1.) Calculate the pH of a 0.0550 M solution of Acetic Acid

State the problem.

$M := \frac{mol}{L}$

Initial Concentration	$C_o := 0.0550 \cdot M$	***Give constants necessary to the solving of the problem. Include units.***
Equilibrium Constant	$Ka := 1.80 \cdot 10^{-5} \cdot M$	

Now, I set up the equilibrium expression for HAc. If x is the degree of dissociation, then at equilibrium, we have

Annotation...

HAc	=	H^+	+	Ac^-	***Set up the physical application of the problem.***
C_o-x		x		x	

Substituting values into the equilibrium expression yields...

Annotation...

$Ka = \frac{(H)\cdot(Ac)}{(HAc)} = \frac{(x)\cdot(x)}{C_o - x}$ I will first assume that $x << C_o$ because Ka is relatively small.

Show substitutions into applicable expressions.

$Ka = \frac{x^2}{C_o}$ solving for x gives... $x = \sqrt{Ka \cdot C_o}$

$x := \sqrt{\left(1.80 \cdot 10^{-5} \cdot M\right) \cdot (.055 \cdot M)}$ $x = 9.94987 \times 10^{-4} M$

Solve equations explicitly with complete units, significant digits and annotations

$\frac{x^2}{C_o - x} = 1.83316 \times 10^{-5} M$ checking assumption..

check assumptions or shortcuts.

The calculated Ka is off, so the assumption is poor. I'll solve for x using the quadratic formula. Rearranging equation into the proper form gives

$Ka \cdot (C_o - x) = x^2$ or $x^2 + Ka \cdot x - Ka \cdot C_o = 0$ The quadratic solutions are

$x = \frac{-b + \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a}$ or $x = \frac{-b - \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a}$ Substituting for proper values gives

$x := \frac{-Ka + \sqrt{Ka^2 - (4) \cdot (1) \cdot (-Ka \cdot C_o)}}{2 \cdot (1)}$ $x = 9.86028 \times 10^{-4} M$

Since Ka and C_o are defined, this is a suitable expression to evaluate

Now, calculating pH. By assignments given above, $H^+ = x$, thus

$pH = -\log(x)$ $pH := -\log\left(5.107 \cdot 10^{-4}\right)$ $pH = 3.29183$

Highlight answer by box, or underline or some other delineation.