

PRACTICE EXAM 13: RED SEAL STEAMFITTER/PIPEFITTER SIMULATION (130 QUESTIONS)

1. A pipefitter must determine the offset travel for a $22\frac{1}{2}^\circ$ fitting where the set is 250 mm. Using the constant for a $22\frac{1}{2}^\circ$ offset (travel = set \times 2.613), what is the approximate travel?

- A. 250 mm
- B. 354 mm
- C. 653 mm
- D. 500 mm

2. Which Canadian code governs the design, construction, and inspection of boilers and pressure vessels?

- A. ASME B31.3
- B. CSA W59
- C. ASME Section IX
- D. CSA B51

3. A 6 m length of steel pipe is heated from 15°C to 115°C . With a coefficient of thermal expansion of about $12 \times 10^{-6} / ^\circ\text{C}$, what is the approximate expansion?

- A. 0.36 mm
- B. 3.6 mm
- C. 1.2 mm
- D. 7.2 mm

4. What is the primary function of a desuperheater in a steam system?

- A. To increase the superheat of the steam
- B. To reduce steam temperature toward saturation
- C. To raise the boiler operating pressure
- D. To remove condensate from the main

5. When selecting a flange rating class such as Class 150 or Class 300, the rating primarily reflects:

- A. The flange outside diameter only
- B. The number of bolt holes
- C. The gasket color code
- D. The allowable pressure–temperature combination

6. A pipefitter must convert a pressure of 100 psi to approximate kilopascals. The result is closest to:

- A. 100 kPa
- B. 345 kPa
- C. 689 kPa
- D. 1,000 kPa

7. What is the purpose of a "telltale" hole drilled in the body of a bellows-sealed valve?

- A. To indicate failure of the bellows by allowing leakage to escape
- B. To increase the valve's flow capacity
- C. To pressurize the bonnet for testing
- D. To drain condensate from the seat

8. Which welding position is designated "5G" for pipe?

- A. Pipe horizontal and rotated during welding
- B. Pipe fixed horizontal, welded without rotation
- C. Pipe fixed vertical, welded around
- D. Pipe at 45° fixed angle

9. A pipefitter calculates the cross-sectional area of a pipe with an inside diameter of 100 mm. Using $A = \pi d^2/4$, the area is closest to:

- A. 7,854 mm²
- B. 314 mm²
- C. 31,416 mm²
- D. 10,000 mm²

10. The primary reason for using a reducing flange instead of a reducer plus a flange is to:

- A. Increase the pressure rating of the joint
- B. Eliminate the need for any gasket
- C. Allow the line to change direction
- D. Save space and reduce the number of joints

11. A steam system operates at 860 kPa gauge. What is the approximate absolute pressure, assuming standard atmospheric pressure of about 101 kPa?

- A. 759 kPa absolute
- B. 860 kPa absolute
- C. 961 kPa absolute
- D. 1,860 kPa absolute

12. What does the term "NPT" specify for a threaded connection?

- A. National Pipe Thread, a tapered thread standard
- B. Nominal pressure tolerance
- C. Net pipe thickness
- D. New piping technique

13. A pipefitter must select a valve that fails to a known safe position on loss of actuator power. This characteristic is called the valve's:

- A. Flow coefficient
- B. Fail-safe action
- C. Turndown ratio
- D. Seat leakage class

14. When sizing a relief valve discharge line, increasing the line length and number of fittings will:

- A. Increase back pressure on the valve
- B. Decrease the back pressure on the valve
- C. Have no effect on the valve operation
- D. Reduce the valve's set pressure

15. A pipefitter reads a weld symbol with the symbol below the reference line. This indicates the weld is to be made on:

- A. The arrow side of the joint
- B. Both sides equally
- C. The far side only, never the arrow side
- D. The field, not the shop

16. What is the main advantage of welded joints over threaded joints in high-pressure steam piping?

- A. They are easier to disassemble for service
- B. They require no inspection
- C. They provide a stronger, leak-resistant connection without thread weakening
- D. They eliminate the need for pipe supports

17. A pipefitter must determine the volume of water in a tank that is 2 m in diameter and 3 m tall (cylindrical). Using $V = \pi r^2 h$, the volume is closest to:

- A. 18.8 m³
- B. 9.42 m³
- C. 12.0 m³
- D. 6.28 m³

18. The primary purpose of a "blowdown" valve on a steam boiler is to:

- A. Remove sediment and control dissolved solids in the boiler water
- B. Increase the steam output temporarily
- C. Vent excess steam to the atmosphere
- D. Add chemical treatment to the water

19. Which gasket type uses a metal ring seated in machined grooves for high-pressure service?

- A. Full-face rubber gasket
- B. Spiral-wound gasket on a flat face
- C. Ring-type joint (RTJ) gasket
- D. Paper gasket

20. A pipefitter must calculate the flow velocity in a pipe given the flow rate and pipe area. Velocity equals:

- A. Area multiplied by flow rate
- B. Flow rate plus area
- C. Area divided by flow rate
- D. Flow rate divided by area

21. What does "hardness" of boiler feedwater primarily refer to?

- A. The temperature of the water
- B. The pH level of the water
- C. Dissolved calcium and magnesium content
- D. The oxygen concentration

22. A pipefitter must select pipe wall thickness using a pressure-design formula. Increasing the design pressure while holding diameter and material constant will:

- A. Decrease the required wall thickness
- B. Have no effect on wall thickness
- C. Allow a lower schedule to be used
- D. Increase the required wall thickness

23. The purpose of a deaerator in a boiler feedwater system is to:

- A. Remove dissolved oxygen and other gases from the feedwater
- B. Increase the dissolved oxygen for treatment
- C. Cool the feedwater before the boiler
- D. Filter solid particles from the water

24. A pipefitter encounters a weld defect described as "lack of fusion." This means:

- A. Excess weld metal above the surface
- B. Gas porosity in the cap pass
- C. The weld metal did not properly bond to the base metal or prior bead
- D. A crater crack at the end of the weld

25. When a centrifugal pump's discharge valve is throttled (partially closed), the flow rate will:

- A. Decrease as system resistance rises
- B. Increase due to higher pressure
- C. Remain exactly constant
- D. Drop to zero immediately

26. A pipefitter must identify the correct symbol convention: on an isometric, dimensions are typically given to:

- A. The outside surface of the insulation
- B. The flange bolt heads
- C. The pipe support rods
- D. The centerline of the pipe and fittings

27. The "critical point" of water on a steam table refers to the condition where:

- A. The water first begins to boil at atmospheric pressure
- B. Condensate flashes to steam
- C. Distinct liquid and vapor phases cease to exist
- D. The feed pump cavitates

28. A pipefitter must select a trap for a steam main drip application with continuous condensate. The most suitable choice is often:

- A. A thermostatic radiator trap
- B. A simple orifice with no moving parts only
- C. An inverted bucket or float-type trap
- D. A vacuum breaker

29. What is the function of an "anchor" in a piping system subject to thermal expansion?

- A. To allow free movement in all directions
- B. To fix a point and direct expansion to flexible elements
- C. To increase the steam pressure locally
- D. To filter debris from the line

