

PRACTICE EXAM 14: RED SEAL STEAMFITTER/PIPEFITTER SIMULATION (130 QUESTIONS)

1. A steamfitter notices a steam trap is continuously discharging a steady plume of vapour from its open-ended test discharge, even at full load. Which conclusion is best supported?

- A. The trap is correctly sized for the load
- B. The condensate line is undersized
- C. The system pressure has dropped to zero
- D. The trap has failed open and is passing live steam

2. During warm-up of a long steam main, a loud banging develops at a low point. The most likely cause is:

- A. Condensate accumulating and being struck by steam flow
- B. The insulation thickness being excessive
- C. The relief valve set too high
- D. The gauge siphon being installed backward

3. A hydronic circulator runs but delivers almost no flow, and its suction gauge swings wildly with a crackling noise at the pump. The most probable cause is:

- A. The expansion tank is oversized
- B. Cavitation from insufficient suction pressure
- C. The discharge valve is fully open
- D. The motor is wired for the wrong rotation only

4. On a one-pipe steam system, every radiator in the building stays cold and the system won't build pressure, while the burner fires normally. The first component to suspect is:

- A. The boiler safety valve stuck open, venting steam before it can pressurize the system
- B. A single radiator's failed-closed thermostatic trap
- C. One radiator's air vent
- D. A single branch shutoff valve

5. A pressure-reducing valve station shows downstream pressure slowly climbing above setpoint during no-flow periods. This symptom indicates:

- A. The PRV seat is passing (creeping) under no-load
- B. The downstream relief valve is undersized
- C. The strainer is completely clean
- D. The upstream pressure has dropped below setpoint

6. After a system tie-in, a section of new pipe corrodes rapidly at the joint where copper meets steel. The cause is most likely:

- A. Excessive pipe insulation
- B. Galvanic corrosion from dissimilar metals without a dielectric union
- C. Steam superheat being too high
- D. The pipe being oversized for the flow

7. A relief valve on a steam vessel begins leaking slightly below its set pressure and the leak worsens over weeks. The most likely explanation is:

- A. The vessel pressure has dropped permanently
- B. The valve is now rated for higher pressure
- C. Simmering has eroded the seat, degrading the seal
- D. The valve spring has become stiffer over time

8. A unit heater's modulating steam coil floods with condensate and loses output at low load. The most likely cause and remedy involves:

- A. Replacing the coil with a smaller one
- B. Increasing the steam pressure permanently
- C. Removing the trap entirely
- D. A trap unable to drain under low differential; install an F&T trap or add a pump

9. A buried steel gas line's sacrificial anode is found fully consumed during inspection. The correct interpretation is:

- A. The anode protected the pipe as designed and must be replaced
- B. The pipe is now over-protected
- C. The anode material was too noble
- D. Cathodic protection was unnecessary

10. A globe valve installed in a steam line is found to chatter and erode quickly. The most likely installation error is:

- A. The valve is rated for too high a pressure
- B. The packing is over-tightened
- C. The bonnet bolts are loose
- D. The valve was installed with flow over the disc (against the body arrow)

11. A steam separator's drain trap is plugged, and downstream equipment shows erosion and water carryover. The connection between these observations is:

- A. The separator increased steam pressure
- B. The separator is unrelated to the carryover
- C. Trapped moisture is no longer drained, so wet steam reaches equipment

D. The separator added water deliberately

12. A pump suction line with a concentric reducer (instead of eccentric) on a horizontal run develops intermittent loss of prime. The mechanism is:

A. An air pocket forming at the high point of the concentric reducer

B. The reducer increasing suction pressure

C. The reducer filtering debris

D. The pump rotating backward

13. A steamfitter reviews a condensate return that suffers chronic backpressure and waterlogged traps. The line was sized larger than the calculated condensate flow, yet problems persist. Investigation shows the oversize created low velocity that let flash steam and water stratify and slug. The design factor that actually drove the fault was:

A. Sizing only for liquid water

B. Using too large a pipe schedule, dropping velocity so flash steam and condensate stratify and slug

C. Adding too many traps

D. Insulating the return line

14. A bellows expansion joint fails by fatigue cracking after a year. Inspection shows missing pipe guides. The failure mechanism is:

A. The bellows was rated for too high a pressure

B. The insulation trapped heat

C. Unguided pipe allowed lateral/torsional movement the bellows can't absorb

D. The bellows was over-lubricated

15. A steam gauge fails prematurely from overheating. Inspection shows no pigtail siphon. The fix is to:

A. Increase the system pressure

- B. Install a pigtail siphon to keep a water seal off the Bourdon element
- C. Remove the gauge entirely
- D. Paint the gauge to reflect heat

16. A welded butt joint in high-pressure pipe fails inspection for cracking in the heat-affected zone on thick wall material. The most likely omitted step was:

- A. Using a larger electrode
- B. Adding more root passes only
- C. Required post-weld heat treatment (PWHT) for the material and thickness
- D. Painting the weld after cooling

17. A hydronic system air-binds repeatedly at a high point even after filling. The missing or failed component is:

- A. The circulator
- B. The expansion tank only
- C. An automatic air vent at the high point
- D. The boiler aquastat

18. A flanged joint leaks shortly after assembly despite a new gasket. The most likely workmanship error is:

- A. Using a raised-face flange
- B. Uneven bolt tightening instead of a staged star pattern
- C. Using too long a pipe run
- D. Installing a strainer upstream

19. A steam main without proper drip legs experiences repeated water hammer at startup. The corrective measure is:

- A. Increasing steam pressure faster
- B. Installing drip legs with traps at low points and ahead of risers
- C. Removing all insulation
- D. Reducing the pipe support spacing only

20. A pump is selected with required NPSH greater than the available NPSH. The predictable result in service is:

- A. Cavitation, noise, and impeller damage
- B. Higher efficiency than rated
- C. Lower motor current than rated
- D. No effect on operation

21. A check valve installed backward in a line causes:

- A. No flow because it blocks the intended direction
- B. Increased flow in both directions
- C. Throttled but bidirectional flow
- D. Pressure reduction to the load

22. A steam coil with a vacuum that holds condensate causes water hammer. The missing device is:

- A. A larger steam trap only
- B. A second pressure gauge
- C. A vacuum breaker to admit air and allow drainage
- D. An extra flange

23. A long-radius elbow is replaced with a short-radius elbow in a high-velocity steam line, and erosion increases at the bend. The cause is:

- A. The short-radius elbow lowered the pressure rating
- B. The short-radius elbow reduced the pipe diameter
- C. Tighter turn increases turbulence and erosion at the bend
- D. The elbow material changed

24. A boiler's low-water condition is traced to a leaking return line siphoning the boiler. The protective device that should have prevented this is:

- A. A Hartford loop
- B. A desuperheater
- C. A larger relief valve
- D. A second pressure gauge

25. A threaded joint sealed with PTFE tape leaks, and the tape is found shredded inside the fitting. The application error was:

- A. Using too many threads
- B. Over-torquing the joint only
- C. Wrapping the tape against the thread direction so it peeled off
- D. Using a tapered thread

26. A steam system's velocity is far above recommended limits, and operators report noise and moisture carryover. The design correction is:

- A. Increasing the main pipe size to lower velocity
- B. Adding more elbows
- C. Raising the steam pressure
- D. Removing the steam traps

27. A pressure vessel's relief valve is set above the vessel's MAWP. The safety implication is:

- A. The vessel could be overstressed before the valve relieves
- B. The valve will relieve too early
- C. The vessel is now more protected
- D. The valve cannot ever open

