Solutions

2.1

- Sum 0, carry 1 (binary 10) ✓.

2.2

- Three ✓.

2.3

- 0 – always false ✓.

3.1

- Pieces: half adder (bit 0) + full adder (bit 1) ✓.
- $s_0 = a_0 \oplus b_0$; $c_0 = a_0 b_0$ ✓.
- $s_1 = a_1 \oplus b_1 \oplus c_0$; $c_1 = a_1 b_1 + c_0(a_1 \oplus b_1)$ ✓.
- Trace: $a = 11$, $b = 01$: $s_0 = 1 \oplus 1 = 0$, $c_0 = 1$; $s_1 = 1 \oplus 0 \oplus 1 = 0$, $c_1 = 0 + 1 = 1 \rightarrow 100$ ✓.

3.2

- $g = \bar{s}a + sb + \bar{s}\bar{a}s$; the last term has $s\bar{s} = 0$ ✓.
- So $g = \bar{s}a + sb = f$ – one identity collapses it ✓.
- Joint table: s=0 → both output a; s=1 → both output b ✓.
- Build f: fewer gates, less delay – the identity is the optimiser ✓.