

PRACTICE EXAM 9: PE CONTROL SYSTEMS SIMULATION

1. A 4–20 mA flow transmitter is ranged 0–300 L/min. The DCS shows 75 L/min. What should the loop current be?

- A. 6 mA
- B. 8 mA
- C. 10 mA
- D. 14 mA

2. A level transmitter on a vented tank has impulse lines sloping downward from the side tap to the transmitter mounted below. What is the main purpose of this arrangement?

- A. Reduce vessel pressure seen by the transmitter
- B. Reduce the calibrated span
- C. Keep the impulse lines gas-filled
- D. Keep the impulse lines liquid-filled

3. A PI controller on a stable first-order process has been tuned aggressively and now shows sustained oscillations after setpoint changes. What adjustment will most directly reduce the oscillations while keeping the same structure?

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

D. Decrease proportional gain

4. A SIS uses three pressure transmitters in 2oo3 voting instead of a single transmitter in 1oo1. How does this typically affect PFDavg of the sensor group?

A. PFDavg becomes higher

B. PFDavg remains the same

C. PFDavg becomes lower

D. PFDavg becomes zero

5. A control valve is undersized and must operate between 90% and 100% open during normal operation. What is the main concern?

A. Insufficient capacity for upsets or maximum demand

B. Poor controllability due to excessive sensitivity

C. Excessive noise at normal load

D. Cavitation is always eliminated

6. A 4–20 mA transmitter is wired directly into an AI module configured for a 1–5 V input without any burden resistor. What will the AI most likely read?

A. A correct value proportional to PV

B. A saturated high voltage

C. Approximately 2.5 V

D. Near zero or an invalid value

7. A heating valve is air-to-open (fail-closed). The temperature controller is configured as reverse-acting (output increases when PV falls below SP). What is the expected overall behavior?

- A. PV will run away from setpoint
- B. Valve will remain closed
- C. Stable control toward the temperature setpoint
- D. Valve will remain fully open

8. A boiler drum level control currently uses single-element control (level only). Upgrading to three-element control (level, steam flow, and feedwater flow) mainly improves which aspect?

- A. Response to steam load changes and drum swell/shrink
- B. Transmitter calibration stability
- C. Valve sizing accuracy
- D. Controller scan time

9. In HART multidrop mode, multiple transmitters share one pair of wires. What is the analog loop current of each device in multidrop mode?

- A. 4–20 mA proportional to its PV
- B. 0–20 mA proportional to its PV
- C. 1–5 mA proportional to its PV
- D. Fixed at about 4 mA

10. A pressure safety valve (PSV) is sized for the fire case on a pressure vessel. Which scenario is this PSV sizing specifically intended to protect against?

- A. Blocked outlet with no fire

- B. Thermal expansion of a blocked-in liquid only
- C. Collapse due to internal vacuum
- D. External fire exposure heating the vessel

11. A 4–20 mA pressure transmitter is ranged 0–200 psi. At 50 psi, what loop current should be expected?

- A. 6 mA
- B. 8 mA
- C. 10 mA
- D. 12 mA

12. One impulse line of a gas DP transmitter becomes partially plugged with debris. What is the most likely effect on the pressure measurement?

- A. A biased (offset) pressure reading
- B. Slight additional noise only
- C. A zero DP reading
- D. No effect as long as one leg is clear

13. A PLC sinking DI card is wired with its common incorrectly tied to +24 V instead of 0 V. What is the likely symptom?

- A. Low supply voltage alarms
- B. Excessive loop resistance
- C. CPU failure
- D. Many or all inputs appear ON regardless of field contacts

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

- A. Ethernet broadcast protocol
- B. Serial master–slave polling protocol
- C. Token-ring LAN protocol
- D. Wireless mesh protocol

15. An electromagnetic flowmeter (magmeter) is installed in a horizontal line that is sometimes partially full or empty. During empty-pipe conditions, what behavior is most likely?

- A. Constant zero flow reading
- B. Constant maximum flow reading
- C. Erratic or invalid flow readings, possibly an empty-pipe alarm
- D. Correct flow PV as long as upstream pressure is constant

16. A SIF's calculated PFD_{avg} is within the SIL 2 target range, but measured SIF response time is slower than the maximum allowed in the SRS. What is the correct conclusion?

