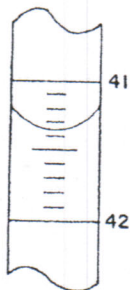
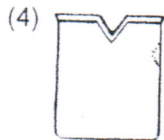
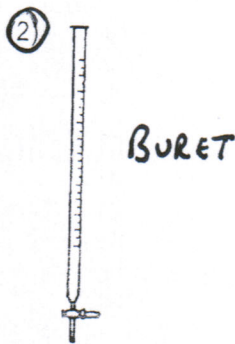
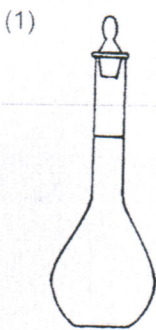


1. Which is the correct reading of the meniscus as shown in the portion of the buret below?



- (1) 41.30 ml
- (2) 41.35 ml
- (3) 42.60 ml
- (4) 42.65 ml

2. Which device should be used to accurately measure a volume of 16.30 milliliters?



3. Which is a characteristic of an aqueous solution of HNO₃? **ACID**

- (1) It conducts electricity.
- (2) It forms OH⁻ ions.
- (3) It turns litmus blue.
- (4) It turns phenolphthalein pink.

4. Which of the following is the best conductor of electricity?

- (1) NaCl(s)
- (2) NaCl(aq) **IONIC**
- (3) C₆H₁₂O₆(s)
- (4) C₆H₁₂O₆(aq) **COVALENT**

5. Beakers A, B, C, and D shown below each contain a different solution.

The bulb will glow when the conductivity apparatus is placed into which beakers?

- (1) A and B
- (2) B and C
- (3) A and D
- (4) C and D

6. A student was given four unknown solutions. Each solution was checked for conductivity and tested with phenolphthalein. The results are shown in the data table below.

Solution	Conductivity	Color with Phenolphthalein
A	Good	Colorless
B	Poor	Colorless
C	Good	Pink BASE
D	Poor	Pink

Based on the data table, which unknown solution could be 0.1 M NaOH?

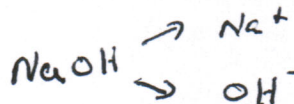
- (1) A
- (2) B
- (3) C **NaOH**
- (4) D **Na⁺ OH⁻**

7. According to the Arrhenius theory, the acidic property of an aqueous solution is due to an excess of

- (1) H₂
- (2) H⁺
- (3) H₂O **HCl**
- (4) OH⁻ **H⁺ Cl⁻**

8. According to the Arrhenius theory, when a base dissolves in water it produces

- (1) H⁺ as the only positive ion in solution
- (2) NH₄⁺ as the only positive ion in solution
- (3) OH⁻ as the only negative ion in solution
- (4) CO₃²⁻ as the only negative ion in solution



9. What are the relative ion concentrations in an acid solution?
- more H^+ ions than OH^- ions
 - fewer H^+ ions than OH^- ions
 - an equal number of H^+ ions and OH^- ions
 - H^+ ions but no OH^- ions
10. According to the Arrhenius theory of acids, citric acid in oranges and acetic acid in vinegar are classified as acids because their aqueous solutions contain
- hydrogen ions H^+
 - hydrogen atoms
 - hydroxide ions
 - hydroxide atoms
11. A sample of $Ca(OH)_2$ is considered to be an Arrhenius base because it dissolves in water to yield
- Ca^{2+} ions as the only positive ions in solution
 - H_3O^+ ions as the only positive ions in solution
 - OH^- ions as the only negative ions in solution
 - H^- ions as the only negative ions in solution
12. Which pH value indicates the most basic solution?
- 7
 - 8
 - 3
 - 11
13. An acidic solution could have a pH of
- 7
 - 10
 - 3
 - 14
14. Adding 0.1 M NaOH to a 0.1 M solution of HCl will cause the pH of the solution to
- decrease
 - increase
 - remain the same
15. Which relationship is present in a solution that has a pH of 7?
- $[H^+] = [OH^-] = H_2O$
 - $[H^+] > [OH^-]$
 - $[H^+] < [OH^-]$
 - $[H^+] + [OH^-] = 7$
16. A solution at $25^\circ C$ with a pH of 7 contains
- more H_3O^+ ions than OH^- ions
 - fewer H_3O^+ ions than OH^- ions
 - an equal number of H_3O^+ ions and OH^- ions
 - no H_3O^+ ions or OH^- ions
17. As an aqueous solution becomes more acidic, the hydroxide ion concentration
- decreases
 - increases
 - remains the same
18. When the pH of a solution changes from a pH of 5 to a pH of 3, the hydronium ion concentration is
- 0.01 of the original content
 - 0.1 of the original content
 - 10 times the original content
 - 100 times the original content

3 4 5
 10x 10x = 100x

19. Which statement describes the characteristics of an Arrhenius base?
- It changes blue litmus to red and has a pH less than 7.
 - It changes blue litmus to red and has a pH greater than 7.
 - It changes red litmus to blue and has a pH less than 7.
 - It changes red litmus to blue and has a pH greater than 7.
20. The table below was compiled from experimental laboratory data.

