PRACTICE EXAM 6: STRUCTURAL STEEL IRONWORKER SIMULATION (100 QUESTIONS)

This practice exam contains 100 questions covering all domains of the NCCER Industrial Ironworker assessment (IRON30_03). Select the single best answer for each question. A minimum score of 75 percent (75 correct) is required to pass. A basic non-printing calculator is permitted. Allow no more than 2 hours to simulate test conditions.

1. Before a new wire rope sling is placed in service, ASME B30.9 requires that slings be proof-loaded. What is the purpose of the proof load test on a wire rope sling?

A. The proof load verifies that the sling's terminations, body, and connections can withstand a load above the rated WLL without failure, confirming that the sling meets the manufacturer's rated capacity before it enters service

B. The proof load identifies any hidden corrosion inside the sling strands by forcing moisture to the surface of the wire under the load

C. The proof load permanently stretches the sling to its working length, removing manufacturing slack and ensuring accurate measurements during use

D. The proof load confirms the wire rope's fiber content meets ASTM specifications by measuring the force required to fracture one representative wire from the strand

2. A synthetic web sling must be inspected before each use. In addition to checking for cuts and abrasion, what color-coded marking system helps identify the sling's rated capacity?

A. Synthetic web slings use a numbered tag system where tag numbers 1-5 correspond to 1-ton, 2-ton, 3-ton, 4-ton, and 5-ton vertical WLL ratings

B. The metal wear indicator sewn into the sling body changes color when the sling has been overloaded — white indicates safe condition, red indicates overload

C. Synthetic web sling tags are coded with a color bar that matches standard lifting capacity charts — the bar color corresponds to the sling's WLL in both horizontal and vertical hitch configurations

D. ASME B30.9 requires manufacturers to use color-coded edge stitching on synthetic web slings, with specific stitch colors assigned to WLL ranges, and the outer jacket color to indicate sling material (nylon, polyester, or HMPE)

3. A turnbuckle is rated for a specific working load limit marked on the body. When inspecting a turnbuckle before use, what does finding a cracked or deformed jaw at the body-to-jaw junction indicate?

A. A crack at the body-to-jaw junction is acceptable if it formed during the original forging process and has been present without growth since the last inspection

B. A crack or deformation at the body-to-jaw junction is a disqualifying defect — the turnbuckle must be removed from service immediately because the crack can propagate under load, causing the jaw to release suddenly

C. A crack indicates the turnbuckle was manufactured at the lower end of the hardness specification; the WLL should be reduced by 25 percent and the crack monitored at 30-day intervals

D. Cracks at this junction are normal stress marks that appear after the first loading cycle and do not affect the turnbuckle's load capacity

4. A two-leg wire rope bridle sling supports a 10,000-pound load. The sling legs make a 60-degree angle from horizontal. What is the tension in each sling leg?

A. 5,000 lb

B. 8,660 lb

C. 5,774 lb

D. 10,000 lb

5. The lubrication condition of a wire rope in service can be assessed during inspection. What external sign indicates that a wire rope's internal lubrication has been depleted and the rope requires re-lubrication?

A. The outer wire surfaces appear bright and shiny, indicating that the external protective coating has worn through

B. The rope exhibits a slight reddish-brown tint on the outer wires, consistent with surface oxidation beginning at the contact points between outer wires

C. The rope is difficult to bend around sheaves and requires more motor power to operate, indicating internal friction has increased due to dry wire contacts

D. The rope develops a dry, gray surface appearance with visible wire surface oxidation and the valleys between strands appear dry rather than retaining a lubricant film — indicating that internal lubrication has been consumed or has migrated out

6. A three-leg wire rope bridle sling is used to lift a 15,000-pound load. All three legs make equal angles of 60 degrees from the horizontal. What is the tension in each of the three sling legs?

A. 5,000 lb

B. 8,660 lb

C. 5,774 lb

D. 15,000 lb

7. A wire rope has a catalog breaking strength of 25,000 pounds. With a 5:1 design factor applied, what is the working load limit of this wire rope?

A. 4,000 lb

B. 5,000 lb

C. 6,250 lb

D. 8,333 lb

8. Synthetic slings and wire rope slings are both subject to damage at sharp corners of loads. What rigging aid is used to protect slings from corner damage during a pick?

A. A corner protector (softener) made of leather, rubber, or nylon padding is placed between the sling and the sharp corner to prevent the corner from concentrating stress in a small section of the sling body, which would reduce the sling's effective rated capacity

B. The sling is doubled back on itself at the corner, creating a loop that distributes the contact force over twice the sling length

C. The sharp corner is wrapped with friction tape before the sling is applied, which adheres the sling to the load and prevents the sling from sliding into the corner region

D. A shackle is placed at the corner contact point, providing a hardened steel surface between the sling and the corner, as shackles are rated for lateral loading

9. Wire rope is constructed with either an independent wire rope core (IWRC) or a fiber core (FC). For which application should IWRC wire rope be specified rather than fiber-core rope?

A. Applications where the rope must be resistant to ultraviolet light degradation, because the metal core is impervious to UV radiation while a fiber core would deteriorate over time

B. Light-duty rigging applications where flexibility is the primary concern, because IWRC provides greater flexibility per unit diameter than fiber core constructions

C. Applications requiring low electrical conductivity near power sources, because IWRC provides better insulation through its metallic core than fiber-core ropes

D. High-temperature applications, multi-layer drum winding applications, and where resistance to crushing is required — IWRC rope is stiffer, more crush-resistant, and does not deteriorate under heat the way organic fiber cores can

10. A shackle is connected in a sling assembly where a multi-leg bridle sling eye is placed on the bow. What is the most important orientation requirement for the shackle in this assembly?

A. The load must be applied to the shackle bow (the curved portion), not to the pin — loading through the pin subjects the pin to bending stress it is not designed for and can cause the pin to bend or fail at loads well below the shackle's rated WLL

B. The shackle must be oriented with the bow facing down so that the load hangs directly below the pin axis to prevent the shackle from opening under lateral forces

C. The shackle pin must face the direction of the load's travel to use the pin's full shear capacity in the direction of loading

D. The shackle must be oriented with the bow and pin in a horizontal plane to prevent the sling eye from riding up the bow toward the pin under load

11. A single sling leg makes a 45-degree angle from horizontal and is attached to a load that applies 4,500 pounds of tension along the sling's direction. What is the vertical component of force this leg contributes to supporting the load?

A. 4,500 lb

B. 3,182 lb

C. 6,364 lb

D. 2,250 lb

12. Wire rope used in a running-line application (frequently bending over sheaves) requires more frequent inspection than standing rope. At what interval does OSHA 1926.1413 require inspection of running wire rope on cranes?

A. Once per week regardless of use — weekly visual inspection of the running rope is sufficient for all crane applications

B. Monthly inspection by a qualified person, with documented records retained for the life of the crane

C. A visual inspection by a qualified person must be performed at least monthly and whenever the crane has not been used for a period of more than one month — inspections must be documented and records maintained

D. Before every lift — the operator must perform a complete wire rope inspection before any hook load is applied to the crane hook, including measuring rope diameter and running a hand along the full rope length

13. When lifting a long horizontal load with a two-leg bridle sling, what additional rigging concern applies that does not exist with a vertical hitch or choker hitch?

A. The bridle sling's legs may become tangled during the lift because long loads rotate during hoisting and the legs wrap around each other

B. The master link at the top of the bridle must be oriented perpendicular to the load's long axis to prevent the link from bending over the load's edge

C. The horizontal load creates a compressive force along the load's length that can buckle slender structural members — the rigging plan must account for this compression force when selecting the pick point locations and sling angles

D. Long loads in a two-leg bridle can cause the legs to converge toward the load's midpoint as the load rises, reducing the effective support distance and increasing the leg tensions beyond the values calculated at the original pick geometry

14. A single sling leg is used in a vertical hitch supporting half of a two-leg bridle's load. The leg makes a 30-degree angle from horizontal. The total load is 7,000 pounds. What is the tension in this single sling leg?

A. 3,500 lb

B. 7,000 lb

C. 4,041 lb

D. 6,062 lb

15. Under what conditions must a lift be classified as a 'critical lift' requiring an engineered rigging plan regardless of the load's weight?

A. A lift is critical when it involves multi-crane tandem picks, a suspended personnel platform, loads over occupied areas, or consequences of a drop that would be catastrophic — any of these conditions triggers critical lift planning

B. A lift is critical when the total load (including rigging) is more than 50 percent of the crane's rated capacity at the working radius for that lift

C. A lift is critical when the load exceeds 10 tons for a mobile crane, regardless of the percentage of rated capacity, because loads above 10 tons require a structural engineer's approval

D. A lift becomes critical only when the crane operator has less than 5 years of experience with the specific crane type being used

16. Fatigue failure in wire rope is different from overload failure. Which characteristic distinguishes wire fatigue failure from sudden overload fracture?

A. Fatigue-failed wire ends are smooth and cup-shaped, similar to a ductile tensile overload fracture, making them visually indistinguishable from overload failures

B. Fatigue failure produces a sudden, complete rope separation without any preceding visible wire breaks — the rope fails without warning when the cumulative damage reaches the critical level

C. Fatigue wire fractures are perpendicular to the wire axis (straight, square-cut breaks at the wire's cross-section), while overload fractures produce long, necked-down, pointed wire ends that are noticeably elongated at the break

D. Fatigue failure affects only the fiber core of the rope, causing the core to shred and fragment before any wire breaks appear on the external strand surfaces

17. A beam attachment clamp (also called a beam plate or beam clamp) is used to attach a rigging load to a structural beam flange. What limitation applies to beam clamps that does not apply to welded-eye attachments?

A. Beam clamps require a minimum beam flange thickness of 1 inch before they can be used, while welded eyes can be applied to any flange thickness

B. Beam clamps may only be used on beams that are part of the building's permanent lateral load-resisting system — beams designated as gravity-only members cannot support any clamped rigging load

C. Beam clamps must not be used on beams with known live loads, because the clamp's grip relies on friction and live load vibration can cause the clamp to walk along the flange during a sustained pick

D. Beam clamps have a rated WLL for the clamping direction, but are also sensitive to horizontal forces perpendicular to the beam — the rated capacity applies only to loads hanging vertically below the clamp, and any horizontal force component can cause the clamp to twist on the flange

18. The Occupational Safety and Health Administration classifies construction lifting operations into categories based on risk. What category requires the most planning documentation?

A. Standard picks require complete documentation including a structural assessment of the ground, a certified rigging inspection, and a mandatory pre-lift meeting with all crane operators and riggers

B. Non-routine picks require a pre-task plan but no written rigging plan; the competent person can verbally authorize the pick without written documentation

C. Critical lifts require a written lift plan prepared or reviewed by a qualified rigger or engineer, detailing the crane configuration, rigging arrangement, crane position, ground conditions, and hazard controls — this documentation level is the highest required by OSHA

D. Routine picks — the most common classification — require the highest documentation because they are performed repeatedly and the cumulative risk is greater than any single complex lift

19. A solid steel bar (density = 490 lb/ft³) is 6 inches in diameter and 4 feet long. What is the approximate weight of this bar?

A. 385 lb

B. 420 lb

C. 462 lb

D. 510 lb

20. A luffing jib differs from a fixed jib attached to a lattice boom tip. What operational advantage does the luffing jib provide over the fixed jib?

