

تجميعة أسئلة اختبارات سابقة حول وحدة Bases and Acids الأحماض والقواعد



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ← المناهج الإماراتية ← الصف الثاني عشر المتقدم ← كيمياء ← الفصل الثاني ← ملفات متنوعة ← الملف

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ملفات اكتب للمعلم اكتب للطالب الاختبارات الكترونية الاختبارات ا حلول ا عروض بوربوينت ا أوراق عمل
منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي للمدرس

المزيد من مادة
كيمياء:

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التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة كيمياء في الفصل الثاني

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Acids – Bases

Previous Exams

تستخدم أوراق العمل للمساعدة على أداء الأنشطة داخل الصف،
ولا تُغني عن الكتاب المدرسي

مع خالص الشكر والامتنان للأستاذ **محمد محسن**
من بذل جهداً فوق العادة في تجميع الأسئلة باللغة العربية



Mohamed
Ahmed Abdelbari

Choose the correct answer:

1. Which of the following is a characteristic of basic solutions? (Advanced 2024)

- Ⓐ They react with metals such as zinc to produce hydrogen gas.
- Ⓑ They react with metal carbonates to produce carbon dioxide gas.
- Ⓒ They have a sour taste.
- Ⓓ They have a bitter taste and a slippery texture.

2. Regarding the substances below, which of the following is correct? (Advanced 2024)

Ⓐ Substance No. (1) is considered a Brønsted–Lowry base.

Ⓑ Substance No. (2) is considered an Arrhenius base.

Ⓒ Substance No. (3) is considered a Lewis acid.

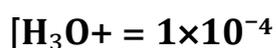
Ⓓ Substance No. (4) is considered a Lewis acid.

N	Substance	Formula
1	Sodium Hydroxide	NaOH
2	Ammonia	NH ₃
3	Boron tri fluoride	BF ₃
4	Water	H ₂ O

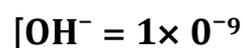
3. A 25.00 mL sample of lithium hydroxide (LiOH) is titrated with sulfuric acid (H₂SO₄) solution of 0.425 M concentration. It was found that 20.25 mL of the acid solution is required to reach the equivalence point. What is the molarity of the lithium hydroxide solution? (Advanced 2024)

- Ⓐ 0.6885 M
- Ⓑ 0.3443 M
- Ⓒ 0.4550 M
- Ⓓ 0.5275 M

4. Which of the following solutions is the most acidic? (Advanced 2024)



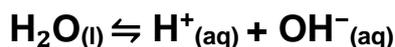
$$\text{pOH} = 13$$



$$\text{pH} = 3$$

- Ⓐ $[\text{H}_3\text{O}^+] = 1 \times 10^{-4}$
- Ⓑ $\text{pOH} = 13$
- Ⓒ $[\text{OH}^-] = 1 \times 10^{-9}$
- Ⓓ $\text{pH} = 3$

5. In the self-ionization of water shown below, what happens if the concentration of hydrogen ions (H^+) increases? (Advanced 2024)



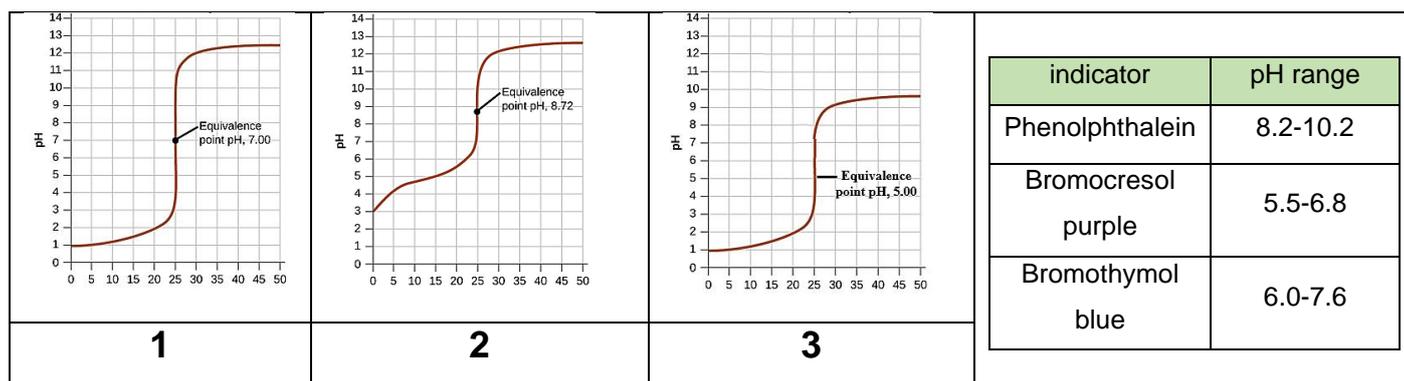
- Ⓐ The concentration of hydroxide ions (OH^-) increases, and K_w increases.
- Ⓑ The concentration of hydroxide ions (OH^-) decreases, while K_w remains unchanged.
- Ⓒ The concentration of hydroxide ions (OH^-) increases, while K_w remains unchanged.
- Ⓓ The concentration of hydroxide ions (OH^-) decreases, and K_w decreases.

6. Which of the following is correct regarding the bases listed in the table below? (Advanced 2024)

Base	Ionization Equation	K_o (298 K)
Ammonia	$NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$	2.5×10^{-5}
Ethylamine	$C_2H_5NH_2(aq) + H_2O(l) \rightleftharpoons C_2H_5NH_3^+(aq) + OH^-(aq)$	5.0×10^{-4}
Methylamine	$CH_3NH_2(aq) + H_2O(l) \rightleftharpoons CH_3NH_3^+(aq) + OH^-(aq)$	4.3×10^{-4}
Aniline	$C_6H_5NH_2(aq) + H_2O(l) \rightleftharpoons C_6H_5NH_3^+(aq) + OH^-(aq)$	4.3×10^{-10}

- Ⓐ An ammonia solution produces the maximum number of ions.
- Ⓑ A methylamine solution contains the highest concentration of non-ionized molecules.
- Ⓒ An aniline solution contains the lowest concentration of non-ionized molecules.
- Ⓓ The methylamine solution contains the highest concentrations of non-ionized molecules.

7. Regarding the titration indicators below, which of the following is correct?
(Advanced 2024)



(A) Curve (1) represents the titration of a strong acid with a strong base, and the suitable indicator is bromocresol purple.

(B) Curve (2) represents the titration of a weak acid with a strong base, and the suitable indicator is phenolphthalein.

(C) Curve (1) represents the titration of a weak acid with a strong base, and the suitable indicator is bromocresol purple.

(D) Curve (2) represents the titration of a strong acid with a weak base, and the suitable indicator is bromothymol blue.

8. Regarding reactions (1) and (2) in the table below, which of the following is correct?
(Advanced 2024)

Reaction 1	Reaction 2
$\text{HX}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} \rightarrow \text{H}_3\text{O}^+_{(\text{aq})} + \text{X}^-_{(\text{aq})}$	$\text{HY}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} \rightleftharpoons \text{H}_3\text{O}^+_{(\text{aq})} + \text{Y}^-_{(\text{aq})}$

(A) In reaction (2), the equilibrium shifts significantly towards the left because H_2O is a stronger base than X^- , making the acid weak compared to H_3O^+ .

(B) In reaction (2), the equilibrium shifts significantly towards the right because H_2O is a stronger base than X^- , making the acid strong compared to H_3O^+ .

(C) In reaction (2), the equilibrium slightly shifts towards the left because H_2O is a weaker base than X^- , making the acid stronger compared to H_3O^+ .

(D) In reaction (2), the equilibrium slightly shifts towards the right because H_2O is a weaker base than X^- , making the acid weaker compared to H_3O^+ .

9. If a 0.20 M acid solution has a pOH of 9.37, what is the formula of this acid?

(Advanced 2024)

- (A) HF
- (B) HCN
- (C) CH₃COOH
- (D) HBrO

Acid	K _a (298 K)
HF	6.3×10^{-4}
HCN	6.2×10^{-10}
CH ₃ COOH	1.8×10^{-5}
HBrO	2.8×10^{-9}

10. Which of the following is not a physical property of acidic solutions? (Science 2024)

- (A) They conduct electricity.
- (B) They have a sour taste.
- (C) They turn blue litmus paper red.
- (D) They have a slippery texture.

11. Which of the following is incorrect regarding salts? (Science 2024)

- (A) Salts are produced from neutralization reactions between an acid and a base.
- (B) Salts are produced from displacement reactions (precipitation) between an acid and a base.
- (C) Salts are ionic compounds consisting of a cation from a base and an anion from an acid.
- (D) Salts are ionic compounds consisting of a cation from an acid and an anion from a base.

12. What is the correct ascending order of the following acids based on their strength?

Acid	Ionization Equation	K _a (298 K)
Hydrofluoric	$\text{HF} \rightleftharpoons \text{H}^+ + \text{F}^-$	6.3×10^{-4}
Hydrocyanic	$\text{HCN} \rightleftharpoons \text{H}^+ + \text{CN}^-$	6.2×10^{-10}
Acetic	$\text{CH}_3\text{COOH} \rightleftharpoons \text{H}^+ + \text{CH}_3\text{COO}^-$	1.8×10^{-5}
Formic	$\text{HCOOH} \rightleftharpoons \text{H}^+ + \text{HCOO}^-$	1.8×10^{-4}

- (A) Weakest → Strongest: CH₃COOH → HCOOH → HCN → HF
- (B) Weakest → Strongest: HF → HCOOH → HCN → CH₃COOH
- (C) Weakest → Strongest: HCN → CH₃COOH → HF → HCOOH
- (D) Weakest → Strongest: HCN → CH₃COOH → HCOOH → HF

13. Which of the following physical properties is characteristic of acidic solutions?

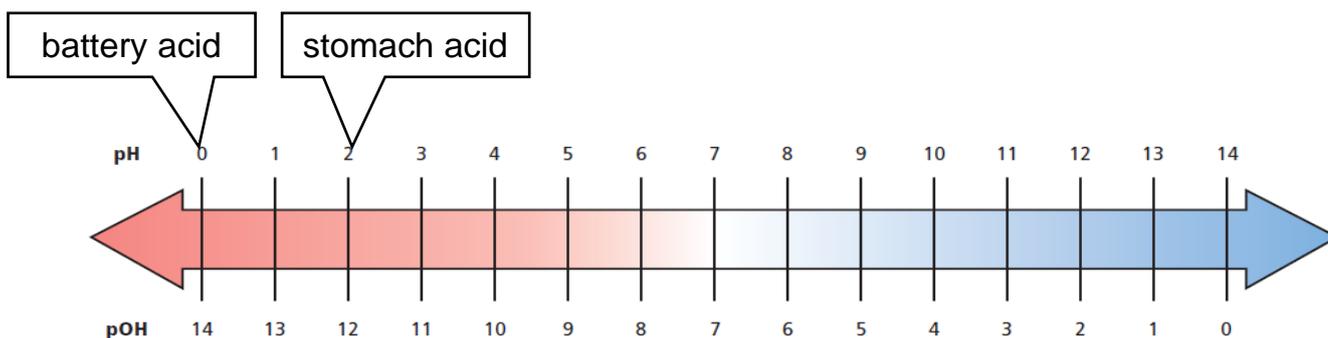
- Ⓐ Bitter taste
- Ⓑ Changes blue litmus paper to red
- Ⓒ Does not conduct electricity
- Ⓓ Slippery texture

14. Which of the following bases completely dissociates in aqueous solutions and produces hydroxide ions (OH⁻)?

- Ⓐ 1
- Ⓑ 2
- Ⓒ 3
- Ⓓ 4

1	NaOH
2	CH ₃ NH ₂
3	NH ₃
4	Ca(OH) ₂

15. By how many times does the concentration of hydrogen ions [H⁺] in battery acid exceed that in stomach acid, according to the diagram below?



- Ⓐ 2 times
- Ⓑ 10 times
- Ⓒ 100 times
- Ⓓ 1000 times

16. What is the K_a value for benzoic acid (C₆H₅COOH) at a concentration of 0.00330 M, with a pH of 3.30?



- Ⓐ 9.5×10^{-5}
- Ⓑ 6.3×10^{-5}
- Ⓒ 7.6×10^{-5}
- Ⓓ 8.9×10^{-5}

17. Which of the following is correct regarding acidic solutions?

- Ⓐ $[H^+] > [OH^-]$
- Ⓑ $[H^+] < [OH^-]$
- Ⓒ $[H^+] = [OH^-]$
- Ⓓ $[H^+] + [OH^-] = 1$

18. What is the concentration of OH^- ions in an ammonia solution with $pH = 11.90$ (assuming the solution temperature is 298 K)?

- Ⓐ $2.1 \times 10^{-2} M$
- Ⓑ $1.3 \times 10^{-12} M$
- Ⓒ $7.9 \times 10^{-3} M$
- Ⓓ $1.9 \times 10^{-10} M$

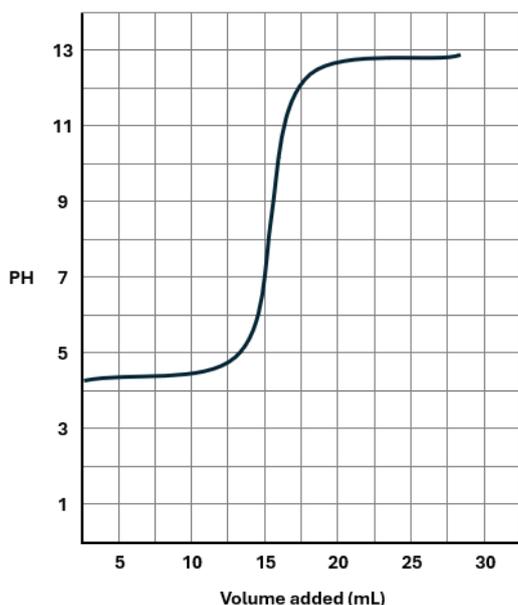
19. Which of the following is not a conjugate acid-base pair?

- Ⓐ SO_4^{2-} , H_2SO_4
- Ⓑ F^- , HF
- Ⓒ NH_4^+ , NH_3
- Ⓓ CO_3^{2-} , HCO_3^-

20. What is the molarity of the hydrobromic acid (HBr) solution if 30.35 mL of sodium hydroxide (NaOH) is required to neutralize 25.00 mL of a 0.100 M acid solution?

- Ⓐ 0.06 M
- Ⓑ 0.24 M
- Ⓒ 0.09 M
- Ⓓ 0.12 M

21. Which of the following is correct regarding the given graph?



indicator	pH range
Methyl red	4.2 - 6.2
Phenolphthalein	8.2 - 10.2
Bromothymol blue	6.0 - 7.6
Methyl orange	3.2 - 4.2

A)

pH at the equivalence point	Suitable indicator	Type of base	Type of acid
13	Methyl Red	Strong	Weak

B)

pH at the equivalence point	Suitable indicator	Type of base	Type of acid
7	Bromothymol Blue	Strong	Strong

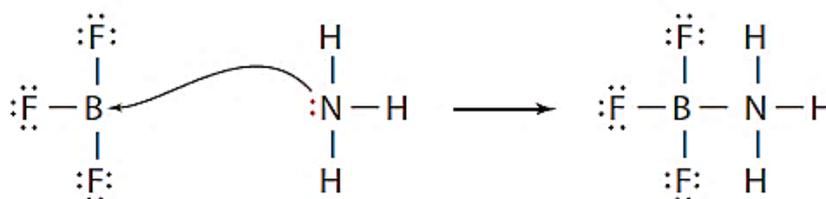
C)

pH at the equivalence point	Suitable indicator	Type of base	Type of acid
5	Methyl Orange	Weak	Strong

D)

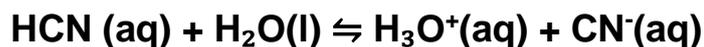
pH at the equivalence point	Suitable indicator	Type of base	Type of acid
9	Phenolphthalein	Strong	Weak

22. Which of the following statements is correct regarding the reaction shown below?



- Ⓐ BF_3 is a Lewis acid because it accepts an electron pair.
- Ⓑ NH_3 is a Lewis acid because it donates an electron pair.
- Ⓒ BF_3 is a Lewis base because it donates an electron pair.
- Ⓓ NH_3 is a Lewis base because it accepts an electron pair.