TABLE M

INDICATOR	CHANGE	pH RANGE AT WHICH CHANGE OCCURS
Bromthymol Blue	yellow → blue	6.2 - 7.6
Thymol Blue	red → yellow	1.2 - 2.8
Methyl Orange	red → yellow	3.1 - 4.4

At what pH would all three indicators appear as yellow?

(1) 1.9
 (2) 2.9
 (3) 4.7
 (4) 8.7

2.8 4.4 6.2

21. One sample of a solution with a pH of 10 is tested with phenolphthalein and another sample of this solution is tested with litmus. In this solution the color of the litmus is
- blue and the phenolphthalein is pink
 - red and the phenolphthalein is pink
 - blue and the phenolphthalein is colorless
 - red and the phenolphthalein is colorless
22. An aqueous solution turns litmus red. The pH of this solution could be
- 14
 - 11
 - 8
 - 5
23. Which 0.1 M solution will turn phenolphthalein pink?
- HBr(aq) ACID
 - CO₂(aq)
 - LiOH(aq) BASE
 - CH₃OH(aq) ALCOHOL
24. An indicator was used to test a water solution with a pH of 12. Which indicator color would be observed?
- colorless with litmus
 - red with litmus
 - colorless with phenolphthalein
 - pink with phenolphthalein - TURNS PINK IN A BASE

TABLE M

TABLE M

25. The results of testing a colorless solution with three indicators are shown in the table below.

Indicator	Result
red litmus	blue
blue litmus	blue
phenolphthalein	pink

A BASE



Which formula could represent the solution tested?

- (1) NaOH(aq) (3) $\text{C}_6\text{H}_{12}\text{O}_6\text{(aq)}$
 (2) HCl(aq) (4) $\text{C}_{12}\text{H}_{22}\text{O}_{11}\text{(aq)}$

26. Which equation represents a neutralization reaction?

- (1) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 (2) $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$
 (3) $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$
 (4) $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$

TABLE I

27. Which products are formed when an acid reacts with a base?

- (1) an alcohol and carbon dioxide
 (2) an ester and water
 (3) a soap and glycerine
 (4) a salt and water

TABLE I

28. Which equation represents a neutralization reaction?

- (1) $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$
 (2) $2\text{HCl} + \text{Zn} \rightarrow \text{ZnCl}_2 + \text{H}_2$
 (3) $\text{H}_2\text{SO}_4 + \text{CaCO}_3 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O} + \text{CO}_2$
 (4) $\text{HNO}_3 + \text{KOH} \rightarrow \text{KNO}_3 + \text{H}_2\text{O}$

ACID BASE SALT WATER

29. What is the pH of a solution that results from the complete neutralization of an HCl solution with a KOH solution?

- (1) 1 (3) 10
 (2) 7 (4) 4

30. How many moles of KOH are needed to exactly neutralize 500. ml of a 1.0 M HCl solution?

- (1) 1.0 (3) 0.25
 (2) 2.0 (4) 0.50

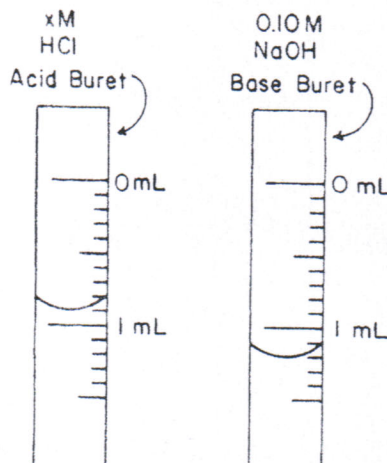
31. How many milliliters of 0.2 M NaOH are required to exactly neutralize 40 milliliters of 0.1 M HCl?

- (1) 10 (3) 40
 (2) 20 (4) 80

32. A 9.0 milliliter sample of HCl solution is exactly neutralized by 6.0 milliliters of a 3.0 M NaOH solution. What is the concentration of the HCl solution?

- (1) 1.0 M (3) 1.8 M
 (2) 2.0 M (4) 1.5 M

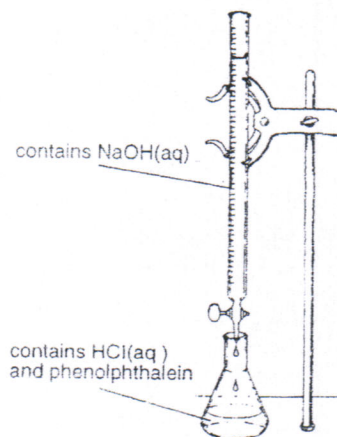
33. The diagram below represents the meniscus on an acid and a base buret at the endpoint of a titration in which 0.10 M NaOH was used to neutralize an unknown concentration of HCl.



If the solution level in each buret was 0.00 milliliter at the start of the titration, what is the molarity of the unknown HCl solution?