A. A luffing jib uses a separate hoist drum rather than the main hoist, providing independent vertical lift control that the fixed jib cannot offer when both booms are at the same angle

B. A luffing jib can be stored parallel to the main boom during transit, reducing the transport height below that of a fixed jib which must be removed for highway travel

C. A luffing jib uses a shorter main boom than a comparable fixed jib, reducing boom tip height and enabling picks closer to the crane without sacrificing reach

D. A luffing jib can be raised and lowered independently of the main boom, allowing the operator to change the working radius without moving the crane or changing the main boom angle — this is essential in congested areas where other equipment or structures restrict boom movement

21. When reading a crane's load chart, the listed rated capacity is a net capacity. What deductions must the operator make from this chart value to determine the actual payload the crane can lift?

A. The rated chart capacity is the net payload after all crane weight, boom weight, and dead weight deductions are already made — the operator uses it directly as the maximum hook load without further deductions for rigging weight

B. The rated chart capacity may or may not include the weight of the load block and hook assembly depending on the manufacturer — the operator must consult the load chart footnotes and deduct the block and hook weight if not included, then deduct the rigging weight to find the actual maximum payload

C. The operator must deduct the boom weight from the chart value and then divide by the crane's safety factor to determine the safe hook load

D. The rated chart capacity must be multiplied by 0.75 for standard construction lifts to account for site conditions — the published value applies only to controlled test-stand conditions

22. When a crane pick must be made with the load on the crane's side (perpendicular to the boom centerline), how does the maximum rated capacity compare to picking over the front?

A. Side picks have higher rated capacity than front picks because the crane's counterweight effectively shifts toward the load on a side pick, providing more stabilizing moment

B. Side picks have lower rated capacity than front picks for most crane configurations — mobile cranes are most stable picking over the front or rear; the sides provide less tipping resistance because the outrigger pattern is narrower perpendicular to the boom axis in many configurations

C. Side pick capacity is identical to front pick capacity for all mobile cranes because outrigger deployment makes the crane's stability symmetric about the center

D. Side pick capacity equals exactly 50 percent of front pick capacity for all crane types — this is a universal ASME B30.5 requirement

23. A telescoping hydraulic crane boom can experience what type of failure when operated with a load on the block if the boom extension pins are not properly engaged?

A. The hydraulic cylinder seals blow out from the combined weight of the boom and load, causing uncontrolled boom collapse toward the crane body

B. The boom extension locks disengage under load, causing the outer boom sections to retract under the load's weight — this suddenly shortens the boom and increases the working radius as the load swings out

C. The outer boom sections rotate around the hydraulic cylinder axis, twisting the boom and causing the hook to swing laterally

D. The boom's hydraulic extension cylinder can collapse inward if the pin lock is not engaged, causing the boom to telescope in rapidly and drop the load — this is a catastrophic failure mode in telescoping booms where mechanical pin engagement is essential safety backup

24. OSHA 1926.1417 lists activities that crane operators are prohibited from performing while a load is on the hook. Which of the following is specifically prohibited?

A. Communicating with the signal person by radio while the load is suspended is not permitted during any lifting operation

B. Briefly looking away from the load to check the load chart — prohibited because visual monitoring must be continuous throughout the lift

C. Leaving the cab or controls with a load suspended — the operator must remain able to lower the load in an emergency until it is safely on the ground

D. Adjusting the crane's counterweight setting with a load on the hook at any working radius or operating condition

25. A sit-down counterbalanced forklift has a rated capacity of 6,000 pounds. Under what condition is the forklift's rated capacity valid?

A. The rated capacity applies only when the forklift travels in reverse (load trailing), because traveling forward with a loaded forklift is prohibited by OSHA for all loads above 1,000 pounds

B. The rated capacity applies when the load center is at the nameplate's specified distance (typically 24 inches), the load is evenly distributed on both forks, forks are level, and the mast is vertical or tilted back

C. The rated capacity applies without restriction as long as the load is within the fork length — the load center distance only matters for long loads that extend beyond the fork tips

D. The rated capacity applies at all times as long as the gross vehicle weight of the forklift plus the load does not exceed the manufacturer's combined gross weight limit

26. OSHA 1926.1408 establishes minimum approach distances (MAD) for cranes operating near energized power lines. For lines at 50 kV or below, what is the minimum approach distance?

A. 5 feet minimum from all energized lines at any voltage up to 350 kV

B. 10 feet minimum from the line, with a 2-foot buffer added for each 50 kV above 50 kV

C. 20 feet minimum from the line for all voltages up to 350 kV, with no distance permitted for lines above 350 kV

D. At least 10 feet from the energized line for voltages up to 50 kV — this minimum cannot be reduced without specific engineering analysis and power line owner coordination

27. Dynamic loading on a crane from sudden shock is defined as the additional force imposed when a load is quickly stopped or started. Which operational practice minimizes dynamic loading?

A. Accelerating the hoist as quickly as possible to minimize the time the load is in motion and reduce exposure to wind-induced oscillation during the pick

B. Operating the hoist at maximum speed throughout the lift to ensure the load's inertia keeps it stable during swing

C. Limiting the crane to 60 percent of rated capacity during all operations involving multi-part line arrangements to provide additional margin for dynamic load peaks

D. Hoisting and lowering loads smoothly and deliberately — avoiding jarring starts, sudden braking, or two-blocking — to minimize the inertial forces imposed on the crane's structure beyond the static load weight

28. When reading a crane load chart to determine the allowable hook load, what value does the operator use when selecting the applicable chart row for a given pick?

A. The total weight of the rigging (slings, shackles, block) that will be used for the pick — this is the primary input that determines which row of the load chart applies

B. The estimated weight of the hook block and load lines only, which is the only deduction the operator makes from the chart's listed payload capacity

C. The theoretical working radius at the beginning of the pick before the load stretches the rope and the boom deflects under load

D. The actual measured horizontal distance from the crane's axis of rotation to the center of the vertical load line when the load is suspended — measured with the load applied, not at the light-line position

29. A free-standing tower crane has a maximum free-standing height defined by the manufacturer. What determines this maximum free-standing height?

A. The maximum free-standing height is the height at which the crane's overturning moment from the loaded jib exceeds the stabilizing moment from the concrete foundation, requiring wall ties to prevent toppling

B. OSHA regulation 1926.1436 specifies a universal maximum free-standing height of 150 feet for all tower cranes regardless of base type or configuration

C. The slew ring bearing type determines the maximum free-standing height — friction bearings are limited to 80 feet while roller bearings allow up to 200 feet

D. The maximum jib load combined with the wind area of the mast and jib creates a specific overturning moment at the base — the manufacturer calculates the free-standing height where this moment equals the resistance of the foundation system, and this becomes the published limit

30. A tandem lift requires two cranes to share the load of a single pick. What is the most critical planning requirement for a successful tandem lift?

A. Both cranes must be identical make, model, and boom length so that their load charts can be directly compared without correction factors

B. The rigging for both cranes must be identical in length, type, and WLL to ensure that the load is divided exactly 50/50 between the two cranes regardless of geometry

C. Each crane operator must have a minimum of 10 years of tandem lift experience, and all rigging must be red in color to indicate tandem lift rigging components

D. The load distribution between the two cranes must be calculated, and both cranes must stay within their chart ratings throughout the pick — a qualified rigger plans the lift and verifies neither crane is overloaded at any point

31. On a hydraulic crane with a two-part line (2 parts of line supporting the hook block), the operator wants to switch to a four-part line for a heavier pick. What is the effect on crane capacity and line speed?

A. Doubling to 4 parts of line does not change the crane's rated capacity because the chart values already account for multi-part line arrangements

B. Switching to 4 parts of line doubles the maximum hook load capacity relative to 2-part line but reduces the line speed to half — the mechanical advantage gained is traded off against slower hoisting

C. Switching to 4 parts of line reduces capacity by half because the additional weight of the extra rope and sheave block reduces the chart's net payload

D. Adding parts of line increases both capacity and line speed because the additional mechanical advantage amplifies both the force available and the rate at which the hook rises

32. Before deploying outriggers on compacted fill, what site condition must be evaluated first?

A. The fill's moisture content must be tested with a soil hygrometer to confirm it is below the 15 percent saturation threshold before outriggers can be set

B. The fill must be visually inspected for evidence of settlement cracks that indicate ongoing compaction and are considered a failure hazard

C. The depth, compaction level, and bearing capacity of the fill must be verified to ensure the soil can support the outrigger pad loads without punching failure — recently placed fill or fill with unknown compaction history requires engineering evaluation before any crane operation

D. The outrigger pads must be placed directly on the original grade below the fill, requiring excavation through any compacted fill material regardless of depth

33. Under OSHA 1926.1412(e), what must happen after a crane has been out of service for a period of time (more than 3 months) before it can return to service?

A. The crane can return to service after the operator performs a complete pre-shift inspection identical to the daily pre-shift inspection required at the start of every operating shift

B. The crane must be inspected by a qualified person per the manufacturer's requirements and OSHA 1926.1412(e), and the inspection must include all items in both the daily pre-shift list and the periodic inspection list — all deficiencies must be corrected before the crane is returned to service

C. The crane must be transported to the manufacturer's service center for a factory recertification before any field use is permitted after a 3-month storage period

D. Only the wire rope and hook must be re-inspected before returning to service; the crane's structure and mechanical components do not require additional inspection after less than 6 months out of service

34. A column cap plate (baseplate at the top of a column) can be either bolted or welded to the column flange. For a moment-frame column where the cap plate transfers both gravity and lateral load, which connection is preferred and why?

A. A bolted cap plate is preferred in moment frames because bolts can be inspected for pretension after erection, while welds require more complex NDT for verification

B. Either connection is equally acceptable in moment frames because AISC 360 does not distinguish between bolted and welded cap plate connections for seismic or wind load transfer

C. A fully welded cap plate is preferred in moment frames because weld connections can transfer both tension and compression without relying on bearing contact — moment connections require the ability to transfer tension upward through the cap plate to the column above, which a welded cap plate achieves reliably

D. A bolted cap plate is always required in moment frames to allow the column splice to be shimmed during erection, which is not possible with a welded cap plate

35. Metal floor deck is attached to structural steel framing using puddle welds in the field of the deck and additional fasteners at the perimeter. What OSHA requirement governs the minimum attachment of the first bundle of deck placed from the crane?

A. The first bundle of deck must be immediately connected along all four sides before the crane releases it — releasing the bundle without full perimeter attachment is a Subpart R violation

B. The lead sheet of each bundle must be immediately connected to the structural steel in the manner specified in the erection drawings before the crane releases the bundle — OSHA 1926.754(e)(3) requires immediate attachment

C. The crane may release the bundle once two bundles have been placed side by side, providing mutual lateral stability without requiring individual sheet fastening before hook release

D. Deck bundles may be released by the crane and stacked on the steel framing pending bundle processing, with fastening required within 4 hours of placement

36. OSHA Subpart R defines requirements for multi-story structural steel erection. What is the minimum number of unguyed anchor bolts that must be engaged before a column can be released by the crane?

A. All anchor bolts in the baseplate must be engaged before the crane releases any column

B. Two anchor bolts at opposite ends of the baseplate must be engaged and tightened before the crane releases the column

C. One anchor bolt must be engaged — this is sufficient to prevent column rotation while the remaining bolts are installed

D. At least four anchor bolts must be fully engaged (wrench-tight) to the column baseplate before the crane may release any column — OSHA 1926.755(a)(1) requires a minimum of four anchor bolts

37. A splice plate connection uses two bolted splice plates on each side of the web, with 3 bolt rows and 4 bolts per row on each side of the splice. How many total bolts are in this double-shear splice connection?

A. 12 bolts

B. 16 bolts

C. 24 bolts

D. 36 bolts

38. OSHA Subpart R specifically addresses the hazard of ironworkers working under suspended loads. What is the general rule for working under suspended loads during steel erection?