23. Why does the equilibrium of hydrocyanic acid (HCN) shift to the left?



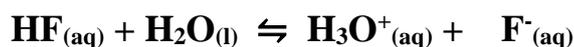
- (1) Because CN^- is a stronger base than H_2O .
 (2) Because CN^- is a weaker base than H_2O .
 (3) Because the conjugate base CN^- has a higher affinity for H^+ ions than water does.

- Ⓐ Only 1
 Ⓑ Only 2
 Ⓒ 3 and 1
 Ⓓ 3 and 2

24. The table below shows the concentration of H^+ or OH^- ions for four aqueous solutions at 298 K. Which of the following solutions is acidic?

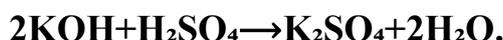
- Ⓐ $\text{OH}^- = 4.0 \times 10^{-5} \text{ M}$
 Ⓑ $\text{H}^+ = 1.0 \times 10^{-3} \text{ M}$
 Ⓒ $\text{OH}^- = 1.0 \times 10^{-4} \text{ M}$
 Ⓓ $\text{H}^+ = 1.0 \times 10^{-7} \text{ M}$

25: What is the value of K_a for a 0.0091 M solution of hydrofluoric acid HF with a pH of 2.68?



- A) 7.6×10^{-5}
 B) 6.2×10^{-4}
 C) 8.9×10^{-5}
 D) 9.5×10^{-5}

26: What is the molarity of a potassium hydroxide KOH solution if it requires 72.1 mL of a 0.543 M sulfuric acid (H_2SO_4) solution to neutralize 39.00 mL of the base solution?



- A) 2.00 M,
 B) 1.00 M,
 C) 0.502 M,
 D) 0.317 M)

27: Which of the following solutions is considered an acidic solution?

- A) Solution 1: Conducts electricity, original colour: Blue, After dipping: Red
- B) Solution 2: Conducts electricity, original colour: Blue, After dipping: Blue
- C) Solution 3: Does not conduct electricity, original colour: Blue, After dipping: Red
- D) Solution 4: Does not conduct electricity, original colour: Blue, After dipping: Blue

28: Which of the following statements is correct regarding the reaction below?



1. SO_3 is a Lewis acid because it accepts an electron pair.
2. SO_3 is a Lewis acid because it donates an electron pair.
3. H_2O is a Lewis base because it accepts an electron pair.
4. H_2O is a Lewis base because it donates an electron pair.

- A. 1,3
- B. 2,4
- C. 1,4
- D. 2,3

29: What is the similarity between the following two reactions?



- Ⓐ Both involve the neutralization of a weak acid and a strong base.
- Ⓑ Both involve the same net ionic equation.
- Ⓒ Both involve the same spectator ions.
- Ⓓ Both are double replacement reactions between an acid and a base.

30: The table below shows the concentration of H^+ ions or OH^- ions for four aqueous solutions at 298 K. Which of the following solutions is basic?

1	2	3	4
$[\text{OH}^-] = 1.0 \times 10^{-13} \text{ M}$	$[\text{OH}^-] = 1.0 \times 10^{-7} \text{ M}$	$[\text{H}^+] = 1.0 \times 10^{-9} \text{ M}$	$[\text{OH}^-] = 1.0 \times 10^{-3} \text{ M}$

- A) Solution 1 only,
- B) Solution 2 only,
- C) Solutions 1 and 4,
- D) Solutions 2 and 3)

31: What is the concentration of H^+ ions in the blood of a healthy person with a pOH of 6.60?

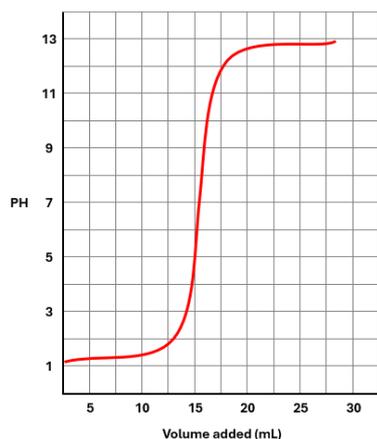
- A) $6.6 \times 10^{-8} M$,
- B) $2.5 \times 10^{-7} M$,
- C) $1.0 \times 10^{-7} M$,
- D) $4.0 \times 10^{-8} M$)

32. Which of the following is correct regarding the reaction equation below?

Acid	Ionization Equation	K_a (298K)
Hydrosulfuric, first ionization	$H_2S \rightleftharpoons H^+ + HS^-$	8.9×10^{-8}
Hydrosulfuric, second ionization	$HS^- \rightleftharpoons H^+ + S^{2-}$	1×10^{-19}
Carbonic, first ionization	$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$	4.5×10^{-7}
Carbonic, second ionization	$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$	4.7×10^{-11}

- Ⓐ The acids in the second column are stronger than the acids in the first column.
- Ⓑ The acids in the second column are of the same strength as the acids in the first column.
- Ⓒ The acids in the second column are weaker than the acids in the first column.
- Ⓓ The acids in the second column are weak, while the acids in the first column are strong.

33. Which of the following is correct regarding the figure and table below?



C	pH range
Methyl red	4.2 - 6.2
Phenolphthalein	8.2 - 10.2
Bromothymol blue	6.0 - 7.6
Methyl orange	3.2 - 4.2

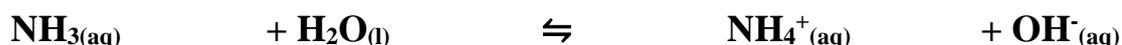
- Ⓐ The equivalence point occurs at $pH = 7$, and the suitable indicator is bromothymol blue.
- Ⓑ The equivalence point occurs at a pH greater than 7, and the suitable indicator is phenolphthalein.
- Ⓒ The equivalence point occurs at a pH less than 7, and the suitable indicator is methyl orange.
- Ⓓ The equivalence point occurs at $pH = 7$, and the suitable indicator is methyl red.

34. Which of the following is correct regarding the reaction equation below?



- Ⓐ The hydrogen ion donor in $\text{HC}_2\text{H}_3\text{O}_2$ is considered an acid.
- Ⓑ The hydrogen ion donor in $\text{HC}_2\text{H}_3\text{O}_2$ is considered a base.
- Ⓒ The conjugate base of $\text{HC}_2\text{H}_3\text{O}_2$ is H_2O .
- Ⓓ The conjugate acid of $\text{HC}_2\text{H}_3\text{O}_2$ is $\text{C}_2\text{H}_3\text{O}_2^-$.

35. What represents the acid-conjugate base pair in the reaction equation below?



- Ⓐ OH^- and NH_3
- Ⓑ NH_4^+ and NH_3
- Ⓒ NH_4^+ and OH^-
- Ⓓ H_2O and NH_3

36. A base has a weak ability to dissolve in water. Which of the following represents this type of base?

- Ⓐ NaOH
- Ⓑ CH_3NH_2
- Ⓒ $\text{Ca}(\text{OH})_2$
- Ⓓ All of the above

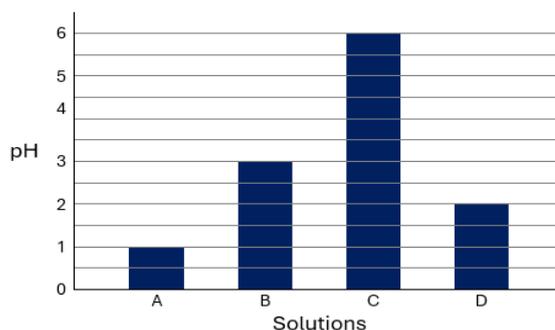
37. Which of the following is correct regarding the self-ionization of water?



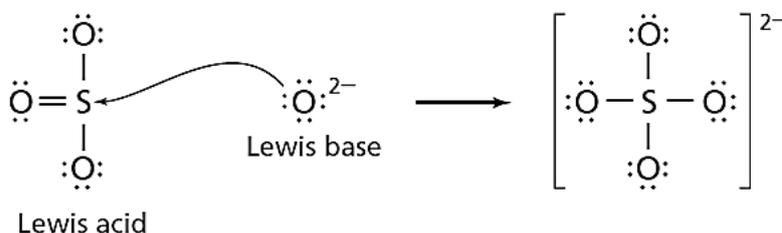
- Ⓐ Equal numbers of H_3O^+ and OH^- ions are produced.
- Ⓑ More H_3O^+ ions are produced than OH^- ions.
- Ⓒ Fewer H_3O^+ ions are produced than OH^- ions.
- Ⓓ OH^- ions are produced in greater numbers than H_3O^+ ions.

38. By how many times is the concentration of hydrogen ions $[H^+]$ greater in solution A compared to solution D according to the diagram below?

- (A) 2 times
- (B) 100 times
- (C) 1000 times
- (D) 10 times



39. Why does SO_3 act as a Lewis acid in the following reaction?



- (A) Because it accepts an electron pair from O^{2-} .
- (B) Because it donates an electron pair to O^{2-} .
- (C) Because it produces hydroxide (OH^-) ions in aqueous solutions.
- (D) Because it produces hydrogen (H^+) ions in aqueous solutions.

40. Which of the following substances completely dissociates in aqueous solutions and produces hydroxide ions (OH^-)?

- (A) I & III
- (B) V & II
- (C) IV & III
- (D) IV & I

I.	NaOH
II.	NH_3
III.	$Ca(OH)_2$
IV.	CH_3NH_2
V.	KOH

41. Which of the following does not represent a conjugate acid-base pair?

- (A) H_3O^+ / OH^-
- (B) H_2O / H_3O^+
- (C) H_2O / OH^-
- (D) OH^- / O^{2-}

42. Two solutions: 0.10 M HF and 0.10 M HCl. If you know the concentration of hydrogen ions $[H^+]$ in 0.10 M HF is 7.9×10^{-3} , what is the difference in pH between the two solutions?

- Ⓐ 1.0
- Ⓑ 0.0
- Ⓒ 0.5
- Ⓓ 2.0

43. What gas is produced during the reaction of sodium bicarbonate ($NaHCO_3$) with aqueous acetic acid ($HC_2H_3O_2$)?

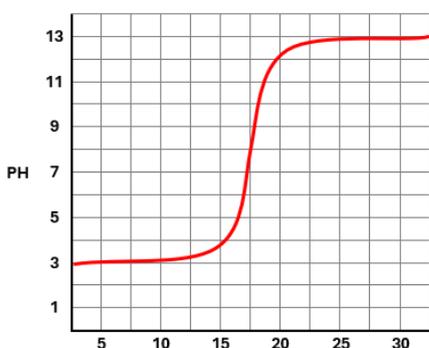
- Ⓐ CO_2
- Ⓑ O_2
- Ⓒ H_2
- Ⓓ Cl_2

44. What is the correct K_a value for chromic acid, H_2CrO_4 , if a 0.040 M sodium chromate solution has a hydrogen ion concentration that results in a pH of 3.946?

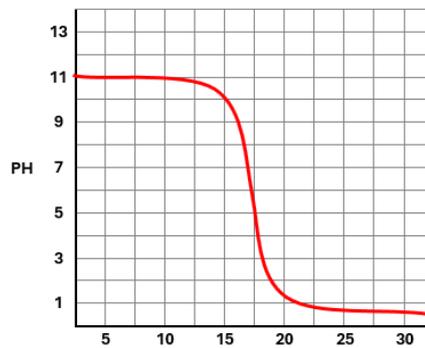
- Ⓐ $K_a = 7.6 \times 10^{-5}$
- Ⓑ $K_a = 4.8 \times 10^{-4}$
- Ⓒ $K_a = 3.2 \times 10^{-7}$
- Ⓓ $K_a = 9.9 \times 10^{-5}$

45. The following two titration curves are shown. What are the expected substances that were added in each titration (1) and (2)?

Titration curve 1

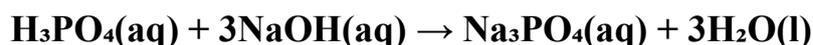


Titration curve 2



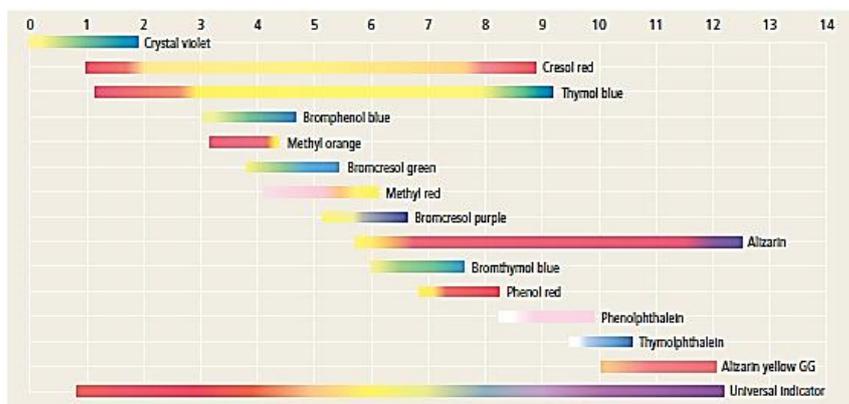
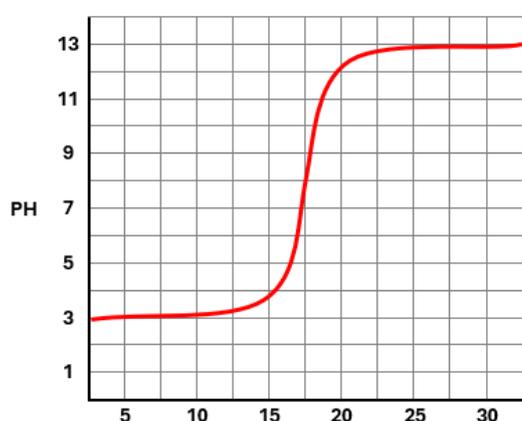
- Ⓐ In titration 1, NaOH solution was used, while in titration 2, HCOOH solution was used.
- Ⓑ In titration 1, HCOOH solution was used, while in titration 2, NaOH solution was used.
- Ⓒ In titration 1, HCl solution was used, while in titration 2, HCOOH solution was used.
- Ⓓ In titration 1, NaOH solution was used, while in titration 2, HCl solution was used.

46. What is the molarity of phosphoric acid (H_3PO_4) if 114 mL of 0.00804 M NaOH solution is required to neutralize 118 mL of the acid solution?



- Ⓐ 0.00259 M
- Ⓑ 0.00777 M
- Ⓒ 0.0105 M
- Ⓓ 0.00518 M

47. During titration, a student selected an indicator from the table. Why did the student choose this specific indicator?



- Ⓐ Because the pH at the equivalence point is less than 7.
- Ⓑ Because the pH at the equivalence point is equal to 7.
- Ⓒ Because the pH at the equivalence point is greater than 7.
- Ⓓ Because all indicators change colour regardless of the equivalence point.

