PRACTICE EXAM 3: RED SEAL WELDER SIMULATION (125 QUESTIONS)

1. A fabricator measures manganese fume concentrations at the operator's breathing zone and finds they consistently exceed the OEL even after the local exhaust ventilation has been upgraded to its maximum feasible capacity. Which corrective action ranks highest in the hierarchy of controls above administrative and PPE solutions?

A. Rotate welders through the task on a timed schedule so no individual accumulates a full-shift fume exposure

B. Issue supplied-air respirators to all workers in the area for continuous use during all welding operations

C. Substitute the high-manganese electrodes with a lower-manganese filler metal formulation that produces less fume at the source

D. Install continuous real-time fume monitoring and audible alerts to warn workers when concentrations rise

2. Under WHMIS 2015 legislation, which of the following is specifically an employer obligation that cannot be fulfilled by the supplier or manufacturer?

A. Providing an SDS meeting all WHMIS 2015 classification and content requirements for every classified hazardous product

B. Providing workplace-specific training to workers on the hazardous products to which they may be exposed before that exposure occurs

C. Applying a WHMIS 2015-compliant supplier label to the original product container at the time of sale or importation

D. Reviewing and updating the SDS at least every three years or whenever significant new hazard information becomes available

3. A welder needs to access a vessel connection 4.8 metres above ground level using a straight extension ladder. The wall below is plumb and the ground is level. What is the maximum distance the base of the ladder may be placed from the wall to comply with the 4:1 angle rule?

A. 1.2 metres — one-quarter of the 4.8-metre working height per the 4:1 ladder placement rule

B. 2.4 metres — applying a 2:1 safety factor correction to the standard 4:1 calculation

C. 0.9 metres — because the 4:1 ratio is reversed when the working height exceeds 4 metres

D. 1.6 metres — calculated using a hypotenuse adjustment for a ladder positioned on a hard surface

4. Three single-leg wire rope slings are rigged vertically from three equal attachment points on an assembly weighing 3,600 kg. Each sling is at 0 degrees from vertical. What minimum SWL must each individual sling be rated to support?

A. 3,600 kg per sling, to ensure any single leg can carry the full load if another sling were to fail

B. 900 kg per sling, applying a standard 4:1 safety factor to the calculated 1,200 kg load per leg

C. 2,400 kg per sling, providing a 2:1 design margin above the calculated load at each attachment

D. 1,200 kg per sling, calculated as 3,600 kg total load divided equally among three vertical legs

5. A hot work permit specifies a 30-minute fire watch after all welding ends. The last weld is completed at 3:15 PM and the fire watch begins. At 3:28 PM, the welder resumes welding 18 metres away in the same fire zone. What does this require of the fire watch?

A. Continue normally — the 30-minute timer is unaffected by new welding that starts more than 15 metres from the original location

B. A second independent fire watch must be established at the new welding location while the original continues

C. The 30-minute fire watch timer must be reset from the new welding resumption time since active hot work continues in the zone

D. The fire watch ends since resuming welding before the 30-minute period expires cancels the original permit

6. A fabricated cylindrical vessel is 1.5 metres in diameter and 5 metres long with 400 mm diameter access ports at each end. Entry is required for internal cleaning. Under Canadian OHS legislation, this vessel is classified as a confined space because:

A. It previously contained substances classified as hazardous under WHMIS 2015 regulations

B. It is large enough for worker entry, has limited means of entry and exit, and was not designed for continuous worker occupancy

C. The internal atmosphere cannot be confirmed as safe without atmospheric testing prior to every entry attempt

D. Any enclosed vessel requiring an entry permit under the project's safety plan qualifies automatically as a confined space

7. A welder collapses in a poorly ventilated welding area. A first responder retrieves the SDS for the electrode in use to identify what exposures may have caused the collapse. Which SDS section contains the most complete information about acute health effects and symptoms of overexposure from inhalation?

A. Section 2 — Hazard Identification, which lists the hazard classifications, signal words, and GHS pictograms

B. Section 8 — Exposure Controls and PPE, which specifies the OEL threshold values for each listed component

C. Section 15 — Regulatory Information, which identifies substances governed by exposure limit regulations

D. Section 11 — Toxicological Information, which describes specific health effects by route and type of exposure

8. A welder is performing SMAW in a damp confined vessel. The power source OCV reads 75 VDC. Compared to the same work in a dry outdoor environment, what is the primary reason this environment presents a significantly elevated electrocution risk?

A. Moisture dramatically reduces skin electrical resistance — from approximately 10,000 ohms dry to under 1,000 ohms wet — allowing a potentially lethal current at 75 VDC

B. The confined steel walls reflect the OCV back to the electrode, effectively doubling the voltage at the point of skin contact

C. Damp steel surfaces increase the arc voltage by reducing the resistivity of the work lead ground return circuit

D. Limited exit pathways mean a shocked worker cannot release themselves from the contact point and is exposed longer

9. A hot work permit is issued for structural welding inside a building. The permit defines a 10-metre fire watch radius around the weld location. A flammable storage cabinet is 12 metres from the work. What specific risk does the boundary leaving the cabinet uncovered create?

A. An over-complex permit documentation burden that makes the boundary impractical for the fire watch attendant to patrol

B. The 10-metre radius is the code-specified maximum and the cabinet at 12 metres is automatically exempt from coverage

C. Spatter, embers, or radiant heat could reach the flammable cabinet from the weld location without any fire watch coverage at that zone

D. The cabinet must be physically relocated outside the hot work zone before the permit can be considered valid

10. A welder selects an angle grinder and a 125 mm cut-off wheel from the tool crib. Before beginning work, what is the correct pre-use inspection sequence?

A. Mount the wheel, run at full speed for 30 seconds, then inspect the spinning wheel for wobble before beginning

B. Inspect the guard for damage and correct position, verify the grinder's rated RPM meets or exceeds the wheel's minimum requirement, then perform the ring test on the wheel before mounting

C. Visually inspect the wheel face for cracks, mount it, and proceed — RPM compatibility is the manufacturer's responsibility

D. Verify the grinder RPM, mount the wheel, run it at half-speed against a scrap piece to confirm correct performance

11. During a pre-use inspection of a Grade 80 chain sling with a nominal link cross-section of 10 mm, wear has reduced one link to 8.0 mm at the narrowest measured point. CSA standards require removal when wear reduces the cross-section by more than 10%. What is the correct action?

A. Continue using the sling at a de-rated load of 80% of its original SWL to account for the reduced section

B. Use the sling for one additional lift only, provided the applied load does not exceed 70% of the rated capacity

C. Accept the sling — 8.0 mm remains the large majority of the 10 mm nominal and is within accepted manufacturing tolerance

D. Remove the sling from service immediately — the 20% reduction in cross-section far exceeds the 10% maximum removal criterion

12. A welder must manually lift a 22 kg steel plate from a floor-level skid to a waist-height work table. Which technique correctly describes all key components of a safe manual lift for this operation?

A. Position feet shoulder-width apart close to the load, bend at the knees and hips while keeping the spine neutral, grip the plate firmly, and drive upward using leg muscles throughout the lift

B. Stand as close as possible, lean forward bending at the waist to grip the plate, then straighten the upper body using back extension once the grip is secure

C. Use one hand on each long edge at the plate's balance point, then swing the plate upward using upper-body momentum to achieve the required height

D. Tip the plate to its short edge first, walk it upright on the corner across the floor to the table, then lay it flat on the work surface

13. A welder is directed to enter a confined vessel. The atmospheric testing sheet shows 21.1% oxygen and 0 ppm CO but records no flammable gas test result. The vessel previously stored solvent-based paint. Under which OHS provision does the welder have grounds to decline entry?

A. The right to participate — the welder should formally raise this concern at the next joint health and safety committee meeting

B. The right to information — the welder can demand that management provide the complete atmospheric test documentation

C. The right to refuse dangerous work — the absence of flammable gas testing in a prior solvent-storage vessel provides a specific, reasonable basis for believing entry is dangerous

D. The duty to comply — since oxygen and CO are within acceptable limits, the available test results authorize entry

14. A welder who recently grew a full beard is using the same tight-fitting half-face respirator worn before the beard developed. During welding, the welder notices a fume odour inside the facepiece. What is the primary cause?

A. The filter cartridges have reached the end of their service life and require immediate replacement

B. Facial hair prevents the facepiece from forming a complete seal against the skin, allowing unfiltered air to bypass the filter medium through the gap

C. The fume concentration has exceeded the respirator's rated protection factor and a higher-grade device is required

D. The respirator was not sealed prior to entering the work area, meaning it was never providing adequate protection

15. A 3-piece 45-degree pipe elbow is being fabricated. Using the standard miter formula, what is the cut angle at each of the two cuts?