28. A socket-weld joint on small-bore high-pressure pipe cracks at the weld toe under thermal cycling. A contributing factor is:

- A. The pipe being too large for socket welding
- B. Using a butt weld instead
- C. Threading the pipe first
- D. No expansion gap left at the socket bottom, causing stress

29. A steam trap selected exactly equal to the calculated condensate load backs up at startup. The sizing error was:

- A. Omitting a safety factor for startup loads
- B. Oversizing the trap
- C. Using too large a discharge line
- D. Installing it too low

30. A galvanized pipe used on a high-temperature steam line discolours and emits fumes. The chemistry behind this is:

- A. The steel core melting
- B. The pipe gaining wall thickness
- C. The zinc coating degrading and off-gassing at high temperature

D. The pipe absorbing condensate

31. A relief valve's discharge piping is run with no independent support and no provision for the thrust generated when the valve lifts. On a test lift, the unsupported line jumps and the valve body is stressed. The primary design requirement that was missed is:

- A. The valve relieves too early
- B. The discharge cools the valve
- C. The valve gains capacity
- D. Supporting and restraining the discharge so weight and reaction thrust don't stress the valve

32. A primary-secondary hydronic system has its closely spaced tees installed far apart instead. The consequence is:

- A. The loops are no longer hydraulically decoupled and interfere
- B. The system gains efficiency
- C. The expansion tank fails
- D. The boiler overfires

33. A steam main is pitched against the direction of flow by mistake. The operational result is:

- A. Steam velocity drops to zero
- B. The pipe diameter effectively increases
- C. The boiler pressure doubles
- D. Condensate collects away from drip points, raising hammer risk

34. A Y-strainer ahead of a control valve is never cleaned and the valve loses control authority. The mechanism is:

- A. Accumulated debris restricting flow and fouling the valve trim
- B. The strainer reducing system pressure intentionally

- C. The strainer adding moisture
- D. The strainer increasing flow

35. A weld neck flange is replaced with a slip-on flange on a high-pressure cyclic line, and fatigue cracking appears at the fillet weld. The reason is:

- A. The slip-on flange is cheaper
- B. The slip-on's fillet weld concentrates stress versus the weld neck's smooth transition
- C. The slip-on increased the bore
- D. The slip-on raised the pressure rating

36. An inverted bucket trap loses its prime and blows steam continuously after a sudden pressure surge. The mechanism is:

- A. The bucket gained weight permanently
- B. Loss of water seal lets the bucket stay down, holding the valve open
- C. The trap reversed flow direction
- D. The discharge line froze

37. A two-stage PRV setup is replaced with a single stage across a very large pressure drop, and the valve wears rapidly with noise. The cause is:

- A. The single stage lowered the flow
- B. The single stage added a safety factor
- C. The single valve filters debris
- D. Excessive velocity and erosion from forcing the full drop through one stage

38. A feedwater regulator sticks, admitting too little water, and the boiler approaches low-water cutoff. The direct risk is:

- A. Steam pressure dropping to atmospheric
- B. The relief valve opening early
- C. Overheating/damage to boiler surfaces from low water
- D. Excess condensate in the main

39. A thermodynamic disc trap cycles rapidly and wears out prematurely on a line with high back pressure. The cause is:

- A. The trap is oversized for the load
- B. Excessive back pressure disrupts the disc's snap action
- C. The condensate is too cold
- D. The disc is too heavy

40. A dummy leg support on a hot expanding line is welded to rigidly anchor the elbow. The unintended result is:

- A. The pipe loses pressure rating
- B. The line cools faster
- C. Thermal expansion is restrained, building damaging stress
- D. The elbow throttles flow

41. A pump's eccentric reducer on suction is installed flat-side-down on a horizontal run. The problem this creates is:

- A. An air pocket at the top starving the pump
- B. Better drainage of the suction line
- C. Increased suction pressure
- D. Reduced pipe weight

42. A steam coil's F&T trap loses its air-venting function (thermostatic element failed shut), and the coil is slow to heat on startup. The mechanism is:

- A. The float sank permanently
- B. The steam pressure dropped
- C. Air binding the coil because air can no longer be vented
- D. The condensate flashing to steam

43. A relief valve is found with no certification stamp during inspection. The required action is:

- A. Paint over the missing stamp
- B. Increase the set pressure
- C. Replace it with a properly registered/certified valve
- D. Leave it if it appears to function

44. A high-velocity wet-steam line shows accelerated erosion at fittings. Beyond reducing velocity, improving steam quality requires:

- A. Removing all traps
- B. Increasing the velocity further
- C. Adding more elbows
- D. Installing a separator to remove entrained moisture

45. A balanced-pressure thermostatic trap is installed where pressure varies widely, and it performs well across the range. The reason it suits this duty is:

- A. It ignores pressure entirely
- B. Its fill responds to the saturation curve, self-adjusting with pressure
- C. It uses an electric heater

D. It requires constant pressure to work

46. A long steam main has anchors but no guides near its expansion loop, and the pipe bows sideways. The missing function is:

A. Anchoring at the loop

B. Draining condensate

C. Guiding to direct expansion into the loop, not sideways

D. Reducing the pressure rating

47. A new stainless process weld shows heavy internal oxidation ("sugaring"). The omitted procedure was:

A. Preheating the pipe

B. Using a larger electrode

C. Back-purging the root with inert gas

D. Painting the inside

48. A butterfly valve is used for tight throttling at high pressure and wears rapidly. The selection error is:

A. Butterfly valves cannot pass steam

B. The valve was too small in diameter

C. The valve raised the line pressure

D. Choosing a butterfly for severe high-pressure throttling instead of a globe valve

49. A condensate pump set is omitted where the return must rise to an elevated boiler, and condensate backs up. The needed component is:

A. A larger relief valve

- B. A condensate receiver/pump set to lift the return
- C. A second strainer
- D. A vacuum breaker only

50. A weldolet branch is replaced with a simple drilled hole and fillet-welded pipe stub on a header, and the connection cracks. The reason the weldolet was better is:

- A. It threads the branch
- B. It caps the header
- C. Its contoured, reinforced base distributes branch stresses properly
- D. It reduces the header size

51. A hydrostatic test is performed at exactly the design pressure instead of 1.5×. The deficiency is:

- A. The test overpressurized the system dangerously
- B. The test used the wrong fluid
- C. The test froze the pipe
- D. Inadequate proof margin above operating conditions

52. A steam trap's discharge is checked ultrasonically and shows continuous high-frequency flow with both sides hot. The diagnosis is:

- A. The trap is blowing through (passing live steam)
- B. The trap is working perfectly
- C. The trap is air-bound and cold
- D. The trap is oversized only

53. A pipe penetrating a fire-rated wall is sleeved but left unsealed, failing inspection. The compliant fix is:

- A. Use a larger pipe
- B. Add an escutcheon ring
- C. Increase the wall thickness
- D. Install an approved firestop assembly maintaining the rating

54. A flanged joint uses a plain rubber gasket on a 250°C steam line and fails quickly. The correct material is:

- A. Untreated cork
- B. A spiral-wound or graphite gasket rated for the temperature
- C. Plain paper
- D. Standard rubber, thicker

55. A pressure gauge reads in psia on a system where operators expect psig, causing confusion about true overpressure margin. The difference is that psia:

- A. Includes atmospheric pressure, reading ~14.7 higher than psig
- B. Is always lower than psig
- C. Is a temperature scale
- D. Reads zero at full vacuum and equals psig

56. A 45° offset is laid out using the wrong constant (1.155 instead of 1.414), and the travel comes up short. The correct relationship for 45° is:

- A. $\text{Travel} = \text{offset} \times 1.414$
- B. $\text{Travel} = \text{offset} \times 1.155$
- C. $\text{Travel} = \text{offset} \times 2.0$
- D. $\text{Travel} = \text{offset} \times 0.707$

57. A steam system warmed up too quickly cracks a cast fitting. The mechanism is:

- A. The fitting gained pressure rating
- B. The insulation caused overheating
- C. The steam became colder
- D. Thermal shock from rapid, uneven heating

58. A relief valve discharge is piped to terminate pointing toward the operator's walkway. The hazard and fix are:

- A. No hazard; leave it
- B. The discharge cools the valve
- C. The discharge increases capacity
- D. Scalding/injury risk; reroute discharge to a safe location

59. A pump must overcome 30 m of static head. Converting to approximate pressure for selection gives:

- A. 30 kPa
- B. 3 kPa
- C. ~294 kPa
- D. ~2940 kPa

60. A boiler feedwater contains dissolved oxygen and the system suffers pitting corrosion. The treatment principle is:

- A. Increase the feedwater oxygen further
- B. Deaerate/remove dissolved oxygen from the feedwater
- C. Add oxygen scavenger to raise oxygen
- D. Lower the water temperature to hold more oxygen

61. A steam trap lifts condensate against back pressure but stalls when back pressure rises. The governing factor is:

- A. The colour of the condensate
- B. The number of flanges
- C. The length of the main only
- D. Insufficient differential pressure to lift against the back pressure

62. A NPT threaded joint is made up with parallel (straight) threads by mistake and won't seal. The reason NPT seals and straight thread doesn't is:

- A. Straight threads are stronger
- B. NPT threads are coated at the factory
- C. The NPT taper wedges threads together to seal
- D. Straight threads have a built-in O-ring

63. A steam main's drip leg is sized the same diameter as a small branch and undersized, so it fails to collect condensate. The drip leg should be:

- A. Smaller than the main always
- B. Sized generously (often near main diameter) to capture condensate
- C. The same as the trap discharge only
- D. Eliminated entirely

64. A 6-inch (150 mm) bore pipe's cross-sectional area is needed for velocity calculation. Using $A = \pi r^2$, it is closest to:

- A. 7,850 mm²
- B. 900 mm²
- C. 450 mm²

D. 17,700 mm²

65. A pilot-operated relief valve's pilot sensing line becomes plugged, and the main valve fails to open at set pressure. The mechanism is:

- A. The pilot carries full relief flow
- B. The blocked pilot can't sense pressure to actuate the main valve
- C. The main valve heats up
- D. The pilot drains condensate

66. A steamfitter must select an electrode for carbon steel pipe requiring low hydrogen to avoid cracking. The correct choice is:

- A. E7018 low-hydrogen electrode
- B. ER4043 aluminum filler
- C. A brazing rod
- D. A cellulose-only flux

67. A control valve specified "fail-open" (FO) is mistakenly set up fail-closed, and on air loss a heating process overheats. The correct fail action for safety here was:

- A. Lock last position
- B. Throttle automatically
- C. Fail closed
- D. Fail open to maintain flow/cooling as designed

68. A relief valve simmers continuously because operating pressure is too close to set pressure. The remedy is:

- A. Raise the operating pressure higher

- B. Increase the margin between operating and set pressure
- C. Remove the relief valve
- D. Paint the valve

69. A buried pipe's cathodic protection uses a copper anode by mistake, and the steel still corrodes. The error is:

- A. Copper is too active
- B. The anode was too large
- C. Copper is more noble than steel, so it can't protect it sacrificially
- D. The pipe was too small

70. A steam trap's body is cold while the inlet line is hot, and condensate backs up. The diagnosis is:

- A. The trap is blowing live steam
- B. The trap is oversized
- C. The trap is blocked/failed shut, holding condensate
- D. The trap is working normally

71. A weld procedure's essential variable (preheat) is changed without requalification, and the weld cracks. The rule violated is:

- A. Essential variables can be changed freely
- B. Preheat is not an essential variable
- C. Only filler colour matters
- D. Changing essential variables requires procedure requalification

72. A schedule 40 pipe is used where the pressure demands schedule 80, and the pipe bursts. The selection factor ignored was:

- A. The pipe colour
- B. The supplier's stock
- C. Wall thickness/pressure rating requirement
- D. The pipe length

73. A globe valve in steam service is installed to drain away from the seat, and condensate pools above the disc causing corrosion. The correct orientation drains:

- A. Toward the seat to prevent pooling above the disc
- B. Away from the seat
- C. Into the bonnet
- D. It does not matter

74. A blind flange is removed from a live, pressurized line without isolation, releasing steam. The safe procedure required:

- A. Removing it faster
- B. Isolating, depressurizing, and verifying zero energy first
- C. Increasing pressure first
- D. Loosening all bolts at once

75. A DN50 European-spec pipe must be matched to North American stock. The fitter selects:

- A. NPS 6
- B. NPS 2 (≈ 50 mm)
- C. NPS 1/2
- D. NPS 12

76. A steam separator improves steam quality, but a fitter questions why drier steam matters for a turbine. The benefit is:

- A. Wet steam increases turbine efficiency
- B. Moisture has no effect on turbines
- C. Drier steam reduces blade erosion and improves efficiency
- D. Wet steam protects the blades

77. A relief valve for steam (compressible) is mistakenly a liquid-service relief that opens proportionally, and it can't relieve fast enough. The correct device for steam is:

- A. A liquid relief valve
- B. No valve at all
- C. A pressure gauge
- D. A safety valve with rapid pop action for compressible fluid

78. A long carbon steel run (40 m) heated through 100°C has no expansion provision. Estimated growth ($\alpha \approx 0.0000117/^\circ\text{C}$) is closest to, and risks buckling:

- A. 4.7 mm
- B. 0.47 mm
- C. 47 mm
- D. 470 mm

79. A steam trap is checked and found to discharge intermittently with a snap as the bucket sinks and rises. The trap type and status are:

- A. An inverted bucket trap operating normally
- B. A failed thermodynamic trap
- C. A blocked F&T trap

D. A leaking relief valve

80. A hydronic direct-return system is difficult to balance, with near terminals overflowing. Converting design intent, the layout that self-balances is:

A. A single-pipe system

B. A reverse-return system with equal circuit lengths

C. A larger direct-return main

D. Removing balancing valves

81. A gas line is placed in service without purging, and a flammable air-fuel mixture ignites. The omitted commissioning step was:

A. Painting the line

B. Pressure-testing only

C. Adding moisture

D. Purging air/inerting before introducing fuel gas

82. A pump suction shows adequate pressure but the impeller still cavitates at higher water temperature. The reason is:

A. Hot water's higher vapour pressure reduces available NPSH

B. Hot water has lower vapour pressure

C. Temperature doesn't affect cavitation

D. The pump gained head

83. A relief valve discharge line is reduced one size smaller than the valve outlet, increasing back pressure. The effect is:

A. Improved relief capacity

- B. Lower set pressure
- C. The valve relieves earlier
- D. Impaired lift and reduced relieving capacity

84. A spiral-wound gasket is replaced with paper on a high-pressure steam flange, which blows out. The property paper lacks is:

- A. Low cost
- B. High-temperature/pressure resilience and recovery
- C. Thinness
- D. Flexibility only

85. A steam coil floods because its trap can't drain under a slight vacuum at low load. Installing which device restores drainage?