48. Which of the following statements is correct regarding the following reaction?

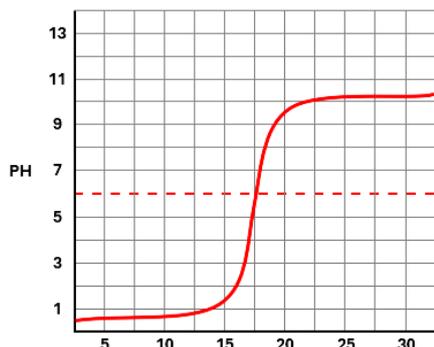


- Ⓐ The acid is weak, and its conjugate base ClO_2^- is strong.
- Ⓑ The acid is strong, and its conjugate base ClO_2^- is weak.
- Ⓒ The acid is weak, and its conjugate base ClO_2^- is also weak.
- Ⓓ The acid is strong, and its conjugate base ClO_2^- is also strong.

49. Which of the following is not a conjugate acid-base pair?

- Ⓐ $\text{H}_2\text{O} / \text{OH}^-$
- Ⓑ $\text{HClO}_4 / \text{ClO}_4^-$
- Ⓒ $\text{HSO}_3^- / \text{SO}_3^{2-}$
- Ⓓ $\text{H}_3\text{O}^+ / \text{OH}^-$

50. Which of the following is correct concerning the titration curve below?



indicator	pH range
Bromothymol purple	5.2 – 6.8
Phenolphthalein	8.2 - 10.2

- Ⓐ The base is NH_4OH , and the suitable indicator is phenolphthalein.
- Ⓑ The base is NH_4OH , and the suitable indicator is bromocresol purple.
- Ⓒ The base is KOH , and the suitable indicator is phenolphthalein.
- Ⓓ The base is KOH , and the suitable indicator is bromocresol purple.

51. What is the correct order of increasing pH for the following solutions?

Household Ammonia	Lemon Juice	Milk of Magnesia	Milk
$\text{pOH} = 2.10$	$\text{pH} = 2.37$	$[\text{OH}^-] = 3.2 \times 10^{-4}$	$[\text{H}^+] = 3.2 \times 10^{-7}$

- Ⓐ Milk of magnesia → Ammonia → Lemon juice → Household ammonia.
- Ⓑ Lemon juice → Milk of magnesia → Ammonia → Household ammonia.
- Ⓒ Milk → Lemon juice → Household ammonia → Milk of magnesia.
- Ⓓ Lemon juice → Milk → Milk of magnesia → Household ammonia.

52. A lamp is connected to a 0.1 M HCl solution in Figure (1) and to a 0.1 M HC₂H₃O₂ solution in Figure (2). What causes the difference in brightness between the two setups?



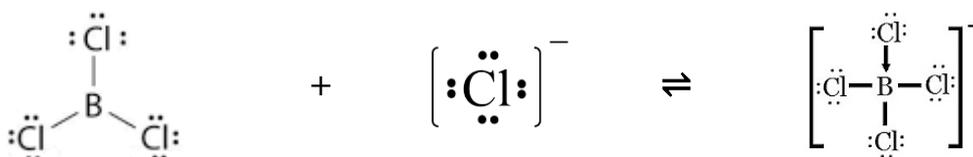
- Ⓐ HC₂H₃O₂ is a weak acid and does not fully dissociate in water.
- Ⓑ The number of ions in the HCl solution is greater than in the HC₂H₃O₂ solution.
- Ⓒ The number of ions in the HC₂H₃O₂ solution is greater than in the HCl solution.
- Ⓓ HCl is a strong acid and only partially ionizes in water.

53. Which of the following statements is correct regarding the ionization equations below?

Acid	Ionization Equation	K _a (298K)
Hydrosulfuric, first ionization	$\text{H}_2\text{S} \rightleftharpoons \text{H}^+ + \text{HS}^-$	8.9×10^{-8}
Hydrosulfuric, second ionization	$\text{HS}^- \rightleftharpoons \text{H}^+ + \text{S}^{2-}$	1×10^{-19}

- A) The second ionization is stronger than the first ionization.
- B) Hydrosulfuric acid is a proton donor.
- C) The first ionization is stronger than the second ionization.
- D) The concentration of sulfide ions is higher than the bisulfide ions from the first ionization.

54. Why is BCl₃ classified as a Lewis acid in the following reaction?



- A) It accepts a proton from the base.
- B) It has an empty orbital for electron pair donation.
- C) It donates an electron pair to the base.
- D) It is a proton donor.

55. Which of the following chemical equations represents the reaction between aqueous carbonic acid and hydrogen carbonate ions?

- A) $\text{NaHCO}_3(\text{s}) + \text{H}_2\text{C}_2\text{O}_4(\text{aq}) \rightarrow \text{Na}_2\text{C}_2\text{O}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
- B) $\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$
- C) $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
- D) $\text{Cu}(\text{s}) + 4\text{HNO}_3(\text{aq}) \rightarrow \text{Cu}(\text{NO}_3)_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) + 2\text{NO}_2(\text{g})$

56. Which of the following statements is correct regarding the ionization equation of ammonia?

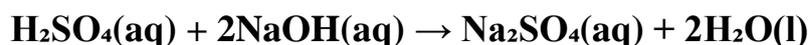


- A) The equilibrium lies to the left because NH_3 is a weak base and OH^- is a strong base.
- B) The equilibrium lies to the right because NH_3 is a strong base and OH^- is a weak base.
- C) The equilibrium lies to the left because NH_3 is a weak base and OH^- is a weak base.
- D) The equilibrium lies to the right because NH_3 is a strong base and OH^- is a strong base.

57. What is the K_a value for a solution of HClO with a concentration of 0.0400 M and a pH of 1.80?

- A) 2.6×10^{-4}
- B) 1.0×10^{-2}
- C) 4.9×10^{-9}
- D) 5.8×10^{-8}

58. What is the molarity of an H_2SO_4 solution if 74.30 mL of it was needed to neutralize 45.78 mL of 0.4388 M NaOH ?



- A) 0.4211 M
- B) 0.3561 M
- C) 0.1569 M
- D) 0.2320 M

59. Which of the following solutions is acidic at 298 K?

- A) Solution A
- B) Solution B
- C) Solution C
- D) Solution D

Solution A	$[\text{H}^+] 1.0 \times 10^{-13} \text{ (M)}$
Solution B	$[\text{OH}^-] 1.0 \times 10^{-3} \text{ (M)}$
Solution C	$[\text{OH}^-] 1.0 \times 10^{-7} \text{ (M)}$
Solution D	$[\text{H}^+] 4.0 \times 10^{-4} \text{ (M)}$

60. Which of the following statements is correct regarding a potassium fluoride (KF) solution?

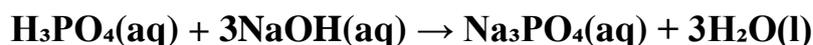
$$\text{KF(s)} \rightarrow \text{K}^{\text{(aq)}} + \text{F}^{\text{(aq)}}$$

- A) The pH is less than 7 because K^+ reacts with water.
- B) The pH is greater than 7 because F^- is a base.
- C) The pH is equal to 7 because neither ion reacts with water.
- D) The pH is greater than 7 because K^+ is a weak acid.

61. Which of the following chemical reactions represents the reaction used by geologists to identify limestone in rocks?

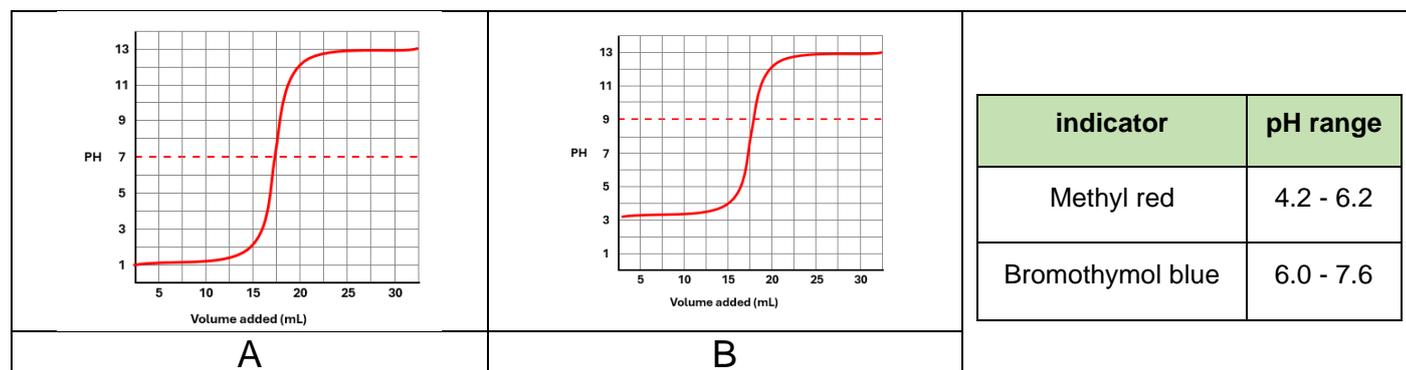
- A) $\text{NaHCO}_3\text{(s)} + \text{H}_2\text{C}_2\text{O}_4\text{(aq)} \rightarrow \text{Na}_2\text{C}_2\text{O}_4\text{(aq)} + \text{H}_2\text{O(l)} + \text{CO}_2\text{(g)}$
- B) $\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{(g)}$
- C) $\text{CaCO}_3\text{(s)} + 2\text{HCl(aq)} \rightarrow \text{CaCl}_2\text{(aq)} + \text{H}_2\text{O(l)} + \text{CO}_2\text{(g)}$
- D) $\text{Cu(s)} + 4\text{HNO}_3\text{(aq)} \rightarrow \text{Cu(NO}_3)_2\text{(aq)} + 2\text{H}_2\text{O(l)} + 2\text{NO}_2\text{(g)}$

62. What is the molarity of an H_3PO_4 solution if 15.00 mL of it was needed to neutralize 25.00 mL of 0.500 M NaOH?



- A) 0.0025 M
- B) 0.0075 M
- C) 0.200 M
- D) 0.100 M

63. Which of the following is correct for both curves (A) and (B) shown below?



- (A) In curve (A), the acid is strong, and the appropriate indicator is bromothymol blue.
- (B) In curve (A), the acid is weak, and the appropriate indicator is methyl red.
- (C) In curve (B), the acid is strong, and the appropriate indicator is methyl red.
- (D) In curve (B), the acid is weak, and the appropriate indicator is bromothymol blue.

64. Which of the following solutions is basic? (Concentrations at 298 K)

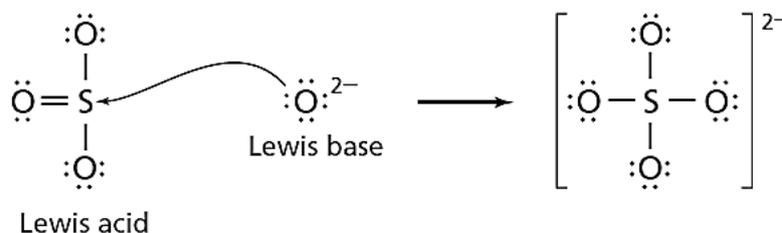
- Ⓐ Coffee cup $[[\text{H}^+] = 1.0 \times 10^{-5}]$
- Ⓑ Pure water $[[\text{OH}^-] = 1.0 \times 10^{-7}]$
- Ⓒ Seawater $[[\text{OH}^-] = 1.0 \times 10^{-6}]$
- Ⓓ Lemon juice $[[\text{H}^+] = 6.0 \times 10^{-3}]$

65. Which of the following statements is correct regarding the following ionization equations?

Acid	Ionization Equation	K_a (298K)
Hydrosulfuric, first ionization	$\text{H}_2\text{S} \rightleftharpoons \text{H}^+ + \text{HS}^-$	8.9×10^{-8}
Hydrosulfuric, second ionization	$\text{HS}^- \rightleftharpoons \text{H}^+ + \text{S}^{2-}$	1×10^{-19}

- Ⓐ The acid in the second ionization is weaker than the acid in the first ionization.
- Ⓑ Carbonic acid is a strong acid because it is polyprotic.
- Ⓒ The acid in the first ionization is weaker than the acid in the second ionization.
- Ⓓ The concentrations of ions resulting from the second ionization are greater than the concentrations of ions resulting from the first ionization.

66. Why does (O^{2-}) represent a Lewis base in the following reaction?



- Ⓐ Because it received a pair of electrons from (SO_3) .
- Ⓑ Because it donated a pair of electrons to (SO_3) .
- Ⓒ Because it donated a proton to (SO_3) .
- Ⓓ Because it received a proton from (SO_3) .

67. Which of the following is an amphoteric substance?

- A) H^+
- B) H_3PO_4
- C) HPO_4^{2-}
- D) PO_4^{3-}

68. Which of the following statements is correct regarding the following ionization equation?

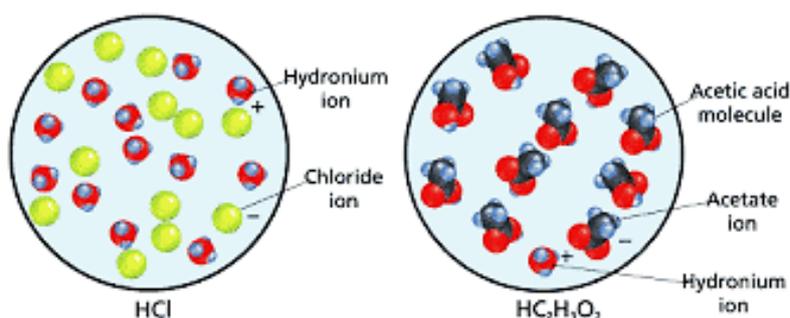
$$\text{HCN(aq)} + \text{H}_2\text{O(l)} \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{CN}^-(\text{aq})$$

- Ⓐ The equilibrium shifts far to the left because the conjugate base (CN^-) has a greater attraction for the (H^+) ion than the base (H_2O).
- Ⓑ The equilibrium shifts far to the left because the conjugate base (CN^-) has a lower attraction for the (H^+) ion than the base (H_2O).
- Ⓒ The equilibrium shifts far to the right because the conjugate base (CN^-) has a greater attraction for the (H^+) ion than the base (H_2O).
- Ⓓ The equilibrium shifts far to the right because the conjugate base (CN^-) has a lower attraction for the (H^+) ion than the base (H_2O).

69. What is the (K_a) value for a ($\text{C}_6\text{H}_5\text{COOH}$) acid solution with a concentration of 0.0044 M and a pH of 3.30?

- Ⓐ (6.5×10^{-5})
- Ⓑ (2.6×10^{-4})
- Ⓒ (3.8×10^{-2})
- Ⓓ (4.9×10^{-9})

70. What is the difference between the two shapes below? (Re-exam - Advanced 2023)



- Ⓐ The HCl acid solution is a weak conductor of electricity, while the $\text{HC}_2\text{H}_3\text{O}_2$ acid solution is a good conductor of electricity.
- Ⓑ The HCl acid molecules in the solution partially ionize, while the $\text{HC}_2\text{H}_3\text{O}_2$ acid molecules in the solution completely ionize.
- Ⓒ The HCl acid solution produces fewer ions, while the $\text{HC}_2\text{H}_3\text{O}_2$ acid solution produces the maximum number of ions.
- Ⓓ The HCl acid solution produces the maximum number of ions, while the $\text{HC}_2\text{H}_3\text{O}_2$ acid solution produces fewer ions.

