

ACIDS, BASES, SALTS, AND BUFFER SOLUTIONS

SMART WORKSHEET

PART A. MEASURING THE pH OF ACIDS AND BASES

Note: Only digits after the decimal point of a logarithmic value are significant

Table A1: pH data and concentration of hydronium ions and hydroxide ions calculations

Solution	Measured pH	1. Calculated [H ⁺], M		2. Calculated [OH ⁻], M	
		Unrounded	Rounded	Unrounded	Rounded
0.100 M HCl	<div>1.46</div> ✓	<div>0.0346737</div> ✓	<div>0.035</div> ✓	<div>2.884030 ×10⁻¹³</div> ✓	<div>2.9 ×10⁻¹³</div> ✓
0.0100 M HCl	<div>2.39</div> ✓	<div>0.00407380</div> ✓	<div>0.0041</div> ✓	<div>2.45471 ×10⁻¹²</div> ✓	<div>2.5 ×10⁻¹²</div> ✓
0.00100 M HCl	<div>3.04</div> ✓	<div>0.000912011</div> ✓	<div>0.00091</div> ✓	<div>1.09648 ×10⁻¹¹</div> ✓	<div>1.1 ×10⁻¹¹</div> ✓
0.100 M CH ₃ COOH	<div>3.07</div> ✓	<div>0.000851138</div> ✓	<div>0.00085</div> ✓	<div>1.17490 ×10⁻¹¹</div> ✓	<div>1.2 ×10⁻¹¹</div> ✓
0.100 M NaOH	<div>12.81</div> ✓	<div>1.54882 ×10⁻¹³</div> ✓	<div>1.5 ×10⁻¹³</div> ✓	<div>0.0645653</div> ✓	<div>0.065</div> ✓
0.0100 M NaOH	<div>11.85</div> ✓	<div>1.41254 ×10⁻¹²</div> ✓	<div>1.4 ×10⁻¹²</div> ✓	<div>0.00707945</div> ✓	<div>0.0071</div> ✓
0.00100 M NaOH	<div>10.25</div> ✓	<div>5.62341 ×10⁻¹¹</div> ✓	<div>5.6 ×10⁻¹¹</div> ✓	<div>0.000177828</div> ✓	<div>0.00018</div> ✓
0.100 M NH ₄ OH	<div>10.65</div> ✓	<div>2.23872 ×10⁻¹¹</div> ✓	<div>2.2 ×10⁻¹¹</div> ✓	<div>0.000446684</div> ✓	<div>0.00045</div> ✓

YOUR PROGRESS ON MEASURING THE pH OF ACIDS AND BASES SECTION

CORRECT

32 / 32

POINTS AWARDED 160 / 160

AUTOSOLVED

0 / 32

NOT FINISHED

0 / 40

PART B. MEASURING THE pH OF SALT SOLUTIONS

Table B1: Measured pH data and concept questions

Salt	Measured pH	Which of the salt's ions is <i>NOT</i> pH neutral?
Sodium acetate, NaCH ₃ COO	<div>8.15</div> ✓	<div>CH₃CO₂⁻</div> ✓
Sodium carbonate, Na ₂ CO ₃	<div>11.47</div> ✓	<div>CO₃²⁻</div> ✓
Sodium hydrogen sulfate, NaHSO ₄	<div>1.42</div> ✓	<div>HSO₄⁻</div> ○
Sodium hydrogen carbonate, NaHCO ₃	<div>9.69</div> ✓	<div>HCO₃⁻</div> ✓

Ammonium chloride, NH ₄ Cl	<div><div><div><div><div></div></div><div>4.53</div><div>✓</div></div></div><div><div><div></div></div><div>NH₄⁺</div><div><div><div></div></div><div>✓</div></div></div></div>
Aluminum chloride, AlCl ₃	<div><div><div><div><div></div></div><div>2.80</div><div>✓</div></div></div><div><div><div></div></div><div>Al³⁺</div><div><div><div></div></div><div>✓</div></div></div></div>

YOUR PROGRESS ON MEASURING THE pH OF SALT SOLUTIONS SECTION

CORRECT

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POINTS AWARDED18 / 18

AUTOSOLVED

0 / 6

NOT FINISHED

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PART C. INVESTIGATING BUFFER CAPACITY

