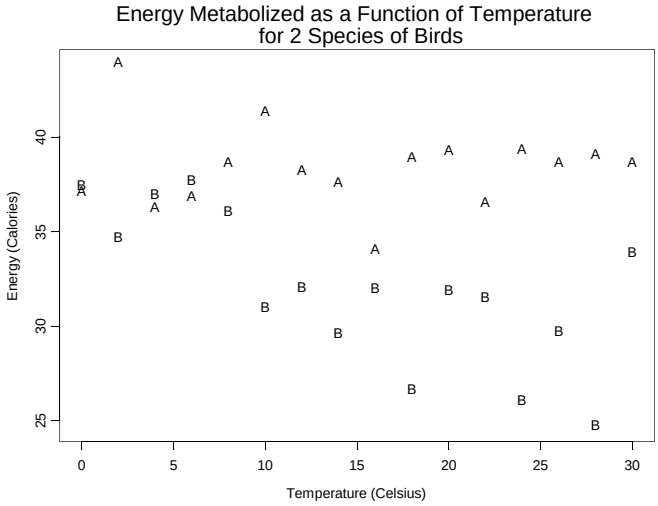
Name:_____ **Total Points (out of 15):**_____

The questions below refer to the bird energy data described on this page.

- The results below summarize a study of the amount of energy metabolized (in calories) by two similar species of birds under different temperatures (in degrees Celsius).
- Three variables are measured: Bird Type ("CODE"), Temperature ("TEMP") and Energy ("CALORIES"). The sample size is 32 birds, of which 16 are from "Species A" and 16 are from "Species B."
- For this dataset, CODE = 1 for "Species A", and CODE = 0 for "Species B".
- We wish to explore how energy varies with temperature and species type.



```
Call: lm(formula = CALORIES ~ TEMP + CODE + TEMP:CODE)

Coefficients:
              Value Std. Error  t value Pr(>|t|)
(Intercept)  36.4501   1.2544    29.0571   0.0000
       TEMP  -0.3004   0.0712    -4.2161   0.0002
       CODE   2.1237   1.7740     ------   -----
  TEMP:CODE   0.2866   ------     2.8440   0.0082

Residual standard error: 2.627 on -- degrees of freedom
Multiple R-Squared: 0.7009
F-statistic: 21.87 on 3 and -- degrees of freedom, the p-value is 1.69e-007

Correlation of Coefficients:
          (Intercept)    TEMP    CODE
     TEMP -0.8519
     CODE -0.7071      0.6024
TEMP:CODE  0.6024     -0.7071   0.8519


Terms added sequentially (first to last)
          Df Sum of Sq  Mean Sq  F Value       Pr(F)
     TEMP  -   67.1350  -------    -----       ----
     CODE  -  329.9356  -------    -----       ----
TEMP:CODE  -   55.8374  -------    -----       ----
Residuals  -  193.2986  -------
```

1. Give a 1-sentence interpretation of the slope for species A. **[1 point]**

2. Test whether the mean energy expended at 0° Celsius is the same for the two species. Give and interpret the p-value for the test. Show all steps. **[3 points]**

3. **True or False. Circle one.** The test performed above also answers the question of whether a common regression line can describe the relationship between energy and temperature for the two species. **[1 point]**

4. Use an Extra Sum of Squares F-test to evaluate the statistical significance of the interaction between temperature and species. Write out null and alternative hypotheses, test statistic, rejection region (use α=0.05) and conclusion. **[3 points]**

5. Let β_3 be the coefficient of the term "CODE:TEMP" in the model implied by the Splus output given. In this context, a test of $H_o: \beta_3 = 0 \; vs. \; H_A: \beta_3 \neq 0$ is a test of which of the following:
Circle all that apply. [2 points]
   a. H_o: separate lines model is adequate vs. H_A: parallel lines model is adequate or preferable
   b. H_o: the linear regression model is adequate vs. H_A: the linear regression model is inadequate and thus non-linearity in the explanatory variables should be considered
   c. H_o: the parallel lines model is adequate vs. H_A: the separate lines model is adequate or preferable
   d. H_o: the equal lines model is adequate vs. H_A: the equal lines model is inadequate
   e. H_o: the coefficient of the interaction term is non-zero vs. H_A: the coefficient of the interaction term is zero

6. Imagine that we need to rescale our temperature measurements to Fahrenheit rather than Celsius and then refit the model. Which of the following would change? **Circle all that apply. [2 points]**

   a. The linear correlation coefficient between temperature and energy
   b. $\hat{\sigma}$
   c. Rejection region for a test of $H_o: \beta_2 = \beta_3 = 0 \; vs. \; H_A: \beta_2, \beta_3 \; free$
   d. F-statistic for testing $H_o: \beta_2 = \beta_3 = 0 \; vs. \; H_A: \beta_2, \beta_3 \; free$
   e. The total sum of squares

7. For the bird data, I wish to determine whether the linear relationship between energy and temperature is best described by separate lines for each species or by a single line for both species. Which of the following methods would be correct to accomplish this goal? **Circle all that apply. [1 point]**

   a. extra sum of squares F-test
   b. an F-test for the significance of the regression line
   c. two t-tests
   d. comparison of adjusted R^2 values
   e. two t-tests along with an adjustment for multiple comparisons (such as Scheffe or Bonferroni)

8. Give a 95% confidence interval for the amount by which the slope for species A exceeds the slope for species B. **[2 points]**