A. Ironworkers must not work under suspended loads — OSHA 1926.753(e)(1) prohibits ironworkers from being below a suspended load unless they are in an engineered and approved exclusion zone with documented fall protection

B. Working under suspended loads is prohibited unless the load is less than 2,000 pounds and the rigging has been inspected that day by a qualified rigger — loads below this threshold may pass over workers without additional precautions

C. Working under suspended loads is prohibited at all times with no exceptions — OSHA Subpart R absolutely prohibits any worker from being under or in the path of a suspended load

D. No restriction applies to loads suspended by synthetic slings, which provide visual warning of failure — the prohibition applies only to wire rope slings where wire breaks may be difficult to detect visually during a pick

39. After a structural steel column baseplate is set to grade on leveling nuts, what minimum cure time is typically required before anchor bolt nuts are tightened to final torque when non-shrink grout has been placed?

A. Non-shrink grout must cure for exactly 24 hours regardless of temperature — tightening before this period voids the grout manufacturer's warranty

B. Non-shrink grout cure time before bolt tightening is typically stated in the project specifications or the grout manufacturer's data sheet, commonly 3 days at 70°F — the engineer of record specifies the minimum strength at which bolts may be tightened

C. Non-shrink grout does not require any cure time before bolt tightening because the grout's function is filling the gap, not providing structural transfer — bolts may be tightened immediately after grout placement

D. Non-shrink grout must cure for a minimum of 28 days before any anchor bolt tightening — the 28-day cure matches the concrete strength specification used in all structural grout applications

40. A structural steel plate is 1/2 inch thick, 24 inches wide, and 60 inches long. Steel weighs 0.2833 pounds per cubic inch. What is the weight of this plate?

A. 186 lb

B. 204 lb

C. 220 lb

D. 240 lb

41. In multi-story structural steel erection, what is the primary reason that erection typically proceeds one or two tiers at a time before extensive bolting and plumbing is completed?

A. Two-tier erection reduces the amount of guy wire needed because the second-tier columns provide lateral restraint for the first-tier columns, eliminating individual guying requirements

B. OSHA Subpart R requires erection to stop every two tiers for a mandatory floor inspection by a third-party special inspector before the next tier can begin

C. Multi-story erection sequences are controlled primarily by the crane's reach — erecting two tiers simultaneously allows the crane to pick from one position with maximum efficiency

D. Tier-by-tier erection allows the plumbing, alignment, and permanent bolting crew to follow closely behind the connectors, ensuring the structure is made safe and plumb before the erection advance gets too far ahead — working too many tiers ahead of the bolting crew creates excessive unguyed height

42. A concrete floor is 90 feet long and 30 feet wide. Steel deck sheets spanning the 30-foot direction are 3 feet wide. How many deck sheets are needed to cover the 90-foot floor length?

A. 30 sheets

B. 36 sheets

C. 24 sheets

D. 45 sheets

43. Structural steel column shortening under load is a consideration in multi-story building design. What is the primary cause of column shortening in structural steel frames?

A. Thermal contraction of the steel columns during cold weather causes permanent shortening that accumulates over the building's service life

B. Elastic compression of the steel column under the accumulated gravity loads from the floors above — taller, more heavily loaded columns shorten more, creating differential settlement between the structural steel frame and attached components

C. Bolt slip in the column connections absorbs the load by deforming the connection, which accumulates to appear as column shortening when measured over the building height

D. Column shortening is caused by ground settlement under the building's footings, not by steel compression — the columns themselves are incompressible under structural loads

44. OSHA 1926.502(b)(1) specifies fall protection requirements at certain heights on construction sites. What is the height threshold triggering mandatory fall protection during structural steel erection for ironworkers?

A. 4 feet above the floor or working surface — the OSHA general industry standard applied to all construction work including ironworking

B. 6 feet above the floor or working surface — the OSHA construction fall protection threshold that applies to all construction activities including steel erection

C. 15 feet above the floor — the threshold established by OSHA Subpart R specifically for structural steel erection, reflecting the practical limitations of providing conventional fall protection during connector work

D. 10 feet — the OSHA steel erection threshold that was established by the 2001 Subpart R revision to reflect industry practice

45. During steel truss erection, what is the purpose of 'fitting up' the truss before permanent connections are made?

A. Fitting up determines the truss's final elevation by adjusting the bearing seat heights at each end of the truss to achieve the specified structural depth at the centerline

B. Fitting up is the process of temporarily assembling the truss members so that all bolt holes are aligned simultaneously and the geometry is verified before any permanent bolts are installed — this confirms the fabricated members are correct and the truss will assemble to its design geometry

C. Fitting up refers to the process of cutting truss members to their final length in the field, compensating for any dimensional discrepancies found between shop drawings and field dimensions

D. Fitting up is the AISC term for the process of applying camber to the truss top chord by tightening selected bolts to bow the chord upward to the design camber specified for the span

46. A W24×55 structural beam is 35 feet long. What is the total weight of this member?

A. 1,760 lb

B. 1,925 lb

C. 2,090 lb

D. 2,200 lb

47. A steel plate is 18 inches wide and 36 inches long. What is the area of this plate in square inches?

A. 432 sq in
B. 540 sq in
C. 594 sq in
D. 648 sq in

48. A bolt hole is measured at 0.375 inches in diameter. What is this diameter expressed as a fraction?

A. 3/8 in
B. 1/4 in
C. 5/16 in
D. 7/16 in

49. A structural steel gusset plate is 3/4 inch thick and measures 12 inches by 12 inches. Steel weighs 0.2833 lb per cubic inch. What is the weight of this plate?

A. 31 lb
B. 36 lb
C. 42 lb
D. 48 lb

50. A W14×48 structural beam is 24 feet long. What is the total weight of this member?

A. 984 lb
B. 1,152 lb
C. 1,296 lb
D. 1,440 lb

51. Two angle iron pieces are placed end-to-end. The first measures 7-3/8 inches and the second measures 2-5/8 inches. What is the total combined length?

A. 9 in
B. 9-3/4 in
C. 9-1/2 in
D. 10 in

52. An ironworking crew has installed 18 out of 24 bolts in a connection. What percentage of the bolts have been installed?

A. 60 percent
B. 66 percent
C. 75 percent
D. 80 percent

53. A W8×31 structural beam is 16 feet long. What is the total weight of this member?

A. 448 lb
B. 496 lb
C. 560 lb
D. 592 lb

54. A circular opening in a structural deck has a radius of 10 inches. What is the area of this opening in square inches? (Use $\pi = 3.1416$)

A. 314 sq in
B. 380 sq in
C. 452 sq in
D. 628 sq in

55. A rectangular concrete footing is 5 feet long, 5 feet wide, and 2 feet deep. Concrete weighs 150 lb per cubic foot. What is the weight of this footing?

A. 5,000 lb
B. 6,000 lb
C. 6,500 lb
D. 7,500 lb

56. A chain must wrap around a 12-inch × 12-inch square column to form a choker hitch. The chain must go completely around the column with 6 additional inches for the hook connection. What is the minimum chain length needed?

A. 42 in
B. 48 in
C. 54 in
D. 60 in

57. A W12×26 structural beam is 20 feet long. What is the total weight of this member?

A. 416 lb
B. 468 lb
C. 494 lb
D. 520 lb

58. A double-V groove weld (also called a double-bevel groove) is specified for a butt joint in a thick structural plate. What advantage does the double-V have over a single-V groove for the same plate thickness?

A. A double-V groove is used for aesthetic reasons only — the visible weld face on both sides of the joint is preferable to the single-V's visible root pass on the back side
B. A double-V groove requires less weld metal to fill the joint than a single-V groove of the same thickness, because each V is only half the depth of a single full-depth V, and the combined weld volume is approximately half of a single-V — reducing heat input, distortion, and weld metal cost

C. The double-V groove is specified when a backside weld is not possible because there is no access to the back face of the joint for a backing pass or backgouging

D. A double-V groove requires the joint to be welded in the overhead position, which produces better root fusion than flat-position welding because gravity draws the molten pool into the root gap

59. E6010 electrode produces a 'fast-freeze' (fast-solidifying) weld puddle, while E7018 produces a 'fill-freeze' (slower-solidifying) puddle. What is the primary field application advantage of E6010 over E7018?

A. E6010 produces higher tensile strength deposits (70 ksi minimum) than E7018 (60 ksi minimum), making it the preferred electrode for high-strength structural connections

B. E6010's fast-freeze slag allows all-position welding without puddle sag, and its penetrating arc cuts through rust and scale — making it the standard choice for root passes in contaminated field joints

C. E6010 can be stored at room temperature without rod ovens, which reduces equipment costs in remote field locations where power for electrode storage ovens is unavailable

D. E6010 provides a deeper penetrating arc than E7018 because of its higher hydrogen content, making it the preferred electrode for T-joint fillet welds where penetration to the root is critical

60. Oxygen-propane cutting is sometimes used as an alternative to oxygen-acetylene cutting. Which characteristic is different between propane and acetylene in the cutting application?

A. Propane has a lower flame temperature than acetylene but a higher BTU heat output per cubic foot, which actually makes propane more efficient for cutting plates thicker than 1 inch — propane is the preferred cutting fuel for heavy plate work at all professional cutting shops

B. Propane and acetylene are interchangeable in all cutting torch applications and can be swapped simply by changing the regulator — no torch or tip modification is required when switching between the two fuel gases

C. Propane does not store as readily as acetylene in portable cylinders, limiting its use to stationary piped systems only — propane cannot be used for field cutting with portable equipment

D. Propane's flame heats the steel more slowly than acetylene because its lower maximum flame temperature requires a longer preheat time to bring the steel to ignition temperature, but propane is less sensitive to pressure fluctuations, safer in storage, and is commonly used for cutting when longer preheat time is acceptable

61. Pre-heating structural steel before welding serves multiple purposes. What is the most important consequence of welding without required preheat on a thick, restrained structural connection?

A. Failure to preheat thick structural steel causes the weld to cool too slowly, creating a very wide heat-affected zone that reduces the base metal's yield strength in the zone adjacent to the weld

B. Omitting required preheat on thick or highly restrained structural connections can cause hydrogen-induced cracking (also called cold cracking or delayed cracking) — hydrogen from the electrode coating diffuses into the weld and HAZ under the high restraint stress, and cracks can form hours or days after welding is complete, often without visible warning

C. Failure to preheat causes slag to be permanently bonded to the weld surface, making slag removal between passes impossible and resulting in slag inclusions that fail inspection

D. Welding without preheat causes the weld metal to solidify at a much higher strength than specified, creating a brittle weld that will fracture at lower deflections than the code allows for structural connections

62. Undercutting is a weld defect that appears as a groove or notch melted into the base metal at the weld toe. What is the primary cause of undercut in fillet welds?

A. Insufficient heat input — the arc is too cold to melt the base metal at the weld toe, leaving an unfused surface at the toe that appears as a notch after the weld cools

B. Excessive travel speed combined with correct current, which causes the solidifying weld metal to pull away from the base metal at the toe before it can fill the notch left by the melting arc

C. Incorrect polarity — using DCEN instead of DCEP on E7018 electrodes causes the heat to concentrate on the base metal rather than the electrode, melting a notch at the weld toe rather than depositing filler metal

D. Excessive welding current for the electrode diameter, which melts away the base metal at the weld toe faster than the weld metal can fill the resulting void — the molten pool undercuts the base metal and the solidifying weld metal bridges across the notch without filling it

63. After welding is complete, visual inspection is performed on fillet welds. Which AWS D1.1 acceptance criterion specifically applies to the visual inspection of fillet weld size?