- A. A larger relief valve
- B. A second gauge
- C. A vacuum breaker
- D. An extra flange

86. A bonnet on a valve is over-tightened on its packing, and the stem binds and galls. The bonnet's actual role is to:

- A. House the stem and contain the packing, connecting to the body
- B. Seal the flange face
- C. Indicate flow direction
- D. Form the seat

87. A new weld shows incomplete root penetration on a butt joint. A likely cause is:

- A. Too large a root gap with proper technique
- B. Improper root gap/technique preventing full fusion at the root
- C. Excessive PWHT
- D. Too much back-purge

88. A steamfitter must verify a vessel's safe pressure limit before setting a relief valve. The nameplate value to use is:

- A. The test pressure
- B. The atmospheric pressure
- C. The hydrostatic pressure only
- D. The MAWP (Maximum Allowable Working Pressure)

89. A condensate line lacks a drip pocket ahead of a vertical riser, and water hammer occurs at the riser base. The fix is:

- A. Increase steam pressure
- B. Add a drip leg with trap at the riser base
- C. Remove the riser
- D. Insulate the riser only

90. A steam main's expansion is restrained by an anchor that fails, allowing the pipe to thrust into equipment. The anchor's intended role was to:

- A. Drain condensate
- B. Reduce pressure
- C. Vent air
- D. Fix the pipe at a point and absorb thrust loads

91. A pump is run against a closed discharge valve ("deadheaded") for an extended time. The risk is:

- A. Overheating and damage from churning the trapped liquid
- B. Increased efficiency
- C. Reduced motor current
- D. No effect

92. A relief valve's discharge reaction force is not accounted for, and the discharge piping whips on lift. The design oversight was:

- A. Using too small a relief valve
- B. Adding a strainer
- C. Failing to support/restrain the discharge for reaction thrust
- D. Over-insulating the line

93. A steam trap installed without a strainer fails repeatedly from debris fouling. The preventive component is:

- A. A larger trap
- B. A bypass line only
- C. A strainer upstream of the trap
- D. A second gauge

94. A welder uses E6010 on a root pass and E7018 on fill/cap for a pipe weld. The reason for E7018 on fill is:

- A. Low-hydrogen deposit reduces cracking risk in the fill/cap
- B. It is cheaper than E6010
- C. It melts at a lower temperature

D. It is non-metallic

95. A dielectric union is omitted between a copper line and steel tank, and corrosion accelerates. Reinstalling the union works by:

A. Increasing flow

B. Electrically isolating the dissimilar metals

C. Reducing the pressure

D. Adding a quick disconnect

96. A steam main is oversized well beyond the load, raising fuel cost. The mechanism is:

A. Higher steam velocity damaging pipe

B. Greater surface area and standing condensate increasing heat loss

C. The traps becoming unnecessary

D. The pressure rating dropping

97. A steam trap that must handle large startup air loads and varying condensate on a heating coil is best served by a:

A. Thermodynamic disc trap

B. Simple orifice

C. Manual valve

D. Float and thermostatic (F&T) trap

98. A pipe support span is set far beyond code tables for a water-filled steel line, and the pipe sags and stresses joints. The factor underestimated was:

A. The pipe colour

- B. The weight of pipe plus contents
- C. The number of welders
- D. The brand of fittings

99. A relief valve is tested and found to open well above its stamped set pressure. The condition this creates is:

- A. The vessel can be overpressurized before relief
- B. The valve relieves too early
- C. The valve is more accurate
- D. The set pressure is now lower

100. A steam line's insulation is removed to "speed cooling," and fuel costs rise with more condensate. The role insulation played was to:

- A. Add pressure rating
- B. Reduce heat loss and condensate formation
- C. Strengthen the pipe structurally
- D. Increase steam velocity

101. A pump curve and system curve intersect far left of the best-efficiency point, and the pump runs hot at low flow. The condition is:

- A. Operating at low flow far from BEP, risking recirculation and heating
- B. Operating at peak efficiency
- C. Cavitation from high flow only
- D. Overpressure relief

102. A flanged connection on cast-iron equipment uses a raised-face flange and cracks the casting on bolt-up. The correct face for cast iron is:

- A. A heavier raised face
- B. A ring-joint face
- C. No gasket at all
- D. A flat face to avoid bending the brittle casting

103. A steam trap discharges condensate to a return under back pressure, and a check valve is added at the trap outlet to:

- A. Prevent backflow of condensate into the trap from the return
- B. Increase the trap capacity
- C. Reduce the steam pressure
- D. Vent air to atmosphere

104. A pressure vessel inspection requires internal access for cleaning, but the vessel has no opening. The missing feature is:

- A. A relief valve
- B. A larger gauge
- C. A second flange
- D. A manway/handhole for internal access

105. A steam coil's condensate "stalls" when modulating control drops steam pressure below the back pressure. The remedy that ensures drainage is:

- A. A pump-trap (combination) or condensate pump to overcome back pressure
- B. A larger gauge
- C. Removing the trap
- D. Increasing pipe colour visibility

106. A weld neck flange is chosen for a high-pressure cyclic line over a slip-on. The fatigue advantage comes from:

- A. Lower cost
- B. The tapered hub giving a smooth stress transition and full-penetration weld
- C. A larger bore
- D. No welding required

107. A grooved coupling is installed on pipe that was cut-grooved too deep, weakening the wall, and it leaks. The correct groove must be:

- A. As deep as possible
- B. To the manufacturer's specified depth for the pipe wall
- C. Threaded instead
- D. Omitted entirely

108. A steam system's pressure gauge has no shutoff cock for service, requiring shutdown to replace. The recommended fitting is:

- A. A larger gauge
- B. A second relief valve
- C. A gauge cock (isolation valve) at the gauge connection
- D. A blind flange

109. A radiator trap that has failed open is wasting steam into the return. The symptom distinguishing it from a failed-closed trap is:

- A. The radiator stays cold
- B. Live steam and excessive heat reaching the return line
- C. The boiler loses pressure to zero

D. The relief valve opens

110. A pump's mechanical seal fails repeatedly due to running dry during priming issues. The protective practice is:

A. Run it dry longer to seat the seal

B. Increase the speed

C. Remove the seal

D. Ensure the pump is primed/flooded before starting

111. A long steam main with rigid anchors but no expansion provision overstresses an anchor. The needed addition is:

A. More insulation

B. An expansion loop or joint to absorb growth

C. A larger relief valve

D. A second gauge

112. A steam trap's discharge temperature is far below saturation, indicating subcooling and condensate backup. This suggests the trap is:

A. Blowing live steam

B. Oversized for live steam passage

C. Working at peak capacity

D. Holding condensate (failed shut or undersized)

113. A pipe's thermal expansion is calculated for design, and the fitter must choose a flexible offset. The simplest passive method to absorb growth is:

A. An expansion loop using the pipe's own flexibility

- B. A rigid weld at both ends
- C. Removing supports
- D. Increasing wall thickness only

114. A steam separator's effectiveness drops when its drain trap is undersized. The connection is:

- A. Collected moisture isn't removed fast enough and re-entrains
- B. The separator adds water
- C. The separator raises pressure
- D. The trap colour matters

115. A relief valve discharges and the operator wants to confirm it reseats properly. The desirable behaviour is:

- A. The valve stays open permanently
- B. The valve never opened
- C. The valve recloses (reseats) once pressure drops below set
- D. The valve relieves continuously below set

116. A control valve's actuator loses air, and a "fail-closed" valve on a fuel line moves to:

- A. The fully closed position, stopping fuel safely
- B. The fully open position
- C. Its last position
- D. A throttling position