30. A pipefitter calculates that a system requires 0.5 m of pipe pitch over a 50 m run. This represents a slope of:

- A. 1:5
- B. 1:50
- C. 1:100
- D. 1:500

31. The main purpose of stress-relieving a weld through PWHT is to:

- A. Add filler metal to the joint
- B. Increase the pipe diameter
- C. Reduce residual stresses and improve toughness
- D. Clean the weld surface of slag

32. A pipefitter must select a material for a chilled-water line where condensation will occur on the exterior. The most important accessory is:

- A. Vapor-barrier insulation to prevent condensation damage
- B. A higher pressure-rated flange
- C. A larger relief valve
- D. A thicker pipe wall only

33. When reading a P&ID, a valve symbol shown with a diagonal line through a circle typically indicates:

- A. A check valve
- B. A control valve with actuator
- C. A simple manual gate valve
- D. A pressure gauge

34. A pipefitter must determine the bolt load for a flanged joint. Increasing the gasket seating stress requirement will:

- A. Reduce the required bolt preload
- B. Have no effect on bolt selection
- C. Increase the required bolt preload
- D. Eliminate the need for a gasket

35. The term "NPSH" in pump selection stands for:

- A. Net positive suction head
- B. Nominal pump shaft height
- C. New pump system housing
- D. Non-positive suction handling

36. A pipefitter must join two sections of large-diameter steel pipe that will require future disassembly. The best choice is:

- A. A continuous butt weld
- B. A bolted flanged connection
- C. A brazed lap joint
- D. A threaded coupling

37. What is the primary purpose of a "steam separator" installed in a steam main?

- A. To increase steam pressure downstream
- B. To remove entrained moisture and improve steam quality
- C. To add water to the steam flow
- D. To reduce the pipe diameter

38. A pipefitter calculates the heat loss from a bare pipe. Adding insulation will:

- A. Reduce the heat loss to the surroundings
- B. Increase the heat loss
- C. Have no measurable effect
- D. Raise the internal steam pressure

39. When performing a hydrostatic test, trapped air in the system is undesirable because it:

- A. Improves the accuracy of the test
- B. Lowers the required test pressure
- C. Stores energy and can mask the true test pressure
- D. Reduces corrosion during the test

40. A pipefitter must select a flange facing for a spiral-wound gasket. The most appropriate facing is typically:

- A. A ring-type joint groove only
- B. A raised face
- C. A flat face with no raised portion
- D. A threaded face

41. The "discharge coefficient" of a relief valve relates to:

- A. The color of the valve body
- B. The number of springs in the valve
- C. The bolt circle of the inlet flange
- D. The actual flow capacity compared to theoretical

42. A pipefitter must lay out a 90° rolling offset. The travel is found using:

- A. The pipe schedule and the gasket thickness
- B. The true offset (from roll and rise) and the fitting angle
- C. The flange rating only
- D. The number of supports in the run

43. What is the purpose of "tracing" (steam or electric) on a process pipe?

- A. To maintain the temperature of the pipe contents
- B. To increase the pipe's pressure rating
- C. To mark the pipe for identification only
- D. To support the pipe weight

44. A pipefitter reviewing a material test report (MTR) is verifying:

- A. The paint color of the pipe
- B. The number of hangers required
- C. The insulation thickness
- D. The chemical and mechanical properties of the material

45. When two dissimilar pipe sizes meet and the line must drain fully, the correct fitting is:

- A. A concentric reducer mounted vertically only
- B. A standard coupling
- C. An eccentric reducer installed flat-side appropriately
- D. A union with no size change

46. The primary reason for de-rating a flanged joint at elevated temperature is that:

- A. The gasket changes color
- B. Material strength decreases as temperature rises
- C. The bolt circle expands permanently
- D. The flow rate increases

47. A pipefitter must select the correct electrode for welding carbon steel pipe in the field with limited shielding. A common choice is:

- A. A bare wire with no coating
- B. A pure tungsten electrode
- C. A brazing rod
- D. A coated SMAW electrode such as E6010 for root work

48. What does the term "turndown ratio" describe for a control valve or burner?

- A. The maximum pressure rating
- B. The ratio of maximum to minimum controllable capacity
- C. The number of turns to close the valve
- D. The bolt torque required

49. A pipefitter must calculate the number of 6 m pipe lengths needed for a 100 m run, ignoring fittings. The minimum number of full lengths is:

- A. 16
- B. 17
- C. 15
- D. 20

50. The purpose of a "check" feature integrated into a stop-check (non-return stop) valve is to:

- A. Throttle flow continuously
- B. Indicate the flow rate
- C. Reduce the line pressure
- D. Prevent reverse flow while also allowing manual shutoff

51. A pipefitter must select pipe for a service at 400°C. Compared with carbon steel, an alloy steel containing chromium and molybdenum is chosen because it:

- A. Retains strength and resists creep at high temperature
- B. Is always less expensive
- C. Cannot be welded
- D. Has no temperature limit

52. What is the main purpose of a "balance line" connected to a condensate pump or trap assembly?

- A. To increase the pump discharge pressure
- B. To filter the condensate
- C. To add chemicals to the condensate
- D. To equalize pressure so condensate drains freely into the receiver

53. A pipefitter reads "Sch STD" and "Sch XS" on a drawing. For many pipe sizes, Sch STD and Sch XS correspond approximately to:

- A. Schedule 5 and Schedule 10
- B. Schedule 40 and Schedule 80
- C. Schedule 80 and Schedule 160
- D. Schedule 10 and Schedule 40

54. The purpose of a "weld neck" flange compared with a slip-on flange is to:

- A. Eliminate the need for any welding
- B. Provide a smooth bore transition and superior strength for high-pressure service
- C. Reduce the flange cost only
- D. Allow threading instead of welding

55. A pipefitter calculates pump power. If the flow rate doubles while head stays constant, the hydraulic power requirement will approximately:

- A. Double
- B. Stay the same
- C. Halve
- D. Quadruple

56. What is the function of a "vortex breaker" at a tank or vessel outlet?

- A. To increase the outflow velocity
- B. To prevent a vortex that would draw air or gas into the outlet
- C. To filter the liquid
- D. To heat the outgoing fluid

57. A pipefitter must determine why a steam trap is "short-cycling" rapidly. A likely cause is:

- A. The trap is grossly undersized for a low load
- B. An oversized trap relative to the light condensate load
- C. The strainer is brand new
- D. The discharge pipe is too long

58. The "schedule" of a pipe combined with its NPS determines:

- A. The actual wall thickness and inside diameter
- B. The color of the pipe
- C. The required gasket only
- D. The flange rating exclusively

59. A pipefitter must select a method to test for leaks in a refrigeration or sealed system without water. A common method is:

- A. Flooding with hot water
- B. Visual inspection only at atmospheric pressure
- C. Pressurizing with dry nitrogen and using a leak-detection solution
- D. Filling with steam under pressure

60. The primary purpose of a "siphon" (pigtail) installed ahead of a steam pressure gauge is to:

- A. Protect the gauge by holding a water seal against direct steam
- B. Increase the pressure reading
- C. Filter debris from the gauge
- D. Vent steam to atmosphere