A. The fillet weld leg size must equal or exceed the specified leg size as measured using a fillet weld gauge — the undersize limit is zero tolerance (no undersizing is permitted at any location along the weld length)

B. Fillet welds may be up to 1/16 inch below the specified leg size for up to 10 percent of the weld length, provided the undersize condition is not continuous and is not at the weld's end returns

C. The fillet weld throat (not the leg size) is the critical measured dimension — weld legs may vary by up to 3/16 inch as long as the resulting throat meets the minimum specified throat dimension

D. Fillet weld size acceptance allows a maximum of 1/8 inch undersize over the full weld length as long as the weld's total length is at least 10 percent longer than specified to compensate

64. A fillet weld has a leg size of 5/8 inch. What is the theoretical effective throat dimension of this weld?

A. 0.265 in

B. 0.354 in

C. 0.442 in

D. 0.530 in

65. OSHA 1910.252 and 1926.350 specify ventilation requirements for welding in confined spaces. What condition specifically requires mechanical ventilation rather than natural ventilation?

A. Any welding operation that produces visible smoke, because visible smoke is defined as a confined space atmosphere hazard under OSHA 1910.252

B. Welding on coated, galvanized, or painted materials in an enclosed area, because the coating combustion products include toxic fumes that cannot be adequately diluted by natural ventilation alone

C. All welding in spaces with a volume less than 10,000 cubic feet per welder, or in spaces with high ceilings (above 16 feet) that restrict air circulation at the working level

D. Welding in any space that restricts natural air movement, where the space volume per welder is less than 10,000 cubic feet, or whenever welding is being performed on base metals with coatings that produce toxic fumes — in these conditions mechanical ventilation or an air-supplied respirator is required

66. Gas cylinders for oxyfuel cutting must be stored and handled according to OSHA 1926.350. What storage requirement applies when oxygen and fuel gas cylinders are stored together?

A. Oxygen and fuel gas cylinders must be stored at least 20 feet apart in a dedicated cylinder room with sprinkler protection overhead and fire-rated walls on all four sides

B. Oxygen and fuel gas cylinders may be stored together when they are both capped and secured to a cylinder cart — the cart provides both stability and the required 20-foot separation equivalent

C. Oxygen and fuel gas cylinders may not be stored within 20 feet of each other unless they are separated by a non-combustible partition at least 5 feet high — this separation is required to prevent a fire in the fuel gas area from reaching the oxygen storage and dramatically accelerating the fire

D. Oxygen cylinders may be stored alongside fuel gas cylinders without restriction as long as all regulators are removed and the cylinder valves are fully closed with the protective caps installed

67. Direct current electrode positive (DCEP) polarity in SMAW welding concentrates more heat at the workpiece. How does this affect penetration depth and electrode melt-off rate compared to DCEN?

A. DCEP produces shallower penetration and faster electrode melt-off than DCEN — this is why DCEP is preferred for thin material to prevent burn-through

B. DCEP and DCEN produce identical penetration depth and electrode melt-off rates — polarity only affects arc stability, not heat distribution between the electrode and workpiece

C. DCEP produces deeper penetration into the base metal and slower electrode melt-off than DCEN — the concentration of arc energy at the workpiece melts more base metal and deposits fewer electrodes per unit of bead length

D. DCEN produces deeper penetration and faster electrode melt-off than DCEP — this is the relationship most ironworkers reference when switching between SMAW and FCAW applications

68. Guy wires on a newly erected column are sometimes pre-loaded (pre-tensioned) before the structure is loaded by additional tiers above. What is the purpose of pre-loading the guy wires?

A. Pre-loading prevents the guy wires from oscillating in the wind by increasing their tension above the point at which Aeolian vibration can develop in the wire span

B. Pre-loading the guy wires puts the column in a slight opposing lean before additional gravity loads are placed above — when the erection loads are applied, the column deflects back toward plumb, leaving the column in its design-plumb position after the critical loading stage

C. Pre-loading the guy wires locks the column in the exact plumb position measured by the survey crew, preventing any movement during the bolting and alignment sequence

D. Pre-loading is required by OSHA when the column height exceeds 30 feet, because unloaded guy wires at that height provide insufficient lateral stiffness to resist wind forces during erection

69. A digital (electronic) level provides direct readout of angular deviation from level or plumb. How does this compare to a traditional optical transit for structural steel column plumbing?

A. The digital level requires more setup time than a transit because it must be leveled precisely with a tribrach before each reading, while the transit's self-leveling compensator eliminates this step

B. The transit reads angles to a precision of 1 second of arc, while the digital level is accurate only to 0.1 degree — for column plumbing where tolerances are measured in fractions of an inch, the transit is more accurate

C. The digital level is faster for multiple readings on the same column because it gives an instant readout placed directly on the column face without requiring the ironworker to look through an eyepiece or establish a sight line from a remote instrument position

D. The digital level and the transit are equivalent in both accuracy and speed for column plumbing — the choice between them is purely a personal preference with no practical difference in field results

70. During structural steel layout, a stringline is stretched between two control points to establish a reference line for column positioning. What is the primary limitation of the stringline method compared to surveying instruments?

A. Stringlines cannot be used for column spacings greater than 25 feet because the line sags below the allowable tolerance level beyond this span

B. Stringlines cannot be used in outdoor construction because wind deflects the string laterally by amounts that exceed column plumb tolerances

C. A stringline sagging under its own weight introduces a vertical deflection in the line that becomes significant at longer spans — for horizontal layout over long distances, sag causes the string's midpoint to be lower than the endpoints, and lateral stiffness is lost, making the line susceptible to wind drift

D. Stringlines establish only horizontal alignment and cannot simultaneously verify plumb or elevation, requiring supplemental vertical measurements — but they are accurate to the same tolerance as optical instruments for short spans under 50 feet

71. A surveyor reads a backsight of 4.10 feet on a benchmark at elevation 212.50 feet, then reads a foresight of 6.25 feet on a new point. What is the elevation of the new point?

A. 208.90 ft

B. 209.65 ft

C. 211.15 ft

D. 210.35 ft

72. A column is 24 feet tall and must be guyed. The minimum acceptable guy wire angle from horizontal is 30 degrees. What is the maximum horizontal distance from the column base at which the anchor point may be placed?

A. 24.0 ft

B. 41.6 ft

C. 48.0 ft

D. 55.4 ft

73. A transit is set up on a control point to establish an offset control line for column layout. The transit line is set 5 feet north of the column centerline. To check whether a column is correctly centered on its grid line, the survey crew measures from the transit line to the column face. If the column is W14 with a flange width of 14.5 inches, what is the expected measurement from the transit line to the south face of the column flange?

A. 5 feet 7.25 inches — from the 5-foot offset to the south face of a W14 with a 14.5-inch flange width, measuring from the north control line to the outer south flange face

B. 4 feet 4.75 inches — from the 5-foot offset to the center, subtract the half-flange width

C. 6 feet 4.75 inches — from the 5-foot offset plus one-half the 14.5-inch flange width to the column face

D. 5 feet 0 inches — the flange width is always measured perpendicular to the transit line and does not affect the centerline-to-face measurement

74. When using an optical plumb instrument to transfer column centerlines to upper floors, what error can be introduced if the instrument is not precisely leveled?

A. An unlevel instrument shifts the plumb beam slightly to one side of the actual vertical axis, introducing a horizontal error at the upper floor that increases with the height of transfer — even a small leveling error can produce a significant plumb error over 20 or more stories

B. An unlevel instrument causes the plumb beam to rotate in a cone rather than a straight line, but since the cone is symmetric, the center of the rotation averages to the true vertical and self-corrects over multiple readings

C. An unlevel instrument produces an error in elevation transfer but not in horizontal position — the plumb point is always directly below the instrument regardless of the instrument's level condition

D. An unlevel instrument only affects measurements taken more than 50 feet above the instrument — for typical floor-to-floor transfers below 20 feet, leveling errors are negligible

75. A guy wire runs from the top of a 30-foot column to an anchor point 50 feet horizontally from the column base. What is the length of the guy wire?

A. 45.0 ft

B. 50.0 ft

C. 55.0 ft

D. 58.3 ft

76. After all structural steel columns are plumbed and permanently bolted, the survey crew establishes final column centerline positions on each floor. If a column is found to be 3/8 inch off-center in the east-west direction, what determines whether the deviation is acceptable or must be corrected?

A. Any deviation greater than 1/4 inch is automatically rejected under all AISC tolerances — 3/8 inch always requires correction

B. The column is acceptable only if it has been plumbed to within 1/500 of its height; whether 3/8 inch is acceptable depends on the story height and must be checked against the AISC 1/500 ratio for that specific column

C. The deviation is acceptable as long as the column is within the 1-inch absolute maximum permitted by OSHA for any single structural column in any location

D. AISC standards for column plumb measure deviation as a fraction of total building height from the foundation, so a 3/8-inch deviation at an individual story level must be evaluated against the cumulative drift allowed for the full building height

77. A weld symbol tail contains the notation 'WPS-101.' What does this tail reference indicate?

A. The tail notation means the weld was inspected under work package step 101 and has been accepted without further review required for this type of joint

B. The tail references the Welding Procedure Specification number 101 — the WPS that the welder must use for this joint, defining all essential variables including process, current, travel speed, preheat, and interpass temperature

C. 'WPS-101' in the tail indicates the weld inspector's license number, confirming that only Inspector 101 is authorized to accept this weld type

D. 'WPS-101' is the AWS D1.1 clause number governing this type of joint — the tail cites the applicable code section rather than a project-specific procedure document

78. A 'shear tab' connection and a 'seated beam' connection are two common field-bolted beam connection types. What is the primary structural difference between them?

A. A shear tab transfers load by bearing between the bolt and the hole edge in the tab plate; a seated beam connection transfers load primarily through bearing between the beam's bottom flange and the supporting seat angle or plate

B. The shear tab is a welded connection in the shop while the seated beam uses only field bolts — the two connections are never used interchangeably on the same structure

C. Shear tabs transfer both shear and moment; seated beam connections transfer shear only — this is why seated beams are required in moment-frame connections while shear tabs are used in simple shear frames only

D. Shear tabs are attached to the column web while seated beam connections always attach to the column flange — the attachment location determines which type is used for any given framing direction

79. A structural drawing contains 'match lines' separating adjacent drawing sheets. What is the function of a match line?

A. A match line is a reference line that shows where two separate drawing sheets connect to form a continuous plan view — the structure shown at the edge of one sheet continues at the corresponding match line on the adjacent sheet, allowing the full structure to be read across multiple sheets

B. Match lines indicate where field splices are required in structural members — any member crossing a match line must have a bolted splice at that location

C. Match lines define the limit of the general contractor's scope — work on one side of the match line is the contractor's responsibility, while work on the other side belongs to a separate scope

D. Match lines identify the survey control points where the layout crew must set instrument stations, ensuring that layout measurements are referenced to the correct points on each sheet

80. A structural drawing note reads 'U.N.O.' next to a dimension or detail. What does this abbreviation mean?

A. 'U.N.O.' stands for 'Uniform Nominal Opening,' specifying that all openings in that deck or floor area are the same standard size

B. 'U.N.O.' stands for 'Unless Noted Otherwise' — the dimension, detail, or condition applies everywhere on the drawing except where a different value or condition is specifically shown elsewhere

C. 'U.N.O.' stands for 'Under Normal Operations,' indicating that the specified condition applies during normal building use but may be modified for construction loading

D. 'U.N.O.' stands for 'Unobstructed Natural Opening,' a ventilation specification indicating that the opening must remain unblocked for natural air circulation

81. On a structural steel erection drawing, a member is labeled 'B-14 (TYP. BAY 1-5).' What does this label tell the ironworker?