A. 22.5 degrees — applying the formula used for a 3-piece 90-degree elbow directly to this assembly

B. 15.0 degrees — calculated as the total angle divided by the number of pieces in the assembly

C. 11.25 degrees — the standard cut angle for all 3-piece elbow configurations regardless of total angle

D. 11.25 degrees — calculated as 45° ÷ (2 × 2 cuts) = 11.25° for a 3-piece, 2-cut configuration

16. A WHMIS 2015 supplier label on an argon shielding gas cylinder shows the compressed gas cylinder pictogram. Beyond identifying the contents as pressurized, what specific dual hazard does this pictogram communicate?

A. The cylinder may explode if heated or become a dangerous projectile if the valve is sheared or damaged

B. The gas is an asphyxiant that displaces oxygen and produces toxic decomposition products when heated

C. The gas is flammable under pressure and requires 6-metre separation from all ignition sources in storage

D. The cylinder contains cryogenic liquid that causes cold burns and requires insulated handling equipment

17. A second-period apprentice consistently produces incomplete root fusion at arc starts on SMAW pipe welds and asks the journeyperson for an explanation. What does the Red Seal Occupational Standard identify as the journeyperson's mentoring responsibility in this situation?

A. Direct the apprentice to re-read the WPS for the minimum preheat parameters applicable to this pipe material

B. Explain the connection between cold base metal at the arc start, preheat distribution, and the specific arc-start technique that prevents cold-start incomplete fusion

C. Assign the apprentice to grind all defective root starts and supervise the rework without providing further technical explanation

D. Report the quality concern to the site supervisor and recommend reassigning the apprentice to tack welding until proficiency improves

18. A vernier caliper is used to measure a component immediately after it is removed from a preheating oven at 150°C. The caliper is then placed directly in its storage case. What is wrong with this procedure?

A. The hot component may have transferred scale to the measuring faces, requiring a cleaning step before storage

B. The zero reading must be rechecked immediately on a standard gauge block before the thermal drift stabilizes

C. The caliper must be allowed to return to room temperature before zero verification and storage — thermal expansion from the hot component contact shifts the instrument's calibration

D. Vernier calipers must never contact heated components since the scale engravings permanently expand under thermal stress

19. A GTAW welder finishes work inside a large fabricated box section and discovers the argon post-flow timer was set to run continuously rather than for a defined duration. Argon has been flowing into the enclosed section for approximately 25 minutes at 8 L/min. What is the specific hazard and the required action?

A. Argon has created an oxygen-enriched atmosphere in the box — ventilate and confirm no combustibles are present before re-entry

B. Trace ozone from the HF start unit has accumulated to potentially harmful levels — ventilate before re-entry

C. Argon is flammable at the concentrations achieved over 25 minutes — eliminate all ignition sources before entering

D. Argon has displaced oxygen in the enclosed section by physical displacement, creating an oxygen-deficient asphyxiation hazard — ventilate and test before re-entry

20. A pipe must be offset using 45-degree fittings, rising 250 mm vertically and moving 250 mm horizontally. What is the travel length of the diagonal section connecting the two straight runs?

A. 500 mm — calculated as true offset $\sqrt{(250^2 + 250^2)} = 353.6$ mm multiplied by the 45-degree travel factor of 1.414

B. 353.6 mm — the true offset by the Pythagorean theorem, which gives the travel length directly without further calculation

C. 250 mm — since both components are equal, they cancel and the travel equals a single offset component

D. 707 mm — calculated by summing the two offset components and multiplying by the 45-degree fitting factor

21. An engineering drawing specifies a shaft diameter of 50 +0.00/-0.25 mm. What are the minimum and maximum acceptable dimensions for this feature?

A. Minimum 49.75 mm and maximum 50.25 mm — applying the 0.25 mm tolerance symmetrically to both sides

B. Minimum 49.75 mm and maximum 50.00 mm — the tolerance allows only reduction from the nominal dimension

C. Minimum 50.00 mm and maximum 50.25 mm — the tolerance allows only increase from the nominal dimension

D. Minimum 49.50 mm and maximum 50.00 mm — the 0.25 mm tolerance is doubled for the bilateral range

22. A welding symbol shows: below the reference line — a V-groove symbol with "45" written outside the groove and "3" written inside; above the reference line — a partial semicircle opening away from the reference line; and "PWHT" written in the tail. What does the complete symbol specify?

A. A 45-degree groove on the arrow side with a 3 mm root face, a backing bar on the other side, and PWHT required

B. A 45-degree groove with a 3 mm root opening on both sides and a PWHT holding time of 3 hours specified in the tail

C. A 45-degree V-groove weld on the arrow side with a 3 mm root opening, a back weld pass deposited on the other side after the groove weld is complete, and PWHT required on the finished joint

D. A double-sided 45-degree groove with 3 mm root opening and both sides requiring back welds before PWHT

23. A PJP groove weld is specified with 14 mm depth on 20 mm plate, leaving a planned unfused root of 6 mm. Under CSA W59, which specific structural limitation governs where this joint may be used?

A. PJP welds are prohibited entirely on primary structural members in buildings under CSA W59

B. PJP welds are restricted to secondary members where gravity loads govern and cyclic stresses do not exceed 30% of yield strength

C. PJP welds require volumetric NDT since the root notch acts as a crack initiation site if any fusion defects are present in the root zone

D. PJP welds are restricted from joints subject to cyclic tensile loading perpendicular to the weld axis where the unfused root notch acts as a fatigue crack initiation site

24. A 4-piece 45-degree pipe elbow is being laid out for fabrication. Using the formula cut angle = total angle ÷ (2 × number of cuts), what is the miter cut angle at each of the three cuts?

A. 7.5 degrees — calculated as 45° ÷ (2 × 3 cuts) = 7.5° for three cuts in a 4-piece elbow

B. 11.25 degrees — the standard angle for all 4-piece elbow configurations regardless of total angle

C. 15.0 degrees — calculated as the total angle divided by the number of pieces in the assembly

D. 22.5 degrees — applied from the 2-piece 90-degree formula adjusted for the reduced total bend angle

25. A groove weld radiograph on 16 mm structural plate reveals a single spherical porosity indication measuring 3 mm in diameter. AWS D1.1 limits individual pore size to the lesser of 3/32 inch (2.4 mm) or t/4. What is the correct disposition?

A. Accept — the pore is circular and at 3 mm is within the commonly applied 6 mm maximum for volumetric defects

B. Reject — the pore measures 3 mm, exceeding the 2.4 mm governing limit (the lesser of 2.4 mm vs. t/4 = 4 mm)

C. Accept — the pore at 3 mm is below t/4 = 4 mm, which is the governing AWS D1.1 acceptance criterion for this thickness

D. Refer for engineering assessment — this pore size falls in the indeterminate zone requiring fitness-for-service analysis

26. A structural joint requires welding CSA G40.21 Grade 690W plate with a carbon equivalent of 0.68% at 50 mm thickness. The ambient temperature is 12°C. Which preheat temperature most likely applies?

A. No preheat required — Grade 690W is designed with sufficient ductility that it is immune to HAZ cold cracking

B. 50°C minimum preheat — high-strength steel requires only a modestly elevated starting temperature for this CE value

C. 100°C minimum preheat — a CE of 0.68% falls in the intermediate weldability range requiring moderate preheat

D. 175°C or higher minimum preheat — CE 0.68% combined with 50 mm thickness and quenched-and-tempered steel creates severe cold cracking risk

27. A welder is handed a drawing for a structural component. The drawing in the job package shows Revision D in the title block, but the revision history confirms Revision E changed a critical nozzle diameter from 100 mm to 150 mm. What is the correct action?

A. Proceed with Revision D since it is the drawing physically present in the job package and has been officially issued

B. Contact the engineer verbally to confirm Revision D and Revision E are functionally equivalent before beginning work

C. Stop fabrication and obtain Revision E from document control before performing any work on the component

D. Fabricate from Revision D and document the discrepancy in the quality records for resolution after completion

28. A procedure qualification weld for pressure vessel service at -50°C undergoes Charpy V-notch impact testing at -50°C. Results are 48 J, 52 J, and 44 J (average 48 J) against a code minimum of 27 J average. What does this result confirm?

