1. Given the following (x,y) pairs

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.01</td>
</tr>
<tr>
<td>2</td>
<td>12.02</td>
</tr>
<tr>
<td>3</td>
<td>17.87</td>
</tr>
<tr>
<td>4</td>
<td>22.91</td>
</tr>
<tr>
<td>5</td>
<td>22.01</td>
</tr>
</tbody>
</table>

where y's are observation with equal weights. There are no correlations between any two observations. The (x,y) pairs are to be fitted by a linear model as

\[ y = ax + b \]

(1) Find a and b using the least-squares method. (10%) 
(2) At x = 9, compute y and its standard error. (5%)

2. The coordinate of A and B are given as follows

<table>
<thead>
<tr>
<th>Point</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

The following angles are observed by a theodolite:

\[ \alpha = 55^\circ 10' 20'', \beta = 65^\circ 20' 40'', \gamma = 59^\circ 29' 04'' \]

The standard errors of the three angles are 1'.

Determine the coordinates of P using the least-squares method. (20%)

3. Please describe what is (1) internal reliability, (2) external reliability. How they are measured? Please use a closed traverse for demonstration. (20%)

4. The reference variance of an adjustment is 0.9. The covariance matrix and unknown parameter matrix are
\[
Q_{xx} = \begin{bmatrix} 0.4 & 0.2 & 0.1 \\ 0.2 & 0.4 & -0.2 \\ 0.1 & -0.2 & 0.9 \end{bmatrix}, \quad X = \begin{bmatrix} A \\ B \\ C \end{bmatrix}
\]

What is the estimated error in the adjusted value for (10%)?

(1) A,

(2) B,

(3) C?

5. 觀測一段距離六次，其觀測值如下：
   \begin{align*}
   215.63 \text{m} & , 
   215.55 \text{m} & , 
   215.57 \text{m} , \\
   215.48 \text{m} & , 
   215.65 \text{m} & , 
   215.50 \text{m} .
   \end{align*}

試計算其觀測值及最或是值之標準誤差？ (15%)

6. 如圖，已知兩準點之高程
   \begin{align*}
   BM1=450.12 \text{m} & , 
   BM2=457.61 \text{m} \end{align*}

另測得兩中間準點之高程差為
   \begin{align*}
   l_1 = 5.08 \text{m} & , 
   l_2 = -0.68 \text{m} , \\
   l_3 = 2.35 \text{m} & , 
   l_6 = -3.00 \text{m} , \\
   l_5 = -1.30 \text{m} & , 
   l_7 = 1.72 \text{m} , \\
   l_4 = -6.14 \text{m} .
   \end{align*}

試計算 A,B,C 三點之高程。 (20%)

\[
BM1=450.12 \text{m}
\]

\[
BM2=457.61 \text{m}
\]