61. A pipefitter must select bolting for a flange and torque it correctly. Over-torquing the bolts can:

- A. Improve the gasket seal indefinitely
- B. Crush or extrude the gasket and damage the flange
- C. Reduce the required gasket rating
- D. Increase the flow capacity

62. What does a "Cv" (flow coefficient) value for a valve indicate?

- A. The valve's color code
- B. The number of turns to open
- C. The flow capacity through the valve at a given pressure drop
- D. The bolt torque specification

63. A pipefitter calculates that condensate at 100 kPa gauge will produce flash steam when released to atmosphere because:

- A. The condensate cools below freezing
- B. The saturation temperature is lower at the reduced pressure, so excess heat flashes water to steam
- C. The condensate gains pressure on release
- D. Air mixes with the condensate

64. The purpose of a "guide" support on a pipe near an expansion loop is to:

- A. Carry the full vertical weight of the loop
- B. Direct axial movement and prevent buckling or lateral displacement
- C. Anchor the pipe rigidly in place
- D. Filter condensate from the line

65. A pipefitter must select a joining method for stainless steel sanitary tubing. A common method is:

- A. Threaded couplings with sealant
- B. Lead-based soldering
- C. Oxy-acetylene cutting only
- D. Orbital TIG welding or sanitary clamp fittings

66. What is the main reason for using a "spectacle blind" (figure-8 blind) in a piping system?

- A. To increase flow capacity
- B. To provide positive isolation that can be flipped between open and blanked
- C. To reduce pipe diameter
- D. To support the pipe weight

67. A pipefitter calculates the resultant of forces on a pipe anchor due to thermal expansion and pressure. These forces must be:

- A. Ignored in the design
- B. Resisted by the anchor and supporting structure
- C. Eliminated by removing all supports
- D. Added to the steam pressure

68. The purpose of a "drain pocket" (collecting leg) sized close to the main diameter is to:

- A. Increase steam velocity
- B. Reduce the main pressure
- C. Add chemicals to the steam
- D. Effectively capture condensate from the fast-moving steam main

69. A pipefitter must select a gasket for a flange in cryogenic service. The most important property is:

- A. Bright color for visibility
- B. Maximum thickness available
- C. Suitability and resilience at very low temperatures
- D. The lowest cost material

70. What does the "minimum design metal temperature" (MDMT) of a component address?

- A. The maximum operating temperature
- B. The painting temperature
- C. The lowest temperature at which the material retains adequate toughness
- D. The welding preheat temperature

71. A pipefitter must determine the correct support for a pipe crossing a building expansion joint. The support must:

- A. Rigidly anchor the pipe across the joint
- B. Prevent any pipe movement at the crossing
- C. Increase the pipe pressure rating
- D. Accommodate the building's differential movement

72. The function of an "economizer" in a boiler system is to:

- A. Reduce the steam pressure
- B. Add chemicals to the feedwater
- C. Vent flue gases directly
- D. Preheat feedwater using flue gas heat to improve efficiency

73. A pipefitter calculates that a 45° offset has a set of 600 mm. Using $\text{travel} = \text{set} \times 1.414$, the travel is:

- A. 600 mm
- B. 848 mm
- C. 424 mm
- D. 1,200 mm

74. The primary purpose of a "false" or "dummy" leg support on an elbow is to:

- A. Increase the flow through the elbow
- B. Reduce the pressure at the elbow
- C. Provide a support point at the elbow without welding directly to the pressure pipe at a stress point
- D. Anchor the pipe permanently

75. A pipefitter must select a valve for tight shutoff in a slurry or dirty service. A suitable choice is often:

- A. A knife gate valve
- B. A precision needle valve
- C. A standard globe valve for clean service
- D. A small orifice plate

76. What does "ASME Section IX" primarily govern?

- A. Pipe color coding
- B. Insulation thickness
- C. Hanger spacing tables
- D. Welding and brazing qualification

77. A pipefitter calculates the linear expansion of a 15 m copper line heated by 80°C, with copper's coefficient about $17 \times 10^{-6} / ^\circ\text{C}$. The expansion is closest to:

- A. 4.1 mm
- B. 20.4 mm
- C. 8.2 mm
- D. 40.8 mm

78. The purpose of a "swing check" valve compared with a "lift check" valve is that the swing check:

- A. Offers lower pressure drop and suits horizontal lines with steady flow
- B. Cannot prevent reverse flow
- C. Is used only on vertical downflow
- D. Requires an external actuator

79. A pipefitter must select the correct fit-up gap (root opening) before welding. Too large a root gap will tend to cause:

- A. Burn-through or excessive penetration at the root
- B. No effect on the weld
- C. Reduced heat input requirements
- D. Automatic improvement in fusion

80. The function of a "pressure-powered pump" (steam-operated condensate pump) is to:

- A. Generate steam directly
- B. Reduce the boiler pressure
- C. Filter the condensate
- D. Move condensate using steam or gas pressure without electricity

81. A pipefitter reads a callout for "RF flange, 125–250 AARH." The "AARH" specification refers to:

- A. The flange material grade
- B. The bolt torque value
- C. The flange face surface roughness
- D. The pressure class

82. What is the main purpose of a "tundish" (air gap fitting) on a drain line?

- A. To increase drain flow velocity
- B. To pressurize the drain
- C. To heat the drainage
- D. To provide a visible air gap preventing backflow contamination

83. A pipefitter must select pipe supports spaced for a vapor (steam) line versus the same size liquid-filled line. The steam line generally:

- A. Can use wider support spacing due to lighter contents
- B. Requires much closer spacing than the liquid line
- C. Needs no supports at all
- D. Must use identical spacing in every case

84. The "set pressure" of a safety relief valve is defined as:

- A. The pressure at which the valve fully closes
- B. The maximum pressure the system will ever see
- C. The inlet pressure at which the valve begins to open
- D. The downstream back pressure

85. A pipefitter must select a method to bend conduit or small tubing to a precise radius. The correct tool is:

- A. A pipe wrench
- B. A torque wrench
- C. A tube bender sized to the tubing diameter
- D. A hacksaw

86. What is the purpose of "hydronic balancing" using flow-measuring valves?

- A. To increase the system pressure
- B. To reduce the boiler temperature
- C. To filter the circulating water
- D. To set design flow rates to each circuit for even distribution

87. A pipefitter calculates that a relief valve must relieve 500 kg/h of steam, but the installed valve is rated for 300 kg/h. The installation is:

- A. Acceptable because any relief valve will protect the system
- B. Inadequate because the relieving capacity is below the required rate
- C. Acceptable if the pipe is painted correctly
- D. Improved by reducing the discharge pipe size

88. The purpose of a "lap joint" flange with a stub end is to:

- A. Allow the flange to rotate for easy bolt alignment and reuse
- B. Eliminate the need for a gasket
- C. Increase the pipe pressure rating beyond all other flanges
- D. Permanently fix the flange orientation

89. A pipefitter must determine the appropriate action when a pressure gauge reads higher than the relief valve set pressure but the valve has not lifted. The correct response is to:

- A. Ignore the reading as a gauge error always
- B. Increase the system pressure further
- C. Paint the valve to mark it
- D. Investigate immediately for a stuck valve and depressurize safely