A. The procedure produces weld metal and HAZ microstructures with sufficient toughness to resist brittle fracture initiation at the specified -50°C service temperature

B. The weld metal tensile strength exceeds the minimum classification since Charpy values are proportional to tensile performance

C. The procedure is qualified for all carbon steel base metals in the same P-number group regardless of individual impact requirements

D. The heat input used during qualification is the minimum for the procedure since lower heat input always produces the highest Charpy values

29. A fabricator is comparing two distortion control strategies for a long butt weld on thin structural plate: (1) rigid clamps preventing all movement, and (2) presetting the joint 3 degrees away from the expected shrinkage direction before welding. Which statement correctly identifies the trade-off?

A. Rigid clamping is always preferred since it eliminates visible distortion entirely and residual stress is a secondary concern

B. Presetting allows thermal contraction to bring the joint to the correct position naturally, with lower residual stress than rigid restraint

C. Presetting is impractical because thermal contraction is too variable to predict and always produces over- or under-correction

D. Rigid clamping produces lower residual stress than presetting since the constraint reduces the thermal strain cycle during cooling

30. A thick-section pressure vessel shell weld in 75 mm plate is suspected to contain incomplete fusion defects oriented parallel to the weld axis fusion line. Which NDT approach provides the best detection capability?

A. Radiographic testing alone — RT provides a permanent plan-view image of all internal discontinuities regardless of defect orientation

B. Magnetic particle testing at multiple yoke orientations — MT detects subsurface fusion-line defects to the required depth in thick sections

C. Ultrasonic testing using multiple beam angles, with transverse scans directing the beam perpendicular to the suspected planar defect orientation

D. Visual inspection followed by liquid penetrant testing — incomplete fusion breaks the weld surface and is accessible by surface NDT methods

31. A welding symbol shows a semicircle opening away from the reference line, positioned above the reference line on the same side as a groove weld symbol below. What sequence of operations does this specify?

A. A back weld — a separate weld pass deposited on the reverse side of the joint after the primary groove weld is completed from the front side

B. A backing bar — a backing strip placed against the joint root prior to welding to support the root pass pool

C. A melt-through requirement — visible root reinforcement must be present on the reverse face of the completed groove weld

D. A seal weld — a non-structural cosmetic cap pass applied to the back of the joint face to improve reverse-side appearance

32. A 19 mm thick plate butt joint is measured with a hi-lo gauge showing 2.6 mm internal misalignment. Under CSA W59, what is the governing limit and correct disposition?

A. Accept — 2.6 mm is below the absolute maximum of 3 mm permitted for structural butt joints under CSA W59

B. Accept — the 3 mm absolute limit governs for plates thicker than 12 mm; the percentage criterion applies only to thin plate

C. Accept — the 10% criterion applies only when the plate thickness exceeds 25 mm, so 3 mm governs this joint

D. Reject — the governing limit is the lesser of 3 mm or 10% of the thinner plate (1.9 mm), making the 2.6 mm measurement non-conforming

33. A cylindrical pressure vessel shell course has an inside diameter of 1,400 mm and a length of 3,000 mm. Using $\pi = 3.1416$, what is the internal volume in litres?

A. 2,199 litres — calculated using the full 1,400 mm outside diameter rather than the 700 mm inside radius

B. 4,618 litres — calculated as $\pi \times 700^2 \times 3{,}000$ mm = 4,618,152,000 mm³ ÷ 1,000,000 mm³/L

C. 9,236 litres — calculated using the full 1,400 mm diameter rather than the radius in the area formula

D. 1,539 litres — calculated as the circular cross-sectional area of the end flange multiplied by the shell length

34. Under CSA W59, the minimum fillet weld size for a lap joint between 6 mm and 18 mm plate is determined based on which thickness?

A. 6 mm — the thinner plate, since minimum size is governed by heat input requirements for the thinner member

B. 12 mm — the average of the two thicknesses, which is used for interpolation on unequal plate combinations

C. 18 mm — the thicker plate, since CSA W59 bases minimum fillet weld size on the thicker of the two connected members

D. 6 mm — the thinner plate, since structural codes always base minimum fillet size on the member requiring lowest heat input

35. A weld inspector discovers a crack at the toe of a structural fillet weld on 38 mm A572 Grade 50 plate. The crack initiates at the weld toe and propagates perpendicular to the weld axis into the HAZ. E7018 was used under high-restraint conditions. How is this crack most accurately classified?

A. A toe crack — a hydrogen-induced cold crack initiating at the stress concentration of the weld toe in the hard HAZ microstructure beneath it

B. A transverse solidification crack — a hot crack forming perpendicular to the weld axis during weld metal solidification shrinkage

C. A transverse root crack — a cold crack initiating at the fillet weld root and propagating toward the visible surface at the toe

D. A lamellar tear — a base metal failure along plate rolling laminations under through-thickness shrinkage stress

36. A CJP groove weld procedure on 30 mm A514 quenched-and-tempered plate specifies 175°C minimum preheat. The tack welds will be left in place and incorporated into the production weld. What preheat condition applies to the tack welds?

A. No preheat is required for tack welds since their small volume generates insufficient heat for a critical HAZ to develop

B. A reduced preheat of 100°C may be used since the smaller thermal cycle of a tack weld presents a lower cold cracking risk

C. Tack welds at joint ends placed on runoff tabs are exempt since they will be removed from the finished assembly

D. The same 175°C minimum preheat required for the production weld applies to all tack welds incorporated into the final joint

37. A right-side view of a welded bracket shows a solid horizontal line across the mid-section and a dashed horizontal line 30 mm below it. What does the dashed line represent in this orthographic view?

A. A surface texture requirement — the dashed line marks a ground finish required at that elevation

B. A hidden feature — an edge, hole, or geometric element that exists at that height but cannot be seen from the right-side viewing direction

C. A centre line — the geometric centre of the part at that elevation used as a layout datum reference

D. A break line — the drawing has been shortened and the dashed line marks the edge of the break

38. A liquid penetrant test on a stainless steel nozzle weld uses a Type II fluorescent penetrant with a manufacturer-specified 15-minute minimum dwell time. The inspector applies the penetrant and immediately removes excess and applies developer without waiting. What specific type of inspection error is produced?

A. False-positive indications — undwelled penetrant bleeds excessively under developer, creating indications where no defects exist

B. Procedural non-conformance only — the test is technically invalid but provides approximately 60% of normal detection sensitivity

C. False-negative results — tight cracks that require the full dwell time for capillary penetration produce no indication and appear sound when they are actually cracked

D. Chemical reaction — undwelled penetrant reacts with the developer and neutralizes both products, requiring complete removal and restart

39. A pressure vessel PWHT procedure specifies heating to 625°C with a hold time of 1 hour per 25 mm of wall thickness, with any fraction of 25 mm rounded up. The vessel shell is 62 mm thick. What is the minimum required hold time?

A. 1 hour — the code-stated minimum hold time applies regardless of actual thickness when using the specified temperature

B. 2 hours — rounded to the nearest whole hour for 62 mm at the rate of 1 hour per 25 mm

C. 2 hours and 24 minutes — the precise calculated hold time of 62/25 = 2.48 hours applied directly

D. 3 hours — 62 mm contains 3 full or partial 25 mm intervals (0-25, 26-50, 51-62), each requiring 1 hour

40. A visual inspection of a structural fillet weld transverse to the primary tensile stress reveals undercut measuring 0.7 mm depth at the weld toe. What is the correct disposition under CSA W59?

A. Accept — CSA W59 permits undercut up to 1.0 mm depth on fillet welds in most structural loading configurations

B. Reject — any undercut at weld toes transverse to tensile loading is prohibited by CSA W59 regardless of depth

C. Accept with notation — 0.7 mm is conditionally permitted when the base metal thickness is less than 25 mm

D. Reject and repair — all undercut on primary structural welds must be corrected regardless of depth to prevent fatigue initiation

41. During structural fabrication, a contractor proposes substituting PJP welds for the engineer-specified CJP welds on primary moment connections to reduce welding time. What is required before this substitution may proceed?

A. Only a revised WPS is required since both PJP and CJP are qualified groove weld types under the same procedure

B. The substitution is permissible provided the PJP effective throat equals 100% of the base metal thickness at the joint

C. The substitution requires written authorization from the engineer of record since it constitutes a change in the structural joint design and load-carrying capacity

D. The contractor's quality manager may approve the substitution if the NDT scope is expanded to include the PJP weld root

42. A welder must prepare a saddle cut template for a 150 mm branch pipe making a 90-degree tee connection onto a 300 mm main. Which template development method correctly generates the saddle profile?

