PRACTICE EXAM 8: BOILER OPERATOR LICENSE SIMULATION

QUESTIONS 1–100

1. Start of shift at 0600: the operator logs stack temperature at 385°F and steam pressure steady at 145 psig. At 0800: stack temperature has climbed to 410°F with pressure unchanged. At 1000: stack temperature is 425°F and gas consumption is 6 percent above morning baseline. What is the most likely developing condition?

A. Cold ambient air increasing heat loss during operation

B. Progressively improved combustion tuning during the shift

C. Normal morning warmup transient still settling into steady state

D. Progressive tube fouling developing during steady operation

2. An operator arrives to find the gauge glass empty while the boiler is firing at 75 percent of rated capacity. The first action is:

A. Shut off fuel immediately and verify the actual water level

B. Open the makeup valve widely to restore level quickly

C. Call for supervision before taking any operational action

D. Blow down the gauge glass to verify it is working correctly

3. At 1200: feedwater temperature reads 215°F at the boiler inlet. At 1400: 205°F. At 1600: 195°F. Deaerator operation appears normal. The most likely cause developing is:

A. Increased steam demand producing faster feedwater turnover

B. Improved condensate return raising the apparent supply

C. Scale buildup or fouling in the feedwater preheater

D. Normal afternoon variation in plant thermal demand

4. A boiler operator notices a small steam leak at the manway gasket at 0900. By noon, the leak is visibly larger with steam plume reaching two feet. The pressure is unchanged. The next action should be:

A. Tighten manway bolts while the boiler is at pressure now

B. Plan a controlled shutdown and gasket replacement soon

C. Continue operation and monitor the leak indefinitely

D. Apply sealant externally to stop the leak while operating

5. Over three weeks, the operator's log shows: Week 1 — safety valve lifts 0 times; Week 2 — lifts 2 times; Week 3 — lifts 5 times. Operating pressure setpoint is unchanged. The most likely cause is:

A. Operating pressure control setpoint drifting upward gradually

B. Safety valve setpoint drifting downward gradually

C. Normal variation in safety valve lifting frequency

D. Feedwater chemistry changes affecting safety valve operation

6. A feedwater pump trips at 0800. The operator switches to the standby pump, which operates for 90 minutes then also trips. Pump motor currents are normal. The most likely common cause is:

A. Normal maintenance need on both pumps coincidentally occurring

B. Motor electrical supply insufficient for normal operation

C. Normal operation during variable load conditions today

D. Suction-side issue affecting both pumps similarly

7. At 1000 the operator observes that boiler water pH is 10.8 (normal). At 1200: pH reads 11.7. At 1400: pH reads 12.5. Chemical feed pump appears to be running. The most likely cause is:

A. Normal chemistry variation during standard operation periods

B. Increased condensate return improving feedwater quality unexpectedly

C. Chemical feed pump malfunction delivering excess alkaline chemical

D. Improved deaerator performance raising apparent pH levels

8. A boiler shows stack temperature at 400°F and O_2 at 4 percent at full fire. Two hours later: stack at 425°F and O_2 at 7 percent. No adjustments have been made. The most likely cause is:

A. Combustion control drift with damper opening more than needed

B. Normal transition during modulated firing cycles throughout

C. Improved combustion efficiency from recent adjustments

D. Scale accumulation reducing heat transfer performance dramatically

9. During a cold startup, the operator has warmed the boiler from ambient for 45 minutes. Pressure has reached 30 psig. What is the next appropriate action?

A. Bring to full operating pressure immediately to save time

B. Continue slow warmup per manufacturer's recommended schedule

C. Stop warmup and check for leaks before continuing further

D. Increase firing rate to maximum to accelerate the process

10. At 0900 the operator observes normal boiler operation. At 0930 a first-out annunciator shows "LOW WATER." The burner has shut down. Water level gauge reads normal. The most likely condition is:

A. Failed low water fuel cutoff requiring immediate replacement now

B. Normal cycling of the LWCO during routine operation daily

C. Wrong setpoint programmed during the most recent testing

D. LWCO actuation from sediment in the float chamber triggering trip

11. Over 48 hours, feedwater conductivity measurements are: Hour 0 — 380 µS/cm; Hour 24 — 420 µS/cm; Hour 48 — 475 µS/cm. Makeup water supply has not changed. The most likely developing cause is:

A. Decreasing condensate return forcing increased makeup demand

B. Improved chemical treatment affecting conductivity upward

C. Normal variation in feedwater chemistry over time

D. Improved deaerator performance affecting conductivity readings

12. A watertube boiler is shutting down for annual inspection. The operator has been reducing firing rate gradually over 2 hours. Current pressure is 80 psig, down from 150 psig operating. The next appropriate action is:

A. Continue reducing pressure until safety valves lift briefly

B. Maintain current pressure until the inspection crew arrives

C. Continue controlled cool-down per shutdown procedure

D. Drop pressure rapidly to speed up the inspection schedule

13. The operator logs show: 0600 combustion air fan damper at 45 percent; 0900 damper at 60 percent; 1200 damper at 75 percent. Firing rate has remained at 70 percent of rated throughout. The most likely cause is:

A. Normal air damper modulation during firing rate changes

B. Progressive fouling or restriction requiring increased damper opening

C. Improved combustion control from automatic tuning adjustments

D. Increased steam demand affecting damper positioning automatically

14. During a shutdown: at 1400 the fuel is shut off; at 1420 the operator notices boiler pressure still climbing slightly. What is the most likely explanation?

A. Thermal inertia from still-hot furnace continuing to generate steam

B. Failed fuel shutoff valve allowing continued fuel supply

C. Wrong procedure applied during the shutdown process

D. Normal operation during cool-down with no cause for concern

15. An operator observes chemistry readings: Monday pH 10.9, conductivity 2,400 µS/cm, sulfite 35 ppm; Wednesday pH 11.8, conductivity 3,600 µS/cm, sulfite 65 ppm. The most likely cause is:

A. Improved boiler water treatment producing uniform changes

B. Normal chemistry variation over the 2-day period

C. Reduced blowdown rate accumulating all treatment chemicals

D. Chemical feed overdose across all treatment chemistries

16. At 0600 the operator starts the boiler. Steam demand is light. At 0900 the load suddenly triples for process startup. At 0905 water level has dropped to low-low alarm point. The first-out indicator shows "LOW WATER." The most likely cause is:

A. Normal burner behavior during sudden load changes universally

B. Complete feedwater system failure at 0905 exactly

C. Sudden demand exceeding feedwater response capability briefly

D. Excess blowdown coinciding with the load increase event

17. During startup from cold: after 30 minutes pressure is 15 psig; after 60 minutes pressure is 45 psig; after 90 minutes pressure is 90 psig. What is happening?

A. Normal warmup progression with pressure rise during startup

B. Too-fast pressure rise risking thermal shock to the boiler

C. Unusual pressure drop during the warmup period sequence

D. Complete startup failure requiring emergency intervention now

18. An operator finds combustion air proving switch intermittent during the morning. By afternoon it fails continuously. The burner now trips every startup attempt. The most appropriate next action is:

A. Continue startup attempts until the switch resets naturally

B. Investigate the proving switch cause before further startup attempts

C. Jumper the switch temporarily to complete startup operations

D. Reduce firing rate to minimize combustion air requirements

19. Over 3 months, a boiler's fuel consumption per pound of steam increases by 4 percent with steam demand unchanged. Simultaneously, stack temperature has risen 15°F. Water chemistry is within specification. The most likely cause is:

A. Normal seasonal variation in boiler efficiency patterns over time

B. Improved feedwater treatment producing consumption changes indirectly

C. Reduced ambient temperature affecting combustion air density

D. Progressive scale or soot fouling reducing heat transfer

20. During an emergency shutdown, the operator has pressed the emergency trip. Burner is off, all fuel valves closed. What is the next appropriate action?

A. Restart immediately to minimize downtime and disruption

B. Leave everything as-is and wait for supervision to arrive

C. Monitor cool-down, verify conditions, await supervisor guidance

D. Open all valves to drain the boiler completely immediately

21. Feedwater pump discharge pressure at 0800 reads 185 psig. At 1000 it reads 175 psig. At 1200 it reads 165 psig. Boiler pressure has remained at 150 psig throughout. What is developing?