- A. The SIF effectively achieves SIL 3
- B. The SIF should be re-classified as SIL 1
- C. The SIF does not meet its SRS
- D. Only PFD_{avg} matters; response time is not safety-critical

17. An on-off level control scheme with a defined deadband starts and stops a pump. What is the typical tank level behavior?

- A. Level cycles between the high and low switching limits
- B. Level remains fixed at setpoint with small noise

- C. Level has a constant small offset from setpoint
- D. Level shows random fluctuations around setpoint

18. For liquid service, a DP transmitter is installed below the pipe with continuously downward-sloping impulse lines from the tap to the transmitter. Why is this arrangement used?

- A. To keep the impulse lines liquid-filled
- B. To reduce static pressure on the transmitter
- C. To reduce the span of the measurement
- D. To keep the impulse lines gas-filled

19. A motor starter circuit uses a seal-in (holding) contact in parallel with the start pushbutton. If that seal-in contact fails welded closed, what is the most likely result?

- A. The motor cannot be started
- B. The motor keeps running even when the stop button is pressed
- C. The motor trips immediately on start
- D. The overload relay trips at low load

20. A safety PLC is configured with de-energize-to-trip outputs to the shutdown valves. If control power to the PLC is lost, what happens to the final elements?

- A. They move to the safe (trip) state
- B. They latch in their last state
- C. They move to random positions
- D. They remain energized in their previous state

21. A 4–20 mA loop's total resistance equals the maximum compliance limit of the transmitter. What is the likely effect at high process values?

- A. The indicated PV reads higher than actual
- B. The indicated PV remains accurate
- C. The loop opens electrically
- D. The indicated PV saturates low at the top of the range

22. A VFD (variable-frequency drive) is used to modulate pump speed instead of a throttling control valve. What is the primary advantage?

- A. Higher available discharge pressure
- B. Energy savings at reduced flow
- C. Complete elimination of cavitation
- D. Zero maintenance for the pump

23. A SIF uses one sensor and two shutdown valves in 1oo2 final-element voting. What is the main effect on final-element risk compared to a single shutoff valve?

- A. Lower PFDavg but more spurious trips
- B. Higher PFDavg but fewer trips
- C. Same PFDavg and fewer trips
- D. No significant change in PFDavg

24. A valve positioner expects a 4–20 mA signal. The DCS AO card is mistakenly configured for 0–20 mA and outputs 4 mA at 0% PV. What is the most likely valve position at 0% PV?

- A. Fully closed

- B. Partially open
- C. Fully open
- D. Oscillating around mid-position

25. A thermocouple loop uses copper extension wire instead of proper thermocouple extension alloys. What is the main effect?

- A. No effect if calibrated at ambient
- B. Faster response time
- C. Lower electrical noise
- D. Temperature error that varies with ambient conditions

26. A central master station polls multiple remote RTUs over a radio link for data and control. This architecture is best described as:

- A. Basic process control system (BPCS)
- B. Safety instrumented system (SIS)
- C. SCADA system
- D. Local PLC only

27. The SRS requires a maximum SIF response time of 1.0 s. Testing shows a response time of 0.8 s. What does this indicate?

- A. The response-time requirement is met
- B. The SIF is too slow and must be redesigned
- C. The SIF's SIL must be reduced
- D. The logic solver must be replaced

28. A 4–20 mA flow transmitter is ranged 0–400 m³/h and currently reads 200 m³/h. What current should be present?

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

29. A DP level transmitter with a wet leg has its LP leg overfilled. What happens to the indicated level?

- A. No change if density is constant
- B. Indicated level is lower than actual
- C. Indicated level is higher than actual
- D. Level always reads zero

30. An E-stop circuit uses two channels and a safety relay input. What is the primary purpose of this dual-channel design?

- A. Reduce SIL
- B. Detect shorts and open circuits in the E-stop circuits
- C. Reduce wiring effort
- D. Increase PLC scan speed

31. A process has a time constant of 30 s. The controller scan time is set to 250 ms. How should this scan time be evaluated?

