pH and pOH Calculations



- 1. Find the pH of the following solutions. Make sure you express your answer in the correct number of significant digits. (12 marks)
 - a) 0.0010 M HClO₄ 3,000 b) 2.35 x 10⁻³ M KOH ... 11,371

 - e) 0.20 M Ba(OH)₂ 13,60 f) 4.30 M H₃O⁺ -0,633
- 2. Find the $[H_3O^+]$ in 0.00256 M HBr. (1 mark)

- Answer _ 0.00256 M
- 3. Find the $[H_3O^{\dagger}]$ in 0.80 M LiOH. (2 marks)

$$[H_30^+] = \frac{1.00 \times 10^{-14}}{0.80} = 1.3 \times 10^{-14}$$
Answer 1.3 × 10 M

4. Find the $[H_3O^+]$ in a solution with a pH = 3.216 (1 mark)

- Answer 6.08 x 10 M
- 5. Find the $[H_3O^+]$ in 0.45 M BaO (2 marks)

$$0^{2} + H_{2}0 \rightarrow 90H^{-}$$

 $(0^{2}) = 0.45M$ [$H_{3}0^{\dagger}$] = 1.00×10^{-14}
 $(0HJ = 0.90M$ Answer $1.01 \times 10^{-14} M$

6. Find the [OH] in 0.150 M HClO₄ (2 marks)

$$[H_3O^{\dagger}] = 0.150 \text{ M}$$

$$[OH^{-}] = 1.00 \times 10^{-14}$$
7. Find the [OH] in a solution with a pH = 8.940 (2 marks)

- Answer 6- 67×10 14 M

Answer 8.71 x 10 6M

8. Find the [OH] in a solution with a pOH = 2.156 (1 mark)

Answer 6.98 110 M

9. Find the [OH] in 0.87 M HNO₃. (2 marks)

Answer 101×10 M

10. Find the $[H_3O^+]$ in a solution in which the pOH = 4.50. (2 marks)

Answer 3-2 X 10 M

- 11. Solution A has a pH of 3.0 while solution B has a pH of 7.0.
 - a) Which solution is more acidic? (1 mark)
 - b) The [H₃O⁺] in solution A is ______times as high as it is in solution B (1 mark).

12. How much water should be added to 500.0 mL of a solution of HCl with a pH of 2.00 to

$$V_1C_1 = V_2C_2$$

$$C_1 = 10^{-2.00} = 0.010 \text{M}$$

$$C_2 = 10^{-2.50} = 0.00316 \text{ M}$$

 $V_1C_1 = V_2C_2$ $C_1 = 10^{-2.00} = 0.010M$ $V_2 = V_1XC_1 = 0.5000 \times 0.010$ $V_3 = 10^{-2.00} = 0.00316M$ $V_4 = 10^{-2.00} = 0.00316M$ $V_5 = 10^{-2.00} = 0.00316M$ $V_6 = 10^{-2.00} = 0.00316M$ $V_7 = 10^{-2.00} = 0.00316M$ $V_8 = 10^{-2.00} = 0.00316M$ $V_9 = 10^{-2.00} = 0.00316M$

13. What mass of NaOH should be added to 300.0 mL of water in order to prepare a solution

with a pH = 11.50. Show all your work. (4 marks)

$$PH = 11.50$$
 $POH = 2.50$
 $POH = 3.50$
 $POH = 3.50$
 $POH = 3.600L = 9.4868 \times 10^{-4}$
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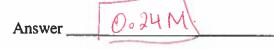
mass NaOH = 9. 4868 × 10-4mol × 40.0 g/mol Answer $\frac{3.8 \times 10^{-2}}{9}$ **Bronsted Acid-Bases and Equilibria**



1. What is the [OH] in a solution made by adding 0.060 moles of calcium oxide to 500.0 mL water? Be careful! (2 marks)

M[(a0] = 0.060 mol = 0.12 M

 $0^{2} + H_2 0 \rightarrow 20H^-$ Answer 0.24MCaO -> Caz+ D2-



What is the [H₃O⁺] in a solution made by adding 0.020 moles of nitric acid to 2. 500.0 mL of water? (2 marks)

[HNO3] = 0.020mol = 0.040M.

Answer 0.040 M.

3. If 0.10 M HSO₃ is mixed with 0.10 M HC₂O₄, which species will donate a proton? (1 mark) Answer HaCaQy

If 0.10 M HSO₄ is mixed with 0.10 M HC₆H₅O₇², which species will **donate** a proton? 4. (1 mark)

- Answer H SQ4
- If 0.10 M HSO₃ is mixed with 0.10 M HC₆H₅O₇², which species will *donate* a proton? 5. (1 mark) Answer HC6H5 07 2
- 6. If 0.10 M HCO₃ is mixed with 0.10 M HC₂O₄, which species will accept a proton? (1 mark) Answer HCO3
- 7. If 0.10 M HS is mixed with 0.10 M NO₂, which species will accept a proton? (1 mark) Answer NO2

If 0.10 M H₂SO₄ is mixed with 0.10 M HPO₄², which species will *accept* a proton?

