Question 1. Use LINDO, or MS-Excel’s Solver add-in, or any other software of your choice to find the optimum solution to Question 51, page 122 (the Silvco “transistor refiring” problem) which you formulated as part of your second homework assignment (the correct formulation is posted on the course web page as part of the solutions to the assignment) - hand in the computer output with the details of your final solution.

Question 2. Consider the following linear program:

Minimize \( Z = 50X_1 + 20X_2 + 30X_3 + 80X_4 \)

\( \text{st} \)

1) \( 400X_1 + 200X_2 + 150X_3 + 50X_4 \leq 800 \)
2) \( 3X_1 + 2X_2 \geq 6 \)
3) \( 2X_1 + 2X_2 + 4X_3 + 4X_4 \geq 10 \)
4) \( 2X_1 + 4X_2 + X_3 + 5X_4 \geq 8 \)

\( X_1, X_2, X_3, X_4 \geq 0. \)

1. Solve the problem using LINDO or the Solver add-in to MS-Excel. Then answer the following:
   a. What are the shadow prices corresponding to Constraints 1, 2 and 4? Clearly interpret these values.
   b. What happens to the value of \( Z \) in each of the following three cases (1) \( c_2=18 \), (2) \( c_3=50 \) (3) \( b_2=4 \)?
   c. By how much can \( b_3 \) change before the current basis is affected? How (if at all) is \( Z \) affected?
   d. Give two interpretations of the reduced cost corresponding to the non-basic variable \( X_4 \).

2. Referring to the optimal tableau (with \( Z^* = 90 \)) shown below, answer the questions that follow:

<table>
<thead>
<tr>
<th>( Z )</th>
<th>( X_1 )</th>
<th>( X_2 )</th>
<th>( X_3 )</th>
<th>( X_4 )</th>
<th>( S_1 )</th>
<th>( S_2 )</th>
<th>( S_3 )</th>
<th>( S_4 )</th>
<th>RHS</th>
<th>Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-27.5</td>
<td>0</td>
<td>0</td>
<td>-50</td>
<td>0</td>
<td>-2.5</td>
<td>-7.5</td>
<td>0</td>
<td>90</td>
<td>Z</td>
</tr>
<tr>
<td>0</td>
<td>137.5</td>
<td>0</td>
<td>0</td>
<td>350</td>
<td>1</td>
<td>62.5</td>
<td>37.5</td>
<td>0</td>
<td>50</td>
<td>( S_1 )</td>
</tr>
<tr>
<td>0</td>
<td>1.5</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-0.5</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>( X_2 )</td>
</tr>
<tr>
<td>0</td>
<td>-0.25</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.25</td>
<td>-0.25</td>
<td>0</td>
<td>1</td>
<td>( X_3 )</td>
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<td>0</td>
<td>0</td>
<td>-4</td>
<td>0</td>
<td>-1.75</td>
<td>-0.25</td>
<td>1</td>
<td>5</td>
<td>( S_4 )</td>
</tr>
</tbody>
</table>

a. What would happen to \( Z \) if \( S_2 \) is increased by 1 units?

b. Suppose we were maximizing (as opposed to minimizing), so that the above tableau is suboptimal, and suppose \( X_1 \) is selected to enter into the basis. Interpret the substitution rates of the basic variables with respect to \( X_1 \).

Based on your answer, which variable would leave the basis? Why?

Without any pivoting, find the value of \( Z \) after the next iteration and explain how you would get this.

Question 3. Answer Question 3 on page 254-255 (Review problems for Chapter 5) of the text (Wivco).

Question 4. Answer Question 16 on page 261 (Review problems for Chapter 5) of the text (Cornco). Define variables for production, sales and inventory of each product in each period, and for the total raw material required - assume that the availability of the raw material is for the entire 3-month period.