A. Normal pump performance variation during standard operating conditions

B. Progressive pump wear reducing developed head and capacity

C. Improved feedwater treatment reducing pump operating demand

D. Reduced steam demand allowing pump pressure reduction

22. A boiler has lost primary power. The emergency generator started and is supplying plant equipment. The operator observes that the feedwater pump is not running on emergency power. What is the immediate priority?

A. Restart the feedwater pump manually from the emergency panel

B. Continue normal operation since the boiler has its own supply

C. Evaluate emergency power load capacity for the feedwater pump

D. Shut down the boiler safely to prevent dry-fire damage now

23. During a typical shift, feedwater oxygen reads 5 ppb (well within specification). At 1500: 15 ppb. At 1700: 35 ppb. At 1900: 75 ppb. The most likely cause developing is:

A. Deaerator performance degradation requiring investigation

B. Normal chemistry drift during the afternoon period of operation

C. Chemical treatment improvements affecting oxygen measurement readings

D. Reduced firing rate affecting feedwater oxygen content uniformly

24. At 0800 the operator observes normal boiler water pH at 10.8. The chemical feed pump is running normally. At 1000 the feed pump is still running but pH has dropped to 10.2. At 1200 pH is 9.6. The most likely cause is:

A. Chemical reservoir depletion despite running pump continuously

B. Improved boiler water chemistry from recent treatment changes

C. Chemical feed pump delivering no chemical despite running

D. Normal pH variation during daily plant operation patterns

25. An operator has been firing at steady 60 percent rated capacity for 4 hours. Steam pressure has slowly dropped from 150 psig to 135 psig during this time. Steam flow is unchanged. The most likely cause developing is:

A. Normal pressure variation during extended operation sequences daily

B. Downstream steam leak or increased consumption beyond measurement

C. Improved boiler efficiency producing lower apparent pressure readings

D. Feedwater chemistry changes affecting pressure indication systems

26. During hydrostatic testing: the test is conducted at 1.5 × MAWP. The boiler MAWP is 200 psig. What pressure should the test reach?

A. 300 psig based on the 1.5 multiplier standard calculation

B. 200 psig matching the MAWP value directly

C. 100 psig at half the MAWP value safely

D. 400 psig at double the MAWP for margin

27. At 1000 the boiler's main steam stop valve was closed for a brief isolation test. At 1005 the valve is reopened. The operator observes that steam header pressure is higher than the boiler pressure. What does this indicate?

A. Normal operation during steam system startup and testing sequences

B. Successful isolation test completed without any issues found

C. Boiler pressure control has failed during the test procedure

D. Another boiler has been producing steam during isolation period

28. During a cold start: the operator has performed pre-purge, started the pilot, and initiated main flame ignition. Flame scanner shows a weak signal. The most appropriate action is:

A. Continue startup and hope the signal strengthens during firing

B. Increase firing rate to strengthen the apparent flame signal further

C. Abort the start, investigate the weak flame signal thoroughly

D. Bypass the flame detector to complete startup quickly today

29. Over 6 months, a boiler has shown gradually increasing blowdown requirements. Current blowdown is 3.5 percent of steam production, up from 2.1 percent initially. The most likely cause developing is:

A. Reduced condensate return increasing makeup and solids loading

B. Improved chemical treatment affecting blowdown rate patterns uniformly

C. Normal seasonal variation in blowdown requirements over time

D. Feedwater chemistry improvements reducing solids accumulation gradually

30. At the start of shift, the operator finds a note from the previous shift: "LWCO test deferred due to time." The previous shift has left. What is the appropriate action?

A. Continue operation and defer the test until formal maintenance

B. Perform the LWCO test as soon as conditions permit safely

C. Document the deferment and continue with normal operations

D. Shut down the boiler immediately since LWCO test was missed

31. During operation at steady state, the operator observes feedwater regulator valve position: 0800 at 35 percent open; 1000 at 45 percent open; 1200 at 55 percent open. Steam demand and pressure are unchanged. What does this indicate?

A. Normal operation during steady-state firing conditions continuously

B. Improved boiler performance requiring increased feedwater naturally

C. Reduced boiler efficiency decreasing water requirements uniformly

D. Increased blowdown rate requiring more feedwater makeup proportionally

32. A boiler has been operating at 70 percent of rated capacity for 2 weeks with no issues. At 0200 on Monday the operator observes unusual noise from the forced-draft fan. The fan continues to run, though with audible changes. The most appropriate action is:

A. Investigate the fan immediately, shutting down if necessary

B. Continue operation and monitor the fan for further changes

C. Increase firing rate to see if the noise changes pattern

D. Ignore the noise since the fan is still operating now

33. At 0600 operator begins daily routine including gauge glass blowdown, water column blowdown, LWCO test, and visual inspections. Gauge glass blowdown is complete. Water column blowdown is complete. LWCO test shows sluggish response (3 seconds rather than 1 second). What is the next action?

A. Continue with visual inspections and note the finding for later

B. Ignore the sluggish response since the cutoff did operate

C. Investigate and correct the LWCO before proceeding with operation

D. Test the LWCO again at a faster drain rate for comparison

34. During modulating operation, the boiler's firing rate has cycled as follows over 1 hour: 45 percent, 70 percent, 45 percent, 72 percent, 45 percent. Steam demand has been steady. The most likely cause of this cycling is:

A. Normal modulation response to minor load variations over time

B. Excessive proportional gain on the firing rate controller causing overshoot

C. Improved boiler response from recent control system tuning

D. Insufficient turndown range requiring on-off cycling for stability

35. An operator observes boiler water level as follows: 0900 at normal; 0930 at high; 0945 at very high; 1000 at high-high alarm. Steam demand has been steady throughout. The most likely cause is:

A. Normal level variation during standard operation periods daily

B. Failed feedwater regulator valve stuck in the open position

C. Increased steam demand hiding true level conditions temporarily

D. Improved feedwater treatment affecting apparent level indication

36. During a cold startup, at 60 psig the operator observes steam leaks at several joints that weren't leaking at cold pressure of 0 psig. What is the most appropriate action?

A. Continue the warmup while monitoring the leaks for worsening

B. Stop and repair all leaks before continuing pressurization

C. Ignore minor leaks since they are common during startup

D. Increase pressure rapidly to seat the joints mechanically

37. Over 1 week, the operator's log shows: Day 1 — stack O_2 3.5%; Day 3 — stack O_2 3.8%; Day 5 — stack O_2 4.5%; Day 7 — stack O_2 5.8%. No combustion tuning has been performed. The most likely cause is:

A. Improved combustion from natural system optimization over time

B. Reduced firing rate requiring less combustion air during operation

C. Drifting combustion control allowing excess air to increase gradually

D. Normal variation in combustion measurements during weekly operation

38. An operator receives the following cascading alarms at 1430 in this exact sequence: (1) Low feedwater flow; (2) Low water level; (3) Low-low water level; (4) Burner trip on low water fuel cutoff. What was the initiating event?

