3. Industrial pollution often makes water supplies acidic (pH < 7) or basic (pH >7). An industrial company claims that the mean pH level of the water in a nearby river is 7, so it is neutral. You, as an environmentalist, randomly select 19 water samples and measure the pH of each. The sample mean and standard deviation are 6.9 and 0.24, respectively. Assume the population of pH levels in all possible water samples is normally distributed.

   a. Is there enough evidence to reject the company's claim at the 5% significance level? At the 10% level?

The two hypothesis:

H_0: $\mu = 7$

H_a : $\mu \neq 7$

Check conditions: random sample, checked. We assumed that the pH levels in all possible water samples is normally distributed, so this one is checked, too.

Test statistic: $t = \dfrac{\bar{x} - \mu_0}{s/\sqrt{n}} = \dfrac{6.9 - 7}{0.24/\sqrt{19}} = -1.816$

From the calculator: STAT → TESTS → 2:T-test (highlight Stat)
$\mu_0 = 7$, x-bar = 6.9, Sx = 0.24, n = 19

p-value: 0.086

Conclusion: At the 5% significance level, we don't have enough evidence to reject the null hypotheses because the p-value > 5%. That is, we cannot reject the claim that the mean pH level of the water in the river is 7.

At the 10% level, however, we have enough evidence to reject the null hypotheses because the p-value < 10%. That is, at the 10% significance level, we can conclude that the mean pH level of the water in the river is not 7.

   b. Can you reach the same conclusion using the appropriate confidence interval for the mean pH level?

The 95% CI for the mean pH level based on the sample mean of 6.9 is (6.7843, 7.0157) using STAT → TESTS → 8: TInterval..

So based on this, since the claimed value, 7, is inside the CI, we cannot reject the null hypotheses at the 5% significance level. Same conclusion as above.

The 90% CI for the mean pH level based on the sample mean of 6.9 is (6.8045, 6.9955). Since the claimed value, 7, is NOT inside the CI, we can reject the null hypotheses at the 10% level. Same conclusion as above.