117. A steam main's drip leg trap is piped without a strainer and a check valve, and it fouls and back-floods. The two protective fittings missing are:

- A. Two gauges
- B. Two flanges
- C. A larger trap and a bypass
- D. A strainer (upstream) and a check valve (downstream)

118. A pump operates with cavitation traced to a clogged suction strainer reducing available NPSH. The fix is:

- A. Increase pump speed
- B. Add discharge throttling
- C. Clean/clear the suction strainer to restore suction pressure
- D. Reduce the impeller size

119. A high-pressure steam flange leaks after thermal cycling despite correct gasket. The likely cause is:

- A. The gasket was too thin only
- B. The pipe was too long
- C. Bolt relaxation/creep under thermal cycling needing re-torque
- D. The flange face was raised

120. A relief valve's set pressure must relate to the vessel's MAWP as:

- A. At or below MAWP so it relieves before overstress
- B. Above MAWP for margin
- C. Equal to atmospheric
- D. Twice the operating pressure

121. A steam trap fails and the fitter must choose a non-invasive verification method during operation. The appropriate technique is:

- A. Cutting the trap open in service
- B. Removing and weighing the trap
- C. Ultrasonic listening plus inlet/outlet temperature comparison
- D. Painting the trap

122. A pump discharge check valve slams shut on pump trip, causing water hammer. A mitigation is:

- A. Removing the check valve entirely
- B. Increasing pump speed
- C. Using a faster-closing valve
- D. Using a slow-closing or spring-assisted (silent) check valve

123. A boiler's water level swings and carries over moisture into the steam main. A contributing cause is:

- A. The relief valve set too low
- B. The pipe being oversized
- C. Rapid load swings/improper level control causing priming and carryover
- D. Excess insulation

124. A steamfitter selects gasket and bolting for a Class 300 flange at elevated temperature. The class rating tells the fitter the:

- A. Allowable pressure decreasing as temperature rises
- B. Bolt-hole count only
- C. Pipe diameter in mm
- D. Flow rate limit

125. A condensate receiver vents flash steam continuously, and the fitter wants to recover that energy. A method is:

- A. Sealing the vent shut entirely
- B. Increasing the receiver pressure to dangerous levels
- C. Removing the receiver
- D. Routing flash steam to a flash tank/low-pressure use

126. A relief valve's discharge piping creates excessive back pressure, reducing capacity. For a conventional (non-balanced) valve, the limit on built-up back pressure is typically about:

- A. 50% of set pressure
- B. 10% of set pressure
- C. 100% of set pressure
- D. Unlimited

127. A steam trap is installed above the equipment it drains with no means to lift condensate, and it floods. The needed condition is:

- A. Lower the equipment
- B. Remove the trap
- C. Increase pipe size only
- D. Sufficient differential pressure or a pump to lift condensate to the trap

128. A pipe is welded with excessive root reinforcement protruding into the bore, restricting flow and catching debris. The defect is:

- A. Undercut
- B. Porosity
- C. Lack of fusion

D. Excessive root penetration (icicles)

129. A steam system's PRV is selected without a downstream relief valve. The code/safety gap is:

- A. No protection if the PRV fails open, over-pressurizing the low side
- B. The PRV cannot reduce pressure
- C. The PRV needs no strainer
- D. The PRV measures flow

130. A steam trap on a drip leg discharges to a return that is higher than the trap, and the fitter must confirm the trap can lift. The deciding factor is:

- A. The trap colour
- B. The number of flanges
- C. The discharge line length only
- D. Whether differential pressure is sufficient to lift condensate the required height

Practice Exam 14: Answer Key and Explanations

1. D — A trap that discharges a steady plume of vapour at full load has failed open and is passing live steam. A working trap releases condensate intermittently, not a continuous steam plume. Blow-through wastes energy and signals the element no longer seals against steam.

2. A — Banging at a low point during warm-up is condensate accumulating and being accelerated by steam flow into fittings. The dense water slug decelerates suddenly, creating the hammer. Proper drip legs and slow warm-up prevent it.

3. B — Wild suction-gauge swings and a crackling (gravel) noise are classic cavitation from insufficient suction pressure. Vapour bubbles form and collapse on the impeller, eroding it and killing flow. Restoring NPSH—clearing strainers, raising suction head—resolves it.

4. A — System-wide failure to pressurize while the burner fires points to the boiler safety valve stuck open, bleeding off steam before the system can build pressure. A single radiator's trap or vent would only affect that one unit, not the whole system. The safety valve is the component whose failure starves the entire system of pressure.
5. A — Downstream pressure creeping above setpoint at no-flow means the PRV seat is passing (leaking by). A worn or fouled seat lets steam bleed through even when closed, raising the low side. The downstream relief eventually lifts if creep continues.
6. B — Rapid corrosion where copper meets steel is galvanic corrosion from joining dissimilar metals without a dielectric union. The metals form an electrochemical cell, and the more active steel corrodes preferentially. A dielectric union breaks the circuit.
7. C — A relief valve leaking below set pressure and worsening over weeks indicates simmering has eroded the seat. The escaping flow wire-draws the sealing surface, degrading the seal progressively. The valve must be repaired or replaced.
8. D — A modulating coil that floods at low load has a trap unable to drain under low differential; an F&T trap or a pump-trap restores drainage. At low pressure the trap can't push condensate out, so it backs up. Matching the trap to modulating service fixes it.
9. A — A fully consumed sacrificial anode means it protected the pipe as designed and must be replaced. The anode is meant to corrode preferentially, sparing the steel; consumption is normal service. Renewing it continues cathodic protection.
10. D — A globe valve that chatters and erodes was likely installed with flow over the disc, against the body arrow. Reverse flow lifts the disc against the stem and causes instability and wear. Correct orientation is flow under the seat per the arrow.
11. C — A plugged separator drain trap means trapped moisture is no longer removed, so wet steam reaches downstream equipment, causing erosion and carryover. The separator only works if its drain continuously discharges collected water. Clearing the trap restores dry steam.

12. A — A concentric reducer on a horizontal pump suction creates an air pocket at its high point, causing intermittent loss of prime. The trapped air starves the impeller. An eccentric reducer installed flat-side-up eliminates the pocket.

13. B — Oversizing the return (too large a pipe schedule) drops velocity so far that flash steam and condensate separate and form slugs, producing backpressure and waterlogging. Correct return sizing keeps velocity high enough to carry the two-phase mix smoothly. Both undersizing and gross oversizing cause problems; here the stated fault is the oversize.

14. C — A bellows joint that fatigue-cracks with missing guides failed because unguided pipe allowed lateral/torsional movement the bellows can't absorb. Bellows take axial movement only; unguided side loads destroy them. Proper guides direct movement axially.

15. B — A steam gauge overheating without a pigtail needs a pigtail siphon installed to keep a water seal off the Bourdon element. The trapped condensate buffers live steam from the sensing element. This is standard protection on steam gauges.

16. C — HAZ cracking on thick-wall high-pressure pipe points to omitted post-weld heat treatment required for the material and thickness. PWHT relieves residual stress and tempers the HAZ. Code thresholds mandate it above certain thicknesses.

17. C — Repeated air-binding at a high point indicates a missing or failed automatic air vent at that high point. Air collects at high points and blocks circulation until vented. Installing a working vent restores flow.

18. B — A flange leaking right after assembly with a new gasket points to uneven bolt tightening instead of a staged star pattern. Uneven load cocks the flange and fails to seat the gasket. Staged cross-pattern torque seals it properly.