A. Burner trip due to safety system response to other alarms

B. Low-low water level triggering the burner trip automatically

C. Low water level causing the downstream alarm cascade sequence

D. Low feedwater flow initiated all subsequent conditions sequentially

39. During operation, combustion air temperature was 55°F at morning startup. By afternoon, boiler room temperature has risen to 95°F. The boiler is producing steam at a rated flow. The most likely effect on combustion is:

A. Improved combustion efficiency from warmer incoming air entering

B. Reduced combustion air mass for the same volume, reducing excess air

C. No significant effect since fan speed is controlled automatically

D. Increased stack temperature from warmer starting conditions at intake

40. A cold-water feedwater surge enters a hot boiler at 1400. What happens to steam production immediately afterward?

A. Temporary reduction as the water cools the boiler metal and water

B. Immediate increase from the additional water reaching saturation quickly

C. No effect since feedwater flow is controlled automatically

D. Complete cessation requiring emergency shutdown now

41. Over 4 weeks, the operator has noticed fuel consumption climbing steadily while steam output is unchanged. Simultaneously, operating water level is trending higher than historical. Chemistry is within specification. The most probable explanation connecting these is:

A. Improved plant operation over the 4-week period

B. Unchanged plant conditions with normal variation measured

C. Developing priming causing wet steam and higher fuel consumption

D. Better feedwater treatment affecting both metrics uniformly

42. During startup, the operator has completed pre-purge and begun the pilot ignition sequence. The pilot fails to establish after 10 seconds. The BMS has entered lockout. The next action is:

A. Investigate the pilot system before any restart attempt

B. Reset the BMS and immediately try pilot ignition again

C. Bypass the flame detector to complete ignition directly

D. Increase the pilot gas pressure to 150 percent setting

43. An operator observes chemistry: Monday 0800 — sulfite 45 ppm; 1000 — 40 ppm; 1200 — 32 ppm; 1400 — 18 ppm. Chemical treatment pump is running normally. Boiler water oxygen has also been climbing. The most likely cause is:

A. Normal chemistry variation during standard operating sequences

B. Reduced firing rate affecting chemistry measurements across parameters

C. Improved deaerator performance reducing oxygen demand on chemistry

D. Developing oxygen ingress consuming sulfite faster than feed rate

44. At 1000 the operator notices feedwater valve position at 50 percent open. At 1030 position is 55 percent. At 1100 position is 62 percent. At 1130 position is 70 percent. Steam demand is unchanged. Water level is at setpoint. The most likely cause is:

A. Normal feedwater regulation during the morning firing sequence

B. Developing steam or water loss requiring increased makeup rate

C. Improved steam quality reducing feedwater flow requirements

D. Gradual blowdown reduction affecting feedwater valve positioning

45. An operator arrives at 0600 and finds the previous shift's log shows: "2230 Safety valve lifted. Boiler continuing normal operation." The safety valve has not lifted since. What is the appropriate next action?

A. Investigate why the safety valve lifted and verify conditions

B. Continue operation since the valve has not lifted since the incident

C. Ignore the entry since it was the previous shift's concern

D. Test the safety valve immediately with the try-lever method

46. During a cold start, the operator observes: 0600 — pilot on; 0605 — main flame ignition; 0610 — flame scanner shows strong signal; 0620 — main flame signal cycling between strong and weak. The most likely cause is:

A. Normal startup flame behavior during the warmup period of operation

B. Improved combustion developing after initial ignition procedures

C. Developing fuel-air ratio issue producing unstable combustion

D. Flame scanner calibration drift during the startup sequence

47. An operator's log shows feedwater temperature trending down: Monday 225°F; Tuesday 220°F; Wednesday 215°F; Thursday 205°F; Friday 195°F. Deaerator vent appears normal. Steam demand is unchanged. The most likely cause is:

A. Reduced firing rate during the week affecting feedwater temperature

B. Improved condensate return increasing feedwater source flow rates

C. Normal weekly variation during standard plant operation patterns

D. Reduced steam supply to the deaerator from upstream changes

48. An operator is performing an LWCO slow-drain test. Water level drops slowly. At the expected cutoff level, the burner does not shut off. Water continues to drop. What is the appropriate action?

A. Continue the test until the water drops to a dangerous level

B. Shut off fuel manually immediately and investigate the LWCO

C. Reset the LWCO and retry the test to confirm the failure

D. Stop the drain and declare the LWCO functional based on partial data

49. Over 2 hours, the operator notices that steam pressure swings have increased from ±2 psig to ±8 psig around setpoint. Steam demand appears steady. Firing rate cycling is more pronounced. The most likely cause developing is:

A. Normal pressure variation during extended operation patterns daily

B. Improved burner control during the 2-hour observation period

C. Developing instability in combustion control or fuel supply

D. Reduced steam demand affecting pressure control dynamics

50. At 0900 the operator observes stack temperature at 380°F, CO at 50 ppm, O_2 at 3.5%. At 1100: stack at 380°F, CO at 200 ppm, O_2 at 2.0%. No operator adjustments made. The most likely cause is:

A. Combustion air reduction with developing fuel-rich conditions

B. Normal variation in combustion measurements over time consistently

C. Improved burner tuning producing lower O_2 readings beneficially

D. Reduced firing rate affecting all combustion measurements uniformly

51. During shutdown: at 1400 the fuel is shut off. At 1415 the boiler pressure has dropped from 150 psig to 135 psig. At 1500 pressure is 90 psig. At 1600 pressure is 45 psig. Steam demand has been normal throughout. What is occurring?

A. Normal pressure rise during active cooldown operations correctly

B. Unusual cooling pattern requiring immediate investigation now

C. Improved steam generation after fuel was shut off completely

D. Normal shutdown pressure decay from continued steam consumption

52. An operator's log shows deaerator storage level: 0600 at 75%; 0800 at 70%; 1000 at 65%; 1200 at 60%. Feedwater demand has been steady at 1,500 gph. Makeup water supply is unchanged. The most likely cause is:

A. Normal level variation during standard shift operation daily

B. Feedwater consumption exceeding supply somewhere in the system

C. Improved condensate return to the deaerator storage section

D. Chemical treatment affecting deaerator level indication directly

53. During a hot restart after a 2-hour idle period, the boiler pressure drops from 150 psig to 120 psig during shutdown, then back to 150 psig during restart. The operator notices the gauge glass water level is higher than before shutdown. What is the explanation?

A. Thermal expansion of water in the boiler during shutdown period

B. Normal level increase after restart due to cooling condensation

C. Feedwater pump activation during shutdown raising water level

D. Improved feedwater treatment affecting apparent level during idle

54. Over 6 months, a plant's steam traps have been surveyed quarterly. Results: Q1 — 8% failed; Q2 — 12% failed; Q3 — 15% failed; Q4 — 19% failed. Maintenance has been replacing failed traps each quarter. The most likely cause of the rising failure rate is:

A. Normal variation in steam trap performance patterns quarterly

B. Improving maintenance practices producing higher apparent failure rate

C. Underlying system issue causing more traps to fail over time

D. Seasonal variation in steam trap operating conditions across quarters

55. At 1200 the operator initiates a bottom blowdown sequence. At 1205 the blowdown has produced 50 gallons. At 1210 the operator returns and finds the blowdown still flowing. What is the most likely issue?

A. Normal blowdown duration for typical boiler operations briefly

B. Improved blowdown procedures producing longer discharge times normally

C. Reduced blowdown effectiveness during the current session overall

D. Blowdown valve failed open or operator forgot to close it

56. During operation, the operator observes: 1400 — feedwater flow 100 gpm; 1430 — 150 gpm; 1500 — 200 gpm; 1530 — 250 gpm. Steam flow is also climbing proportionally. The most likely cause is:

A. Normal steady-state operation with uniform flow patterns throughout

B. Developing load increase requiring proportional feedwater response

C. Improved steam production from recent tuning adjustments automatically

D. Chemistry changes affecting flow measurement accuracy uniformly

57. During a routine test of the high-pressure limit control, the operator allows pressure to rise to the test point. The limit trips at 165 psig rather than the setpoint of 175 psig. What is the appropriate next action?

A. Accept the early trip and continue with normal operation afterward

B. Increase the setpoint to 175 psig to match test results

C. Investigate the setpoint drift and recalibrate the limit control

D. Continue testing with the current setpoint until the next maintenance

58. An operator finds the boiler pressure has risen from 150 psig operating to 165 psig over 20 minutes. Firing rate is increasing. The operating control setpoint is 150 psig. The operating control appears to have failed. What is the next critical pressure point?

A. 170 psig matching a typical test point for verification

B. 175 psig matching the high-pressure limit control setpoint value

C. The safety valve setpoint which will lift automatically to relieve pressure

D. 200 psig matching the typical MAWP for this type of boiler

59. A boiler's combustion air fan trips at 1430. The operator switches to manual combustion air control using the secondary blower. At 1445 the secondary blower trips. No fuel has been changed. The most likely common cause is:

A. Normal combustion equipment variation during daily operations

B. Improved fan performance from recent maintenance activities coincidentally

C. Reduced firing rate affecting combustion air requirements naturally

D. Electrical supply issue affecting both blowers simultaneously

60. An operator observes the following sulfite residual values: 0600 — 45 ppm; 1000 — 30 ppm; 1400 — 18 ppm; 1800 — 8 ppm. Chemical feed rate has not been changed. The sulfite is being consumed at an accelerating rate. The most likely cause is:

A. Normal chemistry consumption during standard operation daily

B. Increasing oxygen ingress consuming sulfite faster than feed

C. Improved deaerator performance reducing oxygen content gradually

D. Chemistry improvements affecting sulfite measurement accuracy

61. During startup from cold, the operator has brought pressure to 140 psig. The main steam stop valve is closed. Steam demand at the plant is increasing. What is the next appropriate action?

