{NaCl}$
  - $\text{ZnCl}_2 + \text{MgSO}_4 \rightarrow \text{ZnSO}_4 + \text{MgCl}_2\text{O}$
  - $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl}$
- 4) In a titration, what will be the molarity of an HCl solution if 45 mL of it is neutralized by 37 mL of 0.382 M NaOH?
- 0.158M
  - 0.314M
  - 0.475M
  - 0.623M
- 5) Strong bases
- Are strong electrolytes that ionize completely in solution.
  - Are strong electrolytes that partially dissociate in solution.
  - Are weak electrolytes that dissociate only partially in solution.
  - Are weak electrolytes that ionize completely in solution.
- 6) What is the pH of a  $1 \times 10^{-6}$  M HCl solution?
- 4
  - 2

- c. 6
- d. 8

7) What is the pOH of the above solution?

- a. 4
- b. 5
- c. 2
- d. 8

8) The  $pK_a$  of a weak acid can be found by finding

- a. The molecular mass of the weak acid in grams
- b. The  $pK_b$  of the conjugate base of the weak acid
- c. The pH of the solution that consists of equal quantities of the weak acid and its conjugate base
- d. The negative logarithm of the concentration of the conjugate base in equilibrium

9) What is a buffer solution?

- a. A solution made with water as a solvent and a weak acid
- b. A solution made with a strong base and a strong acid
- c. A solution made with water as a solvent and a weak base
- d. A solution made with a weak acid and its conjugate base

10) The  $pK_a$  of an acid is 4.82, and this acid is put into a buffer solution with its conjugate base.

The resulting solution will buffer at what pH?

- a. 2
- b. 3
- c. 5
- d. 8

11) What is the difference between boiling and evaporation?

- a. Boiling is exothermic while evaporation is endothermic
- b. Boiling is an intensive property while evaporation is an extensive property.
- c. Boiling occurs at all parts of the solution while evaporation only takes place at the surface.
- d. Boiling can only occur in homogenous solutions while evaporation can occur in both homogeneous and heterogeneous solutions.

12) What is the name of the process that converts a solid straight to a gas, without passing through the liquid phase?

- a. Sublimation
- b. Evaporation
- c. Condensation
- d. Boiling

13) The average kinetic energy of a gas molecule is directly proportional to which of the following quantities of temperature?

- a.  $T^3$
- b.  $\sqrt{T}$
- c.  $T$
- d.  $(\frac{1}{2})T$

14) Which of the following is a list of properties that can be studied about a substance without changing its identity?

- a. Texture, odor, melting point
- b. Density, solubility, reactivity
- c. Combustibility, acidity, reactivity
- d. Acidity, basicity, flammability

15. Which of the following indicates a chemical reaction?

- a. The formation of gas bubbles
- b. The formation of a precipitate after a reaction
- c. A change in color of the resulting solution of the reaction
- d. All of the above

16) For the list below, label each as either a colloid, a suspension, a solution, or none of the above.

- a. Milk (colloid)
- b. bar of Gold (none)
- c. Freshly squeezed, non-uniform orange juice (suspension)
- d. The Kool-aid drink (solution)
- e. Sugar water (solution)
- f. Smoke (colloid)
- g. Blood (colloid)

17.)

<u>Indicator</u>	<u>Results</u>
Methyl Orange	Turns Deep Red
Blue Litmus	Turns Red
Red Litmus	Stays Red
Phenolphthalein	Clear

When tested, an unknown substance gave the experimental results shown above. Based on the results, the unknown is:

- A sugar
- An acid
- A base
- Impossible to Identify

18) Which of the following answer choices has one extensive and one intensive property?

- Melting point, density
- Diameter, length
- Mass, density
- None of the above

19) Which of the following is not a weak acid?

- Lactic acid
- Sulfuric acid
- Acetic acid
- Phosphoric acid

**END OF TEST**