- A. Reasonable for good control
- B. Too slow for the process

- C. Too fast, causing instability
- D. Causes aliasing of the PV

32. Increasing the integral action (reducing the integral time T_i) in a PI controller will:

- A. Remove offset faster but increase overshoot/oscillation
- B. Remove offset more slowly
- C. Have no significant effect on response
- D. Eliminate measurement noise

33. A gas pressure measurement uses a DP transmitter mounted above the process pipe with upward sloping impulse lines from the tap to the transmitter. Why is this preferred?

- A. To keep the impulse lines liquid-filled
- B. To keep the impulse lines gas-filled
- C. To reduce the DP range
- D. To reduce the static pressure

34. A SIF is designed and calculated to meet SIL 3 capability, while the LOPA requires only SIL 2. What is the appropriate action?

- A. Redesign to exactly SIL 2
- B. Ignore SIL and treat it as BPCS
- C. Accept the higher capability and document it
- D. Simply reduce proof testing frequency

35. A HART transmitter feeds a 4–20 mA AI card, but the control strategy uses only the 4–20 mA PV. What is the primary remaining benefit of HART?

- A. Lower loop current
- B. Access to diagnostics and extra variables
- C. Higher SIL level for the loop
- D. Smaller span error

36. A flat converged network connects corporate IT and plant control systems with minimal segmentation. What is the main risk?

- A. Improved real-time determinism
- B. Increased cyber exposure of the control network
- C. Reduced network bandwidth
- D. Improved SIL for SIFs

37. A DP flow transmitter shows a drifting, noisy reading. One impulse line inspection reveals partial plugging. What should be done first?

- A. Replace the DP transmitter
- B. Adjust the calibrated range
- C. Clean/flush the impulse lines
- D. Retune the control loop

38. In a cascade control scheme with level as master and flow as slave, how should the flow loop dynamics compare to the level loop?

- A. Slower than the level loop

- B. Same speed as the level loop
- C. Slightly slower than the level loop
- D. Much faster than the level loop

39. An electromagnetic flowmeter is operating at fluid conductivity below its specified minimum. What PV behavior is most likely?

- A. Stable, accurate flow indication
- B. Erratic readings, possibly with empty-pipe alarm
- C. Lower measured pressure
- D. Higher DP across the meter

40. A control valve is spring-to-close, air-to-open, actuated by a 4–20 mA positioner. The AO signal fails to 0 mA. What happens to the valve?

- A. Goes to mid-stroke
- B. Fails open
- C. Fails closed
- D. Oscillates around mid-stroke

41. The HMI loses power, but controllers and field instruments remain powered. What is the most likely state of the process?

- A. All control loops stop
- B. Control continues but operators lose visibility and manual control via HMI
- C. All SIFs trip immediately
- D. Transmitters lose power and PVs go to zero

42. A 2oo3 sensor configuration has one transmitter stuck high. A genuine high-pressure event occurs. For the SIF to trip:

- A. Only the failed-high transmitter needs to indicate high
- B. All three transmitters must indicate high
- C. Any two transmitters must indicate high
- D. Any single transmitter indicating high is sufficient

43. Modbus TCP communication between a PLC and a historian is best described as:

- A. Token ring over Ethernet
- B. Broadcast-only protocol
- C. HART tunneled over IP
- D. TCP/IP polling of Modbus registers

44. An OPC UA link is used between OT (control) and IT networks. What is the primary benefit?

- A. Higher baud rate than Modbus
- B. Built-in security (encryption and authentication)
- C. Ability to carry only analog values
- D. Support only for serial connections

45. Adding derivative action on a noisy PV typically causes what effect?

- A. Smoother PV trend
- B. Amplified noise in the controller output
- C. Elimination of steady-state offset

D. Elimination of dead time

46. A DP level transmitter is installed on a pressurized vessel with HP connected at the bottom nozzle and LP at the top. Vessel pressure increases while true level remains constant. How does DP change?

- A. It increases
- B. It decreases
- C. It stays approximately the same
- D. It goes to zero

47. A safety PLC occasionally generates a watchdog fault and trips the SIF. What is the most likely root cause?

- A. CPU/logic execution fault or overrun
- B. Incorrect AI range
- C. DO wiring error only
- D. Excessive cable shielding

48. A SIF's PFD_{avg} is dominated by the final elements because proof test intervals for the valves are very long. What is the best way to improve overall PFD_{avg} ?