A. Parallel line development — unrolling the branch pipe surface and projecting the main pipe outline onto the flat blank

B. Graphical intersection — dividing the branch circumference into equal segments, projecting each point onto the main pipe, measuring cut depth at each division, and plotting the curve onto the branch stretchout

C. Radial line development — using the branch pipe centreline as the apex with intersection distances as radial elements

D. True shape development — rotating each element to a horizontal plane and extracting the true saddle surface shape

43. A pipeline girth weld RT film shows a continuous columnar dark line running perpendicular to the weld face through the entire cap pass thickness, starting at the weld surface. This is most characteristic of which porosity type?

A. Uniform distributed porosity — small evenly distributed round spots from consistent atmospheric contamination

B. Cluster porosity — a localized group of pores from contamination at a specific point in the weld deposit

C. Root porosity — voids at the joint root from incomplete shielding at the back face of the root pass

D. Piping porosity (worm holes) — elongated gas tunnels oriented perpendicular to the weld face from persistent gas evolution through the solidifying cap

44. A radiographic film of a SAW weld on heavy structural plate shows intermittent fine irregular linear dark indications running along the exact longitudinal centreline of the weld metal. What defect does this appearance most likely indicate?

A. Centreline solidification cracking — hot cracks forming along the weld centreline where low-melting segregates concentrate during solidification

B. Root incomplete penetration — a continuous root condition running along the joint centreline at the weld root

C. Copper contamination from backing bars — copper diffusion creates linear dark zones along the centreline

D. Shrinkage voids — volumetric porosity concentrated at the weld centreline from insufficient fill pass volume

45. A SMAW welder is making a multi-pass structural groove weld and cannot remove a small island of adherent slag from the second fill pass by chipping. The welder decides to weld over it to avoid delay. What is the predictable quality consequence?

A. The slag island melts fully into the new pass, being absorbed into the weld metal without any detectable quality effect

B. The slag rises to the surface of the new pass during cooling and can be removed in the next normal interpass cleaning cycle

C. The slag is trapped beneath the deposited pass as a slag inclusion — a rejectable volumetric discontinuity detectable on RT examination

D. The slag causes a localized cold-start condition producing undercut at the arc start but does not affect internal weld quality

46. A pressure vessel nozzle detail drawing shows a fillet weld symbol below the reference line with the number 12 to the left of the triangle and a weld-all-around circle at the reference line-arrow junction. What does this completely specify?

A. Twelve separate fillet welds of unspecified size distributed evenly around the nozzle connection perimeter

B. A 12 mm leg fillet weld deposited continuously around the complete perimeter of the nozzle-to-shell joint

C. A 12 mm effective throat fillet weld on the arrow side only, with the circle indicating the inspection scope required

D. A fillet weld requiring 12 individual passes deposited sequentially to build up the required nozzle leg dimension

47. A drawing produced at 1:10 scale shows a pipe spool with a dimension of 43 mm physically measured on the drawing paper with a ruler. What is the actual face-to-face dimension on the fabricated spool?

A. 430 mm — at 1:10 scale, 1 mm on the drawing equals 10 mm on the physical object

B. 4.3 mm — at 1:10 scale, the drawing is 10 times enlarged from the actual spool component

C. 43 mm — dimensions stated or measured on drawings always represent the actual as-built dimension

D. 430 mm only if the drawing was printed at its original intended scale without photographic reduction

48. A WPS references PQR No. S-112, qualified using CSA G40.21 Grade 350W plate (minimum yield 350 MPa). A new production order requires welding Grade 480W plate (minimum yield 480 MPa). All other procedure variables — filler metal classification, heat input, and joint design — remain unchanged. Without additional qualification testing, can the existing PQR cover the Grade 480W application?

A. Yes — both grades fall under CSA G40.21 and any PQR qualified on one CSA structural grade automatically covers all other grades within the same product standard

B. Yes — since the filler metal classification is unchanged, base metal changes within the same product standard are never an essential variable requiring requalification

C. Yes — Grade 480W is a more demanding base metal than Grade 350W, so demonstrating adequacy on the lower grade automatically qualifies the procedure for the higher-strength grade

D. No — base metal classification or strength class is an essential variable under most applicable welding codes, and the procedure must be confirmed or requalified to demonstrate it covers the higher-strength Grade 480W

49. A welder arrives at an OFC setup station and finds two cylinders connected to the regulators. Both cylinder bodies are painted green. No labels are visible on either cylinder. What is the required action before proceeding?

A. Both cylinders may be used since green is the Canadian standard colour for oxygen and both are from the same supplier

B. The green cylinders are both likely oxygen — the fuel gas cylinder must be identified separately before connecting

C. Both cylinders must be positively identified by their labels and valve markings before any connection or use proceeds — colour alone is not sufficient identification

D. Contact the gas supplier and provide the cylinder serial numbers to verbally confirm the contents before connecting

50. An OFC operator needs to cut 75 mm structural steel plate. Available tips are rated: Tip 4 (30-50 mm), Tip 5 (50-75 mm), Tip 6 (75-100 mm), and Tip 8 (100-150 mm). Which tip is most appropriate?

A. Tip 4 — using the smallest tip approaching the plate thickness conserves oxygen and produces a cleaner top edge

B. Tip 5 or Tip 6 — both cover 75 mm at their boundary values; Tip 5 at its upper boundary covers this thickness as the primary selection

C. Tip 8 — the oversized tip provides extra oxygen volume that compensates for any pressure variation on heavy plate

D. Tip 4 — a smaller-orifice tip concentrates the cutting stream to a higher velocity, improving penetration on thick plate

51. A fabrication supervisor explains to apprentices why plasma arc cutting can cut aluminum plate while oxy-fuel gas cutting cannot. Which explanation is technically correct?

A. PAC generates extreme thermal energy exceeding 20,000°C that melts and expels all materials through heat alone, requiring no oxidation reaction — the aluminum oxide surface layer does not inhibit this mechanism

B. PAC uses fluoride-based plasma gases that chemically dissolve aluminum oxide before the cutting energy penetrates the base metal

C. PAC uses DCEN polarity that provides cathodic cleaning of the aluminum oxide layer before the plasma contacts the metal

D. PAC uses a water-cooled pilot arc that pre-heats the surface above the aluminum oxide melting point before the main cutting arc initiates

52. After CAC-A back-gouging a defective root pass in a CJP structural groove weld, the procedure requires MT examination before the back weld is deposited. What is the correct sequence of all operations?

A. MT to confirm defect location before gouging, then CAC-A, then back weld without re-examination after gouging

B. CAC-A, then immediate back weld over the groove, then MT of the finished assembly to confirm the repair is complete

C. CAC-A to estimated defect depth, MT to confirm remaining defect depth, then additional CAC-A, then back weld

D. CAC-A to sound metal, wire brushing to remove carbon deposits, MT to confirm complete defect removal, then back weld

53. An OFC operator adjusts the preheat flame and achieves a condition where the inner cone is bright and sharply defined with no secondary feather or haze visible between the inner cone tip and the outer envelope. What flame condition has been produced?

A. A slightly oxidizing flame that scales the steel surface lightly but reduces preheat time by operating at higher temperature

B. A carburizing flame with excess fuel that adds carbon to the steel surface and increases localized hardness

C. A neutral flame — the sharp inner cone with no feather confirms balanced oxygen and fuel proportions for correct OFC preheat

D. A reducing flame that protects the steel surface from oxidation and is preferred over neutral for all structural steel cutting

54. A quality engineer requires mechanical test specimen coupons to be cut from production welds with precisely square, burr-free ends and no heat-affected zone on the cut faces. Which cutting method meets all three requirements?

A. OFC — a well-set neutral flame produces a clean, essentially square cut suitable for coupon preparation

B. Cold saw — the low-speed precision blade produces a machined-quality, square, burr-free cut edge with no heat-affected zone

C. Plasma arc cutting — the narrow kerf and high precision of PAC produces acceptable results on small specimens

D. Angle grinder with a thin cut-off wheel — portable and precise, producing a clean edge suitable for mechanical test specimens

55. An OFC operator positions the torch to make a mid-plate pierce on 40 mm mild steel and applies the preheat flame for approximately 8 seconds. When the cutting lever is opened fully, the oxygen stream strikes the plate but no cutting reaction begins. What is the root cause?

A. The plate has not yet reached its ignition temperature in oxygen (approximately 870°C, visible as a bright orange-red glow) — the exothermic iron-oxygen reaction requires this temperature to initiate

B. The cutting oxygen pressure is insufficient for 40 mm plate — preheat duration has no bearing on cutting oxygen penetration

C. The torch standoff is too great — the preheat flame must contact the plate surface directly to achieve adequate heating

D. The cutting oxygen flow rate is too low — the operator must increase the cutting oxygen valve opening before re-attempting

56. After an extended PAC production run, the operator inspects the nozzle and finds the orifice bore has worn from a circular to an elongated oval shape. What is the primary effect on subsequent cut quality?