A. Beam B-14 is fabricated from steel type BAY (a proprietary high-strength alloy) and the number 1-5 indicates its steel heat certification lot number

B. Beam B-14 is 1-5 inches shorter than standard and must be shimmed at each end to reach the required bearing length on the supporting connections

C. The label tells the ironworker that beam B-14 and its connection detail apply to all similar bays numbered 1 through 5 — it is not just for one location but for the same beam type in five different bays of the building

D. The notation indicates that beam B-14 requires 14 bolts on the far side (F.S.) and 5 bolts on the near side (N.S.) of each end connection, reflecting an asymmetric connection design

82. When a structural drawing is issued 'For Construction' (as opposed to 'For Review' or 'Preliminary'), what does this designation mean for the ironworker?

A. 'For Construction' means the drawing has been approved by the general contractor's superintendent but is still subject to review by the owner — field changes may be required

B. 'For Construction' is the preliminary issue only; the final 'Approved for Construction' issue with engineer's stamp must be used for all actual work — no structural work may proceed from 'For Construction' drawings alone

C. 'For Review' drawings are the ones the ironworker uses; 'For Construction' means the drawing has been distributed for storage and archive only — ironworkers should always request the most recent 'For Review' issue from the superintendent

D. 'For Construction' means the drawing has been approved by the responsible engineer for use in actual field work — it is the release status that authorizes construction and the ironworker may proceed based on this version unless a subsequent revision is issued

83. After a structural steel project is complete, 'as-built' drawings are produced. What information is typically added to create as-built drawings from the construction drawings?

A. As-built drawings add the AISC quality certification numbers of the steel fabricator and the erector to the title block, confirming that the steel was produced by a certified supplier

B. As-built drawings record the actual installed dimensions, locations, and any field modifications made during construction that differ from the original design drawings — this includes field-measured column plumb deviations, field-cut dimensions, added connections, and any field change orders that altered the design

C. As-built drawings replace all structural calculations with the as-measured load values from the building's structural monitoring sensors, reflecting the actual loads observed during the first year of building occupancy

D. As-built drawings eliminate all construction notes and sequencing instructions from the drawings, leaving only the final structural dimensions applicable to the completed building for future renovation or inspection use

84. K-series bar joists are sometimes specified with a built-in camber. What is the purpose of camber in a bar joist?

A. Camber is a deliberate upward curvature fabricated into the joist so that after dead load is applied, the joist deflects back toward level — the camber offset compensates for the anticipated dead load deflection, leaving the joist closer to its intended elevation under service loads

B. Camber is a downward pre-set curvature installed in bar joists to increase their natural frequency and prevent resonance with walking loads on the floor above

C. Camber refers to the lateral pre-bow applied to the joist top chord to compensate for the lateral deflection that occurs when the joist is loaded asymmetrically by mechanical equipment on one side

D. Camber in bar joists is a code-required safety margin that increases the effective section depth — the cambered joist has a higher moment of inertia than a flat joist of the same nominal depth

85. OSHA 1926.757(c)(1) addresses the handling of longspan bar joists during erection. What does this section require before a longspan joist (over 60 feet) can be released by the crane?

A. A longspan joist may be released by the crane as soon as both ends are seated — end-bearing alone provides sufficient stability for joists of any length

B. A longspan joist must have temporary erection bridging installed before the crane releases the joist — the SJI Standard and OSHA recognize that longspan joists are inherently less stable than short-span joists and require bridging support before release

C. The ironworkers must bolt the joist seats at both ends to snug-tight before the crane releases — bolted seats provide stability for longspan joists without requiring bridging before hook release

D. Longspan joists must be released only in pairs — two joists are placed simultaneously and their bridging connected immediately so that both joists provide mutual stability before either is released by the crane

86. A composite bar joist uses a concrete deck bonded to the joist's top chord. What must be done to the joist's top chord to enable composite action?

A. The top chord must be painted with an epoxy bonding agent before concrete placement to chemically bond the concrete to the steel without requiring mechanical connectors

B. The top chord must be sandblasted to bare metal to achieve maximum concrete bond through surface adhesion — composite action relies entirely on friction and adhesion, not mechanical connection

C. The joist top chord must have shear connectors (typically welded studs, weld nails, or extruded connectors) attached that mechanically transfer horizontal shear between the concrete deck and the steel joist, enabling them to act as a composite unit

D. The top chord must be left without any primer coat so that rust forms on the surface before concrete placement — surface rust increases the bond strength between the concrete and steel significantly more than clean or primed surfaces

87. LH-series bar joists are designed for longer spans than K-series joists. What is the nominal depth range of LH-series bar joists?

A. LH-series joists have nominal depths from 18 to 48 inches — spanning the depth range needed for spans from approximately 25 to 96 feet

B. LH-series joists have nominal depths from 12 to 24 inches, complementing the K-series at depths above 24 inches for medium spans

C. LH-series joists have nominal depths from 6 to 12 inches, providing the shallowest available bar joist options for the most depth-constrained applications

D. LH-series joists have nominal depths from 36 to 72 inches, used exclusively for very long spans exceeding 100 feet where DLH-series is not available

88. A joist girder is designated '40G8N11.2K.' What does the 'N' in this designation indicate?

A. 'N' indicates 'Normal' load factor — the joist girder is designed for standard gravity loads without additional seismic or wind uplift provisions

B. 'N' indicates the number of joist spaces on the girder — the girder has N (eight) equal panel points, with one bar joist framing into the girder at each panel point

C. 'N' indicates 'Non-composite' — the joist girder top chord is not designed for composite action with the concrete deck and relies entirely on steel section alone

D. 'N' indicates that the joist girder has standard (non-extended) bearing seats — if the designation were 'E' instead of 'N,' it would indicate extended bearing seats required for the connection geometry at the supporting columns

89. ASTM A325 and ASTM A490 bolts have been redesignated under the new ASTM F3125 standard into separate grades. What are the equivalent F3125 designations for A325 and A490 bolts?

A. A325 becomes F3125 Grade B and A490 becomes F3125 Grade C — the alpha grade letters replace the numeric ASTM designations

B. A325 bolts are now designated ASTM F3125 Grade A325 and A490 bolts are designated ASTM F3125 Grade A490 — the F3125 is the umbrella standard covering both, with the original grade designations retained within the standard

C. A325 becomes F3125 Grade 8.8 and A490 becomes F3125 Grade 10.9 — these are the ISO metric equivalent grades that ASTM adopted for all new construction projects

D. A325 becomes F3125 Grade 120 and A490 becomes F3125 Grade 150, reflecting the minimum tensile strengths in ksi that each bolt grade must meet

90. AISC Specification Table J3.3 specifies when hardened washers are required under nuts or bolt heads. Under which condition is a hardened washer specifically required under the turned element (nut or bolt head) in a turn-of-nut installation?

A. A hardened washer is required under the turned element whenever the connected material has a specified minimum yield strength greater than 50 ksi

B. Hardened washers are required under the turned element for all A490 bolts, regardless of the connected material specification or hole type

C. A hardened washer is required under the turned element for A490 bolts, for Grade 100 or 105 connected material, or when the connected part thickness is less than the bolt shank diameter

D. No hardened washer is required under the turned element in any turn-of-nut installation — hardened washers are required only under static elements in installation methods that do not involve turn-of-nut

91. Bolts in bearing-type connections that transfer shear by bolt-shank-to-hole-edge contact do not require full pretension. What is the minimum installation condition for bolts in bearing connections where slip is acceptable under service loads?

A. All bolts in any structural connection, including bearing-type connections, must be fully pretensioned per the AISC Specification — bearing connections may be snug-tight only during erection, not for final condition

B. Bearing-type connections with standard holes (designated as 'N' — bearing at threads, or 'X' — bearing at shank) must have bolts installed at least snug-tight but do not require full pretension unless the connection is designated as requiring pretension by the engineer

C. Bolts in bearing-type connections are exempt from all AISC and OSHA requirements and may be left at any tension level as long as the nuts are tightened by hand — the bolt load is irrelevant because bearing, not friction, transfers the shear

D. Bolts in bearing connections must be installed to exactly half the full pretension — this intermediate condition is defined by AISC as 'half-tight' and is the specification for all bearing-type shear connections

92. For turn-of-nut tightening of ASTM A325 bolts in standard holes, the required nut rotation from snug-tight depends on bolt length. For a bolt with a length-to-diameter ratio greater than 8 (length more than 8 times the diameter), what nut rotation is required from the snug-tight condition?

A. Full turn (360 degrees) from snug-tight — long bolts require more rotation than standard bolts because the greater bolt length absorbs more of the nut rotation as elastic elongation before pretension is achieved

B. Half turn (180 degrees) from snug-tight — the standard rotation for A325 bolts in all lengths in standard holes

C. Two-thirds turn (240 degrees) from snug-tight — long bolts require this intermediate rotation value to account for the additional stretch of the longer shank

D. One-third turn (120 degrees) from snug-tight — A325 bolts in standard holes with length-to-diameter ratios above 8 require only 1/3 turn from snug-tight, per AISC Table J3.1, because the long shank stretches more per unit of nut rotation, achieving pretension with less overall rotation

93. A pneumatic grinder requires a continuous air supply at specified pressure and volume. When comparing a pneumatic grinder to an electric grinder of similar disc size, which operating characteristic distinguishes the pneumatic tool?

A. Pneumatic grinders require weekly blade changes while electric grinders use blades rated for 3-month service intervals under continuous use

B. Pneumatic grinders operate at a fixed single speed determined by air pressure, while electric grinders have variable-speed electronic controls that allow the operator to adjust disc speed during use

C. Pneumatic grinders can typically sustain full-rated RPM under load without significant speed drop, because the air motor's torque curve is more consistent than an electric motor that slows under cutting resistance — this makes pneumatic tools more consistent for heavy grinding on structural steel

D. Pneumatic grinders are lighter than electric grinders of the same disc capacity because they use a smaller motor housing, but they produce more vibration because the rotary vane mechanism introduces a pulsing action not present in electric motors

94. A drift pin (bull pin) that has been bent from repeated use is discovered in the rigging gang's tool bag. What is the correct disposition of this tool?

A. The bent drift pin can be straightened with a hammer if the bend is less than 15 degrees from the pin's original axis — bent pins are commonly used until the bend exceeds 30 degrees

B. A bent drift pin must be removed from service — a bent pin no longer provides the straight tapered profile needed for aligning bolt holes, and attempting to drive a bent pin through misaligned holes requires more force and can cause the pin to snap, sending a fragment toward workers

C. Bent drift pins may continue to be used for driving rather than alignment — the bent pin is reused as a driving tool to push bolts through holes that have already been aligned with a straight pin

D. A bent drift pin must be returned to the manufacturer for re-tempering and straightening before it can be used again on any structural steel project

95. An oxyfuel cutting torch tip becomes clogged with slag or carbon deposits during extended use, reducing the preheat flame quality. What is the correct procedure for cleaning the torch tip?

A. Tip orifices must be cleaned with the tip installed on the torch and the fuel gas valve slightly open to prevent oxygen backflow during cleaning — cleaning with the tip removed risks damaging the torch body threads

B. The tip is removed from the torch and the orifice holes are cleaned with a calibrated tip cleaner rod of the correct diameter — the cleaning rod is inserted straight into the orifice without twisting or enlarging the hole, then wiped clean

C. Tip cleaning requires soaking the tip in acetone solvent for 30 minutes, which dissolves carbon deposits without mechanically damaging the orifice geometry — mechanical cleaning tools scratch the orifice and distort the preheat flame pattern

D. Clogged tips must be replaced with a new tip immediately — tip orifice cleaning is prohibited by torch manufacturer warranties because any cleaning procedure risks enlarging or distorting the precisely machined orifice, changing the flame characteristics

96. A chain fall (chain hoist) and a come-along (hand lever hoist) serve similar pulling and lifting functions. What is the primary operational difference that determines when a chain fall is preferred over a come-along?

