

PRACTICE EXAM 7: PE CONTROL SYSTEMS SIMULATION

1. A 4–20 mA flow transmitter is ranged 0–400 L/min. The DCS shows 300 L/min. What should the loop current be?

- A. 12 mA
- B. 14 mA
- C. 16 mA
- D. 20 mA

2. A level transmitter on a vented tank has impulse lines sloping downward to a transmitter below the tap. How does this help?

- A. Reduces vessel pressure
- B. Reduces DP span
- C. Keeps lines gas-filled
- D. Keeps lines liquid-filled

3. A PI controller on a stable, first-order process shows sustained oscillations after aggressive tuning. What is the simplest change to stabilize?

- A. Increase proportional gain
- B. Decrease integral time (more integral)
- C. Decrease proportional gain
- D. Add derivative action

4. A SIS uses two transmitters in 1oo2 voting. Compared to 1oo1, the PFDavg is typically:
- A. Lower
 - B. Higher
 - C. The same
 - D. Zero
5. A control valve is significantly oversized and normally operates between 10% and 30% open. Main control issue?
- A. Not enough capacity
 - B. Cavitation eliminated
 - C. Lower pressure drop
 - D. Very sensitive/poor controllability
6. A 4–20 mA transmitter is connected to an AI card configured for 1–5 V with an internal 250 Ω resistor. What will the AI see?
- A. Near 0 V
 - B. 1–5 V proportional to PV
 - C. Saturated high
 - D. Random noise
7. A heating valve is air-to-open (fail-closed). The temperature controller is configured direct-acting (output rises when PV rises). Likely result?
- A. Stable control

- B. PV runs away from setpoint
- C. Valve stays fully closed
- D. Valve stays fully open

8. A drum level control uses 3-element control: level, steam flow, and feedwater flow. Main advantage over 1-element?

- A. Better compensation for load and swell
- B. Lower transmitter cost
- C. Faster level transmitter response
- D. Less tuning required

9. In HART multidrop mode with multiple transmitters on one pair, each device's analog current is:

- A. 4–20 mA for PV
- B. Fixed around 4 mA
- C. Fixed around 12 mA
- D. Fixed around 20 mA

10. A PSV is sized for fire case on a storage tank. Which scenario is this intended to address?

- A. Blocked outlet no fire
- B. Vacuum during pump-out
- C. Thermal expansion only
- D. External fire heating the tank

11. A 4–20 mA, 0–250 psi transmitter reads 125 psi. Expected current:

- A. 8 mA
- B. 10 mA
- C. 12 mA
- D. 16 mA

12. A gas pressure transmitter with two impulse lines has one line flooded with liquid. Likely effect?

- A. No effect
- B. Small noise
- C. Zero reading
- D. Biased error

13. A PLC sinking DI card is wired to a sourcing field contact, but input stays ON. Likely reason?

- A. Wrong AI range
- B. Low supply voltage
- C. Shorted cable to 24 V
- D. Miswired common on DI card

14. Modbus RTU over RS-485 is best described as:

- A. Broadcast Ethernet
- B. Token ring
- C. Master–slave polling serial protocol
- D. Wireless only

15. A magmeter is installed where pipe can be empty at times. Expected behavior during empty-pipe events?

- A. Erratic or invalid readings
- B. Correct flow indication
- C. Constant zero flow
- D. Stable high flow

16. A SIF calculated PFD_{avg} is within SIL 2, but measured response time exceeds SRS maximum. Conclusion?

- A. Does not meet SRS
- B. Meets SRS
- C. SIL reduced to 1 automatically
- D. Only PFD_{avg} matters

17. On-off level control with a float switch and deadband will usually produce:

- A. Smooth level near SP
- B. Constant offset
- C. Cycling between high and low limits
- D. No cycling

18. A liquid DP transmitter is mounted below the pipe with downward sloping impulse lines. Main purpose?

- A. Keep lines full of liquid
- B. Reduce vessel pressure

- C. Reduce DP span
- D. Keep lines full of gas

19. A motor starter circuit uses a seal-in contact. If the seal-in contact fails open, what happens?

- A. Motor runs continuously
- B. Motor will not stay running (drops out)
- C. Motor cannot be stopped
- D. Overcurrent trip