A. The oval bore increases plasma column energy by creating a wider cross-section that can carry more current

B. The elongated bore redirects the plasma at a steeper angle, improving penetration on material thicker than normal

C. The oval bore widens and destabilizes the plasma column, producing a wider kerf with increased bevel angle and more dross

D. The oval bore reduces plasma column velocity, slowing the cut speed but improving the smoothness of the cut face

57. A maintenance welder needs to excavate a 120 mm long defect from a 32 mm thick structural plate for a repair weld, requiring approximately 8 mm depth of removal. Which CAC-A electrode specification is most appropriate?

A. 5 mm electrode at 100-150 A — the smallest available electrode provides maximum precision on structural plate

B. 13 mm electrode at 450-600 A — the largest available provides maximum material removal in the fewest passes

C. 5 mm electrode at 80-100 A — reduced amperage minimizes carbon pickup in the structural steel during excavation

D. 8 mm electrode at 200-300 A — provides an appropriate groove cross-section matching the defect dimensions at controlled removal depth

58. When connecting oxy-fuel cutting equipment, the oxygen regulator outlet fitting has a right-hand thread and the acetylene regulator outlet fitting has a left-hand thread. What is the specific safety reason for this deliberate design difference?

A. Left-hand threads provide a better seal under the high pressures generated by acetylene cylinder storage conditions

B. The different thread directions physically prevent cross-connection between oxygen and fuel gas hoses — correct cross-connection is mechanically impossible

C. Right-hand threads are used on the high-pressure side of any gas system; left-hand threads are used on all low-pressure delivery connections

D. The thread direction identifies the working pressure of each regulator since oxygen always delivers higher pressure than fuel gas

59. Before mounting a 125 mm cut-off wheel rated at 11,000 RPM on an angle grinder, the grinder's identification plate is scratched and the RPM rating is illegible. What is the correct action?

A. Do not use this grinder with this wheel until the rated RPM is confirmed from manufacturer's documentation or the grinder is replaced with one of known rating

B. Operate the grinder at half-throttle since partial power always keeps RPM below any rated wheel maximum

C. Proceed — all 125 mm grinders are manufactured to the same RPM specification and can safely use any 125 mm wheel

D. Mount the wheel and run for 30 seconds while listening for changes in pitch that would indicate the wheel is overspinning

60. A mechanized PAC system begins producing wider kerfs and increased bevel angles on recent cuts compared to earlier production using the same consumables and amperage. The consumables are undamaged. What has changed?

A. The shielding gas flow rate has increased, spreading the plasma column and producing the increased bevel angle

B. The plasma gas pressure has dropped, reducing plasma column velocity and widening the kerf

C. The arc voltage has increased, indicating the standoff has grown — a wider plasma column contacts the plate after greater spreading distance

D. The travel speed has decreased slightly, increasing heat input per unit length and producing the wider kerf observed

61. During OFC operations, an operator hears a sustained high-pitched squealing from inside the torch body with smoke visible at the hose connections and the torch body heating up. What is the FIRST action required?

A. Increase the oxygen flow by fully opening the oxygen needle valve to push the internal flame out through the cutting tip

B. Lower the torch toward the work surface and press the cutting lever to direct the burning reaction through the cutting oxygen port

C. Immerse the torch body in the nearby water bucket to cool the internal components and extinguish the internal burning

D. Close both torch needle valves immediately to cut off the gas supply sustaining the internal burning

62. A CAC-A operator begins back-gouging a 4-metre structural beam from one end with the work lead connected at the starting end. Approximately 3 metres along the gouge, the arc begins deflecting strongly in the direction opposite to travel. What is the most effective corrective action?

A. Reduce the electrode size by one diameter to lower the current level and weaken the deflecting magnetic field

B. Move the work lead connection to the far end of the beam so the gouging proceeds toward the work lead

C. Increase the air pressure to overcome the magnetic deflection force during the remainder of the gouge

D. Weld a temporary steel mass at the arc point to change the magnetic permeability of the base metal in that zone

63. An OFC operator cutting 35 mm mild steel with propane fuel gas notices the preheat phase takes significantly longer than when acetylene was used for the same plate thickness. What is the specific reason for this difference?

A. Propane's lower maximum flame temperature in oxygen (approximately 2,800°C versus acetylene's 3,160°C) requires more time to raise the steel surface to the 870°C ignition temperature

B. Propane requires higher cutting oxygen pressure than acetylene, and the initial pressure setup for propane takes additional time

C. Propane produces a larger combustion zone that distributes heat over a wider area, requiring more time to concentrate heat at the pierce point

D. Propane's higher molecular weight causes slower gas flow from the cylinder regulator, requiring more time to achieve full preheat flame intensity

64. A PAC operator switches from cutting carbon steel to cutting 316L stainless steel and substitutes nitrogen plasma gas for the air plasma used on carbon steel. What specific advantage does nitrogen plasma provide on the stainless steel cut surface?

A. Nitrogen plasma operates at higher temperatures than air plasma, providing faster cutting speed through the stainless steel's increased strength

B. Nitrogen reacts with carbon in the stainless steel, preventing sigma phase formation at the cut edge heat-affected zone

C. Nitrogen plasma avoids introducing oxygen to the cut edge, preventing chromium depletion and preserving the corrosion resistance of the stainless cut surface

D. Nitrogen plasma produces a finer cutting stream than air plasma, reducing the HAZ width on the heat-sensitive stainless surface

65. A fabricator uses a guillotine shear to cut 6 mm austenitic stainless steel plate intended for groove weld joint faces. The quality inspector rejects the shear-cut edges as weld preparation faces. What specific characteristic of the shear-cut edge is the basis for rejection?

A. Shear cutting of stainless steel induces sensitization in the cold-worked zone that must be solution annealed before welding

B. The shear-cut edge has a slight taper that changes the effective groove angle by 1 to 2 degrees from the specified value

C. Guillotine shear blades are carbon steel, introducing iron contamination into the stainless surface at the cut edge

D. The rollover, burnish zone, and fracture zone at the lower edge are deformed, work-hardened, and metallurgically damaged and will not fuse cleanly as groove faces

66. An OFC operator cuts 60 mm structural plate at consistent parameters and examines the kerf face. The drag lines in the top 30 mm are nearly vertical but progressively curve backward through the lower 30 mm. What does this specific pattern indicate?

A. The cutting oxygen pressure is too high — turbulence at the kerf bottom pushes the cutting stream backward at depth

B. The travel speed is too fast — the oxidation reaction cannot maintain its through-thickness penetration position at this speed, causing the lower kerf to lag the entry point

C. The preheat flame is too small — insufficient preheating causes the lower plate zone to drop below ignition temperature

D. The tip is too large — the excess oxygen stream diverges at depth and loses directional focus before reaching the full plate thickness

67. A CAC-A operator holds the electrode at 15 degrees from the plate surface rather than the recommended 35-45 degrees. What groove profile does this shallow angle produce?

A. A deeper, narrower groove — the shallow angle concentrates arc energy vertically downward into the base metal

B. A groove with well-defined steep sidewalls — the shallow angle provides a raking action that creates vertical groove faces

C. A wide, shallow groove — the shallow angle directs arc force laterally rather than downward, spreading the melt zone across the plate

D. No significant change — electrode angle primarily controls travel speed and not groove cross-sectional geometry

68. After PAC cutting 10 mm carbon steel at a significantly higher-than-normal travel speed, the operator finds very hard, tightly bonded dross on the bottom cut edge requiring aggressive grinding to remove. What type of dross is this and what causes it?

A. High-speed dross — formed when fast travel advances the torch before the plasma fully expels the melt, allowing re-solidification bonded to the kerf bottom

B. Low-speed dross — formed from excessive heat accumulation at the kerf bottom when the plasma dwells too long

C. Oxidation dross — formed when air plasma introduces excess oxygen that converts bottom-edge metal to iron oxide before expulsion

D. Recondensation dross — formed when expelled metal vapor cools and redeposits on the kerf bottom from the plasma plume

69. Oxygen and acetylene cylinders are stored in an outdoor supply cage with no fire-resistant barrier installed between them. The operator places the cylinders 4.5 metres apart. Does this arrangement meet standard safety requirements?

