Psyc 3101, Homework 7

The bus schedule says your trip to school should take 10 minutes. Sometimes it takes a bit longer, sometimes a bit less, but you wonder whether on average it's longer than what the schedule indicates. You time your ride every day for two weeks and get the following durations (in minutes).

{10, 9, 12, 13, 14, 8, 12, 9, 14, 15}

Now let's do a t-test to test the hypothesis that the bus takes longer than the schedule says it should. Use α = 5% throughout this assignment.

1. Given how I worded the hypothesis above, should you do a one-tailed or a two-tailed test?
One-tailed

2. Write the null hypothesis in words.
The average bus time is the same as indicated in the schedule (10 min).

3. Write the null hypothesis as an equation.
$\mu = 10$

4. Write the alternative hypothesis in words.
On average the bus takes longer than it should.

5. Write the alternative hypothesis as an equation.
$\mu > 10$

6. Calculate the mean of your sample.

$$M = \frac{\sum X}{n} = \frac{10+9+12+13+14+8+12+9+14+15}{10} = \underline{11.6}$$

7. Calculate the standard deviation of your sample.

$$s = \sqrt{\frac{\sum (X-M)^2}{n-1}} = \sqrt{\frac{1.6^2+2.6^2+.4^2+1.4^2+2.4^2+3.6^2+.4^2+2.6^2+2.4^2+3.4^2}{9}} = \underline{2.46}$$

8. Calculate the t statistic for testing the null hypothesis you wrote above.

$$t = \frac{M-\mu_0}{\sigma_M} = \frac{M-\mu_0}{s/\sqrt{n}} = \frac{11.6-10}{2.46/\sqrt{10}} = \underline{2.06}$$

9. What are the degrees of freedom for your t statistic?
$n - 1 = \underline{9}$

Here's a t table. For each value of t, it shows the probability of a result greater than or equal to that value, under a t distribution with the degrees of freedom you should have written for question 9.

t	$p(\geq t)$	t	$p(\geq t)$	t	$p(\geq t)$	t	$p(\geq t)$	t	$p(\geq t)$
.00	.5	1.38	.1	1.72	.06	2.06	.035	2.57	.015
.26	.4	1.45	.09	1.83	.05	2.15	.03	2.82	.01
.54	.3	1.53	.08	1.90	.045	2.26	.025	3.25	.005
.88	.2	1.62	.07	1.97	.04	2.40	.02		

10. What's the critical value for your t-test?
$t_{crit} = 1.83$

11. What's the p-value for your t-test?
$p = .035$

12. Which hypothesis do the data support?
Alternative hypothesis

13. Explain your answer to question 12 using the critical value.
$t > t_{crit}$

14. Explain your answer to question 12 using the p-value.
$p < \alpha$

Now imagine you had been interested in whether the bus is faster ***or*** slower on average, instead of just slower.

15. What's your new critical value?
$\alpha/2 = .025$, so $t_{crit} = \underline{2.26}$

16. What's your new p-value?
$p = 2 \cdot .035 = \underline{.07}$

17. Which hypothesis do the data support now?
Null hypothesis

18. Explain why the result changed or stayed the same from question 12 to question 17.
With the two-tailed test, there's the possibility for a Type I error in either direction, so we have to increase the critical value to maintain the same Type I error rate. The t value from our sample is big enough to exceed the one-tailed threshold, but not the two-tailed threshold.