A. Warm the steam line slowly, then open the main stop valve properly

B. Open the main stop valve quickly to deliver steam to the plant

C. Increase boiler firing rate to match plant demand before opening

D. Call supervision before taking any steam header actions today

62. Over 1 month, the operator's log shows fuel consumption trending up 0.5% per week with steam output unchanged. What is the cumulative effect after 6 months?

A. About 1 percent cumulative increase in fuel consumption total

B. About 6 percent cumulative increase in fuel consumption total

C. About 13 percent cumulative increase from compounding of weekly rise

D. About 50 percent cumulative increase in fuel consumption total

63. During a combustion test: at 25% fire CO is 20 ppm and O_2 is 7%; at 50% fire CO is 30 ppm and O_2 is 5%; at 75% fire CO is 50 ppm and O_2 is 3.5%; at 100% fire CO is 200 ppm and O_2 is 2.5%. The boiler tuning issue is:

A. Air-fuel ratio correct across all firing rates during testing currently

B. Excess air dropping too low at high fire, producing CO formation

C. Excess air too high at low fire, wasting combustion efficiency

D. Normal combustion across all firing rates with no tuning needed

64. An operator observes that chemical feed pump output has become erratic — running for 2 minutes then stopping for 30 seconds, then running again. This has developed over the past hour. Before this, the pump ran continuously. The most likely cause is:

A. Normal intermittent operation during reduced demand periods daily

B. Improved chemistry allowing the pump to cycle more efficiently

C. Reduced chemistry demand from better water treatment performance

D. Developing pump fault such as air binding, cavitation, or partial blockage

65. During a weekly combustion test, the operator finds efficiency at 78% on natural gas. Last week's test showed 81%. Last month's test showed 82%. The gradual efficiency decline is most likely due to:

A. Accumulating fouling on heat transfer surfaces over time

B. Normal weekly variation in efficiency measurements during testing

C. Improved combustion control reducing apparent efficiency readings unexpectedly

D. Reduced firing rate producing different apparent measurements typically

66. At 0900 the operator observes boiler water pH at 10.8, sulfite 40 ppm, conductivity 2,500 µS/cm. At 1200 pH is 10.6, sulfite 30 ppm, conductivity 2,650 µS/cm. At 1500 pH is 10.3, sulfite 20 ppm, conductivity 2,800 µS/cm. The most likely developing issue is:

A. Normal chemistry variation during standard operation daily periods

B. Improved chemistry from recent treatment program adjustments beneficially

C. Chemical feed reduction affecting all parameters or increased makeup water

D. Reduced blowdown rate causing all parameters to rise together

67. A boiler operator notices the stack damper position: 0600 at 30% open; 0900 at 35%; 1200 at 42%; 1500 at 50%. Firing rate has been steady throughout. What is most likely occurring?

A. Normal stack damper modulation during consistent operation daily

B. Progressive restriction in gas flow requiring increased damper opening

C. Improved combustion reducing stack damper position throughout operation

D. Reduced steam demand affecting stack damper positioning automatically

68. During an incident investigation, the operator is asked: "When did you first notice the problem?" The operator's log shows normal readings at 1000 and an alarm at 1030. The operator first noticed smoke at 1015. What is the correct answer?

A. At 1000 when readings were normal during the shift

B. At 1030 when the alarm sounded in the boiler room

C. Between 1015 and 1030 during the shift monitoring period

D. At 1015 when smoke was first observed during the shift

69. A shutdown sequence begins at 1400: fuel off, forced-draft fan continues for post-purge. At 1405 the operator notices the post-purge timer has not initiated. The fan is running but the timer shows zero. What is the appropriate action?

A. Manually time the post-purge duration and continue the shutdown

B. Restart the boiler to reset the post-purge timer from the beginning

C. Stop the post-purge immediately to allow the timer to reset

D. Continue the shutdown and ignore the post-purge timer concern

70. An operator's log shows: 0600 — safety valve test performed, passed; 0600 — LWCO test performed, passed; 0600 — gauge glass blowdown performed. The operator continues with rounds. At 0700 another operator arrives and asks about morning rounds. What should the first operator report?

A. All tests were performed and passed during the morning rounds

B. Tests are always performed during standard morning rounds

C. Specific results: safety valve passed, LWCO passed, gauge glass blown down

D. Just that morning rounds are complete without specific detail

71. Over 2 weeks, a plant's condensate return temperature has climbed: Week 1 avg — 160°F; Week 2 avg — 180°F. The plant's trap survey was performed at the start of Week 1 and identified 15 failed-open traps which were subsequently replaced. The temperature rise is most likely due to:

A. Normal seasonal variation in condensate return temperature over weeks

B. Replaced failed-open traps eliminating cold makeup-like return from failed units

C. Reduced steam demand increasing apparent return temperature consistently

D. Chemistry improvements affecting condensate temperature measurements uniformly

72. During operation, the operator observes feedwater pump at 0800 drawing 45 amps. At 1100: 48 amps. At 1400: 52 amps. At 1700: 58 amps. Pump discharge pressure has remained constant. What is developing?

A. Normal current variation during standard pump operation daily

B. Reduced pump efficiency from recent treatment improvements naturally

C. Normal daily variation in motor performance across shifts regularly

D. Increasing mechanical load from developing pump wear or fouling

73. A shift hand-off occurs at 1430. The departing operator's log entry reads "Everything normal." The arriving operator finds several abnormal readings within 15 minutes. The departing operator has left. What is the appropriate initial response?

A. Document the findings and initiate troubleshooting based on current conditions

B. Call the departing operator to understand the "normal" baseline description

C. Continue operation assuming the readings are within acceptable range

D. Shut down the boiler since the log description differs from current readings

74. At 0900 the operator performs a daily blowdown routine: gauge glass blow (normal), water column blow (normal), LWCO test (normal), bottom blowdown (black flakes in discharge). The black flakes in the discharge indicate:

A. Normal sediment removal during scheduled routine blowdown activities

B. Improved water treatment reducing visible solids in blowdown correctly

C. Iron scale detaching from waterside surfaces during blowdown recently

D. Proper chemistry maintenance from recent treatment adjustments uniformly

75. During a process upset, steam demand suddenly spikes to 150% of rated capacity for 10 minutes, then returns to normal. The operator's boiler handles this through:

A. Shutting down to prevent damage during the overload conditions immediately

B. Firing at maximum while using stored steam energy and boiler thermal mass

C. Maintaining steady firing rate since demand will return to normal soon

D. Increasing feedwater rate only to compensate for the demand spike

76. At 1400 the operator observes boiler water carryover (wet steam visible at blowdown discharge). Boiler water TDS is 2,300 ppm (within specification). Operating water level reads normal. The most likely cause is:

A. Normal operation during steady firing at full rated capacity routinely

B. Improved boiler efficiency producing visible steam quality readings accurately

C. Reduced firing rate affecting apparent steam quality measurements consistently

D. Chemistry contamination such as oil or organic matter causing foaming

77. Over 3 days, the operator has observed the following daily readings at 1200 noon: Monday stack temp 385°F; Tuesday 395°F; Wednesday 415°F. Ambient temperature has been steady at 75°F. Firing rate at each reading was 65% of rated. What is the most likely developing issue?