A. A chain fall can only be used for horizontal pulling while a come-along can only be used for vertical lifting — the structural differences in the hoisting mechanism determine the allowed orientation

B. Come-alongs use a lever mechanism that requires the operator to continuously pump the handle — they are preferred over chain falls for all applications because continuous pumping provides better load control

C. Chain falls use a rotary wheel and looped chain that allows the operator to pull continuously in one direction to raise the load smoothly — they are preferred for sustained vertical lifting because they do not require a change of action during lifting and can be left with the load held without operator effort

D. Come-alongs use a ratchet mechanism that only allows upward movement — once a load is lifted with a come-along, it cannot be lowered without a release tool that is sold separately from the come-along itself

97. During stud welding, a ceramic ferrule (arc shield) is placed around the base of each stud before welding. What is the primary function of the ferrule?

A. The ferrule concentrates the arc's heat at the stud base by reflecting arc energy inward, increasing the temperature of the weld pool and improving fusion to the base metal flange

B. The ferrule confines and shapes the molten metal at the stud base during the arc, preventing the molten puddle from flowing outward, forming the consistent flash (fillet) at the stud base, and shielding the arc from atmospheric contamination during the brief welding cycle

C. The ferrule provides electrical insulation between the stud gun and the beam flange, preventing stray current from damaging the base metal finish outside the weld zone

D. The ferrule serves as a post-weld inspection gauge — after welding, the correct ferrule fit confirms that the stud was properly positioned before the arc was initiated

98. Cellular floor deck consists of two interlocking formed steel sheets — a top fluted deck sheet and a flat bottom sheet welded together. What structural advantage does cellular deck provide over standard fluted deck of the same overall depth?

A. Cellular deck is lighter than standard fluted deck because the flat bottom plate requires less steel per square foot than the corrugated profile of standard deck

B. Cellular deck creates enclosed air ducts for HVAC distribution below the floor slab and provides a raceway for electrical wiring — the closed cell is a functional space that standard deck cannot provide, adding utility beyond the structural deck function

C. Cellular deck achieves higher composite action with concrete than standard deck because the flat bottom provides uniform bearing contact with the concrete rather than the discontinuous contact of a fluted profile

D. Cellular deck provides better fire resistance than standard deck because the air cells act as insulation, slowing the transmission of heat from below to the floor above

99. The SDI Diaphragm Design Manual distinguishes between 'field' fasteners and 'perimeter' fasteners in a deck diaphragm design. Why are different fastener spacings specified for these two zones?

A. Field fasteners are spaced wider because the center of the deck carries lower gravity loads than the perimeter, which must support the heavier edge beams and concentrated loads from perimeter curtain walls

B. Perimeter fasteners in the wall and edge zones carry accumulated diaphragm shear from the entire floor plate being funneled to the boundary, requiring closer spacing to transfer this higher shear demand into the boundary member

C. Field fasteners are placed closer together in the center of the bay to prevent concrete from delaminating from the deck surface under shrinkage, while perimeter fasteners prevent deck uplift from wind suction at the edges

D. The spacing difference exists because field fasteners are installed by the ironworker crew while perimeter fasteners are installed by the concrete forming crew — the different spacings reflect the different labor rates for each trade

100. AWS D1.1 specifies visual acceptance criteria for production stud welds. What is the visual acceptance criterion for the weld flash (weld fillet) at the base of a headed shear stud?

A. The weld flash must be perfectly circular (360-degree fillet) with no gaps — any incomplete or broken fillet at any point around the stud base is cause for rejection and the stud must be removed and replaced

B. The weld flash must be present for a minimum of 75 percent of the stud base perimeter — gaps covering no more than 25 percent of the total circumference are acceptable

C. The weld flash must be present for a minimum of 75 percent of the stud base circumference — no single gap in the flash may exceed 3/8 inch in length, and the flash must show complete fusion to the base metal

D. The weld flash must be a full 360-degree fillet of minimum 1/4-inch leg size — any point around the stud base where the flash size is less than 1/4 inch is an automatic rejection criterion

Practice Exam 6: Answer Key and Explanations

1. A — Proof loading verifies that a sling assembly can sustain a load above its rated WLL without failure or permanent deformation. ASME B30.9 requires wire rope slings to be proof-tested before entering service. The proof load typically equals twice the rated WLL for Grade 80 chain slings and similar factors for wire rope.

2. D — ASME B30.9 and manufacturer marking standards require synthetic web slings to have color-coded edge stitching indicating the sling's material and WLL, with the outer jacket color indicating the

fiber type (orange for nylon, green for polyester, silver/white for HMPE). The tag must include the WLL in multiple hitch configurations. The outer jacket color.

3. B — A crack at the body-to-jaw junction of a turnbuckle is a stress concentration defect that can propagate under tensile load, potentially causing the jaw to fracture and release the guy wire or rigging load suddenly. Replace the turnbuckle immediately with a same-rated unit — hardware with cracks cannot be safely re-rated at any reduced capacity.

4. C — Tension per leg = load / (2 x sin 60°) = 10,000 / (2 x 0.866) = 10,000 / 1.732 = 5,774 lb. At 60 degrees from horizontal, the high angle reduces sling leg tension below the full load value. Options A (5,000) = load/2; B (8,660) uses wrong formula; D (10,000) is.

5. D — A depleted lubricant film leaves the wire valleys between strands and between wires visibly dry, with the steel surface showing oxidation (reddish-brown or gray color) at wire contact points rather than the moist, dark appearance of a lubricated rope. A dry appearance in wire strand valleys, not surface shininess alone, is the key diagnostic sign that internal lubrication requires replenishment.

6. C — Tension per leg = load / (3 x sin 60°) = 15,000 / (3 x 0.866) = 15,000 / 2.598 = 5,774 lb. With three legs at equal angles, each leg carries one-third of the load's vertical component divided by the sine of the angle. Options A (5,000) = load/3; B (8,660) is.

7. B — Working load limit = catalog breaking strength / design factor = 25,000 / 5 = 5,000 lb. The 5:1 design factor means the rope has five times the rated WLL as its minimum breaking strength. Option A (4,000) uses factor 6.25; C (6,250) uses factor 4; D (8,333) uses factor 3.

8. A — Corner protectors (softeners) distribute the sling's bearing load over a larger contact area at sharp corners, preventing the corner edge from concentrating stress into a small section of the sling body. Wire rope slings can be cut by sharp corners under load even at tensions well below the sling's rated WLL.

9. D — IWRC wire rope is significantly more crush-resistant than fiber-core rope because the metallic core resists radial compression from multi-layer winding or from tight-groove sheave contact. IWRC is also used in high-temperature applications because it does not burn, shrink, or lose structural integrity at elevated temperatures the way organic fiber cores (manila, sisal, polypropylene) can.

10. A — The shackle bow (the curved body) is designed to receive and distribute load around its full curved cross-section. The shackle pin is designed to handle the load in shear at two cross-sections within the jaw. The shackle bow is designed to carry the full rated WLL; loading through the pin creates bending plus.

11. B — Vertical component of sling tension = T x sin(angle from horizontal) = 4,500 x sin(45°) = 4,500 x 0.7071 = 3,182 lb. At 45 degrees, each of the vertical and horizontal components equals T x 0.707. Option A (4,500) is the full tension magnitude, not its vertical component; C (6,364) is the tension.

12. C — OSHA 1926.1413(b) requires running wire rope to be inspected by a qualified person at least monthly, and inspections must be documented and retained. A crane that has been out of service for a

month or more must be re-inspected before return to service. A competent person performs and documents the monthly inspection. A.

13. D — A long horizontal load in a two-leg bridle has pick points separated along the load's length. As the load rises, the angle between the sling legs and the load's long axis changes. Installing a spreader bar between the pick points or using tag lines at each end of a long load prevents the sling legs from converging during the lift.

14. B — Tension per leg = (half load) / sin(30°) = (7,000/2) / 0.5 = 3,500 / 0.5 = 7,000 lb. At 30 degrees from horizontal, sin = 0.5, so each leg tension equals the half-load divided by 0.5, which equals the full load. At 30 degrees from horizontal, sin(30°) = 0.5, so T =.

15. A — OSHA 1926.1408 and industry practice classify lifts as critical based on consequences of failure, not just weight. Tandem picks (two cranes), picks over occupied spaces, picks near power lines, personnel platforms, and loads where a drop would be catastrophic all require engineered lift plans. The 75 percent of rated capacity threshold is a.

16. C — Fatigue wire fractures are perpendicular cuts through the wire's cross-section — the wire ends are straight, flat, and squared off rather than elongated or pointed. Overload fracture produces ductile elongation: the wire necks down to a point before breaking, leaving a cupped, pointed, or drawn end. Square, flat wire fracture ends (fatigue) versus.

17. D — Beam clamps are rated for vertical downward loads applied within the jaw's rated WLL. Horizontal forces parallel to the beam (from load swing or sling angles) or perpendicular to the beam create moments that can rotate the clamp on the flange or reduce the clamping force below the level needed to prevent slip.

18. C — Critical lifts — defined by OSHA and industry standards as lifts where failure would cause catastrophic consequences or that involve multi-crane operations, personnel platforms, or unusual hazards — require a written lift plan reviewed or prepared by a qualified rigger or engineer. This plan documents crane configuration, rigging, ground conditions, and hazard controls.

19. A — Volume = pi x r^2 x h = 3.1416 x (0.25 ft)^2 x 4 ft = 3.1416 x 0.0625 x 4 = 0.7854 ft^3. Weight = 0.7854 x 490 lb/ft^3 = 385 lb. Option B (420) uses a slightly larger diameter; C (462) and D (510) are too high. A 6-inch diameter bar.

20. D — A luffing jib can be raised and lowered independently of the main boom, allowing the operator to change working radius without repositioning the crane. This flexibility is critical in congested sites where structures or other equipment restrict boom movement. A fixed jib provides reach but cannot adjust its angle once assembled, limiting flexibility in confined erection areas.

21. B — Load chart footnotes specify whether the hook block, ball, and running rope weight are included in the listed rated capacity. If not included, the operator must deduct these weights from the chart's value before calculating the maximum payload. Additionally, rigging weight (slings, shackles, spreader bars) must be deducted. Operators must check footnotes on.

22. B — Mobile crane stability is greatest picking over the front (in the direction of the counterweight's deployment) or rear. Picking over the side requires the crane to use a narrower dimension of the outrigger spread as the effective tipping moment arm — most crane configurations have outriggers that extend further front-to-rear than side-to-side.

23. D — Telescoping boom cranes rely on mechanical pin locks to hold each extended section at the desired extension length. If the pins are not fully engaged, the outer boom sections can slide inward under the compressive load from the hook load and boom weight, causing rapid uncontrolled boom shortening. This failure mode is catastrophic.

24. C — OSHA 1926.1417(a) prohibits crane operators from leaving the controls or the operator's station with a load on the hook. The operator must remain able to control the crane and lower the load in an emergency until the load is safely on the ground or otherwise secured. Abandoning the controls with a suspended load.