71. What is the correct ascending order according to the pH value of each of the following solutions?

Solution A	Solution B	Solution C	Solution D
pOH = 5.60	pH = 7.40	$[\text{OH}^-] = 4.0 \times 10^{-3} \text{ M}$	$[\text{H}^+] = 2.5 \times 10^{-2} \text{ M}$

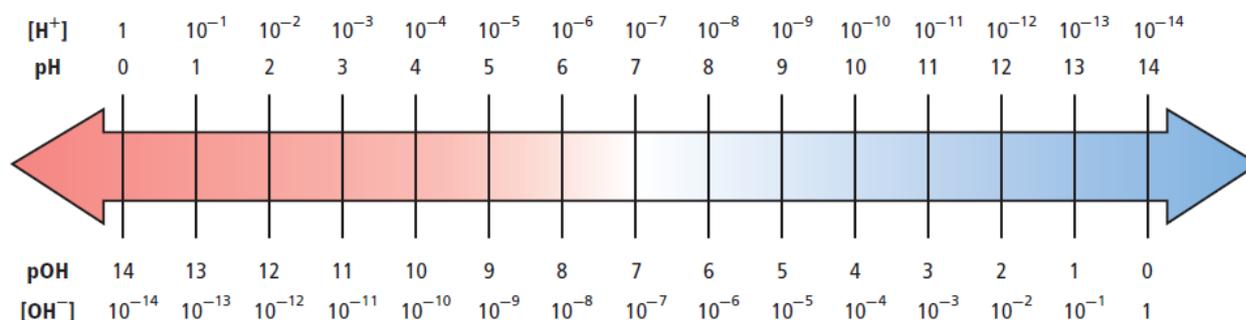
- Ⓐ Solution A - Solution B - Solution C - Solution D
- Ⓑ Solution D - Solution C - Solution B - Solution A
- Ⓒ Solution C - Solution A - Solution B - Solution D
- Ⓓ Solution D - Solution A - Solution C - Solution B

72. Which of the following statements is correct regarding the hydrolysis of ammonium chloride salt (NH_4Cl)?



- Ⓐ The NH_4^+ ion does not react with water, but the Cl^- ion, being a weak Brønsted-Lowry base, reacts with water to produce hydroxide ions, making the solution basic.
- Ⓑ The Cl^- ion does not react with water, but the NH_4^+ ion, being a weak Brønsted-Lowry acid, reacts with water to produce hydronium ions and ammonia molecules, making the solution acidic.
- Ⓒ Both Cl^- and NH_4^+ ions do not react with water, making the solution neutral.
- Ⓓ Both Cl^- and NH_4^+ ions react with water, making the solution neutral.

73. Which of the following relationships is incorrect regarding the pH scale?



- Ⓐ $\text{pH} + \text{pOH} = 14$
- Ⓑ $[\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14}$
- Ⓒ $\text{pH} = -\log[\text{H}^+]$
- Ⓓ $\text{pH} = -\log[\text{OH}^-]$

74. In the reaction below, which of the following is incorrect?

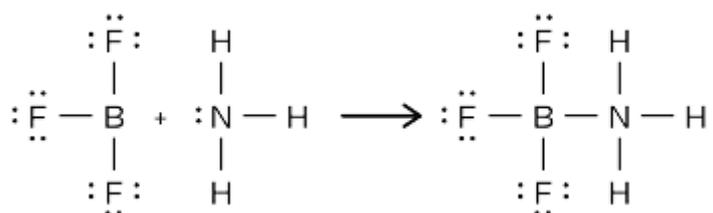


- Ⓐ H₂O donates an H⁺ ion to the CO₃²⁻ ion.
- Ⓑ The CO₃²⁻ ion accepts an H⁺ ion from H₂O.
- Ⓒ H₂O acts as an Arrhenius acid.
- Ⓓ H₂O acts as a Brønsted-Lowry acid.

75. Which of the following is NOT considered an amphoteric substance?

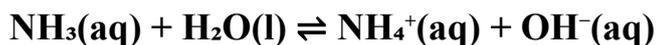
- Ⓐ OH⁻
- Ⓑ H₂O
- Ⓒ C₂H₃O₂⁻
- Ⓓ H₂PO₄⁻

76. In the following reaction, why is BF₃ considered a Lewis acid?



- Ⓐ Because it ionizes to produce hydrogen ions in an aqueous solution.
- Ⓑ Because it donates a pair of electrons to the ammonia molecule (NH₃).
- Ⓒ Because it accepts a pair of electrons from the ammonia molecule (NH₃).
- Ⓓ Because it dissociates to produce hydroxide ions in an aqueous solution.

77. Which of the following is correct regarding the following reaction?



- Ⓐ The base NH₃ is strong and completely ionizes in a dilute aqueous solution.
- Ⓑ The NH₄⁺ ion has a greater attraction for the H⁺ ion than the OH⁻ ion.
- Ⓒ The equilibrium shifts far to the right because the base NH₃ is strong and the conjugate base OH⁻ is weak.
- Ⓓ The equilibrium shifts far to the left because the base NH₃ is weak and the conjugate base OH⁻ is strong.

78. Which of the following are properties of basic solutions?

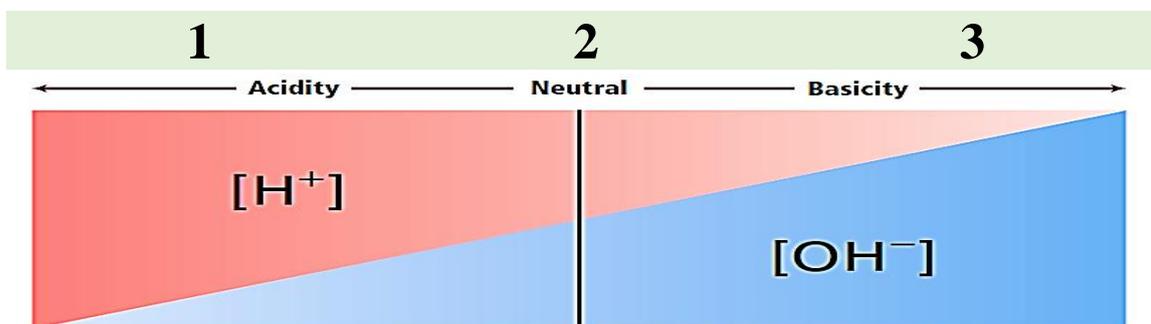
- Ⓐ React with zinc to produce hydrogen gas.
- Ⓑ Turn litmus paper red.
- Ⓒ Bitter taste and slippery feel.
- Ⓓ Sour taste.

79. In the two figures below, an electrical conductivity experiment for aqueous solutions of 0.1 M hydrochloric acid and acetic acid. What can be concluded from the experiment?

- Ⓐ Strong acids are good conductors of electricity.
- Ⓑ Weak acids are good conductors of electricity.
- Ⓒ Strong acids produce fewer ions.
- Ⓓ Weak acids produce the maximum number of ions.

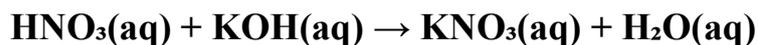


80. The figure below describes the change in the concentration of hydrogen ions and hydroxide ions with the change in the type of solution. Which of the following is correct?



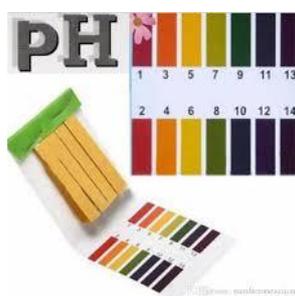
- Ⓐ 1 represents an acidic solution.
- Ⓑ 2 represents a basic solution.
- Ⓒ 3 represents an acidic solution.
- Ⓓ 1 represents a basic solution.

81. What is the molarity of a nitric acid solution if 43.33 mL of a 1.000 M KOH solution is required to neutralize 20.00 mL of the acid solution?



- Ⓐ 0.830 M
- Ⓑ 0.560 M
- Ⓒ 0.217 M
- Ⓓ 0.462 M

82. Which of the following statements is incorrect regarding the two shapes (a, b)?



a



b

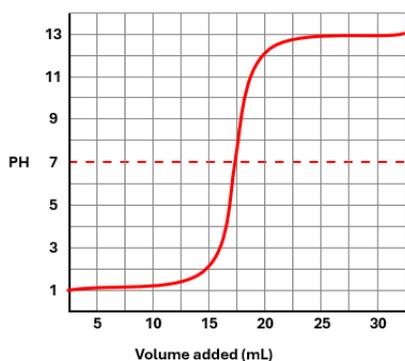
- Ⓐ Both shapes are used to measure the pH of a solution.
- Ⓑ Shape Ⓐ provides a more accurate pH measurement.
- Ⓒ Shape Ⓑ provides a more accurate pH measurement.
- Ⓓ Shape Ⓑ gives a direct digital reading of the pH.

Q83. What is the correct order of the following acids according to their strength, from weakest to strongest?

- Ⓐ (Hydrocyanic → Acetic → Formic → Hydrofluoric)
- Ⓑ (Hydrofluoric → Hydrocyanic → Acetic → Formic)
- Ⓒ (Formic → Hydrocyanic → Hydrofluoric → Acetic)
- Ⓓ (Acetic → Formic → Hydrofluoric → Hydrocyanic)

Acid	K _a (298 K)
Hydrofluoric	6.3 × 10 ⁻⁴
Hydrocyanic	6.2 × 10 ⁻¹⁰
Acetic	1.8 × 10 ⁻⁵
Formic	1.77 × 10 ⁻⁴

84. Which of the following statements is correct regarding the titration curve and indicator table shown below?



indicator	pH range
Methyl red	4.2 - 6.2
Bromothymol blue	6.0 - 7.6
Methyl orange	3.2 - 4.2

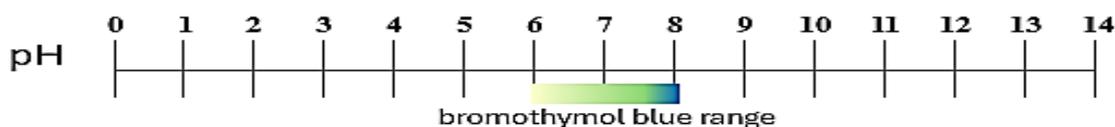
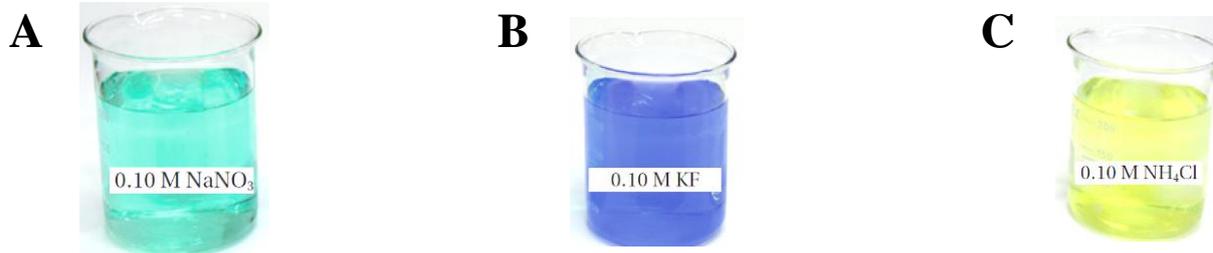
- Ⓐ Strong acid and strong base, and the appropriate indicator is bromothymol blue.
- Ⓑ Strong acid, and weak base, and the appropriate indicator is methyl red.
- Ⓒ Weak acid and weak base, and the appropriate indicator is bromothymol blue.
- Ⓓ Weak acid is and strong base, and the appropriate indicator is methyl orange.

85. Which of the following substances has the highest pH value?

Seawater	Milk	Blood	Ammonia
pOH = 5.60	pH = 6.50	$[H^+] = 4.0 \times 10^{-9} M$	$[OH^-] = 4.0 \times 10^{-3} M$

- Ⓐ Ammonia
- Ⓑ Milk
- Ⓒ Blood
- Ⓓ Seawater

86. When bromothymol blue indicator is added to three aqueous solutions of 0.1 M ionic salts: ammonium chloride (NH_4Cl), sodium nitrate (NaNO_3), and potassium fluoride (KF), the indicator solutions turn to the colours shown in the figure below. Which of the solutions is neutral?



- Ⓐ A only
- Ⓑ B only
- Ⓒ A and B
- Ⓓ B and C

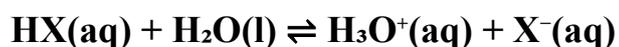
87. Which of the following is considered a property of acids?

- Ⓐ Bitter taste
- Ⓑ Slippery feel
- Ⓒ Turns red litmus paper blue
- Ⓓ Reacts with zinc to produce hydrogen gas

88. Which of the following is correct?

- Ⓐ In an acidic solution, $[\text{OH}^-] > [\text{H}^+]$
- Ⓑ In a basic solution, $[\text{H}^+] > [\text{OH}^-]$
- Ⓒ In an acidic solution, $[\text{H}^+] > [\text{OH}^-]$
- Ⓓ In a neutral solution, $[\text{H}^+] < [\text{OH}^-]$

89. In the reaction equation below, which of the following is correct?

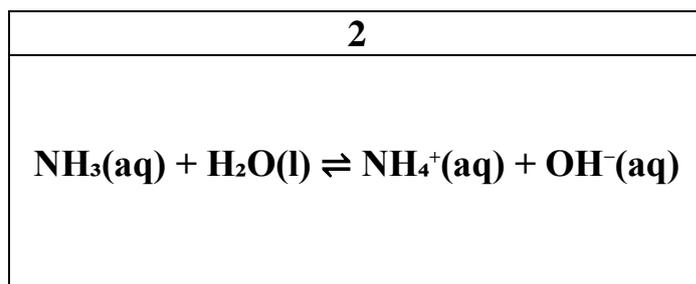
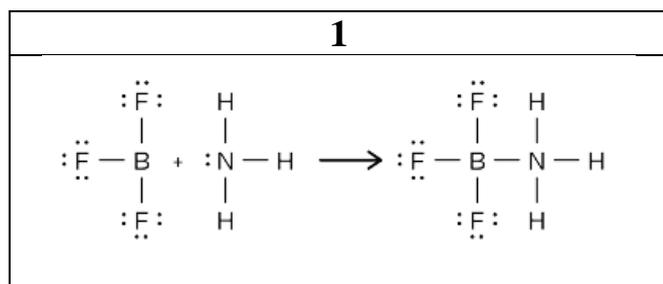


- Ⓐ HX donates a hydrogen ion to H_2O .
- Ⓑ HX is considered a Brønsted-Lowry base.
- Ⓒ HX accepts a hydrogen ion from H_2O .
- Ⓓ H_2O is considered a Brønsted-Lowry acid.

90. What is the substance that contains hydrogen and ionizes to produce hydrogen ions in an aqueous solution?

- Ⓐ Arrhenius acid
- Ⓑ Lewis acid
- Ⓒ Lewis base
- Ⓓ Arrhenius base

91. Which of the following is correct?



- Ⓐ NH₃ in reaction 1 is considered a Lewis base.
- Ⓑ NH₃ in reaction 2 is considered a Brønsted-Lowry acid.
- Ⓒ NH₃ in reaction 2 is an electron pair acceptor.
- Ⓓ NH₃ in reaction 1 is a Lewis acid.

92. Which of the following is a conjugate acid-base pair?

- Ⓐ HNO₃, NO₃⁻
- Ⓑ H₃PO₄, HPO₄⁻
- Ⓒ H₂SO₄, SO₄⁻
- Ⓓ H₂O, O₂⁻

93. The pH of a 0.200 M hydrofluoric acid (HF) solution is 2.15. What is the K_a value for HF?

- Ⓐ 3.2 × 10⁻⁹
- Ⓑ 2.6 × 10⁻⁴
- Ⓒ 1.8 × 10⁻⁵
- Ⓓ 4.7 × 10⁻¹¹

94. What is the pH of a 6.50×10^{-2} M calcium hydroxide ($\text{Ca}(\text{OH})_2$) solution?
- Ⓐ 4.3
 Ⓑ 7.5
 Ⓒ 9.8
 Ⓓ 13.1
95. Which of the following salts produces an acidic solution when dissolved in water?
- Ⓐ Potassium fluoride (KF)
 Ⓑ Ammonium nitrate (NH_4NO_3)
 Ⓒ Rubidium acetate ($\text{RbC}_2\text{H}_3\text{O}_2$)
 Ⓓ Calcium carbonate (CaCO_3)
- 96 Regarding the shape below, which of the following is correct? (Advanced 2022)



2



1

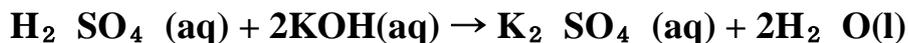
- Ⓐ The bulb glows brightly in 2 because HCl acid only partially ionizes.
 Ⓑ The bulb glows dimly in 1 because CH_3COOH is a strong acid.
 Ⓒ The bulb glows brightly in 2 because HCl is a strong acid.
 Ⓓ The bulb glows dimly in 1 because CH_3COOH completely ionizes.

