1. Graph Theory

Cubing the adjacency matrix will give the number of paths of length 3 in the directed graph.

$$
\begin{array}{c}
\quad A\ B\ C\ D \\
\begin{array}{c} A \\ B \\ C \\ D \end{array}
\left[\begin{array}{cccc}
1 & 0 & 0 & 1 \\
0 & 1 & 1 & 0 \\
1 & 0 & 1 & 0 \\
0 & 0 & 1 & 1
\end{array}\right]^{3}
=
\left[\begin{array}{cccc}
3 & 0 & 3 & 3 \\
3 & 1 & 3 & 1 \\
3 & 0 & 2 & 3 \\
3 & 0 & 3 & 2
\end{array}\right]
\end{array}
$$

A, C and D do not have paths of length 3 to vertex B.

1. A, C, D (A)

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2. Graph Theory

There are 7 cycles from B in the directed graph: BAB, BCAB, BDB, BADB, BAEDB, BCADB, and BCAEDB.

2. 7 (C)

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3. **Digital Electronics**

The Boolean expression represented by the digital circuit is:

$\overline{(A + (\overline{AB})\,(B + C)\,)\,C}$

$= (\overline{A}\,((\overline{AB})\,(B + C))\,\overline{C}$
$= \overline{A}\,\overline{C}\,((\overline{AB}) + \overline{(B + C)})$
$= \overline{A}\,\overline{C}\,(AB + \overline{B}\,\overline{C})$
$= A\,\overline{A}\,B\,\overline{C} + \overline{A}\,\overline{B}\,\overline{C}\,\overline{C}$
$= 0 + 0$
$= 0$

Since the expression is always FALSE, none, or 0, make it TRUE.

3. 0 (A)

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4. Digital Electronics

The Boolean expression represented by the digital circuit is:

$(A \oplus B)(B \oplus C)$
$= (\overline{A}B + A\overline{B})(\overline{B}C + B\overline{C})$
$= \overline{A}\,B\,\overline{B}\,C + \overline{A}\,B\,B\,\overline{C} + A\,\overline{B}\,\overline{B}\,C + A\,\overline{B}\,B\,\overline{C}$
$= 0 + \overline{A}\,B\,\overline{C} + A\,\overline{B}\,C + 0$
$= \overline{A}\,B\,\overline{C} + A\,\overline{B}\,C$

To be TRUE one of the terms must be TRUE.
$\overline{A}\,B\,\overline{C} = 1 \Rightarrow A = 0, B = 1, C = 0 \Rightarrow (0, 1, 0)$
$A\,\overline{B}\,C = 1 \Rightarrow A = 1, B = 0, C = 1 \Rightarrow (1, 0, 1)$

4. (0, 1, 0) (1, 0, 1) (E)

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5. Assembly Language

This is a translation of the assembly language program:

```
x = 21
y = 49
while y != 0
        r = int(x / y) * y
        r = x - r
        x = y
        y = r
end while
output x
```

This is the Euclidean Algorithm to find the greatest common divisor of two numbers. The GCF of 21 and 49 is 7.

5. 7 (B)