- 8. Answer HPQ4 2-(1 mark)
- a) Write the balanced equation which describes the equilibrium present when 9. 0.1 M H₂SO₃ is mixed with 0.1 M NO₂. (1 mark)

	b) For this reaction, equilibrium tends to favour the (reactants/products) (1 mark)		
	Answer products		
	c) For this reaction the value of Keq is (<1, >1 or about =1) (1 mark)		
a) Write the balanced equation which describes the equilibrium present when 0.1 M HSO ₃ is mixed with 0.1 M HC ₂ O ₄ . (1 mark)			
	HSO3+ HC204 = H2SO3 + C204 SA		
	b) For this reaction, equilibrium tends to favour the (reactants/products) (1 mark)		
	Answer Reactants		
	c) For this reaction the value of Keq is (<1, >1 or about =1) (1 mark)		
11.	 a) Write the balanced equation which describes the equilibrium present when 0.1 M HPO₄²⁻ is mixed with 0.1 M H₂C₆H₅O₇. (1 mark) 		
	H2C6H5O7 + HPO42 = H2PO4 + HC6H5O72		
	b) For this reaction, equilibrium tends to favour the (reactants/products) (1 mark)		
	Answer products		
	c) For this reaction the value of Keq is (<1, >1 or about =1) (1 mark)		
12.	The Keq for the reaction: $HA_2B + CD \rightleftharpoons HCD + A_2B$ is 0.0020 (small)		
	a) Which is the stronger conjugate acid in the above equilibrium?(1 mark)		
	b) Which is the stronger conjugate base in the above equilibrium?(1 mark)		
13.	The Keq for the reaction: $H_2X + YZ \neq HYZ + HX$ is 3.4×10^5 (large) a) Which is the stronger conjugate acid in the above equilibrium? (1 mark)		
	a) Which is the stronger conjugate acid in the above equilibrium?(1 mark)		
	b) Which is the stronger conjugate base in the above equilibrium?(1 mark)		
14.	Equilibrium always favours the (stronger/weaker) weaker acid (1 mark)		
15.	Equilibrium always favours the (stronger/weaker)base (1 mark)		

Chem 12

ABS part 1 - REVIEW QUESTIONS (Units 4 pt 1)



1.	1. Rank the following substances in the order of decreasing electr	ical conductivity (i.e.
	brightest light bulb to dimmest light bulb). Justify your answe	·sl

1.0 M cc14 molecular	1.0M H+/CI	1.0 M CHSCOOK molecular
1.0 M CCl ₄	1.0 M HCl	1.0 M CH₃COOH
1.5 M NaCl	2.0 M NaOH	0.5 M HCN
1.5M Na+/CI-	2.0 M Na+/OH-	0.5M HT/CN-
Greatest conductivity \rightarrow	2.0 M NaOH	why? highest [] of Not/OH"
	1.5 M Nacl	why? higher [] of Nat/(1- aissociation
	1.0M HCI	why? higher [] of HT/CI)
	D. SM HCN	why? low [] < 100% dissociation, WA
	1.0M CH3COOH	why? hardly dissociates but WA
Lowest conductivity \rightarrow	1.0M CCIY	why? molecular no dissociation

2. Define the terms *strong acid* and *weak acid*. Using hydrobromic and hydrofluoric acid as examples, write equations to show the dissociation of each acid in aqueous solution.

Ex: HBr -> H+ + F- / HF+ H20 = H30+ + F-

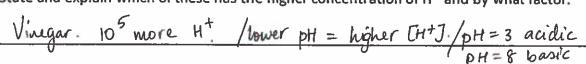
Identify one example of a strong base and one example of a weak base. Outline three
different methods to distinguish between equimolar solutions of these bases in the
laboratory. State how the results would differ for each base.

i) pH meter

ii) conductivity

iii) neutralization/fitration?

4. Vinegar has a pH of approximately 3 and some detergents have a pH of approximately 8. State and explain which of these has the higher concentration of H⁺ and by what factor.



- 5. Calculate the pH of 0.125 M HClO₄. $pH = -\log(0.125) = 0.903$
- 6. The value of the ionic product constant of water, K_W , at 60°C is 5.60×10^{-14} .
 - (a) State the expression for $K_W = [3+30+][OH-]$
 - (b) Calculate the values of [H⁺] and pH in water at 60°C.

40.0 mL of 0.250 M Sr(OH)2.

[H+]=[OH-]=x.
$$\chi^2 = 5.6 \times 10^{-14}$$

[H+] = $\sqrt{5.6 \times 10^{-14}} = 2.366 \times 10^{-14}$

- (c) The value of $[OH^-]$ in water at 60°C is greater than the value at room temperature. Explain why water is not alkaline at 60°C. $[H^+] = [OH^-] \implies \text{water water newboal}.$
- 7. Calculate the resulting pH and pOH of a mixture between 60.0 mL of 0.150 M HI and

$$2HI + Sr(OH)_2 \rightarrow SrI_2 + 2H_2O$$

$$moles H^+: 0.150 \underbrace{mol}_L \times 0.0600 L = 0.00900 \underbrace{mol}_l$$

$$moles OH^-: 2 \times 0.250 \times 0.0400 L = 0.0200 \underbrace{mol}_l \leftarrow excess.$$

exuss [OH] :
$$\left(\frac{0.0200 \,\text{mol} - 0.00900 \,\text{mol}}{0.0600 \,\text{L} + 0.0400 \,\text{L}}\right) = \frac{0.011 \,\text{mol}}{0.01 \,\text{L}} = 0.11 \,\text{M}.$$

$$-pOH = -log 0.11 = \boxed{0.959}$$
 $\therefore pH = 14 - 0.959 = \boxed{13.041}$