- (1) 1.2 M (3) 0.30 M
 (2) 0.13 M (4) 0.090 M

34. The diagram below shows NaOH(aq) being added to HCl(aq). A few drops of phenolphthalein were added to the flask before the titration was started.



The endpoint in this titration is reached when the solution in the flask appears

- (1) pink (3) blue
 (2) colorless (4) yellow

TABLE M

35. If 20. milliliters of 4.0 M NaOH is exactly neutralized by 20. milliliters of HCl, the molarity of the HCl is

- (1) 1.0 M (3) 5.0 M
 (2) 2.0 M (4) 4.0 M

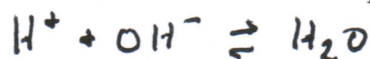
TITRATION = $M_A V_A = M_B V_B$ Page 3

(ARL) I

SEE LAST PAGE

In liquid water, an equilibrium exists between $H_2O(l)$ molecules, $H^+(aq)$ ions, and $OH^-(aq)$ ions. A person experiencing acid indigestion after drinking tomato juice can ingest milk of magnesia to reduce the acidity of the stomach contents. Tomato juice has a pH value of 4. Milk of magnesia, a mixture of magnesium hydroxide and water, has a pH value of 10.

76 Complete the equation in your answer booklet for the equilibrium that exists in liquid water. [1]



77 Compare the hydrogen ion concentration in tomato juice to the hydrogen ion concentration in milk of magnesia. [1]

T.J. 4 mm = 10

4, 5, 6, 7, 8, 9, 10
 $10 \times 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 = 1,000,000 \times$

TOMATO JUICE HAS A
 GREATER H^+ CONC

78 Identify the negative ion found in milk of magnesia. [1]

Hydroxide = OH^-

79 What is the color of thymol blue indicator when placed in a sample of milk of magnesia? [1]

> 9.6 = Blue

36 Which compound is an Arrhenius acid?

(1) CaO

(3) K_2O

(2) HCl

(4) NH_3

TABLE K

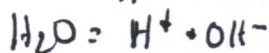
40 According to one acid-base theory, water acts as an acid when an H_2O molecule

(1) accepts an H^+

(3) accepts an H^-

(2) donates an H^+

(4) donates an H^-



37 The data collected from a laboratory titration are used to calculate the

(1) rate of a chemical reaction

(2) heat of a chemical reaction

(3) concentration of a solution

(4) boiling point of a solution

41 Which quantities must be equal for a chemical reaction at equilibrium?

(1) the activation energies of the forward and reverse reactions

(2) the rates of the forward and reverse reactions

(3) the concentrations of the reactants and products

(4) the potential energies of the reactants and products

38 When one compound dissolves in water, the only positive ion produced in the solution is $H_3O^+(aq)$. This compound is classified as

(1) a salt

(2) a hydrocarbon

(3) an Arrhenius acid ← $H^+ + H_2O = H_3O^+$

(4) an Arrhenius base

39 Based on the results of testing colorless solutions with indicators, which solution is most acidic?

(1) a solution in which bromthymol blue is blue > 7.6

(2) a solution in which bromocresol green is blue > 5.4

(3) a solution in which phenolphthalein is pink > 9

(4) a solution in which methyl orange is red < 3.1

TABLE M

42 A solution with a pH of 2.0 has a hydronium ion concentration ten times greater than a solution with a pH of

(1) 1.0

(3) 3.0

(2) 0.20

(4) 20.

QUESTIONS 30 - 35

$$M_a V_a = M_b V_b$$

$$\text{MOLARITY} \times \text{VOLUME} = \text{MOLARITY} \times \text{VOLUME}$$

ACID BASE

30. HCl = KOH

$$M_a V_a = M_b V_b$$

$$1 M \times 500 \text{ ml} = M \times 500 \text{ ml}$$

$$\frac{500 \text{ ml}}{500 \text{ ml}} = 1 \text{ MOLARITY}$$

$$1 M = \frac{? \text{ MOLES}}{.5 L}$$

MOLARITY

.5 MOLES OF KOH

31. HCl = NaOH

$$M_a V_a = M_b V_b$$

$$.1 M \cdot 40 \text{ ml} = .2 M \cdot V$$

$$4 = .2 V$$

$$4 / .2 = V$$

20 = V
ml

32. HCl = NaOH

$$M \cdot 9 \text{ ml} = 3 M \cdot 6 \text{ ml}$$

$$9 M = 18$$

M = 2 M

33. HCl = NaOH

$$M_a V_a = M_b V_b$$

$$M \cdot .9 \text{ ml} = .1 M \cdot 1.2 \text{ ml}$$

$$.9 M = .12$$

M = .13 M

34. TABLE M

35. HCl = NaOH

$$M_a V_a = M_b V_b$$

$$M \cdot 20 \text{ ml} = 4 M \times 20 \text{ ml}$$

$$20 M = 80$$

M = 4 M