97 What is the correct descending order of the acids listed in the table, according to the ion concentrations in each solution? (Advanced 2022)

- Ⓐ $\text{CH}_3\text{COOH} \rightarrow \text{HF} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{S}$
 Ⓑ $\text{H}_2\text{S} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{HF} \rightarrow \text{CH}_3\text{COOH}$
 Ⓒ $\text{H}_2\text{S} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{CH}_3\text{COOH} \rightarrow \text{HF}$
 Ⓓ $\text{HF} \rightarrow \text{CH}_3\text{COOH} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{S}$

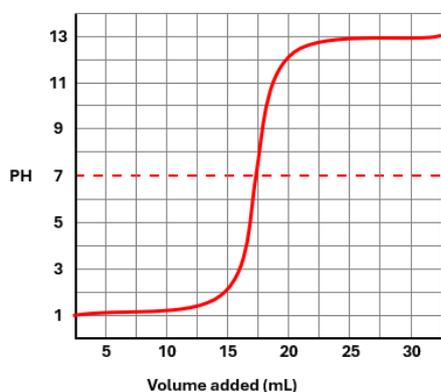
Acid	Ionization Constants
H_2S	8.9×10^{-8}
HF	6.3×10^{-4}
CH_3COOH	1.8×10^{-5}
H_2CO_3	1.77×10^{-4}

98 In an acid-base titration, 25.80 mL of sulfuric acid (H₂ SO₄) solution was titrated to the endpoint with 54.70 mL of 0.6500 M potassium hydroxide (KOH) solution. What is the molarity of the H₂ SO₄ solution? (Advanced 2022)



- Ⓐ 1.4 M
- Ⓑ 0.7 M
- Ⓒ 1.2 M
- Ⓓ 0.6 M

99 Which of the following is correct regarding the titration curve below? (Advanced 2022)



indicator	pH range
Methyl red	4.2 - 6.2
Bromothymol blue	3.1 - 4.7
Bromothymol blue	6.0 - 7.6
Methyl orange	3.2 - 4.2

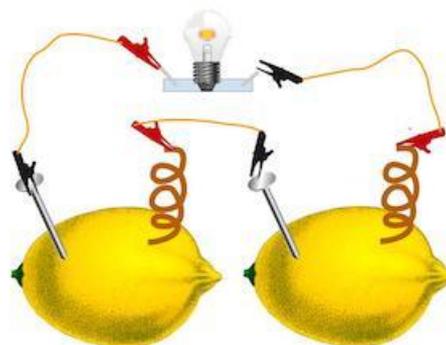
- Ⓐ The acid is strong, the base is weak, and the appropriate indicator is methyl red.
- Ⓑ The acid is strong, the base is strong, and the appropriate indicator is bromothymol blue.
- Ⓒ The acid is weak, the base is strong, and the appropriate indicator is methyl orange.
- Ⓓ The acid is weak, the base is weak, and the appropriate indicator is bromophenol blue.

100 Which of the following is a polyprotic acid? (General 2022)

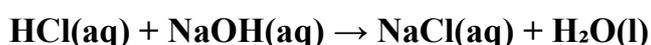
- Ⓐ HC₂ H₃ O₂
- Ⓑ HCl
- Ⓒ H₃ PO₄
- Ⓓ HNO₃

101 What property does the experiment in the opposite reaction describe? (General 2022)

- (A) Sour taste
- (B) Slippery feel
- (C) Electrical conductivity
- (D) Change in the colour of litmus paper



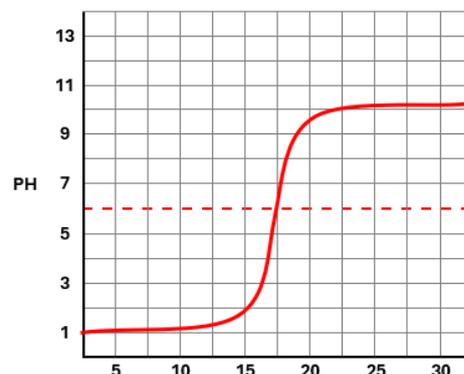
102 40.0 mL of hydrochloric acid (HCl) solution was titrated to the endpoint with 20.0 mL of 0.2 M sodium hydroxide (NaOH) solution. What is the molarity of the HCl solution? (General 2022)



- (A) 0.1 M
- (B) 0.05 M
- (C) 0.025 M
- (D) 0.2 M

103 What type of titration is shown in the opposite figure? (General 2022)

- (A) Strong acid with strong base
- (B) Strong acid with weak base
- (C) Weak acid with strong base
- (D) Weak acid with weak base



104 What are the products of a neutralization reaction? (General 2022)

- (A) Acid and water
- (B) Salt and water
- (C) Base and water
- (D) Acid and base

105 What is the $[\text{OH}^-]$ value in orange juice at 298 K, given that $[\text{H}^+] = 1.0 \times 10^{-3} \text{ M}$?

(General 2022)

- Ⓐ $1.0 \times 10^{-14} \text{ M}$
- Ⓑ $1.0 \times 10^{-11} \text{ M}$
- Ⓒ $1.0 \times 10^{-3} \text{ M}$
- Ⓓ $1.0 \times 10^{-4} \text{ M}$

106 Which of the following is the conjugate acid of the weak base NH_3 ? (General 2022)

- Ⓐ NH_2^-
- Ⓑ NH_4^+
- Ⓒ NH_2^+
- Ⓓ NH_3^+

107 How many times greater is the acidity of solution A compared to solution B?

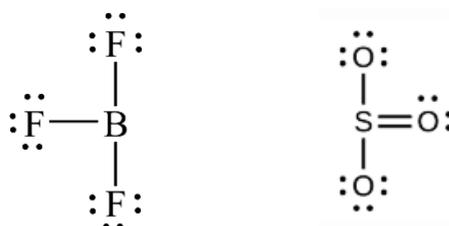
(General 2022)

- Ⓐ 1000
- Ⓑ 3
- Ⓒ 10
- Ⓓ 100

Solution A	pH 2
Solution B	pH 5

108 What is the similarity between the following two formulas? (General 2022)

- Ⓐ Both are Lewis bases
- Ⓑ Both are Lewis acids
- Ⓒ Both are Arrhenius bases
- Ⓓ Both are Arrhenius acids



109 What is the correct order of the following bases according to their strength, from weakest to strongest? (General 2022)

- Ⓐ Ethylamine - Methylamine - Ammonia - Aniline
- Ⓑ Aniline - Ammonia - Methylamine - Ethylamine
- Ⓒ Aniline - Ammonia - Ethylamine - Methylamine
- Ⓓ Methylamine - Ethylamine - Aniline - Ammonia

Base	$K_b(298 \text{ K})$
Ethylamine	5.0×10^{-4}
Methylamine	4.3×10^{-4}
Ammonia	2.5×10^{-5}
Aniline	4.3×10^{-10}

110 The colour of litmus paper turns blue when the concentration of H^+ in the solution is: (General 2022)

- Ⓐ Greater than the concentration of OH^-
- Ⓑ Less than the concentration of OH^-
- Ⓒ Equal to the concentration of OH^-
- Ⓓ Equal to zero



111 Chemical dyes whose colours are affected by acidic and basic solutions are called: (General 2022)

- Ⓐ Anhydrides
- Ⓑ Amphoteric substances
- Ⓒ Indicators
- Ⓓ Standard solutions

112 Which of the following tables is correct regarding the solutions in beakers 1 and 2 below? (General 2022)



1



2

A	Beaker 1	Beaker 2
	Strong Acid	Weak Acid
	Completely Ionized	Partially Ionized

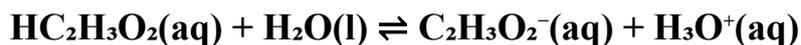
B	Beaker 1	Beaker 2
	Weak Acid	Strong Acid
	Partially Ionized	Completely Ionized

C	Beaker 1	Beaker 2
	Strong Acid	Weak Acid
	Partially Ionized	Completely Ionized

D	Beaker 1	Beaker 2
	Weak Acid	Strong Acid
	Completely Ionized	Partially Ionized

- Ⓐ Beaker 1: Strong acid, completely ionized; Beaker 2: Weak acid, partially ionized
- Ⓑ Beaker 1: Partially ionized; Beaker 2: Completely ionized
- Ⓒ Beaker 1: Weak acid, partially ionized; Beaker 2: Strong acid, completely ionized
- Ⓓ Beaker 1: Strong acid, completely ionized; Beaker 2: Weak acid, completely ionized

113 Which of the following is correct regarding the following reaction: (General 2022)



- Ⓐ The ionization equilibrium shifts to the left.
- Ⓑ The ionization equilibrium shifts to the right.
- Ⓒ The conjugate base $\text{C}_2\text{H}_3\text{O}_2^-$ is weaker than the base H_2O .
- Ⓓ The base H_2O has a greater attraction for the H^+ ion than the base $\text{C}_2\text{H}_3\text{O}_2^-$.

114 What is the pH of an aqueous solution in which $[\text{H}^+] = 2.5 \times 10^{-2}$ at 298 K? (General 2022)

- Ⓐ 1.60
- Ⓑ 12.40
- Ⓒ 2.00
- Ⓓ 10.80

115 Which of the following is NOT an Arrhenius base? (General 2022)

- Ⓐ NaOH
- Ⓑ $\text{Ca}(\text{OH})_2$
- Ⓒ NH_3
- Ⓓ KOH

116 When hydrochloric acid ($\text{HCl}(\text{aq})$) reacts with zinc metal (Zn), the gas produced is: (Re-exam General 2022)

- Ⓐ Carbon monoxide
- Ⓑ Hydrogen
- Ⓒ Carbon dioxide
- Ⓓ Nitrogen

117 Which of the following acids is the weakest? (Re-exam General 2022)

- Ⓐ HF
- Ⓑ HCN
- Ⓒ CH_3COOH
- Ⓓ HCOOH

Acid		$K_a(298 \text{ K})$
Hydrofluoric	HF	6.3×10^{-4}
Hydrocyanic	HCN	6.2×10^{-10}
Acetic	CH_3COOH	1.8×10^{-5}
Formic	HCOOH	1.77×10^{-4}

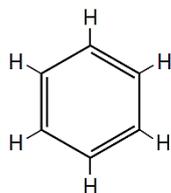
118 Which of the following is NOT a conjugate pair? (Re-exam General 2022)

- Ⓐ $\text{OH}^- / \text{H}_2\text{O}$
- Ⓑ $\text{NH}_3 / \text{NH}_4^+$
- Ⓒ $\text{HC}_2\text{H}_3\text{O}_2 / \text{C}_2\text{H}_3\text{O}_2^-$
- Ⓓ $\text{H}_2\text{SO}_4 / \text{SO}_4^{2-}$

119 Which of the following is correct regarding a strong base? (Re-exam General 2022)

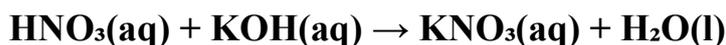
- Ⓐ Produces a small amount of OH^- ions in solution.
- Ⓑ Has a sour taste.
- Ⓒ Produces a small amount of H^+ ions in solution.
- Ⓓ Completely dissociates.

120 Why can a hydrogen atom ionize in an HF solution but not in benzene (C_6H_6)? (Re-exam General 2022)



- Ⓐ Because the bond between hydrogen and fluorine is polar in HF.
- Ⓑ Because the bond between hydrogen and fluorine is nonpolar in HF.
- Ⓒ Because the difference in electronegativity is zero in C_6H_6 .
- Ⓓ Because the difference in electronegativity is high between carbon and hydrogen atoms in C_6H_6 .

121 What is the molarity of a nitric acid solution if 43.33 mL of 0.1000 M KOH solution is required to neutralize 20.00 mL of the acid solution? (Re-exam General 2022)



- Ⓐ 0.217 M
- Ⓑ 0.108 M
- Ⓒ 0.325 M
- Ⓓ 0.432 M

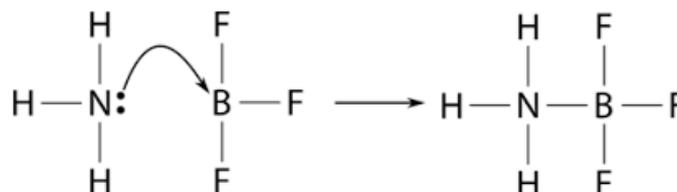
122 How many times greater is the acidity of solution A compared to solution B? (Re-exam General 2022)

- (A) 1000
- (B) 1
- (C) 10
- (D) 100

Solution A	pH 2
Solution B	pH 5

123 What does NH_3 represent in the reaction below? (Re-exam General 2022)

- (A) Lewis base
- (B) Lewis acid
- (C) Arrhenius base
- (D) Arrhenius acid



124 What is the appropriate indicator for the titration of a strong acid and a strong base? (Re-exam General 2022)

- (A) Methyl orange, range 3.2-4.4
- (B) Bromocresol green, range 3.8-5.4
- (C) Bromothymol blue, range 6.2-7.6
- (D) Phenolphthalein, range 8.2-10

125 According to the Brønsted-Lowry theory, a base can: (Re-exam General 2022)

- (A) Donate a pair of electrons
- (B) Donate a proton
- (C) Accept a proton
- (D) Accept a pair of electrons

126 What is the ionic compound formed from a cation from a base and an anion from an acid? (Re-exam General 2022)

- (A) Salt
- (B) Acid
- (C) Indicator
- (D) Base

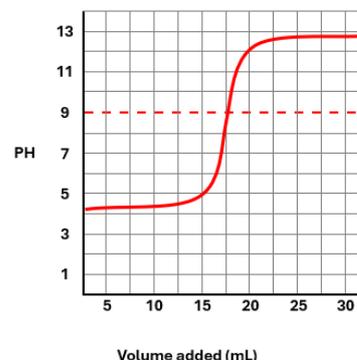
127 Litmus paper turns red when the concentration of H^+ in the solution is: (Re-exam General 2022)

- (A) $1 \times 10^{-11} \text{ M}$
- (B) $1 \times 10^{-9} \text{ M}$
- (C) $1 \times 10^{-7} \text{ M}$
- (D) $1 \times 10^{-1} \text{ M}$

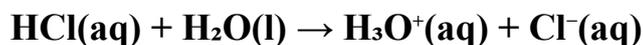


128 What type of titration is shown in the opposite figure? (Re-exam General 2022)

- (A) Strong acid with strong base
- (B) Strong acid with weak base
- (C) Weak acid with strong base
- (D) Weak acid with weak base



129 Which of the following is NOT correct regarding the following reaction: (Re-exam General 2022)



- (A) The ionization equilibrium shifts to the left.
- (B) The conjugate base Cl^- is weaker than the base H_2O .
- (C) The ionization equilibrium shifts to the right.
- (D) The base H_2O has a greater attraction for the H^+ ion than the base Cl^- .

