

4. A student is asked to prepare a buffer solution made with equimolar amounts of $\text{CH}_3\text{NH}_2(\text{aq})$ and $\text{CH}_3\text{NH}_3\text{Cl}(\text{s})$. The student uses 25.00 mL of 0.100 M $\text{CH}_3\text{NH}_2(\text{aq})$, which contains 0.00250 mol of CH_3NH_2 , to make the buffer.

a) Calculate the mass of $\text{CH}_3\text{NH}_3\text{Cl}(\text{s})$ that contains 0.00250 mol of $\text{CH}_3\text{NH}_3\text{Cl}$.

$$0.00250 \text{ mol } \text{CH}_3\text{NH}_3\text{Cl} \times \frac{67.529 \text{ g } \text{CH}_3\text{NH}_3\text{Cl}}{1 \text{ mol } \text{CH}_3\text{NH}_3\text{Cl}} = 0.169 \text{ g } \text{CH}_3\text{NH}_3\text{Cl}$$

1 pt

The student has the following materials and equipment available.

- Distilled water
- Electronic balance
- 50 mL beaker
- Pipets
- 0.100 M $\text{CH}_3\text{NH}_2(\text{aq})$
- Weighing paper
- 10.0 mL graduated cylinder
- pH meter
- Solid $\text{CH}_3\text{NH}_3\text{Cl}$
- 50.00 mL buret
- Small spatula

(b) The following table contains a partial procedure for making the buffer solution. Fill in steps 1 and 4 to complete the procedure using only materials and equipment selected from the choices given. (Not all materials listed will be used. Assume that all appropriate safety measures are already in place.)

Step	Procedure
1	PLACE WEIGHING PAPER ON THE BALANCE, RE-ZERO (TARE) THE BALANCE, THEN CAREFULLY USE THE SMALL SPATULA TO DISPENSE PRECISELY 0.169 g $\text{CH}_3\text{NH}_3\text{Cl}$ ONTO THE WEIGHING PAPER.
2	Place the solid in the 50 mL beaker.
3	Clean the buret and rinse with distilled water.
4	RINSE THE BURET WITH A FEW MILLILITERS OF THE CH_3NH_2 SOLUTION, COATING THE INSIDE OF THE BURET WITH THE SOLUTION. THEN, FILL THE BURET MORE THAN HALFWAY WITH THE CH_3NH_2 SOLUTION.
5	Use the buret to add 25.00 mL of 0.100 M $\text{CH}_3\text{NH}_2(\text{aq})$ to the beaker.
6	Mix well.
7	Check the pH with the pH meter.

1 pt

1 pt

The value of K_b for $\text{CH}_3\text{NH}_2(\text{aq})$ is 4.4×10^{-4} , and the pH of the buffer the student prepared is 10.64.

c) The student prepares a second buffer solution. The student uses 25.00 mL of 0.050 M $\text{CH}_3\text{NH}_2(\text{aq})$ instead of 25.00 mL of 0.100 M $\text{CH}_3\text{NH}_2(\text{aq})$, and half the mass of $\text{CH}_3\text{NH}_3\text{Cl}(\text{s})$ that was used in the first buffer. Is the pH of the second buffer greater than, less than, or equal to the pH of the first buffer? Justify your answer.

1 pt
SINCE HALF THE MASS OF $\text{CH}_3\text{NH}_3\text{Cl}$ IS BEING USED FOR THE SAME VOLUME, THE CONCENTRATION OF $\text{CH}_3\text{NH}_3\text{Cl}$ WILL BE HALF WHAT IT WAS IN THE ORIGINAL SOLUTION. SINCE THE PROBLEM STATES THAT THE CONCENTRATION OF CH_3NH_2 IS HALF THE ORIGINAL PROBLEM, BOTH THE WEAK ACID AND CONJUGATE BASE CONCENTRATIONS ARE CUT EXACTLY IN HALF.

SINCE THE RATIO OF $\frac{[\text{A}^-]}{[\text{HA}]}$ HAS NOT CHANGED, THE pH WILL BE EQUAL TO THE pH FOR THE SOLUTION.