NUNAVUT CHEMISTRY 30 · UNIT D · 25 QUESTIONS

Equilibrium, Acids & Bases — Practice Test

This practice test was made by AI and there may be mistakes. If a question or answer looks wrong, use the Flag a mistake button to let Brett know so he can fix it.

1 **The equilibrium law expression for the reaction $2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$ is**

A $\dfrac{[SO_2]^2[O_2]}{[SO_3]^2}$

B $\dfrac{[SO_3]^2}{[SO_2]^2[O_2]}$

C $\dfrac{[SO_3]}{[SO_2][O_2]}$

D $\dfrac{[SO_3]^2}{[SO_2][O_2]}$

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2 **The synthesis of methanol is represented by the equation**

$CO(g) + 2\ H_2(g) \rightleftharpoons CH_3OH(g) + heat$

Which of the following changes will increase the amount of $CH_3OH(g)$ at equilibrium?

- A Increasing the temperature
- B Adding a catalyst
- C Increasing the pressure
- D Increasing the volume of the container

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3 **Use the following equation to answer this question.**

$NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

In this equation, the species that acts as a Brønsted-Lowry base is

- A $NH_3(aq)$
- B $H_2O(l)$
- C $NH_4^+(aq)$
- D $OH^-(aq)$

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4 **Which of the following pairs of species is a conjugate acid-base pair?**

- **A** $HNO_3(aq)$ and $NO_2^-(aq)$
- **B** $H_2SO_4(aq)$ and $SO_4^{2-}(aq)$
- **C** $NH_4^+(aq)$ and $NH_2^-(aq)$
- **D** $HF(aq)$ and $F^-(aq)$

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5 **A solution has a hydronium ion concentration of 1.0×10^{-4} mol/L. The pH of the solution is**

- **A** -4.0
- **B** 4.0
- **C** 10.0
- **D** 1.0×10^{-10}

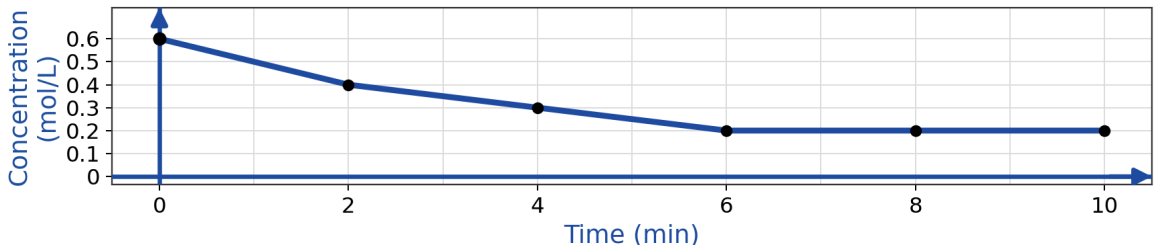
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6

Consider the following equilibrium system.

$N_2O_4(g) \rightleftharpoons 2\ NO_2(g)$

The graph shows the concentration of $N_2O_4(g)$ over time. The equilibrium concentration of $N_2O_4(g)$, in mol/L, is ____.



ANSWER

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7

A system is at equilibrium. Which of the following changes will change the value of the equilibrium constant, Kc, for the system?

A Adding a catalyst

B Increasing the concentration of a reactant

C Increasing the temperature

D Decreasing the volume of the container

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8 **Which of the following species is amphiprotic?**

A $HCO_3^-(aq)$

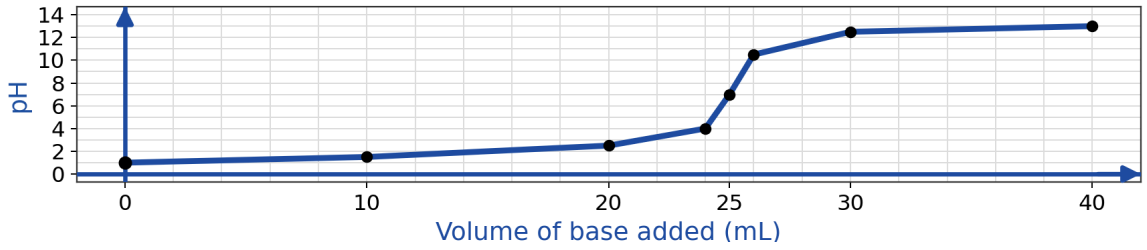
B $CO_3^{2-}(aq)$

C $NH_4^+(aq)$

D $CH_3COOH(aq)$

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9 **The graph shows the pH during the titration of a strong acid with a strong base. The volume of base added at the equivalence point, in millilitres, is**