130 What is the pH of an aqueous solution in which $[\text{H}^+] = 4.0 \times 10^{-8}$ at 298 K? (Re-exam General 2022)

- (A) 7.40
- (B) 12.40
- (C) 6.60
- (D) 10.81

131 What gas is produced during the reaction of sodium bicarbonate with an aqueous solution of acetic acid? (Advanced 2021)

- Ⓐ O₂
- Ⓑ N₂
- Ⓒ CO₂
- Ⓓ H₂

132 Which of the following statements is correct regarding the reaction below? (Advanced 2021)



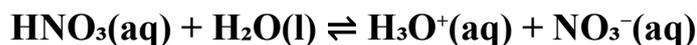
- Ⓐ NH₃ donates a pair of electrons to H₂O.
- Ⓑ NH₃ is considered an Arrhenius base.
- Ⓒ H₂O accepts an H⁺ ion in the forward reaction.
- Ⓓ H₂O is considered a Brønsted-Lowry acid.

133 Which of the following substances completely ionizes in aqueous solutions and produces hydronium ions (H₃O⁺)?(Advanced 2021)

- Ⓐ I and II
- Ⓑ III and I
- Ⓒ I and III
- Ⓓ I, II, and IV

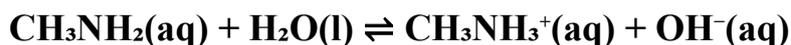
I.	HCl
II.	HC ₂ H ₃ O ₂
III.	H ₂ SO ₄
IV.	HClO

134 What is the acid ionization constant expression for the following equation? (Advanced 2021)



- Ⓐ $K_a = \frac{[\text{H}_3\text{O}^+][\text{NO}_3^-]}{[\text{HNO}_3]}$
- Ⓑ $K_a = \frac{[\text{HNO}_3][\text{H}_2\text{O}]}{[\text{H}_3\text{O}^+][\text{NO}_3^-]}$
- Ⓒ $K_a = \frac{[\text{H}_3\text{O}^+][\text{NO}_3^-]}{[\text{HNO}_3][\text{H}_2\text{O}]}$
- Ⓓ $K_a = \frac{[\text{HNO}_3]}{[\text{H}_3\text{O}^+][\text{NO}_3^-]}$

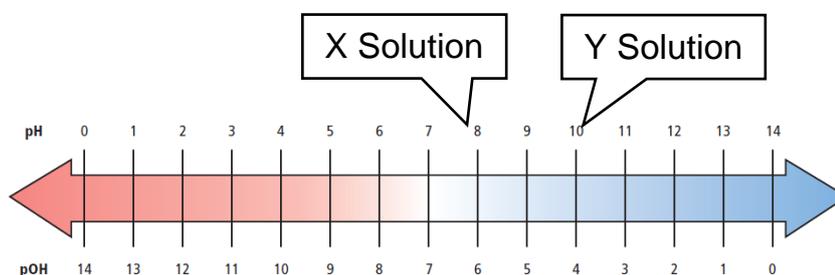
135 Which of the following statements is correct regarding the reaction below?
(Advanced 2021)



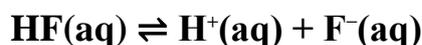
- Ⓐ The base CH_3NH_2 is weak and the conjugate base OH^- is strong.
- Ⓑ The base CH_3NH_2 is strong and the conjugate base OH^- is weak.
- Ⓒ The OH^- ion has a weaker attraction for the H^+ ion than the CH_3NH_2 molecule.
- Ⓓ The equilibrium shifts far to the right.

136 How many times greater is the concentration of the hydrogen ion $[\text{H}^+]$ in solution X compared to solution Y, according to the graph below? (Advanced 2021)

- Ⓐ 1000 times
- Ⓑ 100 times
- Ⓒ 10 times
- Ⓓ 2 times



137 What is the value of K_a for a hydrofluoric acid (HF) solution with a concentration of 0.0091 M and $\text{pH} = 2.68$? (Advanced 2021)



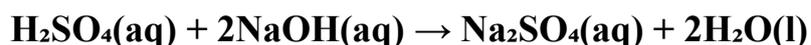
- Ⓐ $K_a = 7.6 \times 10^{-5}$
- Ⓑ $K_a = 6.3 \times 10^{-4}$
- Ⓒ $K_a = 9.9 \times 10^{-5}$
- Ⓓ $K_a = 4.8 \times 10^{-4}$

138 What is the correct ascending order of pOH values for solutions (X), (Y), and (Z) with the following properties? (Advanced 2021)

- Ⓐ Least: (Z) → (X) → (Y) :Greatest
- Ⓑ Least: (Z) → (Y) → (X) :Greatest
- Ⓒ Least: (Y) → (X) → (Z) :Greatest
- Ⓓ Least: (Y) → (Z) → (X) :Greatest

Solution (X)	$\text{pH} = 10.5$
Solution (Y)	$[\text{H}^+] = 10^{-12}$
Solution (Z)	$[\text{OH}^-] = 10^{-9}$

139 What is the molarity of a sulfuric acid (H_2SO_4) solution if 68.4 mL of 0.333 M NaOH solution is required to neutralize 49.0 mL of the acid solution? (Advanced 2021)



- Ⓐ 0.119 M
- Ⓑ 0.232 M
- Ⓒ 0.465 M
- Ⓓ 0.880 M

140 How can acids and bases be safely distinguished in a laboratory? (Final 2019)

- Ⓐ By taking bases as antacids.
- Ⓑ By tasting; acids have a sour taste and bases have a bitter taste.
- Ⓒ By reaction with litmus paper.
- Ⓓ By touching; bases have a slippery feel.

141 Which of the following relationships represents a neutral solution? (Final 2019)

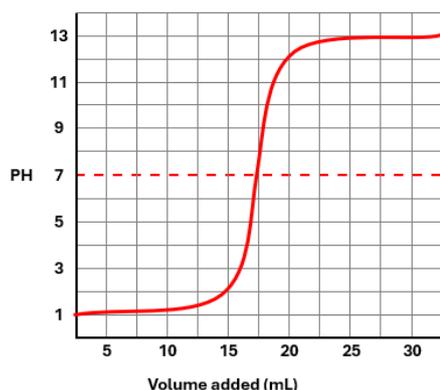
- Ⓐ $[\text{OH}^-] < [\text{H}^+]$
- Ⓑ $[\text{H}^+] < [\text{OH}^-]$
- Ⓒ $[\text{OH}^-] = [\text{H}^+]$
- Ⓓ $[\text{H}^+] = 7.0$

142 Which of the following bases is the strongest according to the table provided? (Final 2019)

- Ⓐ Ethylamine
- Ⓑ Methylamine
- Ⓒ Aniline
- Ⓓ Ammonia

Base	$K_b(298 \text{ K})$
Ethylamine	5.0×10^{-4}
Methylamine	4.3×10^{-4}
Ammonia	2.5×10^{-5}
Aniline	4.3×10^{-10}

143 Which of the following statements is correct regarding the titration curve and indicator table shown below? (Advanced 2021)



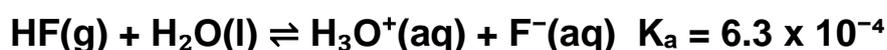
indicator	pH range
Bromothymol blue	6.0 - 7.6
Phenolphthalein	8.2 - 10.2

- Ⓐ The acid is weak and the appropriate indicator for this titration is phenolphthalein.
- Ⓑ The acid is strong and the appropriate indicator for this titration is bromothymol blue.
- Ⓒ The acid is strong and the appropriate indicator for this titration is phenolphthalein.
- Ⓓ The acid is weak and the appropriate indicator for this titration is bromothymol blue.

144 The hydrogen ion concentration in pure water is ten times greater than its value in seawater. If the pH of pure water is 7.0, what is the pH of seawater? (Final 2019)

- Ⓐ 0.0
- Ⓑ 6.0
- Ⓒ 7.0
- Ⓓ 8.0

145 Regarding the following equilibrium reaction, why does the ionization equilibrium shift away to the left? (Final 2019)



- Ⓐ The base H_2O has a much greater attraction for the H^+ ion than the conjugate base F^- .
- Ⓑ The K_a value is high for the acid, so it shifts towards the non-ionized molecules.
- Ⓒ HF is a strong acid and its conjugate base F^- is weak.
- Ⓓ The conjugate base F^- is stronger than the base H_2O , so it attracts the H^+ ion more than the base H_2O .

146 What are the products of the neutralization reaction between KOH(aq) and HCl(aq)? (Final 2019)

- Ⓐ $\text{Cl}^-(\text{aq}) + \text{KH}_2\text{O}^+(\text{aq})$
- Ⓑ $\text{KH}(\text{aq}) + \text{HClO}(\text{aq})$
- Ⓒ $\text{H}_3\text{O}^+(\text{aq}) + \text{KCl}(\text{aq})$
- Ⓓ $\text{H}_2\text{O}(\text{l}) + \text{KCl}(\text{aq})$

147 What explains the formation of bubbles when an acetic acid solution is added to sodium bicarbonate? (Final 2018)

- Ⓐ Production of $\text{H}_2(\text{g})$
- Ⓑ Production of $\text{CO}_2(\text{g})$
- Ⓒ Production of $\text{NH}_3(\text{g})$
- Ⓓ Production of $\text{O}_2(\text{g})$

148. Which of the following is considered a Lewis base?

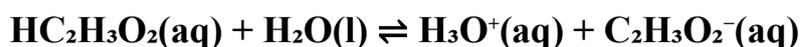
- a) H^+
- b) BF_3
- c) SO_3
- d) NH_3

149. Which of the following acids listed in the table below is the weakest?

- a) HF
- b) H_2S
- c) H_2CO_3
- d) HCN

Acid	Ionization Constant (K_a)
HF	6.3×10^{-4}
H_2S	8.9×10^{-8}
HCN	6.2×10^{-10}
H_2CO_3	4.5×10^{-7}

150. Regarding the following equilibrium reaction, which of the following statements is correct?

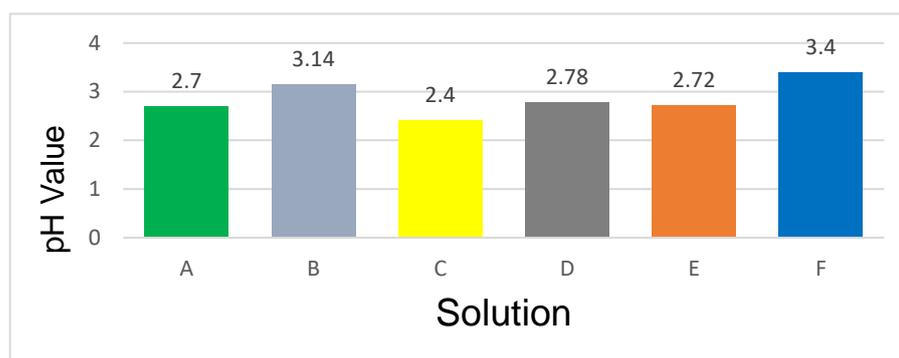


- a) $\text{C}_2\text{H}_3\text{O}_2^-$ is a stronger base than H_2O .
- b) H_2O is a stronger base than $\text{C}_2\text{H}_3\text{O}_2^-$.
- c) $\text{HC}_2\text{H}_3\text{O}_2$ is a strong acid.
- d) The ionization equilibrium shifts far to the right.

151. Which of the following relationships describes a basic solution?

- a) $[\text{OH}^-] < [\text{H}^+]$
- b) $[\text{H}^+] < [\text{OH}^-]$
- c) $[\text{OH}^-][\text{H}^+] = 14$
- d) $[\text{OH}^-] = 0.0$

152. Using the adjacent diagram, based on the concentration of H^+ ions, how many times greater is the acidity of the most acidic solution compared to the least acidic solution?



- a) 1000
- b) 10
- c) 100
- d) 500

153. In the following pure water equilibrium equation:



Why doesn't the value of K_w change when more hydrogen ions are added to water?

- a) The equilibrium shifts to the right and the concentration of H^+ ions increases.
- b) The added H^+ reacts with OH^- to form more H_2O molecules.
- c) The rate of ionization of water molecules increases.
- d) The concentration of OH^- ions in the solution increases.

154. Which of the following salts produces a neutral solution when dissolved in water?

- a) Calcium carbonate
- b) Ammonium nitrate
- c) Rubidium acetate
- d) Potassium sulfate

155. What is the value of $[\text{OH}^-]$ in mol/L in milk if $\text{pH} = 6.5$?

- a) 4.6×10^{-8}
- b) 3.2×10^{-7}
- c) 1×10^{-7}
- d) 2×10^{-8}

156. Which of the following is NOT a property of acetic acid? (2017 Exam)

- a) Turns blue litmus paper red.
- b) Tastes sour and feels slippery.
- c) Reacts with sodium bicarbonate to produce CO_2 gas.
- d) Conducts electricity.

157. Based on the values in the table below, which of these bases has a solution with the highest concentration of unionized molecules? (2017 Exam)

- a) Aniline
- b) Ammonia
- c) Methylamine
- d) Ethylamine

Base	$K_b(298\text{ K})$
Ethylamine	5.0×10^{-4}
Methylamine	4.3×10^{-4}
Ammonia	2.5×10^{-5}
Aniline	4.3×10^{-10}

158. Which of the following relationships represents a basic solution? (2017 Exam)

- a) $[\text{OH}^-] = [\text{H}^+]$
- b) $[\text{H}^+] > [\text{OH}^-]$
- c) $[\text{H}^+] < [\text{OH}^-]$
- d) $[\text{OH}^-][\text{H}^+] = 14$

159. How many times greater is the hydrogen ion concentration in a solution with $\text{pH}=1$ compared to a solution with $\text{pH}=2$? (2017 Exam)

- a) 10
- b) 20
- c) 2
- d) 10

160. Which of the following solutions has the highest concentration of hydronium ions (H_3O^+)?(2016 Exam)

- a) 0.10 M HCl
- b) 0.10 M HF
- c) 0.10 M CH_3COOH
- d) 0.10 M NaOH

161. Regarding the ionization equation of the indicator B:



Red

Yellow

What colour change occurs when the indicator is added to an acidic solution? (2016 Exam)

- a) The solution turns orange.
- b) The solution turns red.
- c) The solution turns yellow.
- d) The colour disappears.

162. Which of the following properties DOES NOT disappear when an acid is neutralized with a base? (2016 Exam)

- a) Reaction of acids with active metals.
- b) Sour taste of aqueous solutions.
- c) Colour change of indicators.
- d) Electrical conductivity of solutions.

163. Which of the following is true for all types of solutions? (2016 Exam)

- a) $K_w = [\text{H}^+][\text{OH}^-]$
- b) $[\text{H}^+] < [\text{OH}^-]$
- c) $[\text{H}^+] > [\text{OH}^-]$
- d) $[\text{H}^+] = [\text{OH}^-]$

164. Which of the following reactions represents ONLY a Brønsted-Lowry acid-base reaction? (2016 Exam)

- a) $\text{NH}_3 + \text{BF}_3 \rightarrow \text{NH}_3\text{BF}_3$
- b) $\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+$
- c) $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \text{OH}^-$
- d) $\text{Ag}^+ + 2\text{NH}_3 \rightarrow [\text{Ag}(\text{NH}_3)_2]^+$

165. Regarding the reaction $\text{HF} + \text{H}_2\text{PO}_4^- \rightleftharpoons \text{F}^- + \text{H}_3\text{PO}_4$, which of the following statements is correct? (2015 Exam)

- a) HF is the base.
- b) F^- is the conjugate base.
- c) H_3PO_4 is the acid.
- d) H_2PO_4^- is the conjugate base.

166. In the equation $\text{AlCl}_3 + \text{Cl}^- \rightarrow \text{AlCl}_4^-$, what is the role of AlCl_3 ? (2015 Exam)

- a) Electron pair donor.
- b) Electron pair acceptor.
- c) Brønsted-Lowry acid.
- d) Lewis base.