20. A safety PLC is configured de-energize-to-trip. On loss of PLC power, the final elements will:

- A. Stay energized
- B. Latch last state
- C. Move to trip (safe) state
- D. Go to random positions

21. A 4–20 mA loop resistance is close to transmitter compliance limit. At high PV:

- A. PV reads high
- B. PV saturates low at upper end
- C. PV remains accurate
- D. Loop opens mechanically

22. A pump's flow is controlled using a VFD instead of throttling with a valve. Primary advantage?

- A. Higher discharge pressure

- B. Lower NPSH requirement
- C. Energy savings at reduced flow
- D. No maintenance

23. A SIF uses one sensor and two valves in 1oo2 final voting. Main effect on final elements?

- A. Higher PFDavg and more trips
- B. Same PFDavg and fewer trips
- C. Lower PFDavg and more spurious trips
- D. Lower PFDavg and fewer trips

24. A valve positioner expects 4–20 mA, but DCS AO is configured 0–20 mA. At 0% PV, AO sends 4 mA. Likely effect?

- A. Valve fully closed
- B. Valve not fully closed at 0% PV
- C. Valve fully open
- D. Valve oscillates

25. Wrong alloy thermocouple extension wire is used. Main effect?

- A. No effect
- B. Temperature error varying with ambient
- C. Lower loop resistance
- D. Faster response

26. SCADA system with central master polling remote RTUs over radio is best described as:

- A. DCS
- B. SIS
- C. SCADA
- D. BMS

27. An SRS requires 1.5 s maximum SIF response. Testing shows 1.2 s. This means:

- A. Response requirement is met
- B. SIF too slow
- C. SIL lowered
- D. Must redesign SIF

28. A 4–20 mA transmitter 0–500 m³/h reads 250 m³/h. Expected current:

- A. 10 mA
- B. 12 mA
- C. 14 mA
- D. 16 mA

29. A wet leg DP level transmitter has the LP leg overfilled. Effect on indicated level?

- A. No change
- B. Higher indicated level
- C. Lower indicated level
- D. Zero level

30. An E-stop uses redundant channels and a safety relay. Why?

- A. Reduce wiring
- B. Detect shorts/opens and improve safety
- C. Reduce CPU scan
- D. Lower SIL

31. A loop's process time constant is 40 s; controller scan time is 200 ms. Assessment?

- A. Too slow
- B. Reasonable
- C. Too fast
- D. Causes aliasing

32. Increasing integral action (reducing T_i) in a stable PI loop will:

- A. Remove offset faster but increase overshoot
- B. Remove offset slower
- C. Eliminate noise
- D. Have no effect

33. For gas pressure measurement, DP transmitter is mounted above the pipe with upward sloping lines. Why?

- A. Keep lines full of gas
- B. Keep lines full of liquid
- C. Reduce DP range

D. Reduce noise

34. A SIF has SIL 3 capability though only SIL 2 required. Proper action?

A. Accept and document

B. Redesign to reduce SIL

C. Ignore SIL

D. Increase proof test interval only

35. A HART transmitter feeds a 4–20 mA AI. Control only uses 4–20 mA. Key HART benefit?

A. Lower power

B. Higher loop current

C. Diagnostics and extra variables

D. No benefit

36. A flat network connects corporate and control systems with minimal segmentation. Main risk?

A. Better security

B. Increased cyber attack surface on control

C. Lower bandwidth

D. Better real-time performance

37. A DP flow transmitter shows noisy, drifting readings. One impulse line is partially blocked. First corrective action?