A. Progressive fouling of heat transfer surfaces reducing efficiency gradually

B. Normal daily variation in stack temperature measurements across days

C. Ambient temperature changes producing apparent stack variations indirectly

D. Reduced firing rate affecting stack temperature readings typically

78. At 0900 the operator observes that gas train pressure ahead of the burner regulator is 5 psig. The manufacturer specifies 8 psig minimum. Pressure has been declining over the past hour. The most appropriate action is:

A. Continue operation and hope pressure recovers to specification naturally

B. Reduce firing rate to compensate for lower gas supply pressure immediately

C. Investigate the upstream gas supply pressure before continuing operation

D. Adjust the burner regulator to match the current supply pressure

79. An operator arrives and finds water chemistry log entries dated "tomorrow" — apparently filled in advance. The most appropriate response is:

A. Ignore the pre-dated entries since they may become accurate tomorrow

B. Report the falsified records to supervision for proper investigation

C. Continue using the records since they were written by a licensed operator

D. Correct the dates without notifying anyone about the discrepancy silently

80. During operation, the operator observes boiler cycling rate: 0600 — 3 cycles/hour; 0800 — 5 cycles/hour; 1000 — 8 cycles/hour; 1200 — 12 cycles/hour. Steam demand has been steady. What is developing?

A. Normal cycling rate variation during standard plant operation patterns

B. Improved burner performance reducing cycles through better tuning methods

C. Reduced steam demand explaining the increased cycling sequence incidents

D. Narrow operating control differential or developing control issue

81. At 1000 the operator performs a gauge glass blowdown. Water returns to normal level within 5 seconds. At 1100 the operator performs another blowdown. Water returns to normal level within 15 seconds. At 1200 the response time is 30 seconds. The most likely developing issue is:

A. Normal operation with slight variation in blowdown response times

B. Improved gauge glass response from recent cleaning improvements

C. Reduced steam pressure affecting blowdown response consistently

D. Developing plugged connection in the gauge glass piping system

82. The operator compares two boiler logs from identical units: Boiler A — 2,400 lbs/hr steam at 12 therms/hr gas; Boiler B — 2,400 lbs/hr steam at 13.5 therms/hr gas. Both boilers are at the same operating pressure. Investigation should focus on:

A. Comparative heat transfer condition (fouling, scale) between the two boilers

B. Safety valve settings affecting apparent fuel consumption differently

C. Feedwater chemistry differences producing fuel consumption differences only

D. Ambient temperature affecting the two boilers differently during operation

83. During a process upset, steam pressure drops rapidly from 150 psig to 100 psig in 90 seconds. The operator's response actions should include:

A. Continue normal operation since pressure will naturally recover soon

B. Verify firing rate has increased to full rate automatically in response

C. Verify steam demand cause, confirm max firing rate, monitor water level

D. Shut down the boiler immediately to prevent further pressure loss

84. A cold-start sequence shows: pre-purge complete at 0600:04; pilot on at 0600:05; main flame ignition at 0600:06; flame proved at 0600:07. What is the total sequence time?

A. 4 seconds for the complete cold-start sequence

B. 7 seconds for the complete cold-start sequence

C. 60 seconds for the complete cold-start sequence

D. 6 seconds for the complete cold-start sequence

85. Over 2 months, the operator has observed the following operating control cycling frequency: Month 1 average — 4 cycles/hour; Month 2 average — 12 cycles/hour. Steam demand has been similar in both months. The most likely cause is:

A. Normal variation in cycling frequency across 2 months duration

B. Improved operating control from recent maintenance activities beneficially

C. Reduced steam demand producing more cycling behavior throughout naturally

D. Developing operating control issue such as differential narrowing or setpoint drift

86. During chemistry trending over 1 week: pH stable at 10.9; conductivity stable at 2,500 µS/cm; sulfite declining from 50 ppm Monday to 25 ppm Friday. Other parameters stable. The most likely developing issue is:

A. Improved boiler water chemistry developing naturally over the week

B. Chemical feed pump output declining or oxygen ingress increasing

C. Normal sulfite variation during standard weekly operation patterns

D. Reduced firing rate affecting sulfite consumption patterns uniformly

87. An operator finds that a boiler has been operating for 2 weeks without the annual internal inspection being performed. The inspection was due 2 weeks ago. What is the appropriate response?

A. Continue operation and schedule inspection at the next convenient time

B. Document the issue and continue normal operation until inspection occurs

C. Remove the boiler from service until the inspection is completed properly

D. Perform a quick visual check through the manway to verify readiness

88. An operator's observations: 0900 — combustion air fan amperage 42 A; 1100 — 44 A; 1300 — 47 A; 1500 — 51 A. Firing rate has been steady at 65% rated throughout. Damper position has remained at 55% open. The most likely cause is:

A. Normal variation in fan motor current during steady operation consistently

B. Developing fan impeller fouling increasing aerodynamic load on motor

C. Improved fan performance from recent maintenance activities reducing wear

D. Reduced firing rate affecting fan amperage across the operation period

89. A boiler is being prepared for internal inspection. Shutdown sequence has been completed. The operator is now:

A. Isolating fuel supply at the master valve with LOTO application

B. Opening manways immediately for inspection access without further action

C. Preparing to restart the boiler since inspection is quick procedure

D. Cooling, depressurizing, draining, and applying LOTO before entry

90. During operation, the operator compares current combustion analysis to the baseline established at commissioning: CO_2 has dropped from 10.5% to 8.5%; O_2 has risen from 3.5% to 5.5%; stack temperature has risen from 375°F to 420°F. The most comprehensive explanation is:

A. Combustion drift plus heat transfer fouling developing simultaneously over time

B. Seasonal variation in all measured parameters occurring coincidentally together

C. Improved combustion efficiency producing all parameter changes uniformly overall

D. Chemistry changes affecting measurements across all parameters indirectly

91. At 1000 the operator observes normal operation. At 1005 a fire alarm sounds. The operator's boiler is not on fire but smoke is visible in the adjacent area. The immediate action is:

A. Continue operation and investigate the smoke source when safe

B. Increase combustion air flow to clear any smoke intrusion to area

C. Secure the boiler safely, evacuate per plan, account for personnel

D. Activate the emergency trip immediately without further sequence steps

92. Over 3 days, the operator observes feedwater pump performance: Day 1 at full fire, pump amperage 50 A, discharge 180 psig; Day 2, 55 A, 175 psig; Day 3, 60 A, 170 psig. What is developing?

A. Normal daily variation in pump performance across 3-day periods

B. Developing pump wear or fouling increasing current and decreasing head

C. Improved pump efficiency from maintenance activities recently performed

D. Reduced pump demand from recent feedwater treatment improvements generally

93. An operator receives the alarm "HIGH STACK TEMPERATURE" for the first time in 18 months of operation. Stack temperature reads 475°F. The operator's most appropriate investigation includes:

A. Combustion tuning only since stack temperature is a combustion parameter

B. Feedwater chemistry only since it affects heat transfer indirectly

C. Safety valve settings only since they affect operating pressure directly

D. Combustion, heat transfer surfaces, and measurement verification simultaneously

94. During a startup after 6-month shutdown, the operator has completed pre-startup checks and is ready for pilot ignition. The BMS will not advance from pre-purge stage. The operator has confirmed that pre-purge is complete. What is the most likely issue?

A. BMS permissive condition not met (damper position, draft, valve status)

B. Fuel supply pressure inadequate for pilot ignition automatically

C. Flame scanner fault preventing the sequence from advancing forward

D. Operator error in activating the pilot ignition sequence manually

95. The operator's log shows chemistry readings every 4 hours for 24 hours. Values have been stable. The operator's next action should be:

A. Increase sampling frequency to ensure continued stability over time

B. Continue the 4-hour interval per the treatment program protocol

C. Reduce sampling frequency since chemistry has been stable for a day

D. Stop sampling temporarily since chemistry is stable for now

96. During combustion testing: 25% fire shows O_2 at 8%; 50% fire shows O_2 at 6%; 75% fire shows O_2 at 4%; 100% fire shows O_2 at 2.5%. This pattern is:

A. Incorrect — O_2 should be similar at all firing rates generally

B. Indicates excess air too low at higher firing rates consistently

C. Typical combustion control with higher excess air at lower firing rates

D. Indicates burner malfunction requiring immediate investigation now

97. At 0800 the operator finds a forced-draft fan bearing running warm (130°F by infrared). At 1000 the bearing is at 145°F. At 1200 the bearing is at 165°F. Manufacturer's limit is 180°F. The appropriate action is:

A. Plan a controlled shutdown and bearing replacement before reaching the limit

B. Continue operation until the 180°F limit is reached momentarily

C. Ignore the rising temperature since it is within specification currently

D. Increase fan speed to reduce apparent bearing temperature artificially

98. An operator observes boiler water level swings during sudden load changes: 20% load increase causes 1 inch level drop; 40% load increase causes 2 inch level drop; 60% load increase causes 3 inch level drop. The feedwater control is:

A. Three-element with excellent dynamic response ideally maintained

B. Two-element with good steam flow anticipation mostly reliable consistently

C. On-off control with no modulation during load changes typically

D. Single-element with reactive response rather than anticipatory

99. A shutdown procedure begins at 1000. The operator initiates fuel cutoff. Over the next 30 minutes: pressure drops, water level stabilizes, stack temperature drops, all valves close in sequence. At 1030 the boiler is at standby. The next step in a typical shutdown is:

A. Immediately open all valves to cool the boiler rapidly now

B. Restart the boiler to verify the shutdown was complete accurately

C. Complete post-purge, cool-down, and depressurization per procedure

D. Apply lockout-tagout before any further shutdown actions take place

100. Over 3 months, the operator's chemistry logs show: conductivity stable at 2,400-2,600 µS/cm; pH stable at 10.8-11.0; sulfite stable at 35-45 ppm; hardness less than 1 ppm consistently. Blowdown rate is 3.2%. What is the assessment of the treatment program?

A. Chemistry out of specification requiring immediate adjustment across all parameters

B. Treatment program operating within acceptable parameters across all measurements

C. Improved treatment program showing steady performance consistently over time

D. Normal variation requiring continued monitoring without specific action

PRACTICE EXAM 8: ANSWER KEY AND FULL EXPLANATIONS (QUESTIONS 1–100)

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1. D — Progressive tube fouling produces exactly this pattern: rising stack temperature (heat not absorbed), increased fuel consumption per pound of steam, and stable pressure from normal firing. The gradual progression over hours is the diagnostic signature. Tube cleaning restores efficiency.

2. A — An empty gauge glass during firing is a potential dry-fire emergency. Shutting off fuel immediately is the only safe first action — it prevents tube and crown-sheet damage from continued firing without water. Verification of actual conditions comes after eliminating the combustion heat source.

3. C — Scale buildup or fouling in the feedwater preheater progressively reduces heat transfer, producing steadily declining feedwater temperature. Deaerator operation appearing normal rules out steam supply issues. The gradual temperature decline over hours is diagnostic of developing fouling.

4. B — A growing steam leak at a pressure-boundary gasket requires planned shutdown for repair, not continued operation. Tightening at pressure risks further damage or operator injury. External sealants and indefinite monitoring both allow the condition to worsen to potential failure.

5. A — Operating pressure control setpoint drifting upward causes the boiler pressure to approach the safety valve setting more closely, resulting in more frequent valve lifts. Safety valve downward drift is less common than operating control drift. Controller recalibration typically resolves the issue.

6. D — A suction-side issue (low tank level, clogged strainer, air binding, low NPSH) would affect both pumps drawing from the same source. Normal motor currents rule out mechanical load increases. Diagnosing and correcting the common suction problem restores redundancy.

7. C — A chemical feed pump malfunction delivering excess alkaline chemical drives pH upward rapidly. The steady progression from 10.8 to 12.5 indicates continuous overfeed. Isolating the chemical feed and blowdown to reduce pH are typical corrective actions.

8. A — Combustion control drift with the air damper opening more than needed explains both rising stack temperature (more air carries away more heat) and rising O_2. No operator adjustments rules out intentional changes. Controller recalibration restores proper excess air.

9. B — Slow warmup per manufacturer's recommended schedule prevents thermal shock to boiler pressure parts. Rushing the warmup produces uneven expansion, potential tube damage, and refractory cracking. The schedule represents accumulated engineering experience with the specific design.

10. D — LWCO actuation from sediment in the float chamber producing a false trip is diagnostic: gauge glass shows normal water level, so water level is actually normal. Sediment can release unexpectedly, allowing float to drop. Daily blowdown of the LWCO prevents this scenario.

11. A — Decreasing condensate return forces more makeup water into the feedwater, and makeup water carries dissolved solids that raise conductivity over time. Normal variation wouldn't show such steady progression. Investigating condensate return identifies the root cause.

12. C — Continuing controlled cool-down per the shutdown procedure is the proper response during planned shutdown. Pressure reduction must be gradual to prevent thermal stress on pressure parts. Rushing or stopping prematurely both create operational problems.

13. B — Progressive fouling or restriction in the air path (filters, ducts, fan impeller) requires the damper to open more to maintain airflow. Normal operation at steady firing rate shouldn't produce this damper trend. Investigation of the air path identifies the restriction.

14. A — Thermal inertia from the still-hot furnace continues to generate steam briefly after fuel shutoff — the refractory and metal surfaces hold significant heat. A minor pressure rise after shutoff is normal. Failed fuel valve would typically show continued firing, not just residual heat.

15. D — A chemical feed overdose across all parameters produces uniform rising pH, conductivity, and sulfite simultaneously. Normal variation would typically be smaller; improved treatment would stabilize rather than spike. Investigating chemical feed rates identifies the source.

16. C — A sudden demand tripling exceeds the feedwater system's response capability briefly, causing rapid level drop before feedwater can catch up. This is a known transient response limitation. Three-element control minimizes but doesn't eliminate this effect.

17. A — Pressure rising 15→45→90 psig over 90 minutes is typical controlled warmup progression. The rate of rise is appropriate for most industrial boilers. Faster rise risks thermal shock; slower isn't problematic.

18. B — Investigating the proving switch cause before further startup attempts is the required safety response. The switch provides proof that combustion air is flowing — without this proof, ignition attempts could produce explosive conditions. Jumpering or bypassing is never acceptable.

19. D — Progressive scale or soot fouling reducing heat transfer is the comprehensive explanation for rising fuel consumption plus rising stack temperature over 3 months. Seasonal variation wouldn't last this long. Chemistry within specification doesn't rule out physical deposits that have already formed.

20. C — After emergency trip: monitor cool-down, verify conditions are safe, and await supervisor guidance for root-cause investigation and restart authorization. Immediate restart before understanding the cause can repeat the triggering condition. Leaving everything unattended risks secondary events.

21. B — Progressive pump wear reducing developed head is the classic pattern: gradual pressure decline while the pump runs normally. Pump internal components (impellers, wear rings) degrade over time. Normal variation wouldn't show such a consistent declining trend.

22. D — Shutting down the boiler safely to prevent dry-fire damage is the safe action when feedwater pump cannot run. Without feedwater, the boiler cannot operate safely for long. Manual restart attempts or continued operation without feedwater both risk catastrophic damage.

23. A — Deaerator performance degradation allowing dissolved oxygen to reach the feedwater system produces this rising oxygen trend. The progression from 5 ppb to 75 ppb in 4 hours indicates developing equipment issue. Investigation of deaerator steam supply, operation, and integrity identifies the cause.

24. C — A chemical feed pump delivering no chemical despite running explains falling pH with continuous pump operation. Pump issues (broken diaphragm, blocked discharge, air binding) all produce this symptom. Verifying actual chemical delivery — not just pump operation — is essential.

25. B — A downstream steam leak or increased consumption beyond measurement depresses header pressure over time even at steady measured steam flow. Increased consumption by unmeasured users or developing leaks are typical causes. Investigation of steam distribution identifies the cause.

26. A — Hydrostatic testing at $1.5 \times$ MAWP means $1.5 \times 200 = 300$ psig. This is the ASME code requirement for testing pressure boundary integrity using water. The test verifies the vessel can safely hold 1.5 times its rated working pressure.

27. D — Another boiler producing steam and pressurizing the header explains why header pressure exceeds the isolated boiler's pressure. In multi-boiler plants, the header is shared. Non-return valves prevent reverse flow when boiler pressure is lower than header.

28. C — Aborting the start and investigating the weak flame signal thoroughly is the required safety response. A weak signal could indicate combustion issues, scanner problems, or fuel supply issues. Continuing without strong signal risks flame failure and potential furnace explosion.

29. A — Reduced condensate return increasing makeup water (which brings dissolved solids) explains increased blowdown requirements to maintain TDS within specification. Over 6 months, gradual condensate return loss compounds. Investigating return rates and loss sources addresses the root cause.