167. Which of the following is NOT a negative impact of acid rain? (2015 Exam)

- a) Decreased biological diversity in ecosystems.
- b) Erosion of statues and marble sculptures.
- c) Decreased fish populations in lakes and rivers.
- d) Increased pH of rainwater.

168. In the reaction $\text{Ag}^+ + 2\text{NH}_3 \rightarrow [\text{Ag}(\text{NH}_3)_2]^+$, what does Ag^+ represent? (2015 Training Exam)

- a) Electron pair donor.
- b) Brønsted-Lowry acid.
- c) Lewis acid.
- d) Lewis base.

169. When sodium hydroxide (NaOH) is added to a solution containing Pb^{2+} ions, a white precipitate ($\text{Pb}(\text{OH})_2$) forms, which dissolves in excess NaOH . What is the correct prediction for the behavior of $\text{Pb}(\text{OH})_2$? (2015 Training Exam)

- a) Strong base.
- b) Strong acid.
- c) Amphoteric.
- d) Salt.

170. A student measured the pH of four juices and recorded them in the table below. Which juice has the highest $[\text{OH}^-]$ concentration? (2015 Exam)

- a) Lemon
- b) Apple
- c) Orange
- d) Banana

Juice	pH
Lemon	2
Apple	3
Orange	4
Banana	5

171. When acid A reacts with base B, compound C is produced, which has a pH value less than 7. What is the correct prediction for the strength of A and B? (2015 Training Exam)
- A is strong, B is weak.
 - A is weak, B is strong.
 - Both A and B are strong.
 - It is impossible to predict the strength of either.
172. Which of the following changes the value of K_w for water? (2015 Training Exam)
- Dissolving a salt in water.
 - Change in hydroxide ion concentration.
 - Addition of a strong acid.
 - Change in temperature.
173. What is the relationship between the concentrations of hydroxide and hydronium ions in an aqueous solution with $\text{pH} = 1.5$? (2015 Training Exam)
- $[\text{H}_3\text{O}^+] = [\text{OH}^-]$
 - $[\text{OH}^-] > [\text{H}_3\text{O}^+]$
 - $[\text{H}_3\text{O}^+][\text{OH}^-] = 7$
 - $[\text{OH}^-] < [\text{H}_3\text{O}^+]$
174. Which definition of acids and bases focuses on the role of protons (H^+)? (2014 Exam)
- Arrhenius
 - Brønsted-Lowry
 - Lewis
 - Bohr
175. Which of the following substances does NOT behave as an amphoteric substance? (2014 Exam)
- Hydroxide ion.
 - Bicarbonate ion.
 - Water.
 - Hydronium ion.

176. What is the value of the water ionization constant K_w at 50°C ? (2014 Exam)

- a) $1.0 \times 10^{-14} \text{ M}$
- b) $5.3 \times 10^{-14} \text{ M}$
- c) $1.2 \times 10^{-15} \text{ M}$
- d) $3.0 \times 10^{-15} \text{ M}$

177. What is the nature of a solution in which $[\text{H}_3\text{O}^+][\text{OH}^-]$? (2014 Exam)

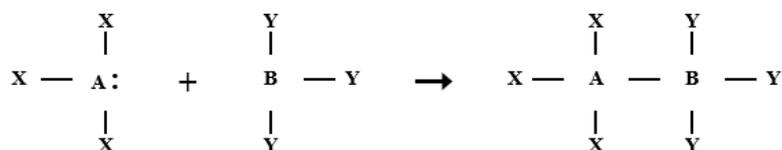
- a) Acidic.
- b) Neutral.
- c) Basic.
- d) Amphoteric.

178. Which of the following properties of acids and bases does NOT disappear when an acid is neutralized with a base? (2014 Postponed Exam)

- a) Electrical conductivity
- b) Sour taste
- c) Bitter taste
- d) Soapy feel

179. Which of the following reactions represents the corresponding symbolic equation? (2014 Postponed Exam)

- a) Arrhenius acid and base
- b) Lewis acid and base
- c) Arrhenius acid and Lewis base
- d) Brønsted-Lowry acid and base



180. When a reaction occurs between an acid and a base, the proton transfer favours the production of: (2014 Postponed Exam)

- a) Strongest acid and strongest base
- b) Strongest acid and weakest base
- c) Weakest acid and weakest base
- d) Weakest acid and strongest base

181. Which of the relationships under each flask matches its contents? (2014 Postponed Exam)



HNO_3
 $\text{pOH} < \text{pH}$



HCl
 $[\text{H}_3\text{O}^+] < [\text{OH}^-]$



KOH
 $\text{pOH} < \text{pH}$



Distilled water
 $\text{pH} = 7$ at 40°C

182. Regarding water, which of the following is true under all conditions? (2014 Postponed Exam)

- a) $[10^{-7} = [\text{OH}^-] = [\text{H}_3\text{O}^+]]$
- b) $[\text{K}_w = [\text{OH}^-][\text{H}_3\text{O}^+]]$
- c) $[14 = \text{pH} - \text{pOH}]$
- d) $[10^{-14} = [\text{OH}^-][\text{H}_3\text{O}^+]]$

183. Which of the following statements does NOT agree with the concept of an indicator? (2014 Postponed Exam)

- a) Its colour changes with the pH of the solution.
- b) Organic compounds that act as weak bases or weak acids.
- c) Each indicator has its own specific transition range.
- d) The value of the transition range changes with the added solution.

184. Which of the following salts undergoes both cation and anion hydrolysis? (2014 Training Exam)

- a) $\text{Al}_2(\text{SO}_4)_3$
- b) $(\text{NH}_4)_2\text{SO}_4$
- c) CH_3COOK
- d) $\text{CH}_3\text{COONH}_4$

185. Which of the following describes a 9.0 M acetic acid solution? (2014 Training Exam)

- a) Weak and concentrated
- b) Strong and dilute
- c) Weak and dilute
- d) Strong and concentrated

186. Which of the following relationships indicates an aqueous solution with a pH greater than 7? (2014 Training Exam)

- a) $[H_3O^+] = [OH^-]$
- b) $[H_3O^+] > [OH^-]$
- c) $[H_3O^+] < [OH^-]$
- d) $pOH = 11$

187. Compound A with $pOH = 4.5$ reacts with compound B to produce compound C and water. Knowing that the resulting solution changes the colour of phenolphthalein to light pink, what is the nature of compounds A, B, and C in order? (2014 Training Exam)

- a) Base - Acid - Salt
- b) Acid - Base - Salt
- c) Base - Salt - Acid
- d) Acid - Salt - Base

Phenolphthalein Indicator	pH
< 7	Colorless
$= 7$	Pink
> 7	Red

188. Which of the following represents all the species present in an aqueous solution of hydrofluoric acid? (2014 Training Exam)

- a) F^- and H_3O^+
- b) HF and F^-
- c) HF and H_3O^+
- d) HF, F^- , and H_3O^+

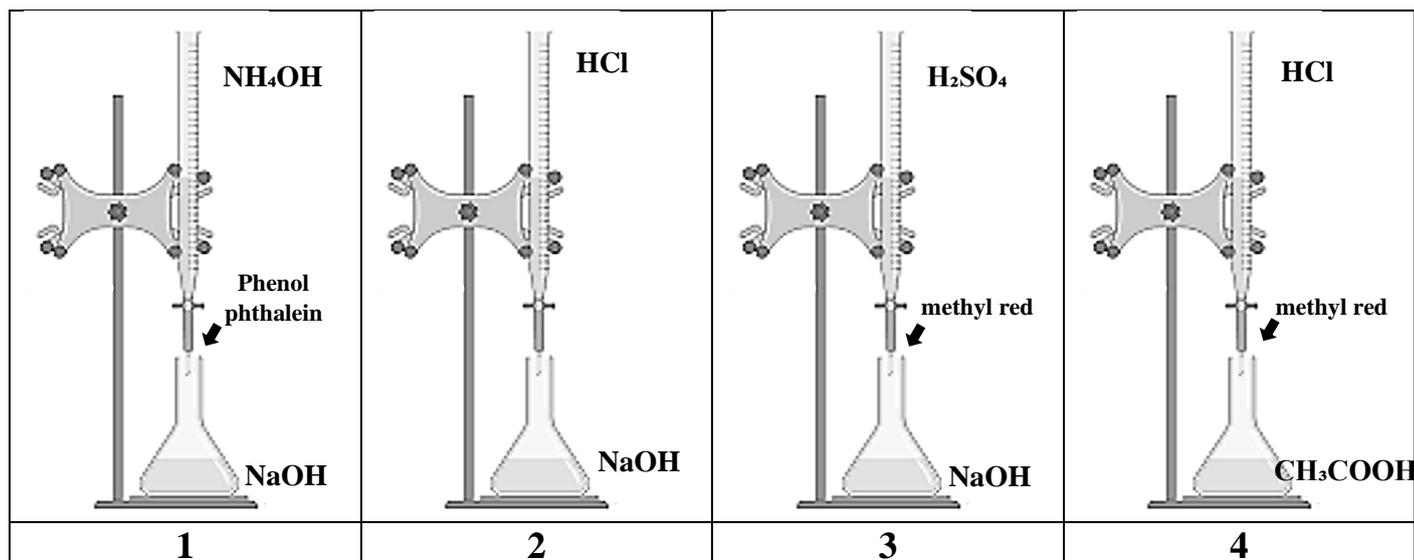
189. What substance has H_2O as its conjugate acid and O_2 as its conjugate base?

- a) H_3O^+
- b) NO_2^-
- c) O_2
- d) OH^-

190. In the equation $Ag^+ + 2NH_3 \rightarrow [Ag(NH_3)_2]^+$, what does the Ag^+ ion represent?

- a) Brønsted-Lowry acid
- b) Brønsted-Lowry base
- c) Lewis acid
- d) Lewis base

191. Which of the following meets the requirements for a correct titration? (2013 Final Exam)



192. Which solution has a pOH value equal to 12? (2013 Final Exam)

- a) $[H_3O^+] = 1 \times 10^{-12} \text{ M}$
- b) $[OH^-] = 1 \times 10^{-2} \text{ M}$
- c) $[OH^-] = 12 \text{ M}$
- d) $[H_3O^+] = 1 \times 10^{-2} \text{ M}$

193. What is the characteristic of 0.01 M hydrocyanic acid (HCN)? (2013 Final Exam)

- a) Strong electrolyte and concentrated
- b) Weak electrolyte and dilute
- c) Weak electrolyte and concentrated
- d) Strong electrolyte and dilute

194. What factor affects the value of the ion product of water, K_w ? (2013 Final Exam)

- a) Pressure
- b) $[OH^-]$ concentration
- c) $[H^+]$ concentration
- d) Temperature

195. Which of the following pairs is a conjugate acid-base pair? (2013 Training Exam)

- a) HCl/ Cl^-
- b) OH^-/H^+
- c) NH_4^+/NH_2^-
- d) SO_4^{2-}/H_2SO_4

196. Which substance does NOT produce acid rain? (2013 Training Exam)

- a) NO
- b) NO₂
- c) O₂
- d) CO₂

197. What type of solution has a pH < pOH? (2013 Training Exam)

- a) Acidic
- b) Neutral
- c) Basic
- d) Amphoteric

198. What happens when the temperature of water increases? (2013 Training Exam)

- a) pH remains constant
- b) [H₃O⁺] decreases
- c) pOH remains constant
- d) K_w increases

199. Which of the following acids is NOT an oxyacid? (2012 Final Exam)

- a) Perbromic acid
- b) Nitric acid
- c) Hydrocyanic acid
- d) Hypochlorous acid

200. Which of the following acids is diprotic? (2012 Final Exam)

- a) Acetic acid
- b) Hydrochloric acid
- c) Carbonic acid
- d) Phosphoric acid

201. Which of the following dissolves in water present in the air to produce acidic solutions? (2012 Final Exam)

- a) NO
- b) NO₂
- c) O₂
- d) SO₂

202. When is a solution neutral? (2012 Final Exam)

- a) When it does not contain H_3O^+ ions.
- b) When it does not contain water molecules that have ionized.
- c) When the concentration of OH^- and H_3O^+ ions are equal.
- d) When it does not contain OH^- and H_3O^+ ions.

203. What is the expected pH value for carbonated beverages? (2012 Final Exam)

- a) 13
- b) 9
- c) 7
- d) 6

204. What is the name given to the pH range over which an indicator changes colour?

- a) Endpoint
- b) Colour range
- c) Equivalence point
- d) Transition range

205. What gas is produced when sulfuric acid reacts with barium metal? (2012 Postponed Exam)

- a) SO_2
- b) SO_3
- c) H_2S
- d) H_2

206. What is the expected pH value for soap products? (2012 Postponed Exam)

- a) 2
- b) 4
- c) 7
- d) 10

207. Water is basic when: (2012 Postponed Exam)

- a) $[\text{H}_3\text{O}^+] > [\text{OH}^-]$
- b) $[\text{H}_3\text{O}^+] < [\text{OH}^-]$
- c) $[\text{H}_3\text{O}^+][\text{OH}^-] < 1 \times 10^{-14}$
- d) $[\text{H}_3\text{O}^+][\text{OH}^-]$

208. What is the criterion for classifying indicators? (2012 Postponed Exam)

- a) Their resulting colors
- b) Their molar masses
- c) Their starting materials
- d) Their transition range

209. What is the conjugate base of HPO_4^{2-} ? (2012 Postponed Exam)

- a) H_3PO_4
- b) H_2PO_4^-
- c) PO_4^{3-}
- d) H_2O

210. Which of the following is a strong base? (2012 Training Exam)

- a) Ammonia
- b) Aniline
- c) Codeine
- d) Sodium hydroxide

211. Which of the following statements agrees with the Brønsted-Lowry acid concept?

- a) Electron pair acceptor
- b) Electron pair donor
- c) Proton donor
- d) Proton acceptor

212. Which of the following is an amphoteric substance? (2012 Training Exam)

- a) H_2O
- b) H_3O^+
- c) H^+
- d) O_2^-

213. What is the expected pH for compounds used as antacids? (2012 Training Exam)

- a) 2
- b) 4
- c) 6
- d) 8

214. Dyes with pH-sensitive colours are used as: (2012 Training Exam)

- a) Solvents
- b) Standard solutions
- c) Indicators
- d) Primary standard materials

215. The pH scale ranges between: (2012 Training Exam)

- a) 1 - 14
- b) 0 - 7
- c) 7 - 14
- d) 0 - 14

216. What is the value of the ion product constant of water (K_w) at 25°C ? (2011 Training Exam)

- a) 0
- b) 10^{-14}
- c) 10^7
- d) 55.4

217. Which component of an aqueous solution of acetic acid has the highest concentration? (2011 Training Exam)

- a) H^+
- b) CH_3COOH
- c) H_3O^+
- d) CH_3COO^-

218. Which element reacts with HCl to produce H_2 gas? (2011 Training Exam)

- a) Copper
- b) Zinc
- c) Silver
- d) Gold

219. Which of the following is classified as a monoprotic acid? (2011 Training Exam)

- a) H_2S
- b) HCOOH
- c) H_2SO_4
- d) H_2CO_4

220. Which of the following is NOT a condition for acid rain formation? (2011 Training Exam)

- a) Acidic oxides
- b) Water vapor
- c) Industrial activity
- d) Marble buildings

221. Which of the following values represents an acidic solution? (2011 Training Exam)

- a) $\text{pOH} = 10$
- b) $[\text{H}_3\text{O}^+] = 10^{-10} \text{ M}$
- c) $\text{pH} = 10$
- d) $[\text{OH}^-] = 10^{-5} \text{ M}$