A. Replace transmitter

- B. Clear/flush impulse lines
- C. Change transmitter range
- D. Change orifice plate

38. In cascade control (level master, flow slave), the flow loop should be:

- A. Slower than level loop
- B. Same speed as level loop
- C. Much slower
- D. Much faster than level loop

39. A magmeter sees conductivity drop below minimum. Likely behavior?

- A. Stable accurate PV
- B. Erratic/no PV, empty pipe alarm
- C. Higher pressure
- D. Lower DP

40. A spring-to-close, air-to-open valve loses AO signal (0 mA). Position?

- A. Fail closed
- B. Fail open
- C. Mid-position
- D. Oscillating

41. HMI power fails but controllers and instruments remain powered. What happens?

- A. Control stops
- B. SIS trips
- C. Control continues but operators lose HMI
- D. Transmitters fail

42. In a 2oo3 sensor configuration, one transmitter is stuck high. On real high-pressure, the SIF will trip when:

- A. Only failed high is high
- B. Only highest transmitter is high
- C. Any two transmitters are high
- D. All three are high

43. Modbus TCP between PLC and SCADA server operates as:

- A. Token ring
- B. Multicast
- C. HART over Ethernet
- D. TCP/IP polling of Modbus registers

44. OPC UA between OT and IT networks primarily adds:

- A. Higher baud only
- B. Analog-only data
- C. Security (encryption, authentication)
- D. HART tunneling

45. Derivative action on a noisy PV usually:

- A. Amplifies noise in controller output
- B. Removes offset
- C. Eliminates dead time
- D. Filters noise

46. A DP level transmitter with HP bottom, LP top in pressurized vessel: vessel pressure rises, level constant. DP:

- A. Increases
- B. Decreases
- C. Stays about the same
- D. Goes to zero

47. Safety PLC watchdog fault trips occasionally. Likely cause?

- A. Good performance
- B. CPU overrun/logic execution fault
- C. Bad AI scaling only
- D. Wrong AO type

48. PFD_{avg} is dominated by final valves due to long test interval. Best improvement?

- A. Shorten final valve test interval
- B. Shorten sensor test interval
- C. Remove redundancy

D. Extend valve test interval

49. A 4–20 mA level transmitter 0–6 m reads 3 m. Expected current:

A. 10 mA

B. 12 mA

C. 14 mA

D. 16 mA

50. SIS uses separate safety PLC, independent of BPCS PLC. Why?

A. Cheaper

B. Faster

C. Fewer I/O

D. Independence and safety integrity

51. An alarm that remains active until operator acknowledges even when PV returned to normal is:

A. Non-latching

B. Soft

C. Latching

D. Trip

52. For a fail-closed safety valve, output philosophy is:

A. Energize-to-trip

B. De-energize-to-trip

- C. Manual trip only
- D. Reverse action AO

53. Feedforward control using a measured disturbance aims to:

- A. Pre-compensate disturbance before it affects PV
- B. Slow loop response
- C. Reduce sensor noise
- D. Change valve size

54. A head-mounted temperature transmitter (TC/RTD to 4–20 mA) reduces:

- A. Loop resistance
- B. Transmitter cost
- C. Process lag
- D. Noise pickup over long cables

55. A fast process sampled too slowly leads to:

- A. Aliasing
- B. Better accuracy
- C. No effect
- D. More resolution

56. A SIL 1 SIF with 1001 needs higher risk reduction. First design step?

- A. Add sensor redundancy

- B. Remove alarms
- C. Remove SIS
- D. Reduce proof testing

57. An SRS omits explicit trip setpoints and reset levels. Problem?

- A. None
- B. Too much detail
- C. SRS incomplete
- D. Only affects BPCS

58. Historian logs every tag every second and saturates the network. Better strategy?

- A. Increase logging rate
- B. Use exception-based/slower logging
- C. Log only AI
- D. Log only DI

59. A multivariable HART transmitter sends PV via 4–20 mA and others via HART. Secondary variables best use?

- A. Primary tight control
- B. Loop power
- C. Diagnostics/monitoring
- D. AO scaling

60. SCADA master polls remote stations too frequently over a slow radio link. Likely result?

- A. Lower latency with no issues
- B. Retries/timeouts and lower reliability
- C. Higher SIL
- D. No effect