90. What does the term "creep" describe in high-temperature piping materials?

- A. Sudden brittle fracture at low temperature
- B. Rapid corrosion of the surface
- C. Slow, time-dependent deformation under sustained stress at high temperature
- D. The flow rate through the pipe

91. A pipefitter must select the correct purge gas for the root side when GTAW welding stainless steel. A common choice is:

- A. Argon or another inert gas to prevent oxidation
- B. Oxygen to promote penetration
- C. Acetylene for heat
- D. Compressed shop air

92. The function of a "balancing damper" differs from a "balancing valve" in that the damper controls:

- A. Liquid flow in pipes
- B. Steam pressure in mains
- C. Condensate return rate
- D. Airflow in ductwork rather than fluid in pipes

93. A pipefitter calculates the area of a rectangular duct $400 \text{ mm} \times 300 \text{ mm}$. The cross-sectional area is:

- A. 700 mm^2
- B. $120,000 \text{ mm}^2$
- C. $1,200 \text{ mm}^2$
- D. $12,000 \text{ mm}^2$

94. The purpose of a "thermostatic air vent" on a steam radiator is to:

- A. Vent air on startup and close when steam arrives
- B. Increase the radiator pressure
- C. Drain condensate continuously regardless of temperature
- D. Add water to the radiator

95. A pipefitter must select a pipe-joining method for a buried gas distribution line in polyethylene. A common method is:

- A. Threaded steel couplings
- B. Soldered fittings
- C. Oxy-acetylene welding
- D. Heat fusion (butt or electrofusion) of the polyethylene

96. What is the primary reason a steam main is "warmed up" gradually rather than rapidly?

- A. To save fuel only
- B. To increase the final pressure
- C. To prevent thermal shock and water hammer from rapid condensate formation
- D. To change the pipe color

97. A pipefitter reads a flange rating de-rated from 285 psi at ambient to a lower value at 400°C. This de-rating reflects:

- A. A change in the bolt count
- B. The reduced allowable stress of the flange material at temperature
- C. An increase in flow capacity
- D. The gasket color requirement

98. The purpose of a "condensate cooler" (sample cooler) before a sampling point is to:

- A. Cool a hot sample so it can be safely collected and measured
- B. Heat the sample for analysis
- C. Pressurize the sample line
- D. Filter solids only

99. A pipefitter must select a support for a pipe subject to dynamic loads such as pump pulsation. A suitable component is:

- A. A simple rigid rod hanger only
- B. A loose U-bolt with no restraint
- C. A snubber or shock arrestor to control sudden movement
- D. No support, allowing free vibration

100. What does "MAWP" stand for in pressure equipment?

- A. Maximum available water pressure
- B. Mean ambient working pressure
- C. Maximum allowable working pressure
- D. Minimum applied weld pressure

101. A pipefitter calculates the force on a blank flange (blind) under pressure. The force equals:

- A. The pressure multiplied by the area of the blind
- B. The pressure divided by the area
- C. The area divided by the pressure
- D. The pressure plus the area

102. The purpose of a "steam trap testing" program is to:

- A. Repaint the traps annually
- B. Increase the steam pressure
- C. Reduce the number of traps installed
- D. Identify failed traps that waste steam or cause backup

103. A pipefitter must select the correct gasket for a raised-face flange in 600 psi steam. A suitable choice is:

- A. A thin paper gasket
- B. A rubber sheet gasket
- C. A plain cork gasket
- D. A spiral-wound metal-and-filler gasket

104. What is the function of a "rupture disc" sometimes used with or instead of a relief valve?

- A. To throttle the flow continuously
- B. To provide a non-reclosing pressure-relief device that bursts at a set pressure
- C. To indicate the flow rate
- D. To reduce the line temperature

105. A pipefitter calculates that doubling the diameter of a pipe increases its cross-sectional area by a factor of:

- A. Four
- B. Two
- C. Eight
- D. Sixteen

106. The purpose of a "thermowell" in a piping system is to:

- A. Allow a temperature sensor to be inserted and removed without breaching the pressure boundary
- B. Increase the fluid temperature
- C. Drain condensate
- D. Reduce the pipe diameter

107. A pipefitter must select a valve that provides quick quarter-turn operation and full-bore flow. The best choice is:

- A. A globe valve
- B. A ball valve
- C. A needle valve
- D. A diaphragm valve

108. What is the main reason for installing "air separators" in a closed hydronic loop?

- A. To pressurize the system
- B. To heat the water
- C. To remove entrained air that causes corrosion and noise
- D. To filter sediment only

109. A pipefitter reads a weld map requiring "10% RT." This means:

- A. All welds require radiography
- B. The pipe must be 10% thicker
- C. The system operates at 10% pressure
- D. Ten percent of the welds are to be radiographically examined

110. The purpose of a "condensate receiver" in a steam system is to:

- A. Generate additional steam
- B. Collect returned condensate before it is pumped back to the boiler
- C. Reduce the boiler pressure
- D. Filter the steam supply

111. A pipefitter must select pipe insulation thickness. Increasing thickness up to the economic optimum will:

- A. Increase heat loss
- B. Have no effect on energy use
- C. Reduce heat loss with diminishing returns
- D. Raise the steam pressure

112. What does the term "hydrostatic head" refer to?

- A. The pressure exerted by a column of static liquid due to its height
- B. The flow rate of the liquid
- C. The temperature of the liquid
- D. The viscosity of the liquid

113. A pipefitter must select the correct procedure when a flange leaks under pressure. The safe action is to:

- A. Tighten the bolts further while fully pressurized
- B. Apply sealant over the leak under pressure
- C. Depressurize before working on the joint
- D. Increase pressure to reseal the gasket

114. The function of a "feedwater regulator" on a boiler is to:

- A. Control the supply of feedwater to maintain the proper drum level
- B. Increase the steam temperature
- C. Vent the flue gases
- D. Reduce the fuel supply directly

115. A pipefitter calculates that a pump delivers 20 m of head. Expressed approximately in pressure for water, this is closest to:

- A. 196 kPa
- B. 20 kPa
- C. 2,000 kPa
- D. 100 kPa

116. The purpose of "passivation" of stainless steel after fabrication is to:

- A. Add color to the surface
- B. Increase the wall thickness
- C. Soften the metal for bending
- D. Restore the protective oxide layer and remove free iron

117. A pipefitter must determine the correct response to a frozen, burst water line discovered on site. The first step is to:

- A. Isolate the water supply to the affected section
- B. Apply heat to thaw it while still pressurized
- C. Increase the system pressure to clear the blockage
- D. Ignore it until the next shift

118. What does the term "schedule" NOT directly tell you about a pipe?

- A. The approximate wall thickness
- B. The relative pressure capacity for the size
- C. The inside diameter when combined with NPS
- D. The exact length of a pipe joint

119. A pipefitter must select the correct fitting to join pipe at a 45° branch for reduced turbulence in flowing service. A suitable choice is:

- A. A 90° standard tee only
- B. A square branch with no shaping
- C. A reducing coupling
- D. A 45° lateral (wye) fitting

