1. **Problem**
   An experiment has $n_1 = 6$ plants in the treatment group and $n_2 = 8$ plants in the control group. After some time, the plants' heights (in cm) are measured, resulting in the following data:

	value1	value2	value3	value4	value5	value6	value7	value8
sample 1:	0.81	0.98	1.39	1.34	0.78	1.11		
sample 2:	1.31	1.3	1.45	1.42	1.22	1.37	1.34	1.31

   (a) Determine degrees of freedom.
   (b) Determine $t^{\star}$ for a 98% confidence interval.
   (c) Determine SE.
   (d) Determine a lower bound of the 98% confidence interval of $\mu_2 - \mu_1$.
   (e) Determine an upper bound of the 98% confidence interval of $\mu_2 - \mu_1$.
   (f) Determine $|t_{\text{obs}}|$ under the null hypothesis $\mu_2 - \mu_1 = 0$.
   (g) Determine a lower bound of the two-tail p-value.
   (h) Determine an upper bound of two-tail p-value.
   (i) Do you reject the null hypothesis with a two-tail test using a significance level $\alpha = 0.02$? (yes or no)

   Solution
   These data are unpaired. We might as well find the sample means and sample standard deviations (use a calculator's built-in function for standard deviation).

$$\overline{x_1} = 1.07$$

$$\overline{x_2} = 1.34$$

$$s_1 = 0.259$$

$$s_2 = 0.0729$$

   We make a conservative estimate of the degrees of freedom using the appropriate formula.

$$df \;=\; \min(n_1,\, n_2) - 1 \;=\; \min(6, 8) - 1 \;=\; 5$$

   We use the t table to find $t^{\star}$ such that $P(|T| < t^{\star}) = 0.98$

$$t^{\star} = 3.36$$

   We use the SE formula for unpaired data.

$$SE = \sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}} = \sqrt{\frac{(0.259)^2}{6} + \frac{(0.0729)^2}{8}} = 0.109$$

   We find the bounds of the confidence interval.

$$CI \;=\; (\overline{x_2} - \overline{x_1}) \pm t^{\star} SE$$

$$CI \;=\; (-0.096,\, 0.636)$$

   We find t_{obs}.

$$t_{\text{obs}} = \frac{(\overline{x_2} - \overline{x_1}) - (\mu_2 - \mu_1)_0}{SE} = \frac{(1.34 - 1.07) - 0}{0.109} = 2.48$$

We find $|t_{\text{obs}}|$.

$$|t_{\text{obs}}| = 2.48$$

We use the table to determine bounds on p-value. Remember, $df = 5$ and $p\text{-value} = P(|T| > |t_{\text{obs}}|)$.

$$0.05 \; < \; p\text{-value} \; < \; 0.1$$

We should consider both comparisons to make our decision.

$$|t_{\text{obs}}| < t^{\star}$$

$$p\text{-value} > \alpha$$

Thus, we retain the null hypothesis. Also notice the confidence interval does contain 0.

(a) 5

(b) 3.36

(c) 0.109

(d) -0.096

(e) 0.636

(f) 2.481

(g) 0.05

(h) 0.1

(i) no