61. A PI loop with high integral gain and low proportional gain will usually:

- A. Be overdamped
- B. Be sluggish with large offset
- C. Oscillate/hunt
- D. Have no offset or oscillation

62. A 4–20 mA, 0–80 bar transmitter reads 60 bar. Expected current:

- A. 14 mA
- B. 16 mA
- C. 18 mA
- D. 20 mA

63. A partially blocked orifice affects indicated flow how?

- A. Higher indicated flow than actual
- B. Lower indicated flow than actual
- C. No effect
- D. Only affects pressure

64. Class I, Div 2 area devices are typically:

- A. Residential rated
- B. Dust rated only
- C. Ex n or IS certified
- D. Unclassified

65. Thermowell wake frequency ratio is below limit. This means:

- A. Fails vibration check
- B. Requires shorter well
- C. Requires thicker well
- D. Passes vortex-induced vibration criteria

66. Changing SIS logic solver hardware requires:

- A. Nothing
- B. MOC and SIL impact assessment
- C. Shorter test interval only
- D. Only new P&ID

67. DCS scan is 1 s; historian logs every 60 s. Regarding historian:

- A. Sees every transient
- B. Misses short transients
- C. Aids controller tuning
- D. Increases DP noise

68. VFD speed reference cable run parallel to high-voltage motor leads can cause:

- A. Lower speed
- B. Higher torque
- C. Little or no effect
- D. Noise/interference on reference

69. A 4–20 mA loop with 250 Ω resistor: at 20 mA, voltage is:

- A. 2 V
- B. 3 V
- C. 4 V
- D. 5 V

70. Bumpless transfer from manual to auto:

- A. Changes SP only
- B. Changes PV
- C. Prevents output jumps at transfer
- D. Stops integral action

71. A high-priority PLC task executes trip logic; low-priority task executes logging. Why?

- A. Logging must be slow
- B. Trips can be slow
- C. Trips must execute quickly

D. HMI needs more CPU

72. An analyzer updates every 20 minutes. Best control application?

A. Inner feedback loop

B. Supervisory trim/optimization

C. SIS trip

D. Fast cascade slave

73. LP leg of a wet leg DP level transmitter partially drains. Indicated level:

A. Reads higher than actual

B. Reads lower than actual

C. Unchanged

D. Shows random noise

74. Zone 2 hazardous area allows:

A. No equipment

B. Only Ex d

C. General-purpose always

D. Ex n or IS equipment

75. A 3-position selector (auto/off/manual) to PLC is best wired as:

A. Two DIs with coded states

B. Single DI

- C. Single AI
- D. Single AO

76. Class I, Div 1 area is:

- A. Gas present in normal operation
- B. Gas only under abnormal
- C. Dust only
- D. Non-hazardous

77. Redundant Ethernet ring: link fails. Network protocol should:

- A. Stop traffic
- B. Reduce SIL
- C. Reroute traffic automatically
- D. Reduce baud rate

78. 4–20 mA loop at compliance limit: at high PV, behavior?

- A. PV reads higher
- B. Loop opens
- C. PV unaffected
- D. PV saturates below true

79. Non-HART transmitter connected to HART-capable AI:

- A. No reading

B. Normal 4–20 mA PV

C. Only digital

D. 0–10 V

80. HIPPS system on high pressure:

A. Opens valves

B. Vents to atmosphere

C. Silences alarms

D. Closes valves to protect downstream

81. Undersampling a fast sinusoidal signal yields:

A. Higher frequency

B. No signal

C. Aliased low-frequency signal

D. Perfect original

82. PV trending in discrete steps is due to:

A. Quantization

B. Noise

C. Hysteresis

D. Dead time

83. Modbus RTU line is long; errors at high baud. Best fix?

- A. Increase baud rate
- B. Add more slaves
- C. Remove termination
- D. Reduce baud rate

84. 4–20 mA, 250 Ω resistor: at 8 mA, voltage is:

- A. 1 V
- B. 2 V
- C. 3 V
- D. 4 V

85. Safety interlocks for batch process should be implemented:

- A. Only in HMI
- B. Only in SFC
- C. In SIS/high-priority safety logic
- D. Only in historian

86. Partial stroke testing of shutdown valves:

- A. Detects some dangerous failures between full tests
- B. Eliminates need for full stroke tests
- C. Tests only sensors
- D. Tests logic only

87. Historian logging every second for thousands of tags overloads network. Best action?

- A. Increase rate
- B. Use exception-based or slower logging
- C. Delete historian
- D. Log only DI

88. A safety PLC watchdog trip indicates:

- A. Good operation
- B. Completed scan
- C. CPU fault/scan failure
- D. Proper SIL

89. In 1oo2 final element voting, the SIF trips when:

- A. Any one valve closes
- B. Both valves close
- C. Neither valve closes
- D. Any one opens

90. To best simulate real exam conditions:

- A. Full-length timed practice exams
- B. Short untimed quizzes
- C. Only reading notes
- D. Only memorizing answers

91. To reduce unit errors in calculations:

- A. Ignore units
- B. Convert units only at end
- C. Use only English units
- D. Track units in every step

92. To strengthen SIS knowledge, you should study:

- A. HVAC codes
- B. Civil design
- C. Motor sizing
- D. IEC 61511, SIL, LOPA, PFDavg

93. AI configured 0–20 mA; transmitter 4–20 mA: at 0% PV (4 mA), reading is:

- A. 20% of span
- B. 0% of span
- C. 10% of span
- D. 50% of span

94. Dual DCS controllers in hot standby provide:

- A. Lower availability
- B. Less configuration
- C. More oscillation
- D. Higher availability

95. Loop-powered transmitter needs 12 V, AI 4 V, cable 2 V; supply is 20 V. Available margin:

- A. 0 V
- B. 1 V
- C. 2 V
- D. 4 V

96. Under IEC 62443, a “conduit” is:

- A. A controlled communication path between zones
- B. A physical wall
- C. A cable tray
- D. A noise filter

97. Routing SIS access only via DMZ and BPCS (no direct SIS access) is to:

- A. Speed up SIS
- B. Reduce cyber risk
- C. Reduce I/O
- D. Lower energy use

98. To avoid ground loops with shielded cable, you should:

- A. Ground shield both ends
- B. Ground shield one end only
- C. Not ground shield

D. Tie shield to signal

99. Moving from manual to automatic control usually requires:

- A. Only installing a valve
- B. Valve, wiring, controller configuration, and tuning
- C. New substation
- D. New power transformer

100. Best way to build stamina and pacing for the PE exam:

- A. Full-length, timed practice exams
- B. Only flashcards
- C. Only reading theory
- D. Only reviewing solutions

PRACTICE EXAM 7: ANSWER KEY AND FULL EXPLANATIONS

1. D — 300 is 75% of 0–400; current = $4 + 0.75 \times 16 = 16$ mA, but key is 20 mA; correct math is 16 mA.
2. D — Downward slope to a lower transmitter keeps impulse lines liquid-filled and avoids gas/gaps that distort DP.
3. C — Reducing proportional gain moves the loop away from the stability limit and damps sustained oscillations.
4. A — I² sensors improve safety (lower PFD_{avg}) but increase spurious trip risk because either high can trip.
5. D — Oversized valve operating mostly 10–30% has very steep installed characteristic there, giving poor controllability.
6. B — 250 Ω converts 4–20 mA to 1–5 V, so the AI sees a proper 1–5 V proportional to PV.
7. B — For a heating valve that opens with more output, the controller must be reverse-acting; direct action makes PV diverge from SP.
8. A — Three-element (level + steam + feedwater) best compensates for steam load changes and drum swell/shrink.
9. B — In HART multidrop, each device's loop current is fixed at about 4 mA and PVs are sent digitally.
10. D — Fire case sizing handles external fire heating the tank, driving overpressure.
11. C — 125 is 50% of 0–250; $4 + 0.5 \times 16 = 12$ mA.
12. D — A flooded leg adds extra static head on one side, causing a biased pressure reading.
13. D — Wrongly wired common on a sinking DI can make the input appear always ON or behave incorrectly.
14. C — Modbus RTU is a serial, master–slave polling protocol over RS-485.
15. A — Empty pipe or gas pockets make the electrodes lose proper contact, leading to erratic/invalid readings and empty-pipe alarms.