120. The purpose of a "balancing" hydrostatic test on a new system is to:

- A. Increase the operating pressure permanently
- B. Replace the need for any inspection
- C. Verify integrity and detect leaks before commissioning
- D. Add chemicals to the system

121. A pipefitter reads "PN16" on European-standard piping. "PN" refers to:

- A. The pipe length in metres
- B. The number of bolts
- C. The nominal pressure rating
- D. The pipe color

122. The function of a "balance" or "bypass" around a control valve is to:

- A. Allow flow to continue and the valve to be serviced without shutting the system down
- B. Increase the control valve's pressure drop
- C. Filter the fluid
- D. Heat the bypassed flow

123. A pipefitter must select a method for cutting large-diameter steel pipe in the field accurately. A common method is:

- A. A hand hacksaw only
- B. A pipe cold-cutting/clamshell machine or guided oxy-fuel track cutter
- C. Breaking it with a hammer
- D. A wood saw

124. What is the main purpose of a "weld backing ring" used in some pipe joints?

- A. To replace the gasket
- B. To increase the pipe diameter
- C. To filter the flow
- D. To support the molten root and ensure full penetration

125. A pipefitter calculates the pressure at the base of a 15 m water column. Using about 9.81 kPa per metre, the pressure is closest to:

- A. 15 kPa
- B. 98 kPa
- C. 1.5 kPa
- D. 147 kPa

126. The function of a "double-block-and-bleed" valve arrangement is to:

- A. Provide verified positive isolation with a bleed between two seats
- B. Increase the flow capacity
- C. Reduce the line temperature
- D. Filter debris from the flow

127. A pipefitter must select the correct insulation for a high-temperature steam line. A suitable material is:

- A. Standard fiberglass batt for walls
- B. Polystyrene foam board
- C. Calcium silicate or mineral wool rated for the temperature
- D. Rubber foam for cold lines

128. What is the primary purpose of "purging" a piping system with inert gas before introducing a flammable product?

- A. To increase the line pressure
- B. To remove oxygen and prevent a combustible mixture
- C. To clean the exterior surface
- D. To add color to the gas

129. A pipefitter must determine the correct slope for a gravity condensate return. A common minimum slope is approximately:

- A. 1:240 or steeper toward the drain point
- B. A perfectly level run with no slope
- C. An uphill grade against flow
- D. A vertical drop only

130. The purpose of a "guide and anchor" layout on a long steam main is to:

- A. Eliminate the need for insulation
- B. Control thermal expansion by directing movement and fixing key points
- C. Increase the steam pressure
- D. Filter the condensate continuously

Practice Exam 13: Answer Key and Explanations

1. C — Travel equals set times the offset constant; for $22\frac{1}{2}^\circ$, that constant is 2.613, so $250 \times 2.613 \approx 653$ mm. Each fitting angle has its own constant derived from $1/\sin(\text{angle})$. Using the correct constant ensures the offset piece is cut to the right length.

2. D — CSA B51 is the Canadian boiler, pressure vessel, and pressure piping code governing their design, construction, and inspection. ASME codes and CSA W59 address piping design and welding but not the overarching Canadian B&PV regulation. Knowing the governing code ensures regulatory compliance.

3. D — Expansion equals length \times coefficient \times temperature change: $6,000 \text{ mm} \times 12 \times 10^{-6} \times 100 = 7.2 \text{ mm}$. Thermal growth is linear with length and temperature rise. Calculating it correctly sizes expansion provisions and prevents overstress.

4. B — A desuperheater reduces steam temperature back toward saturation, typically by injecting water. It is used where process equipment requires lower-temperature or saturated steam. Controlling superheat protects downstream components and matches process needs.

5. D — A flange class such as 150 or 300 reflects the allowable pressure–temperature combination the flange can handle. Higher classes withstand greater pressure at a given temperature. Selecting the right class matches the flange to service conditions.

6. C — $100 \text{ psi} \times 6.895 \approx 689 \text{ kPa}$, since one psi equals about 6.895 kPa. Unit conversion is routine in dual-unit work. Accurate conversion prevents specification and test-pressure errors.

7. A — A telltale hole in a bellows-sealed valve reveals bellows failure by letting leakage escape where it can be seen. The bellows is the primary stem seal, and the hole signals when it fails so the backup packing can be relied upon. This early warning prevents undetected stem leakage.

8. B — In the 5G position the pipe is fixed horizontal and welded without rotation, requiring the welder to work through flat, vertical, and overhead positions around the joint. It tests all-position skill. Position designations define the qualification range of a welder.

9. A — Area = $\pi d^2/4 = \pi \times 100^2/4 \approx 7,854 \text{ mm}^2$. The formula gives the internal cross-section from the diameter. This area underlies flow-velocity and volume calculations.

10. D — A reducing flange saves space and reduces the number of joints by combining the size change and the flanged connection in one component. Fewer joints mean fewer potential leak points. It is chosen where space or joint count matters.

11. C — Absolute pressure equals gauge plus atmospheric: $860 + 101 \approx 961$ kPa absolute. Gauge pressure is measured above atmospheric, so atmospheric must be added for absolute. Distinguishing the two is essential for steam-table work.

12. A — NPT is the National Pipe Thread standard, a tapered thread that seals as the threads wedge together. The taper creates the interference that forms a pressure-tight joint. Recognizing the thread form ensures correct make-up and sealing.

13. B — A valve that moves to a known safe position on loss of actuator power exhibits fail-safe action, such as fail-closed or fail-open. This protects the process during power or signal failure. Specifying the correct fail action is a key safety decision.

14. A — Adding length and fittings to a relief discharge line raises the back pressure the valve must work against. Excessive back pressure can impair the valve's lift and capacity. Discharge piping must be sized to keep back pressure within limits.

15. A — A weld symbol placed below the reference line denotes the weld on the arrow side of the joint. The position relative to the line encodes which side is welded. Reading this convention correctly directs the welder to the right side.

16. C — Welded joints provide a stronger, leak-resistant connection without the wall-thinning that threading causes. Threading removes metal and creates leak paths unsuitable for high-pressure steam. Welds maintain full pipe strength at the joint.

17. B — Volume = $\pi r^2 h = \pi \times 1^2 \times 3 \approx 9.42$ m³, using a radius of 1 m for the 2 m diameter. The cylindrical-volume formula gives tank capacity. Correct geometry prevents sizing errors.

18. A — A boiler blowdown valve removes sediment and controls the concentration of dissolved solids in the boiler water. Periodic blowdown prevents scale and carryover. Maintaining water quality protects boiler surfaces and steam purity.

19. C — A ring-type joint gasket is a metal ring seated in machined grooves for high-pressure and high-temperature service. The metal-to-metal seal handles severe conditions better than flat gaskets. RTJ flanges are specified where pressure demands it.

20. D — Velocity equals flow rate divided by cross-sectional area ($v = Q/A$). For a given flow, a smaller area produces higher velocity. This relationship governs pipe sizing and erosion control.

21. C — Feedwater hardness refers to dissolved calcium and magnesium, the minerals that form scale on boiler surfaces. Scale insulates heat-transfer surfaces and risks overheating. Treating hardness protects boiler efficiency and safety.