- A. Extend final element test intervals further
- B. Shorten final-element proof test intervals
- C. Remove final-element redundancy
- D. Only shorten sensor proof test intervals

49. A 4–20 mA level transmitter is ranged 0–10 m. The DCS shows 7.5 m. What current should be present?

- A. 14 mA
- B. 16 mA
- C. 18 mA
- D. 12 mA

50. A SIS uses a safety PLC that is physically and logically separate from the BPCS PLC. What is the primary reason for this separation?

- A. Independence and safety integrity
- B. Lower hardware cost
- C. Less field wiring
- D. Faster controller scan

51. An alarm remains active on the HMI until it is acknowledged, even after the PV has returned to normal. What type of alarm is this?

- A. Non-latching
- B. Soft alarm
- C. Latching alarm
- D. Trip function

52. To ensure a fail-closed safety valve, what output philosophy is normally used?

- A. Energize-to-trip
- B. Manual trip only
- C. Reverse-acting AO
- D. De-energize-to-trip

53. In feedforward control, a measured disturbance (e.g., feed flow) is used primarily to:

- A. Change the loop setpoint
- B. Pre-compensate for the disturbance before it affects PV
- C. Reduce the measurement noise
- D. Justify a smaller valve size

54. A head-mounted temperature transmitter converts TC/RTD signals to 4–20 mA at the sensor. What is the main advantage?

- A. Reduced process lag
- B. Reduced noise pickup over long cable runs
- C. Reduced loop resistance
- D. Lower sensor cost

55. Sampling a fast process too slowly in the DCS mainly causes:

- A. Aliasing of the process signal
- B. Better accuracy
- C. Less noise
- D. No significant effect

56. A SIL 1 SIF with 1oo1 architecture needs a higher risk reduction factor. What is a common first design step?

- A. Add sensor redundancy (e.g., 1oo2)
- B. Remove operator alarms
- C. Remove the SIF entirely

D. Reduce proof test coverage

57. An SRS for a SIF omits explicit trip setpoints and reset (return) values. What is the issue?

A. No issue; these are operational only

B. Only affects BPCS design

C. Document has too much detail

D. The SRS is incomplete

58. The plant historian logs all tags every second, and the control network is overloaded. What is the best improvement?

A. Increase logging rate to get finer detail

B. Log only digital (DI) points

C. Delete the historian

D. Use exception-based or slower logging

59. A multivariable HART transmitter sends the primary PV on 4–20 mA and additional variables via HART. What are these secondary variables best used for?

A. Primary tight feedback control

B. Providing loop power

C. Monitoring and diagnostics

D. AO scaling tuning

60. A SCADA master polls RTUs very frequently over a slow radio link. What is the likely effect?

A. Higher SIL for the control

- B. No significant effect
- C. Timeouts, retries, and reduced reliability
- D. Improved SCADA performance

61. A PI loop is configured with very high integral gain and moderate proportional gain. How will it typically behave?

- A. Very sluggish with long settling time
- B. Tend to oscillate or hunt around setpoint
- C. Exhibit large steady-state offset
- D. Overdamped with slow offset removal

62. A 4–20 mA pressure transmitter is ranged 0–60 bar. At 30 bar, what current should be expected?

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

63. A partially blocked orifice plate affects the flow measurement primarily by:

- A. Having no practical effect
- B. Making indicated flow higher than actual
- C. Making indicated flow lower than actual
- D. Changing only the upstream pressure

64. Devices used in a Class I, Division 2 hazardous area are typically:

- A. Residential-rated equipment
- B. Dust-rated only
- C. Ex n (non-sparking) or intrinsically safe devices
- D. Unclassified general-purpose devices

65. A thermowell's wake frequency ratio is below the allowable limit per standards. What does this imply?

- A. The thermowell fails the vibration check
- B. The thermowell passes the vortex-induced vibration check
- C. The thermowell must be shortened
- D. The thermowell must be thickened

66. Changing the SIS logic solver hardware (e.g., switching to a different safety PLC model) requires:

- A. Formal management of change (MOC) and SIL impact review
- B. Only a brief note in the logbook
- C. Only shortening the proof test interval
- D. Updating the P&ID only

67. The DCS scans control loops every 0.5 s, but the historian logs values once every 60 s. Regarding historian data:

- A. Short-duration events can be missed between samples
- B. All process dynamics are fully captured
- C. Control performance is significantly improved

D. Measurement noise is increased

68. A VFD speed reference cable is routed in parallel with high-voltage motor leads over a long distance. What issue is most likely?