222. When a sample of distilled water is heated, which of the following relationships is correct? (2011 Training Exam)

- a) $[\text{H}_3\text{O}^+] > [\text{OH}^-]$
- b) $[\text{H}_3\text{O}^+] = [\text{OH}^-]$
- c) $K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$
- d) $[\text{H}_3\text{O}^+] < [\text{OH}^-]$

223. Which of the following is NOT a property of indicators? (2011 Training Exam)

- a) Weak bases
- b) Strong acids
- c) Their colours change with pH of the solution
- d) Weak electrolytes

224. Which of the following substances represents a strong electrolyte? (2011 Final Exam)

- a) Acetic acid
- b) Hydrochloric acid
- c) Ammonium hydroxide
- d) Sugar

225. Which compound has a soapy feel? (2011 Final Exam)

- a) HCOOH
- b) NaCl
- c) - (missing option)
- d) CaCO_3

226. Which of the following represents Lewis bases? (2011 Final Exam)

- a) NH_3
- b) Ag^+
- c) AlCl_3
- d) Cu^{2+}

227. Which of the following oxides does NOT cause acid rain? (2011 Final Exam)

- a) CaO
- b) NO_2
- c) SO_2
- d) SO_3

228. What factor affects the value of K_w for water? (2011 Final Exam)

- a) Dissolving a salt
- b) Change in $[\text{OH}^-]$
- c) Change in temperature
- d) Presence of a strong acid

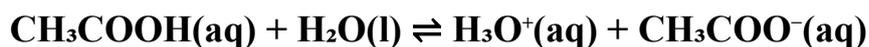
229. Which of the following values represents a basic solution? (2011 Final Exam)

- a) $\text{pH} = 5$
- b) $[\text{H}_3\text{O}^+] = 10^{-8} \text{ M}$
- c) $\text{pOH} = 12$
- d) $[\text{OH}^-] = 10^{-8} \text{ M}$

230. What is the name of the process that measures the amount of a solution of known concentration required to react with a specific amount of a solution of unknown concentration? (2011 Final Exam)

- a) Self-ionization
- b) Neutralization
- c) Titration
- d) Electrolysis

231. What is the relationship between K_{eq} and K_a in the equilibrium: (2011 Final Exam)



- a) $K_a = [\text{H}_3\text{O}^+]/K_{eq}$
- b) $K_a = K_{eq}[\text{H}_2\text{O}]$
- c) $K_{eq} = K_a[\text{H}_3\text{O}^+]$
- d) $K_{eq} = K_a$

232. Which of the following formulas represents an acid that contains only one ionizable hydrogen atom? (2010 Final Exam)

- a) KOH
- b) H_2SO_4
- c) CH_3COOH
- d) H_3PO_4

233. In the equation $\text{HIn} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{In}^-$, the presence of the indicator in an acidic medium leads to: (2010 Final Exam)

- a) Appearance of the color of HIn
- b) Appearance of the color of the In^- ion
- c) Increase in the rate of the forward reaction
- d) Decrease in pH

234. All of the following substances are amphoteric EXCEPT: (2010 Final Exam)

- a) HPO_4^{2-}
- b) H_3O^+
- c) H_2O
- d) OH^-

235. In the reaction $\text{Ag}^+ + 2\text{NH}_3 \rightarrow [\text{Ag}(\text{NH}_3)_2]^+$, Ag^+ is considered: (2010 Final Exam)

- a) Lewis acid
- b) Brønsted-Lowry acid
- c) Lewis base
- d) Brønsted-Lowry base

236. The acid whose aqueous solution contains both its molecules and ions is:

- a) HF
- b) HBr
- c) HI
- d) HCl

237. What is the hydronium ion concentration (M) in a solution with a pOH of 12.40?

- a) 2.5×10^{-2}
- b) 9.8×10^{-2}
- c) 4.4×10^{-2}
- d) 1.0×10^{-1}

238. The conjugate base of OH^- is: (2010 Postponed Exam)

- a) H_2O
- b) H_3O^+
- c) O^{2-}
- d) O_2

239. A substance that can be a weak acid, a strong base, and an amphoteric substance is: (2010 Postponed Exam)

- a) NO^-
- b) HSO_3^-
- c) HS^-
- d) HF

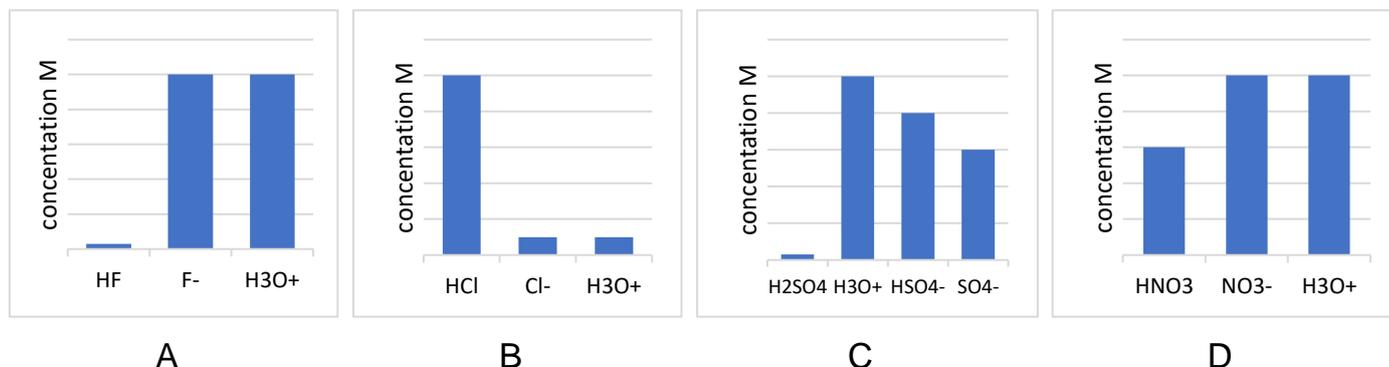
240. What is the pH of a 1×10^{-2} M HNO_3 solution? (2010 Postponed Exam)

- a) 1
- b) 2
- c) 5
- d) 1.3

241. At the equivalence point in the titration of a strong acid with a weak base, the expected pH value is: (2010 Postponed Exam)

- a) 1
- b) 5
- c) 7
- d) 9

242. Consider the following diagrams, which represent the relationship between the molar concentrations of the components of aqueous solutions of a group of acids. Which of the following shapes is correct to represent the aqueous solution of the acid? (2010 Training Exam)



243. The 0.10 M aqueous solution of sulfuric acid contains: (2009 Training Exam)

- H₃O⁺ and HSO₄⁻ only
- H₃O⁺ only
- H₂O, SO₄²⁻, and HSO₄⁻
- H₂O only

244. A 0.10 M aqueous solution of acetic acid (CH₃COOH) contains: (2009 Training Exam)

- CH₃COO⁻ and H₃O⁺ only
- CH₃COOH only
- CH₃COOH, H₃O⁺, and CH₃COO⁻
- H₃O⁺ only

245. Which of the following solutions contains the highest concentration of hydronium ions (H₃O⁺)? (2009 Training Exam)

- 0.10 M HI
- 0.10 M HF
- 0.10 M CH₃COOH
- 0.10 M NaCl

246. Many organic compounds containing nitrogen, like aniline, are considered:

- Weak acids
- Strong acids
- Weak bases
- Strong bases

247. In the reaction $\text{Ni}^{2+} + n\text{H}_2\text{O} \rightarrow [\text{Ni}(\text{H}_2\text{O})_n]^{2+}$, H_2O is considered: (2009 Training Exam)

- a) Brønsted-Lowry acid
- b) Brønsted-Lowry base
- c) Lewis acid
- d) Lewis base

248. The concentration of hydronium ions (H_3O^+) in pure water at 50°C ($K_w=5.3 \times 10^{-14}$) is: (2009 Training Exam)

- a) $5.3 \times 10^{-14} \text{ M H}_3\text{O}^+$
- b) $5.3 \times 10^{-7} \text{ M H}_3\text{O}^+$
- c) $2.3 \times 10^{-7} \text{ M H}_3\text{O}^+$
- d) $1.0 \times 10^{-7} \text{ M H}_3\text{O}^+$

249. Which of the following is a triprotic acid? (2009 Training Exam)

- a) H_3PO_4
- b) CH_3COOH
- c) HNO_3
- d) H_2SO_4

250. Which of the following is an amphoteric substance? (2009 Training Exam)

- a) H_3PO_4
- b) H_3O^+
- c) HPO_4^{2-}
- d) PO_4^{3-}

251. If a drop of phenolphthalein indicator is added to 25 mL of 0.1 M HCl solution, and then 24.9 mL of 0.1 M NaOH is added, what will happen to the colour of the indicator? (2009 Training Exam)

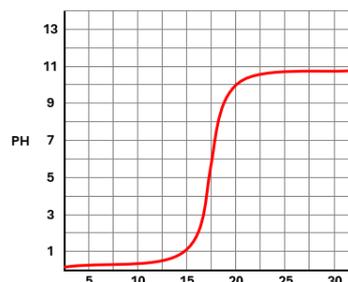
- a) Change from pink to colorless.
- b) Change from colorless to pink.
- c) Change from red to light pink.
- d) No change.

252. When equal volumes of 0.1 M phosphoric acid (H_3PO_4) and 0.1 M NaOH are mixed, the products are: (2009 Training Exam)

- a) $\text{Na}_3\text{PO}_4 + \text{H}_2\text{O}$
- b) $\text{Na}_3\text{PO}_4 + \text{NaH}_2\text{PO}_4$
- c) $\text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$
- d) $\text{Na}_2\text{HPO}_4 + \text{H}_2\text{O}$

253. The adjacent diagram shows an example of a titration of: (2009 Training Exam)

- a) Strong acid with strong base
- b) Strong acid with weak base
- c) Weak acid with weak base
- d) Weak acid with strong base



254. Which of the following is a Lewis acid but NOT a Brønsted-Lowry acid? (2009 Training Exam)

- a) HCl
- b) NH_3
- c) F^-
- d) H^+

255. A weak base is characterized by its tendency to: (2009 Training Exam 2)

- a) Strongly attract protons
- b) Weakly attract protons
- c) Strongly donate protons
- d) Weakly donate protons

256. It is known that at 25°C , $[\text{H}_3\text{O}^+] = [\text{OH}^-]$ in pure water. If the temperature of water is raised to 100°C , then: (2009 Training Exam 2)

	$[\text{H}_3\text{O}^+]$	$[\text{OH}^-]$	K_w
A	Decreases	Decreases	Decreases
B	Decreases	Decreases	Increases
C	Increases	Increases	Remains constant
D	Increases	Increases	Increases

257. A solution of 12 M hydrofluoric acid (HF) is: (2009 Training Exam)

- a) Strong electrolyte and concentrated
- b) Weak electrolyte and concentrated
- c) Weak electrolyte and dilute
- d) Strong electrolyte and dilute

258. A basic solution is one in which: (2009 Training Exam 3)

- a) $\text{pH} = 3$
- b) $[\text{OH}^-] = 10^{-8} \text{ M}$
- c) $[\text{H}_3\text{O}^+] = 10^{-4} \text{ M}$
- d) $[\text{OH}^-] = 10^{-4} \text{ M}$

259. Acid-base titrations determine the volumes of solutions that are: (2009 Training Exam 3)

- a) Equimolal
- b) Equimolar
- c) Equal masses
- d) Chemically equivalent

260. A carbonated beverage has a pH of 3.65. The hydronium ion concentration is:

- a) $2.2 \times 10^{-4} \text{ M}$
- b) $5.6 \times 10^{-1} \text{ M}$
- c) $2.2 \times 10^{10} \text{ M}$
- d) $5 \times 10^{-11} \text{ M}$

261. The pH of a household cleaner with $[\text{OH}^-] = 1.2 \times 10^{-2} \text{ M}$ is: (2009 Training Exam 3)

- a) 12.08
- b) 7.00
- c) 3.84
- d) 1.92

262. Which of the following is NOT a hydrated proton? (2009 Training Exam 4)

- a) H_3O^+
- b) H_7O_3^+
- c) H_9O_4^+
- d) H_2O

263. The reaction of an acid with a carbonate does NOT produce: (2009 Training Exam 4)

- a) Carbon dioxide
- b) Water
- c) Salt
- d) Oxygen

264. A conjugate acid-base pair differs by: (2009 Training Exam 4)

- a) Hydroxide ion
- b) Hydronium ion
- c) Water molecule
- d) Proton

265. The reaction $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{Cl}^-$ is a: (2009 Training Exam 4)

- a) Arrhenius acid-base reaction
- b) Brønsted-Lowry acid-base reaction
- c) Single replacement reaction
- d) Precipitation reaction

266. In aqueous solutions of HCl, H^+ ions are: (2009 Training Exam 4)

- a) Not present
- b) Present in small amounts
- c) Present in moderate amounts
- d) Present in large amounts

267. The pH of a 10^{-5} M KOH solution is: (2009 Training Exam 4)

- a) 3
- b) 9
- c) 5
- d) 11

268. When equivalent amounts of HCl acid are added to NaOH base, all acidic and basic properties disappear EXCEPT: (2009 Final Exam)

- a) Acidic taste
- b) Reaction with zinc
- c) Electrical conductivity
- d) Change in indicator color

269. Which of the following pairs is considered a conjugate pair according to the Brønsted-Lowry theory? (2009 Final Exam)

- a) $\text{HCl}/\text{H}_3\text{O}^+$
- b) $\text{NH}_4^+/\text{NH}_3$
- c) $\text{Na}_2\text{O}/\text{NaOH}$
- d) $\text{H}_3\text{O}^+/\text{NH}_3$

270. In basic solutions at 25°C : (2009 Final Exam)

- a) $K_w < [\text{H}_3\text{O}^+][\text{OH}^-]$
- b) $[\text{H}_3\text{O}^+] = [\text{OH}^-]$
- c) $K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$
- d) $K_w > [\text{H}_3\text{O}^+][\text{OH}^-]$

271. An aqueous solution of barium hydroxide ($\text{Ba}(\text{OH})_2$) has a pH of 10. What is the base concentration (M) in it? (2009 Final Exam)

- a) 1×10^{-4}
- b) 5×10^{-5}
- c) 1×10^{-10}
- d) 5×10^{-11}

272. Which of the following solutions with equal concentrations (M) has the lowest pH value? (2009 Final Exam)

- a) HCl
- b) H_2SO_4
- c) HF
- d) CH_3COOH

273. The following table contains the ionization constant (K_a) for some acids. When arranging the conjugate bases of these acids in ascending order of strength (from right to left), the correct arrangement is: (2009 Final Exam)

- a) ClO_2 , CN^- , HPO_4^{2-} , ClO^-
- b) ClO^- , CN^- , HPO_4^{2-} , ClO_2^-
- c) ClO_2 , HPO_4^{2-} , ClO^- , CN^-
- d) ClO^- , HPO_4^{2-} , ClO_2 , CN^-

Acid	K_a
HClO	3.5×10^{-8}
HClO_2	1.2×10^{-2}
HCN	4.9×10^{-10}
H_2PO_4^-	6.2×10^{-8}

274. Which of the following is a hydrated proton? (2008 Final Exam)

- a) Hydrogen ion
- b) Hydronium ion
- c) Hydrogen chloride molecule
- d) Water molecule

275. Proton transfer reactions favour the production of: (2008 Final Exam)

- a) Stronger acid and weaker base
- b) Stronger acid and stronger base
- c) Weaker acid and stronger base
- d) Weaker acid and weaker base

276. Which of the following is the formula for chlorous acid? (2008 Final Exam)

- a) HClO
- b) HClO₂
- c) HClO₃
- d) HClO₄

277. Dyes with pH-sensitive colours are used as: (2008 Final Exam)

- a) Lewis acids
- b) Standard solutions
- c) Indicators
- d) Primary standard materials

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