A 20 mL

B 24 mL

C 25 mL

D 26 mL

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10 **Which of the following pairs of solutions, when mixed together, will form a buffer solution?**

A HCl(aq) and NaCl(aq)

B HNO_3(aq) and KNO_3(aq)

C NaOH(aq) and NaCl(aq)

D CH_3COOH(aq) and $NaCH_3COO$(aq)

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11 **Ethanoic acid, CH_3COOH(aq), has a K_a value of 1.8×10^{-5}. The pH of a 0.10 mol/L CH_3COOH(aq) solution, to the nearest hundredth, is**

ANSWER _____

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12 **Consider the following equilibrium system.**

$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g) + heat$

If the temperature of the system is increased, then the equilibrium position i and the value of Kc ii.

A i: shifts toward the products ii: increases

B i: shifts toward the reactants ii: decreases

C i: shifts toward the reactants ii: increases

D i: shifts toward the products ii: decreases

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13 **Two weak acids, HX(aq) and HY(aq), have K_a values of 2.0×10^{-4} and 5.0×10^{-6}, respectively. Which of the following statements is correct?**

A HY(aq) is a stronger acid than HX(aq)

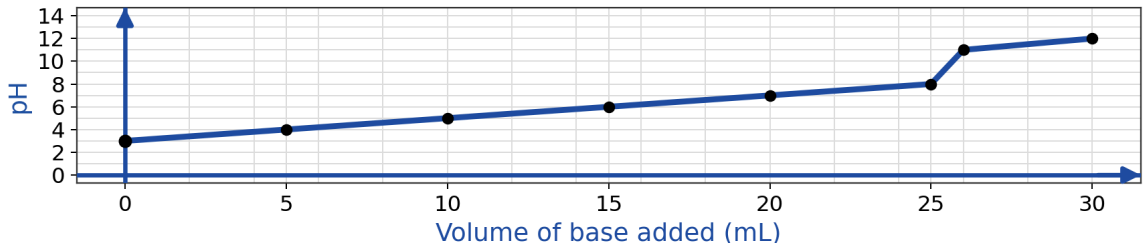
B A 0.10 mol/L solution of HX(aq) has a higher pH than a 0.10 mol/L solution of HY(aq)

C $X^-(aq)$ is a stronger base than $Y^-(aq)$

D $X^-(aq)$ is a weaker base than $Y^-(aq)$

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14 **The graph shows the pH during the titration of a weak acid with sodium hydroxide solution. The pH at the equivalence point is**



- **A** 5.0
- **B** 7.0
- **C** 8.0
- **D** 11.0

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15 **Consider the following equilibrium system.**
$H_2(g) + I_2(g) \rightleftharpoons 2\,HI(g)$
A mixture initially contains 0.50 mol/L $H_2(g)$ and 0.50 mol/L $I_2(g)$. At equilibrium, [HI] = 0.80 mol/L. The value of Kc is

ANSWER _____

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16 **Indicator data:**

methyl orange changes colour over the pH range 3.1 to 4.4

methyl red, 4.4 to 6.2

bromothymol blue, 6.0 to 7.6

phenolphthalein, 8.2 to 10.0

A strong acid is titrated with a strong base, and the pH at the equivalence point is 7.0.

The most suitable indicator for this titration is

A methyl orange

B phenolphthalein

C bromothymol blue

D methyl red

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17 The K_a value of $NH_4^+(aq)$ is 5.6×10^{-10}, and Kw = 1.0×10^{-14}. The Kb value of $NH_3(aq)$ is

A 5.6×10^{-10}

B 1.8×10^{-5}

C 1.8×10^{-9}

D 5.6×10^{-4}

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18 Consider the following equilibrium system.

