Solutions

Each answer shows the steps, then the **result**.

2.1

- $A + AB = A$ (absorption law)

2.2

- $\overline{A \cdot B} = \overline{A} + \overline{B}$

2.3

- $S = A \oplus B$ (A XOR B)
- $C = A \cdot B$ (A AND B)

2.4

- **one bit** (it is bistable — it remembers its state)

3.1

- $Z = AB + A\overline{B} = A(B + \overline{B})$
- $= A \cdot 1 = A$

3.2

- term $= \overline{A}\,\overline{C}$
- a group of 4 removes **2** variables

3.3

A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

- `S` column $= A$ XOR B; `C` column $= A$ AND B; all four rows correct

3.4

- in an SR flip-flop the input `S=1, R=1` is **invalid**
- a JK flip-flop uses `J=1, K=1` to **toggle** (flip) the output — so JK suits counters

3.5

- SOP: $Z = \overline{A} \cdot B + A \cdot B$
- $= B(\overline{A} + A) = B \cdot 1 = B$

3.6

(a) $X = 0, 0, 1, 1, 0, 1, 0, 1$ for the eight rows in the order given

(b) reading the same values into the map: row 00 gives $0, 0$; row 01 gives $1, 1$; row 11 gives $0, 1$; row 10 gives $0, 1$

(c) two groups: the whole $AB = 01$ row, which is $\bar{A}B$

- and the vertical pair in the $C = 1$ column covering $AB = 11$ and $AB = 10$, which is AC
- so $X = \bar{A}B + AC$

(d) consecutive rows must differ in **exactly one variable** — that is Gray-code order

- it is what makes an adjacent pair of 1s correspond to a term with one variable eliminated, so grouping works at all

(e) simplified: one NOT, two ANDs and one OR — **four** gates

- the original has three AND terms, two of them three-input, plus two NOTs and two ORs: at least **eight** two-input gates