Solution:

1. $R^2 = \frac{RegS.S.}{TotalS.S.} = \frac{96.0794}{101.6} = 0.94566.$
   Then multiple correlation coefficient is $\sqrt{R^2} = \sqrt{0.94566} = 0.9725$

2. $\hat{y}(x_0) = 0.81937 + 1.93414 * 2.2 + 1.01989 * 5 = 10.17393$
   $\hat{\sigma^2} = RSS/7 = 0.78866$
   $x_{0c}^T = (1, 2.2 - \bar{x}_1, 5 - \bar{x}_2) = (1, 2.2 - \frac{12}{10}, 5 - \frac{30}{10}) = (1, 1, 2)$
   $x_{0c}^T (X_c^T X_c)^{-1} x_{0c} = 0.31911$
   $t_{0.025,7} = 2.365$
   The 0.95 prediction interval for y at $x_1 = 2.2$ and $x_2 = 5$ is $10.17393 \pm 2.365\sqrt{0.78866 \times (1 + 0.31911)}$ $=10.17393 \pm 2.41222 = [7.76171, 12.58615]$.

   Remarks:
   We make use of centered model to compute $(X^T X)^{-1}$, so the corresponding x_0^T is (1,2.2-$\bar{x}_1$, 5-$\bar{x}_2$) = (1,1, 2)

3. F test for testing $H_0 : C\beta = d$.

   C = [0 1 -1]

   $d = 0$

   $C\hat{\beta} - d = 0.91425$

   In this case, since the first element of C is 0, so

   $[C(X^T X)^{-1} C^T] = [C(X_c^T X_c)^{-1} C^T] = 0.13303$

   Value of test statistic = 7.96652

   Critical value = $F_{0.05,1,7} = 5.59$

   Since $F_{obs} > F_{1,7,0.05}$, reject the null hypothesis.

4. "Increase in Regression Sum of Squares". The reduced model is $y = \beta_0 + \beta_1(x_1 + x_2) + e_i$
   Take $x' = x_1 + x_2$, and under reduced model, $\hat{\beta}_1 = \frac{S_{x'y}}{S_{x'x'}} = \dfrac{S_{x_1 y} + S_{x_2 y}}{S_{x_1 x_1} + 2S_{x_1 x_2} + S_{x_2 x_2}} = 1.04902$

   $RSS_{reduced} = S_{yy} - \hat{\beta}_1 S_{x'y} = 11.80392$

   Increase in Regression Sum of Squares = $RSS_{reduced} - RSS_{full}$ = 11.80392-5.52062 =6.28331

   $F_{obs} = \frac{RSS_{reduced} - RSS_{full}}{1 * \hat{\sigma}^2} = \frac{6.28331}{1 * 0.7887} = 7.9666 > F_{0.05,1,7} = 5.59$

   Reject the null hypothesis.