22. D — Raising the design pressure while diameter and material stay constant increases the required wall thickness, since the wall must resist greater hoop stress. The pressure-design formula relates thickness directly to pressure. Higher pressure demands a heavier schedule.

23. A — A deaerator removes dissolved oxygen and other gases from feedwater to prevent corrosion in the boiler and system. Oxygen is a primary cause of pitting in boiler tubes. Deaeration is essential to feedwater treatment.

24. C — Lack of fusion means the weld metal failed to bond to the base metal or a previous bead. It leaves an unbonded interface that weakens the joint. Proper heat input and technique ensure full fusion.

25. A — Throttling a centrifugal pump's discharge raises system resistance and moves the operating point to a lower flow. The pump follows its curve to a reduced flow at higher head. Understanding the curve explains throttling behaviour.

26. D — Isometric dimensions are given to the centerline of the pipe and fittings. Centerline dimensioning provides a consistent reference for fabrication. Working to centerlines with proper take-offs yields accurate spools.

27. C — At the critical point, distinct liquid and vapor phases cease to exist and the substance becomes a supercritical fluid. Above this point boiling does not occur in the usual sense. The critical point is a fundamental limit on the steam table.

28. C — A steam main drip with continuous condensate is best served by an inverted bucket or float-type trap that handles steady loads well. Thermostatic traps suit intermittent or temperature-based service. Matching trap type to the load ensures reliable drainage.

29. B — An anchor fixes a point in the piping and directs thermal expansion toward flexible elements such as loops. By controlling where movement occurs, it protects equipment and supports. Anchor placement is central to expansion design.

30. C — A drop of 0.5 m over 50 m is a ratio of 0.5:50, which simplifies to 1:100. Slope is expressed as drop over run. Correctly interpreting the ratio sets the proper pitch.

31. C — Post-weld heat treatment reduces residual stresses and improves toughness in the weld and heat-affected zone. Welding leaves locked-in stresses that PWHT relieves through controlled heating. It is required on certain materials and thicknesses.

32. A — A chilled-water line needs vapor-barrier insulation to stop moist air from condensing on the cold surface and causing corrosion or dripping. The barrier blocks vapor migration to the cold pipe. Proper insulation protects the pipe and surroundings.

33. B — A circle with a diagonal line (or similar actuator symbol) on a P&ID typically denotes a control valve with an actuator. P&ID symbols distinguish manual from automatically actuated valves. Reading them correctly reveals how the system is controlled.

34. C — A higher gasket seating-stress requirement increases the bolt preload needed to compress and seal the gasket. The bolts must supply enough force to seat the gasket and resist the pressure load. Correct bolt selection follows from the gasket requirement.

35. A — NPSH stands for net positive suction head, the suction-side margin above vapor pressure needed to avoid cavitation. Available NPSH must exceed the pump's required NPSH. This relationship governs safe pump installation.

36. B — A bolted flanged connection is the best choice where large-diameter pipe must be disassembled in the future. Flanges allow removal without cutting. They balance integrity with serviceability.

37. B — A steam separator removes entrained moisture to improve steam quality, delivering drier steam downstream. Wet steam reduces efficiency and erodes equipment. Separators protect turbines, traps, and process equipment.

38. A — Adding insulation reduces heat loss to the surroundings by lowering the rate of heat transfer through the pipe wall. Less standby and distribution loss improves efficiency. Insulation also protects personnel and maintains steam quality.

39. C — Trapped air during a hydrostatic test stores energy and can mask the true test pressure, making the test unsafe and unreliable. Air must be vented so the system fills completely with water. Bleeding air ensures a valid, safer test.

40. B — A spiral-wound gasket is normally used with a raised-face flange, which concentrates seating stress on the gasket area. The raised face suits the gasket's compression needs. Matching face to gasket type ensures a reliable seal.

41. D — The discharge coefficient compares a relief valve's actual flow capacity to the theoretical ideal, accounting for real-world losses. It is used in sizing calculations to determine relieving capacity. The coefficient ensures the valve relieves the required rate.

42. B — A 90° rolling offset travel is found from the true offset—derived from the roll and the rise—and the fitting angle. The true offset is the hypotenuse of the two component dimensions. These inputs drive the travel calculation.

43. A — Tracing maintains the temperature of the pipe contents, preventing freezing or maintaining process heat. Steam or electric tracing adds heat along the line. It is essential for temperature-sensitive services.

44. D — A material test report verifies the chemical composition and mechanical properties of the material. It documents that the pipe or fitting meets the specified grade. MTRs provide traceability for code work.

45. C — An eccentric reducer installed with the flat side oriented correctly lets a line drain fully or vents air, since one side stays level. A concentric reducer keeps the centerline common, which can trap condensate or air. Correct orientation manages drainage.

46. B — Flanged joints are de-rated at elevated temperature because the material's allowable stress decreases as temperature rises. The same flange handles less pressure when hotter. De-rating tables keep the joint within safe limits.

47. D — A coated SMAW electrode such as E6010 is a common field choice, valued for its deep penetration on the root pass with limited shielding. The flux coating provides the shielding gas and slag. It suits field conditions where gas shielding is impractical.

48. B — Turndown ratio is the ratio of maximum to minimum controllable capacity for a valve or burner. A high turndown allows stable control over a wide range. It is a key selection parameter for modulating service.

49. B — $100 \text{ m} \div 6 \text{ m} \approx 16.7$, so 17 full lengths are required to cover the run. You always round up to the next whole length to span the distance. Rounding down would leave a gap.

50. D — A stop-check valve combines a check feature that prevents reverse flow with a manual stop that allows positive shutoff. It serves dual duty on boiler feed and similar lines. The combined function adds protection and control.

51. A — A chromium-molybdenum alloy steel retains strength and resists creep at high temperature better than plain carbon steel. Creep resistance is critical above the carbon-steel limit. Alloy selection matches the material to service temperature.

52. D — A balance line equalizes pressure between a trap or pump and the receiver so condensate drains freely by gravity. Without it, pressure differences can prevent drainage. The balance line ensures reliable condensate handling.

53. B — For many common pipe sizes, Schedule STD corresponds to Schedule 40 and Schedule XS to Schedule 80. These designations predate the schedule numbering and still appear on drawings. Knowing the equivalence prevents wall-thickness errors.

54. B — A weld-neck flange provides a smooth bore transition and superior strength for high-pressure service through its tapered hub butt-welded to the pipe. The gradual transition reduces stress concentration. It is preferred for severe conditions.

55. A — Hydraulic power is proportional to flow times head, so doubling flow at constant head approximately doubles the power required. The relationship is linear in flow. This guides motor and pump sizing.

56. B — A vortex breaker prevents a swirling vortex from forming at an outlet, which would otherwise draw air or gas into the line. Entrained gas harms pumps and downstream equipment. The breaker keeps the outflow gas-free.

57. B — Short-cycling typically results from a trap oversized for a light condensate load, so it fills and discharges too rapidly. The mismatch wears the trap and wastes energy. Correct sizing to the actual load stops the cycling.

58. A — NPS combined with schedule defines the actual wall thickness and inside diameter, since the outside diameter is fixed for a given NPS. Together they fully specify the pipe dimensions. This is the basis for selection and calculation.

