1. The last time the 2 loops are executed prior to ending, J has a value of 1 and K has a value of 9 since K assumes values of 3, 5, 7 and 9. Therefore, B(1,9) is the last element modified.

2. Without any simplification, the circuit translates as follows:

\[ A ( \overline{A} + \overline{B} ) \]

3. The circuit translates as follows:

\[ \overline{A + \overline{B} \cdot C} \]

Using DeMorgan’s theorem gives: \( \overline{A ( \overline{B} \cdot C )} \). To be TRUE, both factors must be TRUE. A must always be 0. The second factor must be FALSE since the negation will make it true. Two possibilities exist. Either \( ( \overline{B} , \overline{C} ) \) equals \( (0, 0) \) or \( (1, 1) \). There are 3 ordered triples that make the circuit TRUE.

4. The squaring the adjacency matrix produces all the paths of length 2. Summing the elements gives 9 paths of length 2.

\[
\begin{bmatrix}
1 & 1 & 1 \\
0 & 0 & 1 \\
1 & 0 & 0
\end{bmatrix}
\begin{bmatrix}
2 & 1 & 2 \\
1 & 0 & 0 \\
1 & 1 & 1
\end{bmatrix}
\]

4. 9

5. The cycles in the graph are: ABCA, ABCDA, ACA and ACDA

5. 4
6. The circuit translates as follows: \((A + B) \overline{B}\).
To be TRUE both factors must be TRUE. \(B\) must be equal to 0.
Therefore, \(A\) must be equal to 1.

\[6. (1,0)\]

7. The circuit translates as follows: \((\overline{X} \overline{Y})(Y \oplus \overline{Z})\). It simplifies to:
\[(X + \overline{Y})(YZ + \overline{Y}Z) = XYZ + \overline{Y}YZ + \overline{Y}YZ + \overline{Y}YZ =
XYZ + \overline{Y}Z(X + 1) = XYZ + \overline{Y}Z\]

\[7. XYZ + \overline{Y}Z\]

8. The expression simplifies as follows:
\[
\overline{A}B + \overline{A}\overline{C} + \overline{A}B + \overline{B}C + A\overline{C} + B\overline{C} =
\]
\[(A \overline{B} + A\overline{B}) + (\overline{B}C + \overline{B}\overline{C}) + (A\overline{C} + A\overline{C}) =
\]
\[A(B + \overline{B}) + B(C + \overline{C}) + \overline{C}(A + \overline{A}) =
\]
\[A + B + C = ABC \quad \text{(note that} \ A \ B \ C \ \text{is not equivalent)}\]

\[8. ABC\]

9. By definition a simple path is a path with no vertex repeated. Choice A is not a valid path. Choice B has vertex B repeated. Choice C is a simple path. Choice D is not a valid path.

\[9. C\]

10. A “1” is placed in the matrix when a path exists. Otherwise, the matrix contains a “0”.

\[
\begin{array}{cccc}
|   & A & B & C & D |
|---|---|---|---|---|
| A | 1 & 1 & 0 & 1 |
| B | 1 & 0 & 1 & 1 |
| C | 0 & 0 & 0 & 1 |
| D | 0 & 0 & 1 & 0 |
\end{array}
\]

\[10. \text{The matrix as shown at the left.}\]