cuit transformation known as the KMS (Keutzer, Malik, and Saldanha) algorithm [352].

12.2 *Robust path-delay tests.* Remove the redundant fault Q stuck-at-1 from the circuit of Figure 12.2 and verify that all path-delay faults in the irredundant circuit are robustly testable.

12.3 *Robust path-delay tests.* Show that a robust path-delay test must produce a "real" transition (different initial and final values) at the output. Is any path in the circuit of Figure 12.4 robustly testable?

12.4 *Single-input change (SIC) tests.* Prove that every singly-testable (i.e., non-robustly testable) fault has a single-input change test.

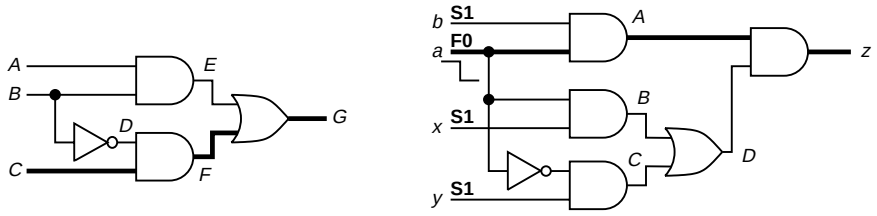
12.5 *Path-delay tests.* Consider the path $C-F-G$ in the circuit of Figure 12.14(a):

(a) Derive a test for a rising transition at C.

(b) Will the above test work if a falling transition is applied at B?

(c) Sketch all signals in the circuit of Figure 12.14(a) for the case (b) above when all gates have one unit of delay. Assuming that the permitted delay for the circuit is 2.5 units, interpret the result of the test. Can you locate the faulty path?

(d) How will you diagnose the faulty path?



(a) Circuit for Problem 12.5. (b) Circuit for Problem 12.6.

Figure 12.14: Path-delay fault testing circuits for Problems 12.5 and 12.6.

12.6 *Path-delay test robustness.* Consider the path shown in bold lines in the circuit of Figure 12.14(b). Suppose that we choose a test: $b = S1$, $a = F0$, $x = S1$, and $y = S1$.

(a) The permitted circuit delay is 3.5 units. Assuming that the gate A has a delay of 5 units and that all other gates have one unit of delay, sketch the relevant waveforms to show that the test is not robust.

(b) Can you derive a robust test?

12.7 *Off-path signals.* Specify the off-path signal states for delay testing of a two-input XOR gate.