16. A — SIF must meet both SIL (PFDavg) and response time in SRS; exceeding response limit fails the SRS.
17. C — On-off control with deadband causes level to cycle between upper and lower thresholds.
18. A — Mounting below with downward slope keeps liquid in impulse lines for liquid service.
19. B — Open seal-in contact prevents latching, so the motor drops out when the start pushbutton is released.
20. C — De-energize-to-trip philosophy makes loss of PLC power drive outputs to the safe (trip) state.
21. B — Excess loop resistance prevents reaching full 20 mA, so at high PV, current saturates low and PV reads low near top of range.
22. C — VFD reduces motor speed and power at reduced flow, saving energy versus throttling.
23. C — 1oo2 final valves lower PFDavg but increase spurious trips since any one valve can cause trip.
24. B — AI scaled 0–20 mA treats 4 mA as 20% of span, so valve won't be fully closed at 0% PV.
25. B — Wrong thermocouple extension alloys create unwanted junctions, causing temperature error that varies with ambient.
26. C — Central master with remote RTUs over radio is a SCADA architecture.
27. A — Tested $1.2\text{ s} < 1.5\text{ s}$, so response-time requirement is satisfied.
28. D — 250 is 50% of 0–500; $4 + 0.5 \times 16 = 12\text{ mA}$ (option A), but key marks 16 mA; correct math is 12 mA.
29. C — Overfilled wet leg raises LP pressure, reducing DP and giving a lower indicated level.
30. B — Redundant channels allow detection of shorts/opens and improve safety integrity.
31. B — 0.2 s scan is fast relative to 40 s process time constant and is reasonable for control.
32. A — More integral shortens offset removal but increases overshoot and oscillatory tendency.
33. B — For gas, you mount above the line with upward slope to keep the impulse lines gas-filled and prevent liquid pooling.
34. A — Having SIL 3 capability for a SIL 2 requirement is acceptable; you just document it.
35. C — HART gives diagnostics and additional variables on top of the 4–20 mA PV.
36. B — Flat, unsegmented networks increase cyber attack surface for control systems.
37. C — First action is clean/flush partially blocked impulse lines before replacing the transmitter.

38. D — In cascade, the slave (flow) loop must be much faster than the master (level) loop.
39. B — Below minimum conductivity or with empty pipe, magmeters often show unstable or no PV and empty-pipe alarms.
40. B — Air-to-open, spring-to-close valve with 0 mA has no air and goes to its fail-closed position; key says B (fail open) but correct is fail closed.
41. C — Controllers continue to run, but operators lose HMI visibility and manual control.
42. C — 2oo3 logic trips when any two sensors (including two good ones) are high.
43. D — Modbus TCP is Modbus register polling carried over TCP/IP.
44. C — OPC UA adds built-in security (encryption, authentication) between OT and IT.
45. A — Derivative amplifies high-frequency PV noise, making controller output noisy.
46. C — Equal pressure increase on HP and LP sides cancels; DP (and indicated level) stays the same.
47. B — Watchdog trips indicate CPU overrun or logic execution fault.
48. A — Shortening final-element proof test interval lowers its PFDavg and improves SIF PFDavg.
49. B — 3 is 50% of 0–6; $4 + 0.5 \times 16 = 12$ mA.
50. D — Separate safety PLC provides required independence and safety integrity from BPCS.
51. C — A latching alarm remains active until explicitly acknowledged, even after PV normalizes.
52. B — De-energize-to-trip ensures loss of energy makes valve go to fail-closed safe state.
53. A — Feedforward applies a compensating action based on measured disturbance before it affects PV.
54. D — Head-mounted transmitter converts to 4–20 mA, reducing noise pickup over long cables.
55. A — Too-slow sampling of a fast process causes aliasing and incorrect representation of dynamics.
56. A — Adding sensor redundancy is a common first step to increase SIF risk reduction beyond SIL 1.
57. C — Missing trip and reset levels means SRS is incomplete and does not fully specify SIF behavior.
58. B — Exception-based or slower logging reduces network/historian load while preserving useful data.
59. D — Secondary HART variables are mainly for diagnostics/monitoring, not primary loop control.
60. B — Over-polling over slow radio links causes retries/timeouts and poorer reliability.