30. B — Performing the LWCO test as soon as conditions permit safely is the appropriate action. The previous shift's deferment doesn't eliminate the requirement. Safety tests cannot be indefinitely deferred. Immediate shutdown is excessive; continuing without testing is not appropriate.

31. D — Increased blowdown rate requiring more feedwater makeup explains steady climbing feedwater valve position with unchanged steam demand. The additional feedwater compensates for water leaving as blowdown. Verifying blowdown rate and adjusting if excessive addresses the situation.

32. A — Investigating the fan immediately, shutting down if necessary, is the appropriate response to unusual noise from rotating equipment. Developing bearing or impeller issues can progress rapidly to failure. Continuing operation risks catastrophic fan failure with forced shutdown.

33. C — Investigating and correcting the LWCO before proceeding with operation is required for sluggish response. A cutoff operating 3 seconds when 1 second is normal may not respond fast enough during an actual low-water event. Safety testing failures must be corrected immediately.

34. D — Insufficient turndown range requiring on-off cycling for stability explains steady cycling between 45% and 70-72% firing rates. The controller cannot modulate in between because the turndown doesn't support the needed intermediate firing rate. Upgrade to modulating control with adequate turndown resolves this.

35. B — A failed feedwater regulator stuck in the open position allows continuous feedwater flow, causing water level to rise steadily. The progression from normal to high-high alarm over 1 hour is consistent with continuous overfeeding. Manual feedwater control until repair is typical response.

36. A — Continuing warmup while monitoring leaks for worsening is correct — minor joint leaks at pressure are common during warmup as thermal expansion seats connections. Major leaks require stopping. The operator's judgment distinguishes concerning from routine startup behavior.

37. C — Drifting combustion control allowing excess air to increase gradually explains steady rising O_2 from 3.5% to 5.8% over a week. Without tuning, combustion controls gradually drift. Recalibration and tuning typically restores the lost excess air control.

38. D — Low feedwater flow initiated the cascade: feedwater flow dropped first, water level dropped, then low-low level triggered, then LWCO caused burner trip. First-out annunciation shows the initiating event at the top of the cascade chronologically.

39. B — Warm intake air has less mass per volume (lower density), so the same volumetric airflow provides less oxygen for combustion. Fixed damper position with warmer air produces less excess air. Combustion tuning typically must accommodate seasonal intake temperature variations.

40. A — A cold-water feedwater surge temporarily reduces steam production because the water must be heated to saturation, absorbing heat that would otherwise make steam. The dip is temporary;

steam production recovers once water reaches saturation. This is why feedwater is usually preheated.

41. C — Developing priming causing wet steam and higher fuel consumption connects fuel rise with elevated water level. Priming reduces effective heat content of delivered steam while wasting energy in entrained water. Level adjustment and chemistry review typically corrects the situation.

42. A — Investigating the pilot system before any restart attempt is the required response after pilot ignition failure and BMS lockout. Immediate restart without investigation can repeat the failure and potentially create an explosive condition. Investigation identifies the pilot system problem.

43. D — Developing oxygen ingress consuming sulfite faster than feed rate explains declining sulfite despite normal pump operation. The sulfite is being consumed by dissolved oxygen. Verifying deaerator operation and checking for air leaks identifies the oxygen source.

44. B — Developing steam or water loss requiring increased makeup rate causes steadily climbing feedwater valve position even with unchanged steam demand and normal water level. Steam traps failing open, heat exchanger leaks, or other losses all produce this pattern. Investigation of the downstream system identifies the loss.

45. A — Investigating why the safety valve lifted and verifying current conditions is the professional response to any safety valve lift. Even if the boiler appears to be operating normally now, the root cause must be understood and documented. Lifted safety valves are operational events requiring investigation.

46. C — A developing fuel-air ratio issue producing unstable combustion explains a strong signal that develops cycling over time. Drift in fuel supply pressure, air damper position, or other factors all produce this. Investigation of combustion parameters identifies the cause.

47. D — Reduced steam supply to the deaerator from upstream changes produces this steady decline in feedwater temperature. If deaerator steam is from another source that has changed, the deaerator cannot heat as effectively. Investigation of deaerator steam supply identifies the issue.

48. B — Shutting off fuel manually immediately and investigating the LWCO is the correct response to LWCO failure during testing. The test has identified a safety-critical failure that must be addressed before any further operation. Continuing the drain test to dangerous levels or resetting without investigation are both inappropriate.

49. C — Developing instability in combustion control or fuel supply explains increasing pressure swings even at steady steam demand. Controller tuning drift, fuel supply oscillations, or other control issues all produce this. Controller recalibration and system investigation identify the root cause.

50. A — Combustion air reduction with developing fuel-rich conditions explains simultaneous dropping O_2 and rising CO at constant stack temperature. As air reduces, O_2 drops and incomplete combustion produces CO. Investigation of the air path or combustion controls identifies the cause.

51. D — Normal shutdown pressure decay from continued steam consumption explains the gradual pressure drop after fuel cutoff. Steam continues to flow to loads even without firing. The progression from 150 to 45 psig over 2 hours is typical of post-shutdown pressure decay.

52. B — Feedwater consumption exceeding supply somewhere in the system drops deaerator storage level over time with steady feedwater demand and unchanged makeup. Normal operation would maintain level. Investigation of actual feedwater consumption vs. makeup identifies the imbalance.

53. A — Thermal expansion of water in the boiler during shutdown period explains the higher apparent level after restart. Water at the same mass expands as temperature rises, raising the visible level in the gauge glass. Return to normal level occurs as operating conditions stabilize.

54. C — An underlying system issue causing more traps to fail over time is the likely explanation for steadily rising trap failure rates over 6 months. Factors might include steam quality, water hammer, pressure surges, or chemistry issues. System investigation identifies the root cause affecting trap performance.

55. D — Blowdown valve failed open or operator forgot to close it explains a blowdown continuing after expected duration. 50 gallons in 5 minutes, then continued flow, suggests the valve isn't closing as expected. Investigation of valve status is essential.

56. B — A developing load increase requiring proportional feedwater response explains the steadily climbing feedwater flow with matching steam flow increase. This is typical normal operation during load ramping. Both flows should increase proportionally in properly functioning systems.

57. C — Investigating the setpoint drift and recalibrating the limit control is correct when the limit trips early. A drifted setpoint is a safety system issue — if it drifts further, it may not provide adequate protection. Restoring the correct setpoint is essential.

58. C — The safety valve setpoint is the next critical pressure point. With operating control failed at 150 psig, the high-pressure limit should trip at 175 psig, but the safety valve will lift automatically at the safety valve setpoint. Understanding the protective pressure hierarchy is essential.

59. D — An electrical supply issue affecting both blowers simultaneously explains both trips without common mechanical causes. Shared electrical supply, dual fault, or control issues can affect both. Investigation of electrical supply to both blowers identifies the common cause.

60. B — Increasing oxygen ingress consuming sulfite faster than feed explains accelerating sulfite depletion with unchanged feed rate. The dissolved oxygen is increasing over time. Investigation of the oxygen source (deaerator, feedwater piping, etc.) addresses the root cause.

61. A — Warming the steam line slowly, then opening the main stop valve properly is the correct startup sequence. Rapid opening of cold steam lines to high-pressure steam causes water hammer from thermal shock condensation. Gradual warmup prevents this dangerous condition.

62. C — 0.5% per week compounding for 26 weeks (6 months) = 1.005^26 ≈ 1.138, or about 13%. Straight-line calculation gives 13% as well for this small rate. Either approach gives approximately 13% cumulative increase. Understanding compounding rates helps with trend analysis.

63. B — Excess air dropping too low at high fire, producing CO formation, is the tuning issue. O_2 at 2.5% and CO at 200 ppm at 100% fire indicates insufficient combustion air. Proper tuning at high fire typically targets 3-4% O_2 with CO below 100 ppm.

64. D — A developing pump fault such as air binding, cavitation, or partial blockage explains changing pump behavior from continuous to cycling operation. Normal demand wouldn't produce this pattern. Investigation of the pump and its suction path identifies the cause.

