1. The head of a Biology Department at a large university wants to know how non-transfer students and transfer students differ in terms of their performance on a test that all incoming biology majors have to take. She collected the following data from a random sample of students in the department and summarized their test scores. There are roughly 2500 non-transfer students and 1500 transfer students in the Biology Department.

	Mean	**SD**	**Sample Size**
Non-Transfer Students	41.48	6.03	119
Transfer Students	40.79	6.79	69

(a) What are we estimating? (Define the parameters of interest.)

We are estimating $\mu_N - \mu_T$, where
$\mu_N =$ the true mean test score on the biology test for non-transfer students and
$\mu_T =$ the true mean test score on the biology test for transfer students.

(b) Verify that the necessary conditions for inference have been met.

1. Independent samples — stated that students were randomly sampled from the biology department.
2. $n_N = 119 < 0.05(2500) = 125$ ($< 5\%$ of non-transfer students) and
   $n_T = 69 < 0.05(1500) = 75$ ($< 5\%$ of transfer students).
3. $n_N = 125 > 30$ and $n_T = 69 > 30$

(c) Find a point estimate for the difference in mean biology test score.

$\overline{x}_N - \overline{x}_T = 41.48 - 40.79 = 0.69$

(d) Find the standard error for this difference.

$$\sigma_{\overline{x}_N - \overline{x}_T} = \sqrt{\frac{s_N^2}{n_N} + \frac{s_T^2}{n_T}} = \sqrt{\frac{6.03^2}{119} + \frac{6.79^2}{69}} = 0.98678$$

(e) Suppose that JMP software calculates a 95% confidence interval for $\mu_T - \mu_N$ to be $(-2.069, 0.689)$. What is the confidence interval for $\mu_N - \mu_T$?

$(-0.689, 2.069)$

(f) Interpret your confidence interval in Part (e).

We are 95% confident that the true mean biology test score for non-transfer students is between 0.689 points lower and 2.069 points higher than the true mean biology test score for transfer students. (i.e. that the true difference in sample means is between -0.689 and 2.069.)

(g) Can we conclude that non-transfer students do better on average than transfer students?

No, we cannot conclude that $\mu_N > \mu_T$ because zero is contained in the interval.

2. Do people walk at different speeds in the airport depending on whether they are departing (getting on a plane) or arriving (getting off a plane)? Researcher Seth B. Young measured the walking speeds of different travelers in San Francisco International Airport and Cleveland Hopkins International Airport. His findings are summarized in the following table.

	Mean (ft/min)	**SD (ft/min)**	**Sample Size**
Departure	259.2	60.3	35
Arrival	268.9	39.9	35

(a) Definte the parameters of interest and state the null and alternative hypothesis.

μ_D = true mean walking speed of departing airport travelers
μ_A = true mean walking speed of arriving airport travelers

$H_0 : \mu_D = \mu_A$ versus $H_a : \mu_D \neq \mu_A$

(b) Is the normality condition for inference met?

Yes, because $n_D = 35 > 30$ and $n_A = 35 > 30$.
(This could also be satisfied if you were provided with roughly linear normal quantile plots.)

(c) Calculate the test statistic that could be used to compare these two means in a hypothesis test.

$$t_0 = \frac{\overline{x}_D - \overline{x}_A}{\sqrt{\frac{s_D^2}{n_D} + \frac{s_A^2}{n_A}}} = \frac{259.2 - 268.9}{\sqrt{\frac{60.3^2}{35} + \frac{39.9^2}{35}}} = -0.794$$

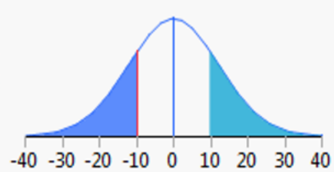
(d) You generate the following JMP output to test the hypotheses defined in Part (a).

t Test

departure-arrival

Assuming unequal variances

Difference	-9.743	t Ratio	-0.79724
Std Err Dif	12.221	DF	58.99072
Upper CL Dif	14.711	Prob > |t|	0.4285
Lower CL Dif	-34.197	Prob > t	0.7857
Confidence	0.95	Prob < t	0.2143



What is the p-value for the test?

p-value = 0.4285 (Select the two-tailed test option.)

(e) State your conclusion regarding the hypothesis test in context of the problem.

We do not reject H_0 because the p-value > 0.05 $(1 - 0.95)$. At the 5% significance level, there is insufficient evidence to conclude that people walk at different speeds (on average) whether they are departing or arriving.

(f) If a 95% confidence interval for the difference is found, would it contain zero? Explain.

Yes, because there is not a statistically significant difference in the mean walking speeds at the 5% level.