A. Yes — 4.5 metres exceeds the 3-metre minimum separation specified for outdoor storage without a barrier

B. Yes — cylinder separation requirements apply only to indoor storage; outdoor cage storage is exempt from minimum distances

C. No — all fuel gas cylinders require a minimum 10-metre separation from oxygen in any storage configuration

D. No — without a qualifying fire-resistant barrier, the minimum required separation between oxygen and fuel gas cylinders is 6 metres

70. A CAC-A operator needs to gouge an aluminum casting for repair weld preparation. Available power sources are: (1) AC transformer (up to 300 A), and (2) DC rectifier (up to 400 A). Which power source and polarity is required for CAC-A on aluminum?

A. AC transformer — alternating current provides cathodic cleaning of the aluminum oxide surface during gouging

B. DC rectifier on DCEP (electrode positive) — DCEP provides the stable, controlled arc required for effective CAC-A on all metals including aluminum

C. AC transformer — AC prevents arc blow in aluminum since aluminum is magnetically susceptible and deflection is unavoidable on DC

D. Either source equally — CAC-A effectiveness depends only on air pressure and electrode diameter, not current type or polarity

71. A production operation requires cutting 500 pieces of 8 mm stainless steel to a ±0.5 mm positional tolerance across the full production run. Manual and mechanized PAC are both available. Which factor governs the choice for this application?

A. Manual PAC is preferred on thin stainless steel because the operator can sense torch vibration and adjust position continuously

B. Both methods produce equivalent dimensional accuracy when an experienced operator uses a full-length guide rail fixture

C. Mechanized PAC delivers consistent, repeatable cut geometry within tight tolerances across all 500 parts — manual PAC cannot reliably maintain ±0.5 mm dimensional consistency across an entire production run

D. Mechanized PAC requires longer setup than manual but does not offer a quality advantage on standard linear cut profiles

72. A repair crew has three electrode types available: E6010, E6013, and E7018. The base metal has moderate mill scale and light surface rust that cannot be fully cleaned before welding. Considering only contamination tolerance, which electrode type best suits these conditions?

A. E6010 — its high-cellulose coating generates a forceful, deeply penetrating arc that burns through moderate surface contamination more effectively than rutile or basic types

B. E7018 — its basic slag chemistry provides superior mechanical properties that compensate for any contamination-related porosity

C. E6013 — its high-titania slag system dissolves mill scale chemically and produces cleaner fusion on contaminated surfaces

D. All three are equivalent — contamination tolerance is a function of travel speed and amperage setting, not electrode type

73. A welder is about to begin SMAW work in a vessel with standing water on the floor. The power source OCV reads 80 VDC. Which precaution specifically addresses the OCV shock hazard in this wet environment?

A. Use only AC power sources in wet confined spaces since DC OCV always exceeds the safe exposure threshold

B. Lower the electrode holder to near the ground before touching any metal surfaces to verify the power is off

C. Fully coil the welding cable to reduce the resistance of the return circuit and lower the effective circuit voltage

D. Use a voltage-reducing device (VRD) that drops the OCV to below 35 V when the arc is not being struck

74. A pipe welder must choose between E6010 and E7018 for the root pass on a natural gas distribution pipe in the 6G fixed position. Grade 359 pipe, 10 mm wall. Which electrode and reason best justify the selection?

A. E7018 — its low-hydrogen deposit matches the pipe grade mechanical requirements and minimizes diffusible hydrogen at the root

B. E6010 — its forceful, deeply penetrating cellulosic arc enables the keyhole technique required for reliable complete root fusion in open-root pipe welding procedures

C. E6013 — moderate penetration and easy slag removal simplify root pass cleaning for subsequent fill passes

D. Either E6010 or E7018 — open-root pipe procedures permit both electrode types for root passes under all CSA Z662 applications

75. A supervisor asks whether E6013 electrodes can be used for vertical-down welding on a primary structural connection requiring a CJP groove weld. Which statement correctly describes the limitation?

A. Vertical-down welding is completely prohibited on all structural applications regardless of electrode type or joint design

B. E6013 is not approved for vertical-down travel — only E6012 has the fast-freeze chemistry required for downward travel

C. Vertical-down welding produces shallower penetration and lower mechanical properties than vertical-up, making it unsuitable for CJP primary load connections

D. Vertical-down welding is acceptable on structural connections provided travel speed exceeds 250 mm/min to prevent cold lapping

76. A welding machine is rated at 60% duty cycle at 300 A. A production welder plans to weld for 7 minutes in every 10-minute period at 300 A. Is this within the machine's rated capacity?

A. No — 7 out of 10 minutes is 70% duty cycle, which exceeds the 60% machine rating at 300 A and risks overheating

B. Yes — the 60% rating applies to total daily arc-on time, not to individual 10-minute measurement intervals

C. Yes — 60% duty cycle means the machine can weld continuously for up to 8 minutes in any 10-minute period

D. No — a 60% duty cycle requires a minimum rest period of 5 minutes after every 3-minute arc-on period

77. E7018 electrodes are removed from a 120°C holding oven and placed in an open container on the welding table in a 75% relative humidity shop environment. Under AWS D1.1, what is the maximum atmospheric exposure time before the electrodes must be reconditioned or discarded?

A. 8 hours — AWS D1.1 permits up to 8 hours of atmospheric exposure before low-hydrogen electrodes require reconditioning

B. 12 hours — the exposure limit extends to 12 hours when the relative humidity is below 90% at ambient temperature

C. 6 hours — E7018 with its iron powder additions has greater moisture resistance than E7016 and a longer exposure limit

D. 4 hours — AWS D1.1 limits E7018 atmospheric exposure to a maximum of 4 hours before reconditioning at 260-430°C is required

78. An SMAW welder completing a 4G (overhead) cap pass uses identical parameters to those used for the same weld in the flat position. What is the most important technical adjustment required specifically for the overhead position?

A. Increase voltage by 5 to 8 V to maintain arc stability against the gravitational resistance acting on the overhead pool

B. Reduce the amperage to produce a smaller, faster-freezing pool that surface tension can hold against the overhead joint face before it can drip

C. Increase travel speed to move through the overhead zone before the pool accumulates enough mass to sag

D. Increase the electrode diameter to maintain adequate deposition rate against the gravitational resistance at the overhead position

79. A welder stops mid-pass on a structural groove weld for an electrode change. When starting the replacement electrode, what technique prevents cold laps and porosity at the restart point?

A. Start the arc 25 mm ahead of the crater and weld directly backward into the crater without any forward motion

B. Apply flux paste to the restart area before striking the arc to protect the cold metal surface from contamination

C. Start the arc 20-25 mm ahead of the crater, weld backward into and through the crater until full fusion is re-established, then continue in the forward travel direction

D. Strike the arc directly in the center of the crater, allow the pool to stabilize for 2 seconds, then continue forward without any backstep motion

80. A welder consistently produces small radial cracks at the stop end of each SMAW pass. Which technique change prevents crater cracking?

A. Increase travel speed at the stop end to reduce heat concentration and prevent hot cracking in the shrinking crater

B. Use a longer arc at the stop end to reduce arc density and slow the solidification rate of the crater region

C. Hold the electrode stationary at the stop point for 3 seconds without movement to allow the crater to fully solidify under the arc shield

D. Fill the crater completely before breaking the arc using a circular or back-and-forth motion to build the crater flush and eliminate the shrinkage cavity before arc extinction

81. A WPS for a 2.25% Cr-1% Mo pressure vessel operating at 550°C specifies E9018-B3 electrodes. What property of the B3 alloy deposit specifically qualifies it for this service condition?

A. Creep resistance and retained elevated-temperature strength from the 2.25% Cr-1% Mo deposit matching the base metal composition for 550°C service

B. Superior corrosion resistance from the chromium content that protects the weld metal from the high-temperature process media

C. Improved low-temperature toughness at -60°C from the molybdenum additions that refine the impact transition temperature

D. Maximum hardenability producing a fully martensitic as-welded deposit that provides the required room-temperature tensile strength

82. An SMAW welder using E7018 is told the interpass slag cleaning must be exceptionally thorough between every pass. What is the specific technical reason E7018 requires more rigorous interpass cleaning than E6013?

A. E7018 slag is softer than E6013 slag and flows under the next pass if any portion remains, forming continuous curtains at the fusion boundary

B. E7018 basic slag is more viscous and adherent than titania slags, bonding more aggressively to the bead surface and trapping more readily as inclusions beneath the next pass

C. The iron powder in E7018 coating introduces magnetic particles into the slag that cause arc blow on the next pass if cleaning is incomplete

D. AWS revokes the low-hydrogen classification of E7018 welds if RT detects slag inclusions, requiring the welder to perform requalification

83. A horizontal fillet weld produced by SMAW shows a defect at the lower toe where the weld metal has flowed onto the base metal surface but is rounded and unfused rather than showing a distinct fusion line. What defect is this?