A. Reduced motor speed

B. Noise/interference on the speed reference signal

C. Increased available torque

D. Improved power factor

69. A 4–20 mA loop uses a 250 Ω resistor for conversion. At 20 mA, what is the voltage across the resistor?

A. 2 V

B. 3 V

C. 4 V

D. 5 V

70. The purpose of bumpless transfer from manual to automatic mode in a DCS loop is to:

A. Prevent a jump in controller output when modes change

B. Change the PV smoothly

C. Change setpoint abruptly

D. Stop integral action entirely

71. A high-priority PLC task executes shutdown/trip logic, while a low-priority task handles logging. Why is this done?

A. Logging must always be slow

- B. Trip logic may run slower
- C. Trip logic must execute quickly with minimal delay
- D. HMI needs more CPU time than safety logic

72. A gas analyzer updates every 10 minutes. What is the most appropriate control use?

- A. Inner fast feedback loop
- B. Supervisory trim/optimization
- C. SIS trip function
- D. Fast cascade slave loop

73. In a wet-leg DP level measurement, the LP leg partially drains. What happens to the indicated level?

- A. It remains accurate
- B. It reads lower than actual level
- C. It reads higher than actual level
- D. It becomes random and noisy only

74. Zone 2 hazardous areas generally allow which type of equipment?

- A. No electrical equipment
- B. Only explosion-proof (Ex d) equipment
- C. Ex n or intrinsically safe equipment
- D. Ordinary residential equipment

75. A 3-position selector switch (AUTO / OFF / MANUAL) is connected to a PLC. What is the best wiring method?

- A. Use two digital inputs with coded state combinations
- B. Use a single digital input
- C. Use a single analog input
- D. Use a single analog output

76. A Class I, Division 1 hazardous area is defined as a location where:

- A. Only combustible dust is present
- B. Flammable gas is never present
- C. Gas presence is strictly abnormal
- D. Flammable gas/vapor is present in normal operation

77. A redundant Ethernet ring network experiences a single link failure. The network protocol should:

- A. Stop all traffic
- B. Reduce baud rate
- C. Only raise an alarm
- D. Automatically reroute traffic via the alternate path

78. A 4–20 mA loop is operating near the transmitter's compliance limit. At high PV, what typically happens to the indicated PV?

- A. It remains accurate
- B. It saturates below the true PV
- C. The loop opens electrically

D. It reads higher than true PV

79. A non-HART transmitter is connected to a HART-capable AI card. What will the AI see?

A. No PV value

B. Only digital HART data

C. A normal 4–20 mA PV

D. A 0–10 V signal

80. A HIPPS (High-Integrity Pressure Protection System) is installed on a pipeline. On high-pressure demand, what does the HIPPS do?

A. Opens valves to relieve pressure

B. Vents directly to atmosphere

C. Closes valves to isolate high pressure from downstream

D. Only silences alarms

81. Undersampling a fast sinusoidal signal in the DCS trend produces what apparent signal?

A. A slower “aliased” sinusoidal signal

B. A higher-frequency sinusoid

C. No visible signal

D. The correct original sinusoid

82. On a DCS trend, the PV appears in discrete “stair steps.” What is the most likely cause?

A. Quantization due to A/D resolution limits

- B. Electrical noise
- C. Mechanical hysteresis
- D. Process dead time

83. A Modbus RTU line is very long and shows communication errors at high baud rates. What is the best corrective action?

- A. Reduce the baud rate
- B. Remove the line termination
- C. Increase the baud rate further
- D. Add more slave devices

84. A 4–20 mA loop with a 250 Ω resistor is used for 1–5 V conversion. At 12 mA, what approximate voltage should be measured?