65. A — Accumulating fouling on heat transfer surfaces over time explains gradual efficiency decline from 82% to 78% over a month. The 3% loss over a month is consistent with progressive fouling. Tube cleaning typically restores lost efficiency.

66. C — Chemical feed reduction affecting all parameters or increased makeup water diluting the treatment explains declining pH, sulfite, and rising conductivity together. Chemical feed issues produce coordinated parameter changes. Verification of feed rates and makeup water identifies the cause.

67. B — Progressive restriction in gas flow requiring increased damper opening explains steady damper position increase with constant firing rate. Something is increasing gas-path resistance. Investigation of tube condition, damper mechanism, and flue path identifies the restriction.

68. D — At 1015 when smoke was first observed is the correct answer to "when did you first notice the problem?" The factual chronological sequence matters for incident investigation. Normal readings at 1000 don't represent problem noticing; smoke observation is the first problem identification.

69. A — Manually time the post-purge duration and continue the shutdown is appropriate — the actual post-purge function (running the fan) is working. The timer is a monitoring/indicating function. Continuing the physical post-purge with manual timing achieves the safety objective.

70. C — Specific results provide actionable information for the incoming operator. "All tests passed" is acceptable, but specific details (safety valve, LWCO, gauge glass) allow verification of completeness. Logged specific results support the operator continuity between shifts.

71. B — Replaced failed-open traps eliminating cold makeup-like return from failed units. When traps fail open, live steam passes to the condensate return, but it also dilutes with subcooled condensate in the return. After replacement, only proper condensate returns, at higher average temperature.

72. D — Increasing mechanical load from developing pump wear or fouling explains steady current rise at constant discharge pressure. Normal operation wouldn't show this pattern. Investigation of pump internals at the next available opportunity identifies the developing issue.

73. A — Documenting the findings and initiating troubleshooting based on current conditions is the professional approach. The operator's duty is to address actual conditions, not rely on prior shift reports. Log the findings and proceed with appropriate diagnostic actions.

74. C — Iron scale detaching from waterside surfaces during blowdown produces visible black flakes in the discharge. This is a sign that scale is releasing — often after chemistry improvements that reduce scale-forming tendencies. Continued blowdown removes the released scale.

75. B — Firing at maximum while using stored steam energy and boiler thermal mass is the standard response to demand spike. The boiler's water volume and heat content provide buffering for 10-minute transients. Shutting down during demand would prevent service.

76. D — Chemistry contamination such as oil or organic matter causing foaming explains wet steam carryover with normal TDS and normal water level. Contamination produces foaming even at low measured TDS. Investigation of chemistry and potential contamination sources identifies the cause.

77. A — Progressive fouling of heat transfer surfaces reducing efficiency gradually explains steadily rising stack temperature with all other parameters constant. This is a classic fouling signature over several days. Tube cleaning typically restores the original stack temperature.

78. C — Investigating the upstream gas supply pressure before continuing operation is correct. Below-specification supply pressure risks burner flame-out and unreliable combustion. Rate reduction is a work-around, not a fix. The supply issue must be resolved.

79. B — Reporting the falsified records to supervision for proper investigation is the required professional response. Pre-dated entries indicate falsification, which is unethical and often illegal. Supervision has the authority to investigate and address the underlying issue.

80. D — Narrow operating control differential or developing control issue explains escalating cycling at constant steam demand. Controllers with narrow differentials or developing faults cycle more frequently. Investigation of the operating control settings and function identifies the cause.

81. D — A developing plugged connection in the gauge glass piping explains increasingly slow blowdown response from 5 to 15 to 30 seconds. The restriction is getting worse over time. This is why daily gauge glass blowdown is essential — it flushes the piping and verifies connections are clear.

82. A — Comparative heat transfer condition (fouling, scale) between the two boilers explains the fuel consumption difference for identical units at the same load. 12.5% more fuel for the same steam

output strongly suggests heat transfer degradation in Boiler B. Comparative inspection identifies the specific issue.

83. C — Verifying steam demand cause, confirming maximum firing rate, and monitoring water level covers the critical responses to rapid pressure drop. Three simultaneous actions address the cause, the boiler response, and the water supply necessary to recover. Shutting down or doing nothing are both inappropriate.

84. B — Pilot on at 0600:05, main flame ignition at 0600:06, flame proved at 0600:07 = 7 seconds total sequence from pilot through flame proving. The 0600:04 completion of pre-purge is the start time.

85. D — Developing operating control issue such as differential narrowing or setpoint drift explains tripled cycling frequency without steam demand change. Controllers drift over time without maintenance. Recalibration typically restores normal cycling frequency.

86. B — Chemical feed pump output declining or oxygen ingress increasing explains declining sulfite with stable other parameters. If only sulfite is changing, the cause is specific to the sulfite cycle. Investigation of sulfite feed and oxygen sources identifies the issue.

87. C — Removing the boiler from service until the inspection is completed properly is the appropriate response to an overdue annual inspection. Operating with expired inspection is a code violation. The inspection must be performed before authorized operation continues.

88. B — Developing fan impeller fouling increasing aerodynamic load on the motor explains steadily rising amperage at constant firing rate and damper position. Something is making the fan work harder to move the same air. Inspection and cleaning of the fan typically restores normal current.

89. D — Cooling, depressurizing, draining, and applying LOTO before entry is the correct preparation sequence for internal inspection. Each step has a safety purpose: cooling prevents burns, depressurizing prevents stored-energy release, draining removes water, LOTO prevents accidental energization. All steps are required.

90. A — Combustion drift plus heat transfer fouling developing simultaneously provides the comprehensive explanation. Dropping CO_2 and rising O_2 indicate combustion drift (excess air increase); rising stack temperature indicates heat transfer fouling. Both contribute to efficiency loss; addressing both provides full restoration.

91. C — Securing the boiler safely, evacuating per plan, and accounting for personnel is the correct response to a fire alarm even when the boiler isn't on fire. The fire risk to the boiler room requires evacuation; accounting ensures everyone reached safety. Investigation comes after safety is ensured.

92. B — Developing pump wear or fouling increasing current and decreasing head explains rising amperage (52A→60A) with falling discharge pressure. The pump is working harder (higher

current) but delivering less (lower pressure). This is classic pump degradation requiring maintenance.

93. D — Combustion, heat transfer surfaces, and measurement verification simultaneously is comprehensive investigation for a first-ever high stack temperature alarm. The alarm could result from combustion changes, tube fouling, or measurement error. All three should be investigated in parallel.

94. A — A BMS permissive condition not met (damper position, draft, valve status) is the most likely cause of BMS unable to advance from pre-purge. The BMS requires multiple conditions to be satisfied before ignition — any one unsatisfied stops the sequence. Checking all permissive indicators identifies the specific issue.

95. B — Continuing the 4-hour interval per the treatment program protocol is correct. Stability over 24 hours doesn't justify reducing sampling frequency below the protocol. Chemistry can change quickly even after periods of stability. The treatment program defines appropriate sampling intervals based on historical experience.

96. C — Typical combustion control with higher excess air at lower firing rates is normal combustion tuning. At lower fires, combustion stability requires more excess air; at higher fires, optimization reduces excess air. This pattern (8% at 25% fire, 2.5% at 100% fire) is standard for well-tuned modulating burners.

97. A — Planning a controlled shutdown and bearing replacement before reaching the limit is the safe approach. Operating to the specification limit before acting risks bearing failure during operation, with uncontrolled shutdown consequences. Proactive shutdown allows proper bearing replacement.

98. D — Single-element control with reactive response produces progressively larger level drops with larger load changes. The controller only responds to level, so larger loads produce larger excursions before correction. Three-element control would minimize all level drops; two-element would reduce but not eliminate them.

99. C — Completing post-purge, cool-down, and depressurization per procedure is the correct next step. The boiler is at standby but still hot and pressurized. Full shutdown requires these additional steps. Restarting or opening valves rapidly at this point is inappropriate.

100. B — Treatment program operating within acceptable parameters across all measurements correctly assesses stable chemistry within specifications. pH 10.8-11.0, conductivity 2,400-2,600, sulfite 35-45, hardness <1 ppm are all within typical targets. Consistent stability over 3 months demonstrates program effectiveness.