59. C — A sealed or refrigeration system is commonly leak-tested by pressurizing with dry nitrogen and applying a leak-detection solution to find bubbles. Nitrogen is inert and moisture-free, protecting the system. This avoids introducing water.

60. A — A siphon or pigtail holds a water seal that protects a pressure gauge from direct, high-temperature steam. The trapped condensate buffers the gauge element. This extends gauge life and accuracy.

61. B — Over-torquing flange bolts can crush or extrude the gasket and distort or damage the flange, causing leaks. Correct, even torque seats the gasket without overloading it. Following the torque spec preserves the seal.

62. C — A valve's C_v (flow coefficient) indicates its flow capacity at a given pressure drop. A higher C_v passes more flow for the same drop. C_v is used to size valves to required flow rates.

63. B — Hot condensate at 100 kPa gauge has more heat than saturated water at atmospheric pressure can hold, so the excess flashes part of it to steam on release. The saturation temperature is lower at the reduced pressure. Recovering this flash steam improves efficiency.

64. B — A guide support directs axial movement and prevents lateral displacement or buckling near an expansion loop. It keeps the pipe aligned while letting it grow lengthwise. Guides complement anchors in expansion control.

65. D — Sanitary stainless tubing is commonly joined by orbital TIG welding or sanitary clamp fittings to maintain a clean, crevice-free system. These methods suit hygienic service. Threaded or soldered joints are unacceptable for sanitary work.

66. B — A spectacle blind provides positive isolation that can be flipped between the open (bored) and blanked (solid) positions. The visible figure-8 shape shows its status at a glance. It gives reliable, verifiable isolation for maintenance.

67. B — Thermal-expansion and pressure forces on an anchor must be resisted by the anchor and the supporting structure. The anchor transfers these loads safely into the structure. Designing for them prevents support failure.

68. D — A drain pocket sized close to the main diameter effectively captures condensate from the fast-moving steam rather than letting it skip past a small connection. The full-bore pocket lets condensate fall out of the flow. This improves drainage at drip points.

69. C — A cryogenic-service gasket must remain suitable and resilient at very low temperatures, sealing without becoming brittle. Material selection for the cold condition is the governing concern. The wrong material would crack and leak.

70. C — MDMT is the lowest temperature at which a material retains adequate toughness to resist brittle fracture. Below it, the material may fail suddenly under load. Specifying MDMT ensures safe low-temperature operation.

71. D — A pipe crossing a building expansion joint needs a support that accommodates the building's differential movement, allowing the structure to move without overstressing the pipe. Rigidly anchoring it would transfer building movement into the pipe. Flexibility at the crossing protects both.

72. D — An economizer preheats boiler feedwater using heat recovered from the flue gas, raising overall efficiency. Capturing waste heat reduces fuel consumption. It is a standard efficiency device on larger boilers.

73. B — Travel equals set times 1.414 for a 45° offset: $600 \times 1.414 \approx 848$ mm. The 45° constant comes from $1/\sin 45^\circ$. Using it gives the correct cut length for the offset.

74. C — A dummy leg provides a support point at an elbow without welding directly to the pressure-retaining pipe at a high-stress location. It carries load while avoiding a stress concentration on the elbow. This protects the fitting from added local stress.

75. A — A knife gate valve gives tight shutoff in slurry or dirty service because its sharp gate cuts through and seats against suspended solids. Standard globe and needle valves clog or wear in such service. The knife gate suits abrasive, particle-laden fluids.

76. D — ASME Section IX governs the qualification of welding and brazing procedures and personnel. It defines how procedures and welders are tested and certified. Compliance ensures welds meet code requirements.

77. B — Expansion = length \times coefficient \times temperature change = $15,000 \text{ mm} \times 17 \times 10^{-6} \times 80 = 20.4$ mm. Thermal growth scales linearly with length and temperature rise, and copper's higher coefficient produces more movement than steel for the same conditions. Calculating it correctly sizes the expansion provision and prevents overstress..

Hold on — let me recompute: $30,000 \times 17 \times 10^{-6} = 0.51$, and $0.51 \times 80 = 40.8$ mm, which is option D, not the pre-assigned B. The pre-assigned key letter is B (20.4 mm), but the arithmetic for the stem as written yields 40.8 mm. I am flagging this in the error report rather than forcing the explanation to fit.

78. A — A swing check valve offers lower pressure drop and suits horizontal lines with steady flow, its hinged disc swinging open with forward flow. It reseats to block reverse flow. The low-resistance design favours steady horizontal service.

79. A — Too large a root opening tends to cause burn-through or excessive penetration at the root, as the heat melts through the wide gap. Correct fit-up controls penetration. Proper root opening is essential to a sound root pass.

80. D — A pressure-powered pump moves condensate using steam or gas pressure, needing no electricity. It is used where electrical pumps are impractical or where condensate is hot. The motive pressure displaces the condensate from the body.

81. C — AARH (arithmetic average roughness height) specifies the flange face surface roughness, such as 125–250, to suit the gasket. The correct finish helps the gasket seal. Surface roughness is part of the flange specification.

82. D — A tundish provides a visible air gap on a drain line that prevents backflow contamination from the drain into the system. The open break stops back-siphonage. It also lets discharge be observed.

83. A — A steam (vapor) line carries lighter contents than a water-filled line, so it can generally use wider support spacing for the same size. Less weight means less deflection between supports. Support tables reflect the lighter load.

84. C — The set pressure is the inlet pressure at which a safety relief valve begins to open. It is the reference pressure for protecting the system. Setting it correctly ensures relief before the maximum allowable pressure is exceeded.

85. C — A tube bender sized to the tubing diameter produces a precise radius without kinking. Matching the bender to the tube supports the wall through the bend. The correct tool yields clean, accurate bends.

86. D — Hydronic balancing with flow-measuring valves sets the design flow rate to each circuit, distributing flow evenly. Without balancing, some circuits are starved and others overfed. Balanced flow ensures consistent heating performance.

87. B — A valve rated for 300 kg/h cannot relieve the required 500 kg/h, so the installation is inadequate to protect the system. Relief capacity must equal or exceed the maximum required relieving rate. An undersized valve allows overpressure.

88. A — A lap-joint flange with a stub end can rotate freely for easy bolt-hole alignment and can be reused, since it is not welded to the pipe. The stub end takes the gasket load. This eases alignment and saves cost.

89. D — A gauge reading above the relief set pressure with no valve lift signals a possible stuck valve, requiring immediate investigation and safe depressurization. A stuck relief valve removes overpressure protection. Prompt action prevents a dangerous condition.

90. C — Creep is slow, time-dependent deformation under sustained stress at high temperature. It can lead to eventual failure even below the yield strength. Creep limits the service life of high-temperature piping.

91. A — Argon or another inert purge gas protects the root side of a stainless GTAW weld from oxidation. Without it, the root oxidizes (sugars) and loses corrosion resistance. Inert purging preserves root quality.

92. D — A balancing damper controls airflow in ductwork, whereas a balancing valve controls fluid flow in pipes. The damper sets air distribution in HVAC systems. Distinguishing the two avoids misapplication.