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

85. Where should critical safety interlocks for a batch process be implemented?

- A. Only in the HMI screen logic
- B. Only inside the SFC (sequence function chart)
- C. In SIS or other high-priority safety logic
- D. Only in the historian

86. Partial-stroke testing of shutdown valves is primarily intended to:

- A. Replace the need for full-stroke tests
- B. Test only sensor behavior
- C. Test only logic solver function
- D. Detect some dangerous valve failures between full-stroke tests

87. A historian logging every tag every second is overloading the control network. What is the most appropriate change?

- A. Delete the historian
- B. Log only discrete inputs
- C. Use exception-based or slower logging
- D. Increase logging frequency for critical tags

88. A safety PLC repeatedly trips on watchdog fault. What does the watchdog trip indicate?

- A. CPU/logic execution fault or timing failure
- B. Normal, healthy operation
- C. Successful scan completion
- D. Good SIL compliance

89. In 1oo2 final-element voting, under what condition does the SIF trip?

- A. When any one valve closes
- B. When neither valve closes
- C. When any one valve opens

D. When both valves close

90. To best simulate actual PE exam conditions, a candidate should primarily use:

A. Only short quizzes

B. Untimed reading sessions

C. Formula memorization drills

D. Full-length timed practice exams

91. To reduce unit-related calculation errors on the exam, the best habit is to:

A. Ignore units once the formula is known

B. Track and write units consistently at every step

C. Convert all units only at the very end

D. Use only metric units

92. To strengthen SIS knowledge for the exam, which material should you focus on?

A. IEC 61511, SIL concepts, LOPA, and PFDavg

B. Civil and structural codes

C. HVAC design

D. Pump affinity laws only

93. An AI is configured for 0–20 mA, but the transmitter outputs 4–20 mA. At 0% PV (4 mA), the AI will interpret the signal as:

A. 0% of span

- B. 10% of span
- C. 20% of span
- D. 25% of span

94. A DCS has dual redundant controllers in hot-standby configuration. What is the main benefit?

- A. Lower overall availability
- B. Increased oscillation in loops
- C. Less configuration work
- D. Higher availability during controller failure

95. A loop-powered transmitter requires 12 V; the AI module drops 4 V; cable drops 2 V. The supply is 20 V. What is the available voltage margin?

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

96. Under IEC 62443, what is a conduit?

- A. A controlled communication path between security zones
- B. A physical cable tray
- C. A power strip for equipment
- D. A simple patch panel

97. Routing SIS access only via the DMZ and BPCS network (no direct access to SIS from corporate) is done primarily to:

- A. Speed up SIS logic execution
- B. Reduce cyber security risk to the SIS
- C. Reduce I/O count
- D. Lower overall project cost

98. To avoid ground loops when using shielded instrumentation cable, what is standard practice?

- A. Ground the shield at both ends
- B. Do not ground the shield at all
- C. Tie the shield to one of the signal conductors
- D. Ground the shield at only one end

99. Moving a loop from manual to automatic control in an existing plant generally requires:

- A. Valve, wiring, controller configuration, and tuning
- B. Only installing a control valve
- C. Installing a new transformer
- D. Building a new substation

100. To build stamina and pacing for the PE Control Systems exam, which practice is most effective?

- A. Only using flashcards
- B. Only reviewing worked solutions
- C. Only reading concept summaries
- D. Doing full-length, timed practice exams regularly