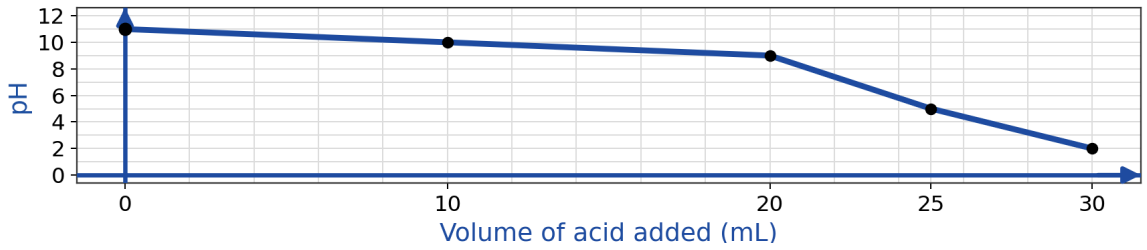
$2\ NH_3(g) \rightleftharpoons N_2(g) + 3\ H_2(g)$

A sample initially contains only $NH_3(g)$, at a concentration of 1.00 mol/L. At equilibrium, $[NH_3]$ = 0.60 mol/L. The value of Kc, to two decimal places, is

ANSWER _____

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19 **The graph shows the pH during the titration of a weak base with a strong acid. The pH at the equivalence point is**



- **A** 9.0
- **B** 5.0
- **C** 2.0
- **D** 11.0

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20 **When the pH of a solution increases from 3.0 to 6.0, the hydronium ion concentration decreases by a factor of**

- **A** 1000
- **B** 3
- **C** 100
- **D** 2

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21 **Acid ionization constants:**

K_a of HF(aq) = 3.5×10^{-4}

K_a of CH_3COOH(aq) = 1.8×10^{-5}

K_a of HCN(aq) = 6.2×10^{-10}

HCl(aq) ionizes completely.

Which of the following 0.10 mol/L solutions has the lowest pH?

A HCN(aq)

B CH_3COOH(aq)

C HCl(aq)

D HF(aq)

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22 **Ammonia, NH_3(aq), has a Kb value of 1.8×10^{-5}. The pH of a 0.050 mol/L NH_3(aq) solution, to the nearest hundredth, is**

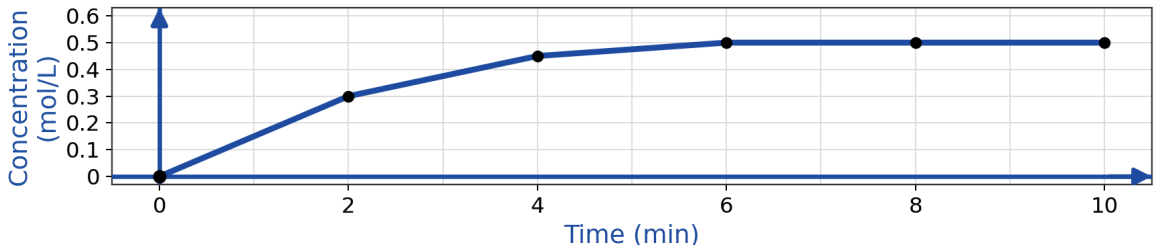
ANSWER _____

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23 **Consider the following equilibrium system.**

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

The graph shows the concentration of $Cl_2(g)$ over time. The time at which equilibrium is first reached, in minutes, is



A 2 min

B 4 min

C 6 min

D 8 min

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24 **Consider the following equation.**

$H_2PO_4^-(aq) + CO_3^{2-}(aq) \rightleftharpoons HPO_4^{2-}(aq) + HCO_3^-(aq)$

In this equation, $H_2PO_4^-(aq)$ acts as an i, and $HPO_4^{2-}(aq)$ is the conjugate ii of $H_2PO_4^-(aq)$.

A i: acid ii: acid

B i: base ii: base

C i: base ii: acid

D i: acid ii: base

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25 **A student dissolves 0.0020 mol of HNO_3 in water to make 500 mL of solution. The pH of the solution, to the nearest hundredth, is**

ANSWER _____

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ANSWER KEY

1. B
2. C
3. A
4. D
5. B
6. 0.2
7. C
8. A
9. C
10. D
11. 2.88
12. B
13. D
14. C
15. 64
16. C
17. B
18. 0.12
19. B
20. A
21. C
22. 10.97
23. C
24. D
25. 2.4

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