Table C1: Change in pH of buffer and volume dispensed calculations

	Buffer I (mix 0.100 M Hac with 0.100 M NaAc)	Buffer II (mix 0.200 M Hac with 0.200 M NaAc)
Titrant added to buffer	NaOH ✓	NaOH ✓
Measured initial pH of buffer	4.81 ✓	4.83 ✓
Measured final pH of buffer	5.86 ✓	5.79 ✓
3. Change in pH of buffer	1.05 ✓	0.96 ✓
Quality of data	Well done, pH change is positive 5	Well done, pH change is positive 5
Initial (HCl or NaOH) buret volume, (mL)	17.15 ✓	25.15 ✓
Final (HCl or NaOH) buret volume, (mL)	25.15 ✓	40.52 ✓
4. Volume dispensed from (HCl or NaOH) buret, (mL)	8.00 ✓	15.37 ✓

YOUR PROGRESS ON INVESTIGATING BUFFER CAPACITY SECTION

CORRECT

8 / 8

POINTS AWARDED22 / 22

AUTOSOLVED

0 / 8

NOT FINISHED

0 / 16

PART D. INVESTIGATING PHOSPHATE BUFFERS

Table D1: Desired pH and acid and base chosen

	Value	Units
Desired pH	<div><div><div><div></div></div><div>7.00 - 9.00</div><div>✓</div></div></div>	<div><div><div><div></div></div><div>unitless</div><div><div><div></div></div></div></div></div>
Acid chosen	<div><div><div><div></div></div><div>H₂PO₄⁻</div><div>✓</div></div></div>	
K _a of chosen acid	6.2 ×10 ⁻⁸	
Base chosen	<div><div><div><div></div></div><div>HPO₄²⁻</div><div>✓</div></div></div>	

Table D2: pH of buffer calculation

	Unrounded	Rounded	Units
Volume of acid solution (mL)		<div><div><div><div><div></div></div><div>10.00</div><div>✓</div></div></div></div>	
Volume of base solution (mL)		<div><div><div><div><div></div></div><div>10.00</div><div>✓</div></div></div></div>	

Concentration of acid solution (M)	<div><div></div><div>0.200</div><div>✓</div></div>	
Concentration of base solution (M)	<div><div></div><div>0.200</div><div>✓</div></div>	
Measured pH of buffer	<div><div></div><div>6.95</div><div>✓</div></div>	<div><div></div><div>unitless</div><div>✓</div></div>
5. Calculated pH of buffer	<div><div></div><div>7.20761</div><div>✓</div></div>	<div><div></div><div>7.21</div><div>✓</div></div> <div><div></div><div>unitless</div><div>✓</div></div>

YOUR PROGRESS ON INVESTIGATING PHOSPHATE BUFFERS SECTION

CORRECT

8 / 8

POINTS AWARDED

24 / 24

AUTOSOLVED

0 / 8

NOT FINISHED

0 / 13

POSTLAB QUESTIONS

QUESTION 1

	Unrounded	Rounded
Question 1a: Calculate the pH expected for the 0.0100 M HCl solution used in part A	<div><div></div><div></div><div></div></div>	<div><div></div><div>2.00</div><div>✓</div></div>
Question 1b: Calculate the percent error between the expected pH and the measured pH of 0.0100 M HCl (part A)	<div><div></div><div>19.5000</div><div>✓</div></div>	<div><div></div><div>2.0 × 10¹</div><div>✓</div></div>

QUESTION 2

The acid dissociation constant, K_a is 0.000018

	Unrounded	Rounded
Question 2a: Calculate (approximation method) the pH of 0.100 M acetic acid	<div><div></div><div>2.87236</div><div>✓</div></div>	<div><div></div><div>2.87</div><div>✓</div></div>
Question 2b: Calculate the percent error between the expected pH and the measured pH of 0.100 M acetic acid (part A)	<div><div></div><div>6.88082</div><div>✓</div></div>	<div><div></div><div>6.9</div><div>✓</div></div>

QUESTION 3

	Unrounded	Rounded
Question 3a: Calculate pK_a of $H_2PO_4^-$	<div><div></div><div>7.20761</div><div>✓</div></div>	<div><div></div><div>7.21</div><div>✓</div></div>

YOUR PROGRESS ON THE POSTLAB QUESTIONS SECTION

CORRECT

9 / 9

POINTS AWARDED

26 / 26

AUTOSOLVED

0 / 9

NOT FINISHED

0 / 9

YOUR OVERALL PROGRESS

Visual status toggles for statistics by question type

- ☐ Concept
- ☐ Calculations
- ☐ Rounding
- ☐ Quality of data