19. B — A main without drip legs that hammers at startup needs drip legs with traps at low points and ahead of risers. These collect and remove condensate before steam can drive slugs. It is the standard hammer-prevention detail.

20. A — When required NPSH exceeds available NPSH, the predictable result is cavitation, noise, and impeller damage. The liquid flashes to vapour at the impeller eye and collapses violently. Selection must keep available NPSH above required.

21. A — A check valve installed backward blocks the intended flow direction, so there is no flow. The valve only opens to forward flow, which is now reversed by the misinstall. Correct orientation follows the body arrow.

22. C — A steam coil holding condensate under vacuum needs a vacuum breaker to admit air and allow drainage. When internal pressure drops below atmospheric, the breaker opens so condensate can drain freely. This prevents water hammer in the coil.

23. C — Increased erosion after swapping to a short-radius elbow happens because the tighter turn increases turbulence and erosion at the bend. Faster directional change scours the wall, especially in wet high-velocity steam. Long-radius elbows reduce this.

24. A — Low water from a leaking return siphoning the boiler should have been prevented by a Hartford loop. The loop connects the equalizer near the normal water line, stopping the boiler from draining below a safe level. It is a classic steam-boiler safeguard.

25. C — Shredded PTFE tape inside a leaking joint means it was wrapped against the thread direction so it peeled off during makeup. Tape must follow the thread spiral to stay seated. Correct wrapping fills the threads and seals.

26. A — A steam system far above velocity limits with noise and carryover is corrected by increasing the main pipe size to lower velocity. Larger bore drops velocity, reducing erosion and moisture entrainment. Proper sizing keeps velocity within limits.

27. A — A relief valve set above the vessel's MAWP means the vessel could be overstressed before the valve relieves. The protection only works if the valve lifts at or below MAWP. Setting it higher defeats the safeguard.

28. D — Socket-weld cracking under thermal cycling is linked to no expansion gap left at the socket bottom, causing stress. The code-required small gap (about 1.5 mm) lets the pipe expand without loading the weld. Bottoming the pipe creates a stress riser.

29. A — A trap sized exactly to calculated load that backs up at startup omitted a safety factor for startup loads. Cold-start condensate greatly exceeds running load, so traps are sized with margin. A factor of about 2–3× prevents backup.

30. C — Galvanized pipe discolouring and fuming on hot steam is the zinc coating degrading and off-gassing at high temperature. Zinc breaks down above its stable range, releasing fumes and flaking. Bare or alloy pipe is used for high-temperature steam.

31. D — Relief discharge piping must be independently supported and restrained so its weight and the reaction thrust on lift don't transfer into the valve body. Unsupported piping distorts the valve and can impair reseating or operation. Drip-pan elbows and anchored supports isolate these loads.

32. A — Closely spaced tees installed far apart mean the loops are no longer hydraulically decoupled and interfere. The low pressure drop between near tees is what isolates the loops; spacing them adds drop and cross-flow. Correct spacing restores independence.

33. D — A main pitched against flow collects condensate away from drip points, raising hammer risk. Water pools where no trap can remove it, then gets driven by steam. Correct pitch is downward in the flow direction toward drip legs.

34. A — A never-cleaned Y-strainer that costs a valve its control authority is accumulating debris restricting flow and fouling the valve trim. The clogged screen starves and disturbs the controlled flow. Routine cleaning protects the valve.

35. B — Fatigue cracking after swapping a weld neck for a slip-on flange occurs because the slip-on's fillet weld concentrates stress versus the weld neck's smooth transition. The weld neck's tapered hub distributes cyclic load better. High-pressure cyclic service favours weld necks.

36. B — An inverted bucket trap that loses prime and blows steam after a surge suffers loss of water seal, letting the bucket stay down and hold the valve open. Without the seal the bucket can't float to close. Re-priming restores normal cycling.

37. D — Rapid wear and noise from replacing a two-stage PRV with one stage across a large drop is excessive velocity and erosion from forcing the full drop through one stage. Splitting the ratio limits velocity and wear. Two stages give stable control.

38. C — A feedwater regulator admitting too little water risks overheating/damage to boiler surfaces from low water. Uncovered heating surfaces overheat and can fail catastrophically. Maintaining proper drum level is critical for safety.

39. B — A thermodynamic disc trap cycling rapidly on a high-back-pressure line suffers because excessive back pressure disrupts the disc's snap action. The pressure difference that closes the disc is reduced, causing rapid recycling and wear. Disc traps need adequate differential.

40. C — A dummy leg welded to rigidly anchor a hot elbow means thermal expansion is restrained, building damaging stress. The support should carry load while allowing the line to grow. Rigid anchoring on an expanding line overloads it.

41. A — An eccentric reducer installed flat-side-down on a pump suction creates an air pocket at the top starving the pump. Flat-side-up is required so no high spot traps air. The misorientation causes loss of prime and cavitation.

42. C — An F&T trap whose thermostatic element failed shut causes air binding the coil because air can no longer be vented. Trapped air blocks steam and slows startup heating. The thermostatic element's job is to purge that air.

43. C — A relief valve with no certification stamp must be replaced with a properly registered/certified valve. The stamp proves it was built and tested to code; without it, safe performance is unverified. Uncertified relief devices are not permitted.

44. D — Beyond reducing velocity, improving wet-steam quality at fittings requires installing a separator to remove entrained moisture. The separator flings out water droplets that cause erosion. Drier steam protects fittings and equipment.

45. B — A balanced-pressure thermostatic trap performs across wide pressure swings because its fill responds to the saturation curve, self-adjusting with pressure. The capsule boils just below steam temperature at any pressure. This makes it versatile.

46. C — A main with anchors but no guides near its loop bows sideways because guiding to direct expansion into the loop is missing. Guides restrain lateral motion so growth goes into the loop's flexibility. Without them the pipe buckles sideways.

47. C — Internal "sugaring" on a stainless weld means back-purging the root with inert gas was omitted. Shielding the back side from oxygen prevents oxidation and preserves corrosion resistance. Clean process welds require purging.

48. D — Rapid wear from tight high-pressure throttling with a butterfly valve is choosing a butterfly for severe high-pressure throttling instead of a globe valve. Butterflies suit large low-pressure on/off or light throttling; severe service erodes the disc and seat. A globe valve handles it.

49. B — When the return must rise to an elevated boiler and condensate backs up, the needed component is a condensate receiver/pump set to lift the return. Gravity can't move it uphill, so a pump set collects and pumps it. This maintains return flow.

50. C — A drilled-and-stubbed branch that cracks shows why a weldolet was better: its contoured, reinforced base distributes branch stresses properly. The reinforcement compensates for the opening in the header. Unreinforced branches concentrate stress and fail.

51. D — Wait — testing at exactly design pressure instead of $1.5\times$ gives inadequate proof margin above operating conditions, which is option D as keyed, and the reasoning supports it. The test fails to demonstrate the safety margin codes require. The standard factor is $1.5\times$ design pressure.

52. A — Continuous high-frequency flow with both sides hot on ultrasonic check means the trap is blowing through (passing live steam). A working trap would show intermittent flow and a cooler outlet between discharges. Both-sides-hot plus steady flow confirms failure open.

53. D — An unsealed sleeve through a fire-rated wall is corrected by installing an approved firestop assembly maintaining the rating. The firestop seals the annular space against fire and smoke. A bare sleeve or escutcheon does not preserve the rating.

54. B — A plain rubber gasket failing on a 250°C steam flange must be replaced with a spiral-wound or graphite gasket rated for the temperature. These withstand high heat and pressure where rubber degrades. Gasket selection must match service.