93. B — $\text{Area} = 400 \text{ mm} \times 300 \text{ mm} = 120,000 \text{ mm}^2$. Rectangular area is simply width times height. Correct area underlies airflow and sizing calculations.

94. A — A thermostatic air vent on a steam radiator vents air on startup and closes when hotter steam reaches it. Removing air lets steam fill the radiator for full heat output. The temperature-sensitive element automates the venting.

95. D — Buried polyethylene gas pipe is joined by heat fusion, either butt or electrofusion, creating a continuous leak-free bond. Threading or soldering is unsuitable for PE. Fusion is the standard method for plastic gas mains.

96. C — Gradual warm-up of a steam main prevents thermal shock and water hammer caused by rapid condensate formation. Slow valve opening lets condensate drain and the metal heat evenly. This protects the piping during startup.

97. B — Flange de-rating at 400°C reflects the reduced allowable stress of the flange material at that temperature. The same flange handles less pressure when hot. De-rating tables keep the joint within safe limits.

98. A — A sample cooler cools a hot fluid sample so it can be safely collected and accurately measured. Cooling prevents flashing and protects the operator. It is standard at boiler-water sampling points.

99. C — A snubber or shock arrestor controls sudden movement from dynamic loads such as pump pulsation while allowing slow thermal motion. It restrains rapid displacement without blocking expansion. This protects piping from dynamic stress.

100. C — MAWP is the maximum allowable working pressure a vessel or system may safely operate at. It sets the basis for relief-valve settings and operating limits. Staying within MAWP ensures safe operation.

101. A — The force on a blind flange equals the pressure multiplied by the area it acts on ($F = P \times A$). Pressure acting over the blanked area produces the total thrust. This force determines bolting and flange requirements.

102. D — A steam-trap testing program identifies failed traps that waste steam or cause condensate backup. Failed traps are a major source of energy loss. Routine testing recovers efficiency and reliability.

103. D — A spiral-wound metal-and-filler gasket suits a raised-face flange in 600 psi steam, providing resilient high-pressure sealing. Paper, rubber, and cork cannot withstand those conditions. Matching gasket to service is essential.

104. B — A rupture disc is a non-reclosing relief device that bursts at a set pressure to protect equipment. It opens fully and instantly but must be replaced after actuation. It is used alone or with a relief valve for fast or full relief.

105. A — Doubling the diameter increases the cross-sectional area by a factor of four, since area varies with the square of the diameter ($A = \pi d^2/4$). The squared relationship means small diameter changes have large area effects. This governs flow-capacity scaling.

106. A — A thermowell lets a temperature sensor be inserted and removed without breaching the pressure boundary. The sensor sits in the well, protected from the process and replaceable under pressure. This allows safe maintenance.

107. B — A ball valve gives quick quarter-turn operation and full-bore flow when open, with low pressure drop. The bored ball aligns with the pipe for unrestricted flow. It is ideal for fast on/off isolation.

108. C — Air separators remove entrained air from a closed hydronic loop, preventing corrosion, noise, and circulation problems. Trapped air causes oxygen corrosion and air-bound circuits. Removing it protects and quiets the system.

109. D — "10% RT" means ten percent of the welds are to be radiographically examined. Spot radiography samples a fraction of welds to verify quality. The weld map and test plan specify which welds.

110. B — A condensate receiver collects returned condensate before it is pumped back to the boiler. It provides storage and a stable pump suction. The receiver is central to condensate recovery.

111. C — Increasing insulation up to the economic optimum reduces heat loss with diminishing returns, as each added layer saves less energy. Beyond the optimum, added cost outweighs savings. This balance sets the economic thickness.

112. A — Hydrostatic head is the pressure exerted by a static liquid column due to its height. It depends on height and fluid density. This pressure is fundamental to tank, pump, and piping calculations.

113. C — The safe response to a leaking flange under pressure is to depressurize before working on the joint. Tightening or sealing under pressure risks sudden failure and injury. Removing the energy first protects the worker.

114. A — A feedwater regulator controls the supply of feedwater to maintain the proper boiler drum level. Stable level protects against low-water and carryover conditions. Automatic regulation keeps the boiler safe and steady.

115. A — 20 m of water head $\approx 20 \times 9.81 \approx 196$ kPa, using about 9.81 kPa per metre of water. Head and pressure are interchangeable through fluid density. This conversion links pump head to system pressure.

116. D — Passivation restores stainless steel's protective oxide layer and removes free iron left from fabrication. The clean oxide film resists corrosion. Passivating after welding or machining preserves corrosion resistance.

117. A — The first step with a burst water line is to isolate the water supply to the affected section, stopping further flooding and damage. Containing the source precedes any repair. Isolation is the priority in a leak emergency.

118. D — Schedule, even with NPS, does not tell you the exact length of a pipe joint—only wall thickness, pressure capacity, and bore. Length is a separate, ordered dimension. Schedule is purely a wall-thickness designation.

119. D — A 45° lateral (wye) fitting joins a branch at 45° for reduced turbulence in flowing service, easing flow into the main. A square tee creates more turbulence. The lateral suits drainage and flowing-stream branches.

120. C — A hydrostatic test verifies integrity and detects leaks before a system is commissioned. Pressurizing with water exposes weak joints safely. Passing the test confirms the system is fit for service.

121. C — "PN" denotes the nominal pressure rating in the European flange standard; PN16 indicates a 16-bar nominal rating. It is the metric counterpart to ASME pressure classes. Recognizing PN ratings ensures correct flange matching.

122. A — A bypass around a control valve lets flow continue and the valve to be serviced without shutting the system down. The bypass carries flow manually during maintenance. This maintains operation while isolating the valve.

123. B — Large-diameter steel pipe is accurately field-cut with a cold-cutting/clamshell machine or a guided oxy-fuel track cutter. These tools produce square, controlled cuts. Hand or improper tools cannot achieve the needed accuracy.

124. D — A weld backing ring supports the molten root and helps ensure full penetration on a pipe butt weld. It backs the root pass so the weld fuses completely. Backing rings aid consistent root quality where access is limited.

125. D — Pressure = $15 \text{ m} \times 9.81 \text{ kPa/m} \approx 147 \text{ kPa}$. The pressure at the base of a liquid column is height times the per-metre value. This is a routine hydrostatic calculation.

126. A — A double-block-and-bleed arrangement provides verified positive isolation with a bleed between two seats. Bleeding the cavity confirms both blocks are holding. This gives reliable isolation for safe work.

127. C — Calcium silicate or mineral wool rated for high temperature is the suitable insulation for a hot steam line. These materials withstand the service temperature without degrading. Foam and batt products are unsuitable for steam heat.

128. B — Purging with inert gas removes oxygen and prevents a combustible mixture before introducing a flammable product. Displacing air eliminates the explosion hazard. Inert purging is a critical commissioning safety step.

129. A — A gravity condensate return commonly uses a minimum slope of about 1:240 or steeper toward the drain point. Adequate pitch keeps condensate moving by gravity. Insufficient slope causes pooling and water hammer.

130. B — A guide-and-anchor layout controls thermal expansion by fixing key points and directing movement into flexible elements. Anchors set fixed points and guides channel the growth. Together they manage expansion on long steam mains.