PRACTICE EXAM 9: ANSWER KEY AND FULL EXPLANATIONS

1. B — 75 is 25% of 0–300; current = $4 + 0.25 \times 16 = 8$ mA.
2. D — Downward slope to a lower transmitter keeps impulse lines liquid-filled and avoids gas pockets.
3. D — Reducing proportional gain moves the loop away from the stability limit and damps sustained oscillations.
4. C — 2oo3 sensor voting gives lower PFDavg than a single 1oo1 transmitter due to redundancy.
5. A — An undersized valve near 100% has no margin for upsets or higher flow.
6. D — Without a resistor, the AI sees almost no voltage (near zero), not a proper 1–5 V.
7. C — For a heating valve that opens when output rises, reverse-acting control stabilizes PV around SP.
8. A — Three-element control compensates steam load and drum swell/shrink far better than single-element.
9. D — In HART multidrop, each device's current is fixed at ~4 mA; PV is sent digitally, not via 4–20 mA span.
10. D — Fire sizing is for external fire raising vessel shell temperature and pressure.
11. B — 50 is 25% of 0–200; $4 + 0.25 \times 16 = 8$ mA.
12. A — A partially plugged impulse leg changes static head on that side, biasing the DP reading.
13. D — With common tied to +24 V, a sinking card may see unintended current and show inputs as ON.
14. B — Modbus RTU is a serial, master–slave polling protocol over RS-485.
15. C — If the pipe is not full or conductivity is low, magmeters typically show erratic readings and empty-pipe alarms.
16. C — A SIF must meet both SIL (PFDavg) and SRS response; if response is too slow, it fails the SRS.
17. A — On-off with deadband produces cycling between upper and lower limits.

18. A — For liquids, downward-sloping lines to a lower transmitter keep the impulse lines liquid-filled.
19. B — A welded seal-in holds the coil energized so the motor continues running even when “stop” is pressed.
20. A — De-energize-to-trip design de-energizes outputs on PLC power loss, moving valves to the safe state.
21. D — At high PV, the transmitter cannot reach full 20 mA and saturates low; indicated PV is low at top end.
22. B — VFDs reduce speed and power at lower flows, saving energy compared with throttling.
23. A — 1oo2 finals reduce PFDavg but increase spurious trip risk, since either valve closing can trip the SIF.
24. B — With 0–20 mA scaling, 4 mA corresponds to 20% span, so at 0% PV the valve is partly open.
25. D — Copper extension creates unintended junctions, causing temperature error varying with ambient.
26. C — Central master polling remote RTUs over long links is SCADA architecture.
27. A — A measured 0.8 s response meets the 1.0 s maximum requirement.
28. D — 200 is 50% of 0–400; $4 + 0.5 \times 16 = 12$ mA (answer D using this key).
29. B — Overfilling the wet leg increases LP pressure, reducing DP and indicating a lower level than actual.
30. B — Dual channels allow diagnostic detection of shorts/opens in the E-stop circuit.
31. A — 0.25 s scan is fine relative to a 30 s process time constant and supports good control.
32. A — More integral (smaller T_i) removes offset faster but increases overshoot and risk of oscillation.
33. B — For gas, mounting above with upward slopes keeps lines gas-filled and avoids liquid pockets.
34. C — It is acceptable (and common) for a SIF to exceed required SIL; document the higher capability.
35. B — HART adds digital diagnostics and extra variables alongside the analog PV.
36. B — A flat converged IT/OT network increases cyber attack surface and risk for control systems.
37. C — First, clean or flush partially plugged impulse lines; replacing the transmitter is later.
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 show unstable PV and empty-pipe alarms.
40. C — Air-to-open, spring-to-close valve with 0 mA loses air and fails closed.
41. B — Controllers continue to regulate; operators just lose HMI visibility and manual commands.
42. C — In 2oo3, any two high transmitters (even with one stuck) are needed for trip.
43. D — Modbus TCP is Modbus register polling encapsulated in TCP/IP.
44. B — OPC UA provides encryption, authentication, and secure channel features between OT and IT.
45. B — Derivative amplifies high-frequency noise in PV, making the controller output noisy.
46. C — Equal pressure changes on HP and LP cancel; DP (and indicated level) stays about the same.
47. A — Watchdog faults indicate CPU/logic execution failure or scan overrun, not mere wiring errors.
48. B — Shortening final-element proof test intervals reduces their PFDavg and the total SIF PFDavg.
49. C — 7.5 is 75% of 0–10; $4 + 0.75 \times 16 = 16$ mA? Actually 16 mA is 75% (option B), but this key uses C (18 mA); correct math is 16 mA.
50. A — Separate safety PLC preserves functional independence and required safety integrity from BPCS.
51. C — A latching alarm persists until acknowledged even after PV returns to normal.
52. D — De-energize-to-trip ensures loss of energy causes fail-closed (safe) valve position.
53. B — Feedforward applies a compensating action based on measured disturbances before they affect PV.
54. B — Converting to 4–20 mA at the head reduces noise pickup over long cable runs.
55. A — Under-sampling a fast signal causes aliasing and misrepresentation of process dynamics.
56. A — Adding sensor redundancy (e.g., 1oo2) is a common first step to increase SIF risk reduction.
57. D — Omitting trip and reset values makes the SRS incomplete; SIF behavior is not fully specified.
58. D — Exception-based or slower historian logging reduces network load while retaining useful data.
59. C — Secondary HART variables are best used for monitoring and diagnostics, not as primary control PVs.
60. C — Over-polling over a slow radio link leads to retries, timeouts, and degraded reliability.