55. A — psia includes atmospheric pressure, reading about 14.7 psi higher than psig. Confusing the two misstates the true overpressure margin. Gauge pressure (psig) reads zero at atmospheric; absolute (psia) adds the atmosphere.

56. A — For a 45° offset, travel = offset \times 1.414. The constant is $1/\sin 45^\circ$, the standard fitter multiplier. Using 1.155 (the 30° constant) shorts the travel.

57. D — A cast fitting cracking from too-fast warm-up failed by thermal shock from rapid, uneven heating. Sudden temperature gradients stress brittle cast material. Slow, controlled warm-up prevents it.

58. D — A relief discharge pointed at a walkway is a scalding/injury risk; reroute discharge to a safe location. Released steam must not endanger personnel. Safe termination away from work areas is required.

59. C — 30 m of water head \times \sim 9.81 kPa/m \approx 294 kPa. Each metre of water equals about 9.81 kPa, so 30 m is roughly 294 kPa. This converts head to pressure for pump selection.

60. B — Pitting from dissolved oxygen is treated by deaerating/removing dissolved oxygen from the feedwater. Oxygen drives pitting corrosion in boiler systems. Deaerators and oxygen scavengers eliminate it.

61. D — A trap that stalls when back pressure rises is limited by insufficient differential pressure to lift against the back pressure. The pressure difference provides the lifting energy; when it falls, condensate can't be moved. Sizing must account for back pressure.

62. C — Straight threads won't seal because the NPT taper wedges threads together to seal. The interference along the taper, aided by sealant, forms the pressure-tight seal. Parallel threads lack that wedging action.

63. B — An undersized drip leg should instead be sized generously (often near the main diameter) to capture condensate. A small drip leg lets condensate skip past in the fast steam flow. Adequate size lets water drop out for the trap.

64. D — $\text{Area} = \pi r^2 = \pi \times 75^2 \approx 17,671 \approx 17,700 \text{ mm}^2$. With a 150 mm bore the radius is 75 mm, giving about 17,700 mm². This is the cross-section for velocity calculations.

65. B — A plugged pilot line leaving the main valve shut at set pressure happens because the blocked pilot can't sense pressure to actuate the main valve. The pilot uses system pressure to control the main valve; without sensing, it won't open. Pilot lines must stay clear.

66. A — For carbon steel needing low hydrogen to avoid cracking, the correct electrode is E7018 low-hydrogen. Its low-moisture coating minimizes hydrogen-induced cracking. It is the standard fill/cap electrode for such service.

67. D — A heating process overheating on air loss shows the correct fail action was fail open to maintain flow/cooling as designed. Fail-safe direction is chosen for the process's safe state; here open keeps cooling/heating control safe. Setting it fail-closed defeated that.

68. B — Continuous simmer because operating pressure is too close to set pressure is fixed by increasing the margin between operating and set pressure. Too small a gap keeps the valve on the verge of lifting. Adequate margin lets it seat firmly.

69. C — A copper anode failing to protect steel is wrong because copper is more noble than steel, so it can't protect it sacrificially. The sacrificial anode must be more active (magnesium/zinc) than the protected metal. Copper would actually accelerate corrosion.
70. C — A cold trap body with a hot inlet and backed-up condensate means the trap is blocked/failed shut, holding condensate. No discharge lets condensate accumulate and cool the body. A failed-shut trap must be cleared or replaced.
71. D — Cracking after changing preheat without requalification violates the rule that changing essential variables requires procedure requalification. Preheat is an essential variable affecting weld properties. Altering it invalidates the WPS qualification.
72. C — A schedule 40 pipe bursting where schedule 80 was needed ignored the wall thickness/pressure rating requirement. Higher pressure demands thicker wall (higher schedule). Selection must match the pressure rating with margin.
73. A — A globe valve draining away from the seat that pools condensate is corrected by orienting it to drain toward the seat to prevent pooling above the disc. Proper orientation lets condensate clear rather than collect and corrode. It follows the body flow arrow.
74. B — Removing a blind flange from a live line is corrected by isolating, depressurizing, and verifying zero energy first. Working on pressurized systems risks dangerous releases. Verified zero-energy state is mandatory before breaking containment.
75. B — DN50 corresponds to NPS 2 (≈ 50 mm). DN is the metric nominal-diameter equivalent of NPS. Knowing the equivalence lets fitters match European and North American specs.
76. C — Drier steam matters for a turbine because it reduces blade erosion and improves efficiency. Water droplets at high velocity erode blades and waste energy. Separators deliver the dry steam turbines require.

77. D — For steam (compressible), the correct device is a safety valve with rapid pop action for compressible fluid. The snap opening quickly relieves expanding gas; a liquid-service relief opens too gradually. Fluid type dictates valve type.

78. C — Expansion = $40,000 \text{ mm} \times 0.0000117 \times 100 \approx 46.8 \approx 47 \text{ mm}$. A 40 m carbon steel run through 100°C grows about 47 mm. Without provision this growth buckles the pipe.

79. A — Intermittent discharge with a snap as a bucket sinks and rises is an inverted bucket trap operating normally. The cyclic sink-float action is the type's signature. It indicates healthy operation, not a fault.

80. B — A hard-to-balance direct-return system is solved by a reverse-return system with equal circuit lengths. Equal total path lengths give near-equal pressure drops, so the loop self-balances. This corrects the near-terminal overflow problem.

81. D — Ignition from unpurged gas commissioning omitted purging air/inerting before introducing fuel gas. Displacing air prevents a flammable mixture in the line. It is a mandatory safety step before service.

82. A — Cavitation at higher water temperature despite adequate pressure is because hot water's higher vapour pressure reduces available NPSH. As vapour pressure rises, the margin against flashing shrinks. Hot systems need more suction head.

83. D — Reducing the relief discharge line one size and raising back pressure causes impaired lift and reduced relieving capacity. Excess back pressure opposes valve opening. Discharge piping must be no smaller than the outlet.

84. B — Paper blowing out where a spiral-wound gasket belongs lacks high-temperature/pressure resilience and recovery. Spiral-wound gaskets maintain seal load under heat and cycling; paper cannot. Material must suit the service.

85. C — A coil that can't drain under slight vacuum at low load is restored by a vacuum breaker. Admitting air breaks the vacuum so condensate drains. This prevents flooding and hammer in modulating coils.

86. A — An over-tightened bonnet that galls the stem reveals the bonnet's role: to house the stem and contain the packing, connecting to the body. It is not a sealing face or flow indicator. Proper packing adjustment prevents binding.

87. B — Incomplete root penetration on a butt joint is caused by improper root gap/technique preventing full fusion at the root. Too tight a gap or poor manipulation leaves the root unfused. Correct fit-up and technique ensure penetration.

88. D — The nameplate value to set a relief valve against is the MAWP (Maximum Allowable Working Pressure). It is the vessel's design safe limit, and relief is set at or below it. Test and atmospheric pressures are not the reference.

89. B — Hammer at a riser base with no drip pocket is fixed by adding a drip leg with trap at the riser base. Condensate collecting before the rise must be drained, not driven up by steam. The drip leg captures and removes it.

90. D — A failed anchor letting the pipe thrust into equipment shows the anchor's role: to fix the pipe at a point and absorb thrust loads. Anchors direct expansion and resist forces from pressure and flow. Their failure releases damaging movement.

91. A — Deadheading a pump against a closed valve risks overheating and damage from churning the trapped liquid. With no flow to carry heat away, the liquid and pump overheat. A minimum-flow path or relief prevents it.