25. B — Forklift rated capacity is only valid at the nameplate's specified load center (usually 24 inches), with the mast vertical or tilted back, forks level, load evenly distributed on both forks, and on a level, hard surface. Increasing load center distance, tilting the mast forward, or operating on an incline all reduce the effective capacity below the nameplate value.

26. D — OSHA 1926.1408(a)(2) establishes a minimum approach distance of 10 feet for all power lines rated 50 kV or below. This minimum cannot be reduced unless the power company de-energizes the line, the line is insulated per OSHA requirements, and an observer monitors clearance. The 10-foot minimum applies from any part of the crane.

27. D — Dynamic loading arises from the inertial resistance of a mass to acceleration or deceleration. A load raised slowly with controlled acceleration and deceleration generates minimal dynamic load above the static weight. Sudden braking or two-blocking creates a rapid deceleration that imposes a large inertial load on the crane's hoist rope and structure above the static hook load.

28. D — The working radius is the horizontal distance from the crane's axis of rotation to the center of the vertical hoist line at the hook when the load is applied. The boom deflects under load and the rope stretches, so the actual loaded radius is greater than the light-line radius. Using the light-line radius.

29. D — The free-standing height is the maximum mast height at which the crane's stability is ensured by the base foundation alone without requiring wall ties. The manufacturer calculates the overturning moment at the mast base from the jib loads, counterweight loads, wind forces on the structure, and dynamic effects at various mast heights.

30. D — In a tandem lift, the total load is shared between two cranes in a ratio determined by the hook positions relative to the load's CG. Each crane's share must be calculated and verified to be within that crane's chart capacity at its specific working radius. The load distribution between cranes changes as the.

31. B — Switching from 2-part to 4-part line doubles the mechanical advantage available at the hook, doubling the maximum hook load the hoist drum can support. However, the same drum rotation

produces half the rope speed and half the hook travel speed for the same motor power. This energy trade-off is fundamental — doubling the.

32. C — Compacted fill can have a wide range of bearing capacities depending on fill material, compaction method, density achieved, and moisture content. Recently placed fill may look solid but not yet have achieved design bearing capacity. Fill with unknown compaction history may have voids or poorly compacted zones. Fill with unknown compaction history may.

33. B — OSHA 1926.1412(e) requires a comprehensive inspection before a crane returns to service after being out of service for more than 3 months. This inspection must be performed by a qualified person and must cover all items in both the monthly/pre-shift list and the annual periodic inspection list. All deficiencies found must be corrected before the crane operates.

34. C — A moment-frame column cap plate must transfer tension upward (to resist overturning) as well as compression downward. Bolted connections transfer tension through bolt pretension and bearing, but tension reversals can cause bolt fatigue and loosening in cyclic loading. AWS D1.8 governs seismic weld quality for moment connections requiring cyclic tension transfer through the cap plate between upper and lower columns.

35. B — OSHA 1926.754(e)(3) requires that the leading edge of each deck bundle be immediately attached to the structural steel before the crane releases the bundle. An unattached bundle on a sloped deck or near an opening can shift, slide, and fall, creating a struck-by hazard below. Immediate attachment of the lead sheet provides stability for the entire bundle.

36. D — OSHA 1926.755(a)(1) requires that a minimum of four anchor bolts be engaged to the column baseplate before the crane may release any column. Four bolts at the corners of a rectangular bolt pattern provide restraint against column rotation in both principal planes. OSHA 1926.755(a)(1) specifies a minimum of four anchor bolts fully engaged.

37. C — Each side of the splice has 3 rows x 4 bolts = 12 bolts. With splice plates on both sides of the web (double shear connection), total bolts = 2 sides x 12 = 24 bolts. Each bolt passes through the web and both splice plates — two shear planes per bolt. Total.

38. A — OSHA 1926.753(e)(1) prohibits ironworkers from working in areas where they could be struck by a falling load or where a falling load could reach them. The general rule prohibits ironworkers from being under suspended loads. Exceptions exist for connectors who must pass under loads to make connections — specific OSHA provisions govern these situations with additional safety requirements.

39. B — Non-shrink grout must reach adequate compressive strength before anchor bolt tightening applies load to it. Tightening bolts on partially cured grout can crush the grout before it has developed sufficient bearing strength, potentially cracking the grout pad and producing an improperly supported baseplate. Tightening anchor bolts on partially cured grout can crush the.

40. B — Volume = 0.5 x 24 x 60 = 720 cubic inches. Weight = 720 x 0.2833 = 204 lb. Option A (186) uses 0.258 lb/in³; C (220) uses 0.306 lb/in³; D (240) uses 0.333 lb/in³. Steel's standard weight density is 0.2833 lb/in³ (490 lb/ft³ converted). Steel density = 0.2833 lb/in³. Volume = 0.5.

41. D — Proceeding too many tiers ahead of the plumbing and bolting crew means the lower tiers remain in a temporary guyed-but-not-permanently-bolted condition for an extended period. Unbolted steel framing resists lateral loads only through temporary guys and friction in connections — this is more hazardous than a fully bolted and plumbed structure.

42. A — Number of sheets = floor length / sheet width = 90 ft / 3 ft = 30 sheets. Option B (36) would use 2.5-ft-wide sheets; C (24) uses 3.75-ft-wide; D (45) uses 2-ft-wide. Standard deck sheets are always 36 inches (3 ft) wide. Standard deck sheets are always 36 inches (3 ft) wide.

43. B — Structural steel columns shorten elastically under the accumulated gravity loads from each floor above. A first-floor column carries the full building load while a top-floor column carries only roof loads — the first-floor column shortens more. Differential elastic shortening must be accounted for in connection design and in coordinating the structural frame with concrete cores or architectural cladding systems.

44. C — OSHA 29 CFR 1926.760 (Subpart R) establishes 15 feet as the fall protection trigger height for structural steel erection activities specifically, recognizing that connectors and other ironworkers must work in challenging positions where conventional fall protection is more difficult to provide. The 15-foot threshold applies specifically to Subpart R steel erection. Other construction.

45. C — Fitting up is the assembly of truss members into their final geometry in a temporary condition before any permanent bolts are installed. During fit-up, drift pins are used to bring bolt holes into alignment while temporary bolts are inserted to hold the assembly. Fitting up verifies that all fabricated members assemble correctly at.

46. B — A W24x55 designation means the beam weighs 55 pounds per linear foot. Total weight = 55 x 35 = 1,925 lb. Option A (1,760) uses 50.3 lb/ft; C (2,090) uses 59.7 lb/ft; D (2,200) uses 62.9 lb/ft. Option A (1,760) uses 50.3 lb/ft; C (2,090) uses 59.7 lb/ft; D (2,200) uses 62.9 lb/ft.

47. D — Area = length x width = 36 x 18 = 648 square inches. Option A (432) is 24 x 18; B (540) is 30 x 18; C (594) is 33 x 18. Rectangle area calculations are used for plate take-off (estimating steel weight), checking connection plate area for bearing calculations, and determining concrete form areas.

48. A — 0.375 inches = 3/8 inch. To convert: 0.375 = 375/1000 = 3/8 when simplified (375 / 125 = 3; 1000 / 125 = 8). Option B (1/4) = 0.250; C (5/16) = 0.3125; D (7/16) = 0.4375. Converting between decimal and fractional dimensions is performed daily when mixing field measurements with drawing dimensions in fractional format.

49. A — Volume = 0.75 x 12 x 12 = 108 cubic inches. Weight = 108 x 0.2833 = 30.6 lb ≈ 31 lb. Option B (36) uses 0.333 lb/in³; C (42) uses 0.389 lb/in³; D (48) uses 0.444 lb/in³. Steel weighs 0.2833 lb per cubic inch. Gusset plate weight is calculated for crane pick.

50. B — A W14x48 designation means the beam weighs 48 pounds per linear foot. Total weight = 48 x 24 = 1,152 lb. Option A (984) uses 41 lb/ft; C (1,296) uses 54 lb/ft; D (1,440) uses 60 lb/ft. The x-number always provides the weight in pounds per linear foot for any W-shape.

51. D — 7-3/8 + 2-5/8 = (7+2) + (3/8 + 5/8) = 9 + 8/8 = 9 + 1 = 10 inches. The fractions sum to 8/8 = 1 whole inch carried to the whole number. Option A (9) ignores the fraction sum; B (9-3/4) and C (9-1/2) are incorrect. Option A (9) ignores the.

52. C — Percent installed = (18 / 24) x 100 = 75 percent. Option A (60%) = 14.4 installed; B (66%) = 15.8 installed; D (80%) = 19.2 installed. Bolt installation progress is tracked to identify connections ready for final tensioning, verify minimum bolt counts before the erection crew advances, and report accurate progress for billing milestones on structural steel projects.

53. B — A W8x31 designation means 31 pounds per linear foot. Total weight = 31 x 16 = 496 lb. Option A (448) uses 28 lb/ft; C (560) uses 35 lb/ft; D (592) uses 37 lb/ft. The x-number in any W-shape designation directly gives weight per foot, making total member weight a straightforward multiplication by length in feet with no conversion required.

54. A — Area = pi x r^2 = 3.1416 x 10^2 = 314.16 ≈ 314 sq in. Option B (380) uses r = 11; C (452) uses r = 12; D (628) uses the diameter (20) directly instead of the radius (10). Using the diameter directly without halving to radius first doubles the calculated area.

55. D — Weight = volume x unit weight = (5 x 5 x 2) x 150 = 50 cu ft x 150 lb/cu ft = 7,500 lb. Option A (5,000) uses only the plan area without depth; B (6,000) = 5x4x2x150; C (6,500) is incorrect. Normal-weight concrete weighs 150 lb/ft^3. Normal-weight concrete is 150 lb/ft^3.

56. C — Chain length = column perimeter + overlap = (4 x 12) + 6 = 48 + 6 = 54 inches. The perimeter of a 12-inch square column is 4 x 12 = 48 inches. Adding 6 inches for the hook connection gives 54 inches minimum. The entire chain must encircle the member to.

57. D — A W12x26 designation means 26 pounds per linear foot. Total weight = 26 x 20 = 520 lb. Option A (416) uses 20.8 lb/ft; B (468) uses 23.4 lb/ft; C (494) uses 24.7 lb/ft. The x-number provides the weight per foot for any W-shape directly. Option A (416) uses 20.8 lb/ft; B (468).

58. C — A double-V groove has two half-depth V preparations, one from each side. The combined weld volume is approximately half that of a single-V of the same plate thickness, because the cross-sectional area of two half-depth V's is much less than one full-depth V. Double-V also distributes heat more evenly through the plate than.

59. B — E6010's cellulosic coating produces a fast-freeze slag that solidifies almost immediately, allowing all-position welding without the puddle sagging in vertical or overhead positions. The high-hydrogen arc also produces a deep-penetrating, forceful jet that cuts through rust and mill scale. E6010 electrodes must be stored at room temperature, unlike E7018 which requires rod ovens.

60. D — Propane's maximum flame temperature (approximately 3,600°F) is lower than acetylene's (approximately 5,620°F), requiring longer preheat to bring steel to its cutting ignition temperature. Once the exothermic iron-oxygen reaction begins, cutting proceeds similarly with both fuels. Propane is safer to store, widely available, less expensive per BTU, and commonly used where the additional preheat time is acceptable.

61. B — Hydrogen from electrode coatings dissolves into the hot weld pool and diffuses into the heat-affected zone under residual tensile stress. In thick, restrained connections, rapid cooling without preheat traps hydrogen at high local concentration. Hydrogen-induced cracking in thick restrained structural connections can appear hours or days after welding — preheat is the primary prevention measure.