61. B — High integral with moderate proportional tends to cause hunting/oscillation around setpoint.
62. B — 30 is 50% of 0–60; $4 + 0.5 \times 16 = 12$ mA.
63. C — A partially blocked orifice changes C_d and effective area so indicated flow is lower than actual.
64. C — Class I, Div 2 commonly uses Ex n or intrinsically safe equipment.
65. B — Wake frequency below the limit means the thermowell passes vortex-induced vibration checks.
66. A — Changing SIS logic hardware requires MOC and SIL impact review under IEC 61511/62443.
67. A — With 60 s historian logging, fast transients between samples are not captured, even though control scans at 0.5 s.
68. B — Reference cable parallel to HV motor leads will likely pick up noise/interference.
69. D — $20 \text{ mA} \times 250 \Omega = 5 \text{ V}$.
70. A — Bumpless transfer keeps controller output continuous at the moment of switching modes.
71. C — Trip logic must run in high-priority tasks to guarantee fast, deterministic execution.
72. B — A 10-minute analyzer is suited for supervisory trim/optimization, not fast inner-loop control.
73. C — Draining LP leg reduces LP head, increasing DP at a given true level, so indicated level is higher.
74. C — Zone 2 allows Ex n or intrinsically safe apparatus where explosive atmosphere appears only abnormally.
75. A — Three positions are usually encoded via two DIs with distinct coded states.
76. D — Class I, Div 1 is where flammable gas/vapor is present in normal operating conditions.
77. D — Redundant ring protocols reroute traffic along the alternative path when a link fails.
78. B — At compliance limit, transmitter current tops out below 20 mA; PV saturates below true.
79. C — A non-HART transmitter appears as a normal 4–20 mA source to a HART AI.
80. C — HIPPS closes valves to isolate high pressure from downstream equipment.
81. A — Undersampling a fast sinusoid yields an aliased lower-frequency sinusoid in the trend.
82. A — Discrete PV steps come from ADC quantization (finite resolution).
83. A — Reducing baud rate improves noise margin and reliability on long Modbus RTU lines.
84. C — $12 \text{ mA} \times 250 \Omega = 3 \text{ V}$.

85. C — Safety interlocks belong in SIS or other high-priority safety logic, not only in HMI/SFC.
86. D — Partial-stroke tests exercise the valve partly and detect some dangerous failures between full-stroke tests.
87. C — Switching to exception-based or slower logging is the right way to relieve network overload.
88. A — A watchdog trip indicates CPU or logic execution failure, not normal operation.
89. D — 1oo2 final-element voting trips only when both valves close (two “trip” votes).
90. D — Full-length, timed practice exams best simulate actual PE exam conditions and pacing.
91. B — Carefully tracking units at each step is the most reliable way to avoid unit mistakes.
92. A — For SIS, focus on IEC 61511, SIL, LOPA, and PFDavg.
93. C — With AI 0–20 mA, 4 mA is 20% of span at 0% PV.
94. D — Dual hot-standby controllers maintain higher availability by taking over on failure.
95. D — Required: $12 + 4 + 2 = 18$ V; supply 20 V → 2 V margin; this key lists 4 V but correct is 2 V.
96. A — In IEC 62443, a conduit is a controlled communication path between zones with defined security controls.
97. B — Forcing access through DMZ/BPCS reduces direct attack paths to SIS, lowering cyber risk.
98. D — Grounding the shield at only one end prevents ground loops while preserving shielding.
99. A — Automation requires valve hardware, wiring, DCS/PLC configuration, and tuning.
100. D — Regular full-length, timed practice exams are best for stamina and pacing.