92. C — Discharge piping that whips on lift reflects failing to support/restrain the discharge for reaction thrust. The momentum of relieved steam creates large reaction forces. Proper anchoring and supports contain them.

93. C — A trap failing from debris without protection needs a strainer upstream of the trap. The strainer catches scale and debris before they foul the trap. It is standard protection on trap installations.

94. A — E7018 on fill/cap is used because its low-hydrogen deposit reduces cracking risk in the fill/cap. E6010 gives good root penetration but more hydrogen; E7018 finishes with tougher, crack-resistant weld metal. This pairing is common on pipe.

95. B — Reinstalling an omitted dielectric union works by electrically isolating the dissimilar metals. Breaking the galvanic circuit stops the accelerated corrosion at the copper-steel junction. It is the standard fix for mixed-metal joints.

96. B — An oversized steam main raising fuel cost does so through greater surface area and standing condensate increasing heat loss. More metal radiates more heat and holds more condensate to reheat. Correct sizing minimizes these losses.

97. D — A coil with large startup air loads and varying condensate is best served by a float and thermostatic (F&T) trap. The float handles variable condensate while the thermostatic element vents air. This matches modulating heating service.

98. B — A support span set far beyond code tables that sags underestimated the weight of pipe plus contents. Filled pipe is heavy, and spans must limit sag and joint stress. Code tables base spans on size, material, and contents weight.

99. A — A relief valve opening well above its stamped set pressure means the vessel can be overpressurized before relief. The protection fails to act at the intended limit. The valve must be reset or replaced to lift at set pressure.

100. B — Removing insulation that raised fuel cost and condensate confirms insulation's role: to reduce heat loss and condensate formation. Less radiated heat means lower fuel use and less condensate to handle. It does not affect pressure rating or velocity.

101. A — A pump running far left of BEP is operating at low flow far from the best-efficiency point, risking recirculation and heating. Internal recirculation and low throughput trap heat. Operating near BEP avoids it.

102. D — A raised-face flange cracking a cast-iron casting is corrected with a flat face to avoid bending the brittle casting. The raised face concentrates load and bends the rim; flat-face full contact spreads it. Cast iron requires flat-face mating.

103. A — A check valve at a trap outlet under back pressure prevents backflow of condensate into the trap from the return. It keeps return-line condensate from re-entering and waterlogging the trap. This protects trap operation.

104. D — A vessel needing internal access for cleaning but having no opening lacks a manway/handhole for internal access. The sealable opening lets personnel enter to inspect and clean. It is not a relief, gauge, or flow device.

105. A — A stalled modulating coil where steam pressure drops below back pressure is solved with a pump-trap (combination) or condensate pump to overcome back pressure. The pump provides the energy the low differential can't. This guarantees drainage at low load.

106. B — A weld neck flange's fatigue advantage on cyclic high-pressure lines is the tapered hub giving a smooth stress transition and full-penetration weld. The gradual geometry lowers stress concentration versus a slip-on fillet. It suits demanding cyclic duty.

107. B — A cut groove made too deep that weakens the wall and leaks must instead be to the manufacturer's specified depth for the pipe wall. Correct groove depth balances coupling engagement against wall strength. Over-grooving compromises the pipe.

108. C — A gauge with no service shutoff should have a gauge cock (isolation valve) at the gauge connection. It lets the gauge be changed without shutting the system down. It is standard on instrument connections.

109. B — A radiator trap failed open is distinguished by live steam and excessive heat reaching the return line. A failed-closed trap instead leaves the radiator cold. Steam in the return confirms blow-through.

110. D — Repeated seal failure from running dry is prevented by ensuring the pump is primed/flooded before starting. Mechanical seals rely on liquid for lubrication and cooling. Dry running destroys them quickly.

111. B — A rigidly anchored main overstressing an anchor needs an expansion loop or joint to absorb growth. Without a flexibility provision, thermal expansion loads the anchors. The loop or joint relieves the stress.

112. D — A trap discharging far below saturation with backup indicates it is holding condensate (failed shut or undersized). Subcooled backup means water sits in the trap instead of draining. The trap is not passing condensate properly.

113. A — The simplest passive method to absorb thermal growth is an expansion loop using the pipe's own flexibility. The looped pipe flexes to take up movement without mechanical parts. It is reliable and maintenance-free.

114. A — A separator losing effectiveness with an undersized drain trap means collected moisture isn't removed fast enough and re-entrains. If the drain can't keep up, water carries back into the steam. The drain trap must match the separation rate.

115. C — Confirming a relief valve reseats means the desirable behaviour is the valve recloses (reseats) once pressure drops below set. Proper reseating restores normal operation after relieving. A valve that won't reseat wastes steam and needs service.

116. A — A fail-closed valve on a fuel line moves to the fully closed position, stopping fuel safely on air loss. The spring drives it shut so the process defaults safe. This is the intended fail-safe action for fuel service.

117. D — A drip-leg trap fouling and back-flooding is missing a strainer (upstream) and a check valve (downstream). The strainer keeps debris out; the check valve prevents back-flooding from the return. Both protect trap operation.

118. C — Cavitation from a clogged suction strainer is fixed by cleaning/clearing the suction strainer to restore suction pressure. The blockage drops available NPSH below required. Clearing it restores proper suction conditions.

119. C — A high-pressure flange leaking after thermal cycling despite a correct gasket points to bolt relaxation/creep under thermal cycling needing re-torque. Heat cycles relax bolt preload, loosening the joint. Re-torquing (hot torque) restores the seal.

120. A — A relief valve's set pressure must be at or below MAWP so it relieves before overstress. This guarantees protection acts before the vessel is endangered. Setting it above MAWP defeats the safeguard.

121. C — Non-invasive trap verification in service uses ultrasonic listening plus inlet/outlet temperature comparison. These reveal whether the trap passes steam, is blocked, or works—without removing it. It is the standard field diagnostic.

122. D — Check-valve slam causing hammer on pump trip is mitigated by using a slow-closing or spring-assisted (silent) check valve. Closing before flow fully reverses prevents the slam. It reduces the pressure surge.

123. C — Level swings carrying moisture into the main are caused by rapid load swings/improper level control causing priming and carryover. Unstable level lets water entrain into the steam. Stable level control and proper sizing prevent it.

124. A — A Class 300 flange rating tells the fitter the allowable pressure decreasing as temperature rises. The class is a pressure-temperature designation, not a dimension or bolt count. Higher temperature lowers the allowable pressure.

125. D — Recovering continuous flash steam from a condensate receiver is done by routing flash steam to a flash tank/low-pressure use. Capturing the flash recovers energy otherwise vented. It improves overall efficiency.

126. B — For a conventional (non-balanced) relief valve, built-up back pressure is typically limited to about 10% of set pressure. Above this, the back pressure impairs lift and capacity. Balanced or pilot-operated valves tolerate more.

127. D — A trap mounted above the equipment that floods needs sufficient differential pressure or a pump to lift condensate to the trap. Without enough lift energy, condensate can't reach the trap and backs up. A pump or proper differential resolves it.

128. D — Root reinforcement protruding into the bore and catching debris is excessive root penetration (icicles). The defect restricts flow and creates turbulence and collection points. Proper technique limits root protrusion.

129. A — A PRV station without a downstream relief valve has no protection if the PRV fails open, over-pressurizing the low side. The relief valve safeguards downstream equipment rated for the reduced pressure. It is a required safety component.

130. D — A drip-leg trap discharging to a higher return is governed by whether differential pressure is sufficient to lift condensate the required height. The pressure difference provides the lifting energy. Inadequate differential means condensate won't rise.