62. D — Excess welding current generates a wider, hotter arc that melts away the base metal at the weld toe faster than the weld deposit can fill the resulting groove. The weld pool bridges the melted notch as it solidifies, leaving an unfilled groove (undercut) at the toe. Reducing current and slowing travel speed allows.

63. A — AWS D1.1 Section 9.6.1.1 requires fillet welds to meet or exceed the specified leg size at every point — zero undersize tolerance. This ensures the full design shear and moment capacity is available at every cross-section of the weld. Zero undersize tolerance ensures the full design capacity at every cross-section. Minor undersizing is.

64. C — Fillet weld throat = 0.707 x leg size = 0.707 x 5/8 = 0.707 x 0.625 = 0.442 in. Option A (0.265) is the throat of a 3/8-inch leg; B (0.354) is the throat of a 1/2-inch leg; D (0.530) is the throat of a 3/4-inch leg. Option A (0.265) is the throat.

65. D — OSHA 1910.252(c)(1) and 1926.353 require mechanical ventilation or supplied-air respirators when welding in spaces with less than 10,000 cubic feet per welder, when natural air circulation is restricted, or when welding base metals with coatings (paint, galvanizing, lead primer) that produce toxic fumes. Mechanical ventilation must be used any time welding occurs in.

66. A — OSHA 1926.350(a)(11) and NFPA 51 require oxygen and fuel gas cylinders stored within 20 feet of each other to be separated by a non-combustible barrier at least 5 feet high with a 30-minute fire rating. The 5-foot-high non-combustible barrier with 30-minute fire rating prevents fire in the fuel gas area from propagating to the oxygen cylinder storage area.

67. C — In DCEP (DC Electrode Positive), electrons flow from the workpiece to the electrode tip, depositing more arc energy at the electrode. More energy at the electrode means the electrode melts off more slowly (lower melt-off rate) while deeper penetration occurs into the base metal because the arc column provides concentrated heat to the work surface.

68. B — Pre-loading guy wires pushes the column top slightly away from plumb before erection loads are applied. When subsequent tier weights compress the column, the column settles toward plumb, compensating for predictable load-induced gravity effects during the erection sequence. This technique is used when erection analysis predicts the column will lean toward the load side under dead load.

69. C — A digital level placed directly on the column face gives an immediate angular readout without requiring the ironworker to align with a distant instrument, establish a sight line, or coordinate between two workers. Multiple readings can be taken quickly at different heights on the same column face without repositioning any equipment.

70. C — A stringline sags under its own weight in a catenary curve, and the sag increases with the square of the span. At spans above 50-60 feet, sag can exceed plumb tolerances even when the string is

highly tensioned. Additionally, any lateral air movement pushes the string sideways, making the midpoint position unreliable.

71. D — HI = benchmark elevation + backsight = 212.50 + 4.10 = 216.60 ft. New point elevation = HI - foresight = 216.60 - 6.25 = 210.35 ft. Option A (208.90) subtracts both readings from the benchmark; B (209.65) uses an incorrect HI. Backsight is always added to the known elevation; foresight is always.

72. B — Maximum horizontal distance = height / tan(angle) = 24 / tan(30°) = 24 / 0.5774 = 41.6 ft. At exactly 30 degrees from horizontal, the horizontal distance equals the column height divided by the tangent of 30 degrees. Option A (24) is the column height; C (48) doubles the height; D (55.4) uses tan(23°).

73. A — The transit line is 5 feet north of the column centerline. The column centerline is at the mid-width of the flange. For a W14 with 14.5-inch flange: half-flange = 7.25 inches = 0.604 ft. South face = centerline - half-flange = 5.000 ft - 0.604 ft... From the transit line (5 ft north.

74. B — An optical plumb instrument must be precisely leveled because the instrument rotates around a vertical axis established by its leveling mechanism. If the instrument axis is not truly vertical, the plumb beam does not project vertically — it projects along the tilted instrument axis. At 100 feet of transfer height, even a 0.1-degree.

75. D — Guy wire length = $\sqrt{(\text{height}^2 + \text{horizontal distance}^2)} = \sqrt{(30^2 + 50^2)} = \sqrt{(900 + 2500)} = \sqrt{3400} =$ 58.3 ft. This is the Pythagorean theorem applied to the right triangle formed by the column height (vertical leg), horizontal anchor distance (horizontal leg), and the guy wire (hypotenuse). Option A (45), B (50).

76. B — AISC Code of Standard Practice Table 7.13.1.1 specifies column plumb tolerance as 1/500 of the story height for any individual column story. A 3/8-inch deviation is acceptable for story heights above 15.6 feet (1/500 x 156 in = 0.31 in... wait: 0.375 x 500 = 187.5 in = 15.6 ft story height threshold).

77. B — The tail of a welding symbol can reference the applicable Welding Procedure Specification (WPS) by number. 'WPS-101' instructs the welder to use Welding Procedure Specification 101, which documents the approved welding parameters (process, current, travel speed, preheat, interpass temperature, and other essential variables) for that joint type and base material.

78. C — A shear tab is a plate welded to the column web, with the beam web bolted to the plate in the field. Load transfers from the beam web through the bolts to the tab plate and into the column web. Shear tab load path: beam web → bolts → tab plate → column.

79. A — Match lines appear where a building plan or structure is too large to fit on a single drawing sheet. The match line marks the edge of what is shown on one sheet, with a note indicating the adjacent sheet number where the structure continues. Members crossing a match line must have their full.

80. B — U.N.O. stands for 'Unless Noted Otherwise' — a shorthand indicating that the specified dimension, detail, connection type, or material applies at all similar locations on the drawing except where a different condition is explicitly shown. Rather than noting exceptions at every location, the engineer uses U.N.O. to establish a governing default.

81. C — 'B-14 (TYP. BAY 1-5)' indicates that beam B-14 and its associated connection details are typical (identical) in bays 1 through 5. Rather than annotating each of the five bay beams separately, the engineer labels one and marks it as typical for the range. Missing a typical callout results in inconsistent installations — not.

82. D — 'For Construction' is the drawing release status indicating the engineer has approved the drawing for use in actual field work. Before this status, drawings may be 'Preliminary,' 'For Review,' or 'Issued for Comment' — none of which authorize construction. The ironworker may proceed from a 'For Construction' drawing unless a subsequent revision is issued. Later revisions (Rev.

83. B — As-built drawings document what was actually constructed, recording field deviations from the design drawings made during construction. Typical additions include field-measured column plumb deviations, field-cut member dimensions, added connection plates or braces, and all field change orders that altered the design. As-built drawings are required by most contracts for owner handover and are.

84. A — Bar joist camber is a built-in upward bow that the SJI manufacturer introduces during fabrication. When the dead load of the concrete slab and deck is applied, the joist deflects downward by approximately the camber amount, leaving the joist near its level design position. Without camber, dead load deflection creates permanent sag that.

85. D — OSHA 1926.757(c)(1) and SJI erection requirements mandate that longspan bar joists have temporary erection bridging installed before the crane releases the joist. Longspan joists (over 60 feet) are more slender and laterally flexible than short-span joists and cannot maintain lateral stability under their own weight without bridging. Longspan joists cannot maintain lateral stability.

86. C — Composite bar joists require mechanical shear connectors to transfer horizontal shear between the concrete slab and the joist top chord. Without shear connectors, the two elements cannot develop composite action — the concrete and steel carry load independently at lower combined capacity. Shear connectors are typically factory-welded nails or site-welded headed studs through the deck.

87. A — LH-series (Longspan H-series) bar joists have nominal depths from 18 to 48 inches, designed for spans from approximately 25 to 96 feet. The LH designation indicates the H-configuration with longspan capability above the K-series range. K-series spans up to approximately 60 feet at lesser depths. LH-series depth range (18–48 inches) bridges K-series at.

88. B — In the joist girder designation '40G8N11.2K': '40' is the depth in inches, 'G' identifies it as a joist girder, '8' is the number of joist spaces (panel points), 'N' indicates standard (non-extended) bearing seats, and '11.2K' is the factored load per joist in kips at each panel point. The 'N' designation indicates standard-height.

89. B — ASTM F3125 is the umbrella standard for structural bolts that replaced the individual A325 and A490 standards. Within F3125, the original grade designations are retained as sub-grades: F3125 Grade A325 (for the familiar medium-strength hex bolt) and F3125 Grade A490 (for the higher-strength bolt). F3125 consolidates A325, A490, F1852, and F2280 into one.

90. C — AISC Specification Table J3.3 requires hardened washers under the turned element during turn-of-nut installation when the connected material is Grade 100 or 105 (F36 or higher), when the connected part thickness is less than the bolt shank diameter, or for all A490 bolts. The hardened washer prevents the nut or bolt head from.

91. D — AISC Specification J3.6 and RCSC permit bolts in standard-hole bearing-type connections (designated Type N or Type X) to be installed at snug-tight condition when the engineer of record approves this condition in the design documents. Snug-tight is sufficient to ensure bolt heads and nuts are in firm contact with the connected plies, transferring shear by bearing.

92. A — AISC Table J3.1 specifies nut rotation from snug-tight for A325 bolts in standard holes based on bolt length. For bolts with a length-to-diameter ratio greater than 8 (long bolts), the required nut rotation is one full turn (360 degrees) from snug-tight. Long bolts (L/D > 8) require one full turn (360°) from snug-tight.

93. C — Pneumatic grinders use a rotary vane air motor that maintains relatively constant torque as the load varies because the air supply continues to push the vanes regardless of cutting resistance. Electric grinders slow down under heavy cutting resistance, dropping below their rated RPM. The pneumatic tool's consistent speed under load produces more predictable.

94. B — A bent drift pin no longer has the straight, uniformly tapered profile needed to align bolt holes — the bent body pushes holes in unpredictable directions rather than drawing them into coaxial alignment. A bent pin no longer provides straight tapered alignment geometry and must be replaced immediately to prevent fragments from being ejected toward nearby workers.

95. B — Oxyfuel torch tip orifices must be cleaned with a calibrated tip cleaner rod of the correct diameter for each orifice. The rod is inserted straight and withdrawn without twisting or rotating, which would enlarge or distort the precision-machined orifice. A clean, undistorted orifice is essential for a properly shaped preheat flame and cutting oxygen jet.

96. D — A chain fall uses a hand-chain wheel and a load chain in a continuous loop, allowing the operator to pull the hand chain in one direction for raising and the other direction for lowering — no change of action is needed during sustained lifting. Come-alongs require reversing the lever action to lower —.

97. B — The ceramic ferrule around the stud base during welding serves three simultaneous functions: it constrains the molten flash to form a consistent circular fillet at the stud base rather than allowing the metal to spray outward; it shields the arc from atmospheric contamination during the brief welding cycle; and it provides a refractory surface that shapes the weld puddle.

98. B — Cellular deck creates a closed air space between the upper fluted deck and the lower flat plate. This enclosed raceway serves as an HVAC distribution duct for conditioned air delivered through slots in the upper plate and as a protected chase for electrical conduit and communication cables. Cellular deck's enclosed air cell adds.

99. B — Diaphragm shear from wind and seismic loads enters the floor deck from the entire bay area and must be funneled to the boundary members (beams, collector elements, drag struts) at the perimeter. This means the perimeter fasteners must transfer the accumulated shear from potentially the entire floor area, while field fasteners transfer only local tributary shear.

100. D — AWS D1.1 Section 7.8.4 requires the weld flash (stud base fillet) to be present for a full 360-degree perimeter and meet minimum leg size criteria. A complete 360-degree fillet confirms adequate fusion around the entire stud base. A gap in the weld flash indicates insufficient heat or contamination at that location. AWS D1.1.