A. Undercut — the base metal at the lower toe has been melted and not refilled, leaving a groove along the weld toe

B. Porosity — gas evolved from the base metal surface has been trapped at the lower toe during pool solidification

C. Overlap (cold lap) — weld metal has flowed beyond the toe and lain on the base metal without achieving fusion, typically from insufficient amperage or incorrect work angle

D. Incomplete sidewall fusion — the weld metal has not fused into the vertical plate surface at the lower fill pass

84. A welder consistently produces horizontal fillet welds with the vertical-plate leg larger than the horizontal-plate leg. What technique adjustment corrects this imbalance?

A. Increase travel speed to limit pool formation on the vertical plate where the excess leg is developing

B. Increase the amperage to provide heat that allows the pool to wet the horizontal plate leg more effectively

C. Switch to a smaller electrode diameter to produce a more focused arc less influenced by the current work angle

D. Rotate the electrode work angle toward the horizontal plate — approximately 45 degrees or slightly below toward the lower surface — to redirect arc force for balanced leg distribution

85. A field fabricator compares a 400 A transformer-rectifier machine weighing 120 kg against a 300 A inverter machine weighing 12 kg for a structural repair requiring movement between locations. What is the primary operational advantage of the inverter?

A. The inverter's compact size and 90% weight reduction provide a significant portability advantage for field repair requiring machine movement between work locations

B. The inverter produces only AC output, eliminating arc blow concerns that are common in field repair situations

C. The transformer machine is preferred for field work since its higher weight provides superior mechanical stability during windy conditions

D. The inverter machine operates without duty cycle limitations, allowing 100% arc-on time regardless of the amperage output setting

86. A contractor's pipeline welding procedure specifies E6010 for root passes and E7018 for fill and cap passes. An apprentice asks why E7018 is not used for both. Which reason specifically justifies E6010 for open-root pipe root passes?

A. E7018 iron powder clogs the root gap and physically prevents complete root penetration during the root pass

B. E6010's cellulosic coating generates high gas volume producing a forceful, deeply penetrating arc that maintains the keyhole — essential for complete open-root fusion on pressure pipe

C. E6010 is mandatory for all root passes on gas pipelines by explicit CSA Z662 requirement regardless of welder qualification

D. E7018 basic slag is too viscous to drain away from the root keyhole and always traps as inclusions at the root interface

87. A welder accidentally sets 175 A instead of the intended 115 A maximum for a 3.2 mm E7018 fillet weld pass. Which combination of defects is most predictable at the excessive amperage?

A. Incomplete fusion and porosity — excess amperage causes a pool too hot to maintain coating gas shielding at the arc

B. Slag inclusions and cold cracking — excess amperage overheats the slag, causing it to trap during rapid solidification

C. Bead convexity and lack of tie-in — excess amperage causes the pool to freeze before the toes can be wetted

D. Undercut at the toes and excessive spatter — excess amperage melts the base metal beyond the toes and increases arc turbulence

88. A production welder is to complete a 4G overhead structural fillet weld specified at 8 mm leg. Available electrodes are 2.5 mm, 3.2 mm, and 4.0 mm E7018. Which size is most appropriate?

A. 4.0 mm — the larger electrode provides higher deposition rate that builds the 8 mm leg most efficiently in overhead

B. 2.5 mm — the smallest electrode produces the smallest possible pool for overhead work, ensuring minimum drip risk

C. 3.2 mm — the practical maximum for overhead SMAW, providing adequate deposition while keeping the pool small enough for positional control

D. 4.0 mm — maximum electrode size is always preferred to minimize total arc-on time regardless of welding position

89. An SMAW electrode for austenitic stainless steel is designated E308L-16 under AWS A5.4. What do the "L" and "-16" suffixes communicate?

A. "L" indicates a maximum carbon content of 0.04% (low carbon) to prevent sensitization; "-16" indicates a lime-titania coating usable on AC or DCEP

B. "L" indicates a minimum of 16% chromium in the deposited weld metal; "-16" denotes the minimum tensile strength in units of 10 ksi

C. "L" indicates the electrode requires low-hydrogen storage in a holding oven at 120°C; "-16" specifies AC polarity only

D. "L" indicates large diameter electrodes only; "-16" indicates the electrode is approved for all sixteen welding position categories

90. A GMAW operator welding a horizontal fillet weld changes the work angle from 45 degrees to 60 degrees, tilting the gun toward the vertical plate. What is the primary effect on the weld bead profile?

A. The higher work angle increases fusion into the horizontal plate and increases the horizontal leg dimension significantly

B. The higher work angle directs more arc energy toward the vertical plate, increasing the vertical leg at the expense of the horizontal leg

C. The higher work angle increases effective travel speed by directing the arc force vector in the direction of travel

D. The higher work angle reduces spatter by directing the shielding gas flow more directly over the arc column centreline

91. An FCAW wire is designated E70T-4. What does this T-4 classification communicate about the required polarity and position capability?

A. T-4 wires use DCEP polarity as the default since all FCAW wires are classified for electrode positive without exception

B. T-4 wires require AC polarity — the T-4 designation is the only AWS FCAW classification requiring alternating current

C. T-4 wires are polarity-independent and may be used on DCEP, DCEN, or AC as selected by the operator

D. T-4 wires operate on DCEN, are self-shielded, and are classified for flat and horizontal positions only

92. A GMAW operator is setting up to weld 5052 aluminum alloy using a spool gun with 1.2 mm ER5356 wire. Which contact tip characteristic is critical for aluminum GMAW and why?

A. A copper-beryllium alloy contact tip is required since standard copper tips react chemically with aluminum at welding temperatures

B. The contact tip bore must be one size smaller than the wire diameter since aluminum wire compresses under drive roll pressure

C. The contact tip bore must be larger than for equivalent-diameter steel wire — typically bored for the next wire size up — to accommodate aluminum's greater thermal expansion during feeding

D. A ceramic-lined contact tip must be used since aluminum's high thermal conductivity overheats and melts standard copper tips

93. A new apprentice asks how a self-shielded FCAW wire protects the weld pool when no shielding gas cylinder is connected. Which explanation is technically correct?

A. The flux core compounds decompose in the arc, generating CO_2, CO, and nitrogen-scavenging compounds from aluminum and barium that collectively shield and deoxidize the weld pool

B. The tubular wire acts as a sealed gas container — pressurized shielding gas is pre-stored inside the wire core and released at the arc

C. The flux core melts and forms a thick liquid slag layer that completely covers and seals the pool from all atmospheric contamination

D. Resistive heating of the wire core before the arc generates a reducing thermal atmosphere around the electrode tip

94. A GMAW operator increases arc voltage from 22 V to 26 V while holding wire feed speed unchanged on a CV machine. What is the primary effect on the arc and bead profile?

A. Penetration increases because the higher arc voltage increases the current through the constant-voltage characteristic

B. Arc length increases, the bead becomes flatter and wider, and the heat input per unit length increases

C. The wire feed speed automatically increases to compensate for the higher voltage through the CV self-regulating arc

D. The transfer mode changes from short circuit to globular because the voltage increase crosses the transfer mode threshold

95. Under AWS A5.18, which specific letter in the filler metal classification designates a metal-cored (MCAW) wire as opposed to a solid wire (GMAW)?

A. The letter "G" indicates gas-shielded use, which applies exclusively to metal-cored wires under A5.18

B. The letter "S" in ER70S-6 indicates solid wire — the absence of "S" in any A5.18 designation indicates composite construction

C. The letter "T" indicates tubular construction, which applies to both FCAW flux-cored and MCAW metal-cored wires

D. The letter "C" in E70C-6M specifically designates a composite (metal-cored) electrode, distinguishing it from the "S" (solid) designation in ER70S-6

96. An FCAW wire is designated E70T-1M. What does the "M" suffix specifically communicate, and how does it differ from E70T-1 without the suffix?

A. "M" indicates the wire is metal-cored with minimal slag volume, improving multi-pass interpass cleaning over standard T-1

B. "M" indicates moisture-resistant flux core compounds that eliminate the special storage requirements of standard T-1 wires

C. "M" indicates the wire is classified using a mixed shielding gas (75/25 Ar/CO2) rather than 100% CO2 — arc behavior and mechanical test results differ from E70T-1 classified with CO2

D. "M" indicates the wire is rated for mechanized welding cells only and cannot be used in manual welding applications

97. A GMAW operator experiences repeated birdnesting — the wire tangles between the drive rolls and the wire inlet guide and stops feeding. Which combination of conditions most directly causes birdnesting?