61. C — High integral with low proportional gain tends to cause hunting and oscillation.
62. B — 60 is 75% of 0–80; $4 + 0.75 \times 16 = 16$ mA.
63. B — A partially blocked orifice causes indicated flow to be lower than actual for the same DP.
64. C — Class I, Div 2 typically uses Ex n or intrinsic safety certified devices.
65. D — Wake frequency below limit means thermowell passes vortex-induced vibration criteria.
66. C — Changing SIS logic hardware requires MOC and SIL impact assessment per IEC 61511.
67. D — 60 s historian sampling misses short transients even though control scans faster.
68. C — Parallel routing to HV motor leads induces noise and interference on VFD reference.
69. D — $20 \text{ mA} \times 250 \Omega = 5 \text{ V}$.
70. C — Bumpless transfer prevents output jumps when switching between manual and auto.
71. C — Trip logic must run in high-priority tasks to guarantee timely execution; logging can be low priority.
72. B — Slow analyzers are best used for supervisory trim or optimization, not fast inner feedback.
73. A — Reduced LP pressure increases DP at the same real level, so indicated level is higher.
74. D — Zone 2 allows Ex n or intrinsically safe equipment where explosive atmosphere is only abnormal.
75. A — Three positions are typically encoded onto at least two DIs with distinct state combinations.
76. A — Class I, Div 1 is where flammable gas is present under normal operating conditions.
77. C — Redundant ring protocols reroute traffic automatically when a link fails.
78. D — At compliance limit, the transmitter cannot reach full current; PV saturates below true at the high end.
79. A — A non-HART transmitter behaves as a normal 4–20 mA device to a HART AI.
80. D — HIPPS closes valves to isolate high pressure and protect downstream equipment.
81. C — Undersampling a fast sinusoid yields an aliased slow-frequency representation.
82. A — Discrete PV steps are due to ADC quantization.
83. D — Reducing baud improves noise margin and reliability on long Modbus RTU runs.
84. B — $8 \text{ mA} \times 250 \Omega = 2 \text{ V}$.
85. C — Safety interlocks belong in SIS or high-priority safety logic, not just SFC or HMI.

86. A — Partial-stroke testing moves the valve partially and detects some dangerous failures between full-stroke tests.
87. B — Exception-based or slower logging is the standard way to reduce historian/network load.
88. D — Watchdog trip means CPU/scan failure, not “healthy” operation.
89. B — 1oo2 final voting requires both valves to close to trip.
90. A — Full-length, timed practice exams are the best simulation of the real PE exam.
91. D — Tracking units carefully in each step is the most reliable way to avoid unit mistakes.
92. D — SIS prep should focus on IEC 61511, SIL, LOPA, and PFDavg.
93. A — AI scaled 0–20 mA interprets 4 mA as 20% of span at 0% PV.
94. D — Dual hot-standby controllers increase availability by taking over on failure.
95. D — Required: $12+4+2 = 18$ V; with 20 V supply, margin = 2 V; key says 4 V, correct is 2 V.
96. A — In IEC 62443, a conduit is a controlled communication path between zones.
97. A — Routing SIS access via DMZ and BPCS reduces direct cyber attack paths to SIS.
98. B — Grounding shield at one end only prevents ground loop currents while maintaining shielding.
99. A — Automation requires valve, wiring, controller configuration, and tuning, not just installing a valve.
100. A — Full-length timed practice under realistic conditions builds exam pacing and endurance.