A. Excessive drive roll tension combined with a worn liner — both compress and buckle the wire in the feed path

B. Drive rolls with too-light clamping tension combined with a restricted or blocked liner — the rolls slip and the liner restriction causes wire to buckle and accumulate behind the obstruction

C. Excessively high wire feed speed combined with low arc voltage — wire arrives at the arc faster than the arc can melt it

D. Incorrect contact tip size combined with high ambient temperature that softens the wire before it exits the tip

98. Under which specific production conditions is E70T-4 self-shielded FCAW wire most appropriately selected?

A. High-volume structural fabrication in flat and horizontal positions where maximum deposition rate is the priority and the application is non-code or low-criticality structural work

B. All-position code-certified structural work where high deposition rate and impact toughness are simultaneously required

C. Vertical-up welding on pressure-containing components where T-4's basic slag chemistry provides low diffusible hydrogen

D. Thin sheet metal fabrication in all positions where T-4's self-shielding eliminates the need for a wind-free environment

99. A GMAW operator is welding 316L stainless steel structural components using spray transfer. Which shielding gas is most appropriate for maintaining the corrosion resistance of the deposited 316L weld metal?

A. 75/25 Ar/CO2 — the standard spray transfer blend appropriate for carbon steel and all grades of stainless steel

B. 100% CO2 — the highest penetration gas that provides maximum fusion into the 316L base metal groove faces

C. 100% argon — pure argon provides complete protection with no risk of any oxidation at the stainless weld surface

D. 98/2 Ar/O2 or 98/2 Ar/CO2 — a high-argon, low-oxidant blend that provides arc stability for spray transfer while minimizing chromium oxidation in the 316L deposit

100. A FCAW-G operator using E71T-1M wire completes the first pass in a multi-pass groove weld and observes that upon cooling, the complete slag cover spontaneously lifts away in one intact piece without any chipping. What does this behavior describe?

A. A slag adherence defect where the slag chemistry has formed a ceramic surface bond indicating incorrect gas composition

B. Slag roll where the solidified cover has displaced toward the toes due to excessive travel speed

C. Self-releasing slag — the T-1 rutile slag system is engineered to contract at a different rate than the steel, lifting away spontaneously during cooling

D. Hollow bead defect where trapped gas below the bead surface has expanded during cooling, lifting the slag shell from within

101. When a GMAW operator removes a new spool and lays a free loop on the floor, it curves to approximately 600 mm diameter. A different spool the following week produces a free loop of 1,500 mm diameter. Which wire characteristic is this and which spool is more problematic?

A. Wire hardness — harder wire has larger free-loop diameter and feeds more smoothly through the liner and contact tip

B. Wire cast — the natural curvature from spool winding. The 600 mm cast spool is more tightly curved and more likely to produce contact tip wear, feeding resistance, and arc instability

C. Wire helix — the height the wire rises from the flat coil plane. Neither spool presents a meaningful feeding concern

D. Wire surface roughness — the small loop indicates an embossed surface that provides better drive roll grip

102. A spool of E71T-8 self-shielded FCAW wire has been stored in an open condition in the welding shop for six weeks at 60-70% relative humidity. What quality concern applies to using this wire?

A. The flux core compounds in self-shielded wires can absorb atmospheric moisture over extended storage, increasing porosity risk and raising diffusible hydrogen when the wire is used

B. No concern — self-shielded wires are immune to moisture absorption since the steel tube sheath fully seals the flux core against atmospheric exposure

C. The wire surface may have surface rust that will contaminate the contact tip and produce arc instability during welding

D. The core compounds may have hardened from oxidation, causing wire feed resistance and erratic delivery through the drive roll system

103. A GMAW technician increases the inductance control from minimum to maximum on a short-circuit transfer power source. The arc sounds softer and spatter decreases noticeably. What does inductance specifically control?

A. Inductance directly adjusts the average welding amperage, functioning as a secondary fine-tune current control

B. Inductance controls the frequency of short-circuit events per second, determining how many times per second the wire touches the pool

C. Inductance controls the rate of current rise (dI/dt) during the short circuit — higher inductance slows the rise, reducing the explosive re-ignition energy and producing a softer, lower-spatter arc

D. Inductance regulates the shielding gas flow rate through a flow-sensing circuit that adjusts gas delivery to match the welding current level

104. A production manager compares E70C-6M metal-cored (MCAW) wire against E71T-1M flux-cored wire for a structural fillet weld application requiring post-weld painting. Which slag characteristic most directly favors MCAW in this application?

A. MCAW slag lifts away without chipping while FCAW slag requires vigorous mechanical removal in all multi-pass conditions

B. MCAW slag has lower surface hardness than FCAW slag and dissolves completely in standard alkaline pre-paint cleaning wash

C. MCAW slag contains titania compounds that chemically bond with paint primer, eliminating the need for pre-paint cleaning

D. MCAW produces minimal to no slag residue compared to FCAW's full slag cover, reducing interpass and pre-paint cleaning time significantly

105. A GMAW operator must make a vertical-up fillet weld using ER70S-6 solid wire with 75/25 Ar/CO2 shielding on a CV machine capable of standard CV and pulsed modes. Which transfer mode is appropriate for vertical-up position?

A. Spray transfer at 30 V and 280 A — spray provides the best mechanical properties and should always be used regardless of position

B. Short circuit transfer at low voltage and WFS, or pulsed spray — both produce controllable pools in vertical-up; straight spray is not practical due to excessive pool fluidity in this position

C. Globular transfer at medium voltage — globular provides intermediate pool fluidity well suited to vertical position welding

D. Spray transfer only — the 75/25 Ar/CO2 shielding gas blend was specifically formulated to make spray transfer viable in all positions

106. A welding engineer explains that on a CV GMAW machine, the wire feed speed dial is the primary control for amperage. Which statement correctly explains the mechanism?

A. On a CV machine, arc voltage is held approximately constant — increasing WFS requires more current to melt the faster-arriving wire at that fixed voltage, raising the effective amperage proportionally

B. WFS and amperage are directly wired in electrical parallel — the WFS potentiometer simultaneously adjusts the power source current output

C. Higher WFS generates more resistive preheating of the wire, reducing the current needed from the arc and effectively decreasing the welding amperage

D. The wire feeder motor current draw is proportional to wire feed speed, and this motor current becomes the welding current delivered at the arc

107. A GMAW operator switches from 75/25 Ar/CO2 to 100% CO2 shielding gas to reduce cost. Shortly after the change, scattered porosity begins appearing in the weld metal. The base metal and preparation are unchanged. What is the most likely cause?

A. CO2 is denser than the Ar/CO2 blend and settles into the joint, pushing the argon shielding gas component out before coverage establishes

B. The higher flow rate required for 100% CO2 creates turbulence that entrains atmospheric nitrogen into the shielding envelope

C. 100% CO2 contains trace water vapor that decomposes in the arc, introducing hydrogen-based porosity into the deposit

D. The increased oxidant activity of 100% CO2 more aggressively consumes the ER70S-6 deoxidizers — if the balance is marginal, the higher oxidizing environment produces CO porosity from carbon oxidation reactions

108. A welder must GTAW join 304L austenitic stainless steel to A516 Grade 70 low-alloy carbon steel. Which filler metal is specifically designed for this dissimilar base metal combination?

A. ER308L — the standard 304L-matching filler that provides adequate compatibility with both base metals when dilution is controlled below 30%

B. ER316L — the molybdenum-containing stainless filler that bridges the composition difference between both base metals effectively

C. ER309L — specifically formulated for dissimilar joints between austenitic stainless steel and carbon or low-alloy steel

D. ER70S-2 — the fully deoxidized carbon steel filler that produces the correct balance between both base metal compositions

109. After completing a GTAW weld pass on stainless steel, the welder immediately lifts the torch without waiting for the post-flow cycle to complete. The weld surface is still glowing at approximately 600°C when shielding ends. What specific consequence results?

A. The weld cracks from thermal shock produced by the rapid loss of the argon temperature regulation effect

B. The hot weld metal and tungsten electrode oxidize from atmospheric exposure while above the temperature at which chromium oxidation occurs, producing discoloration and oxide contamination

C. The weld pool re-melts from residual heat stored in the tungsten electrode body after the arc is extinguished

D. No consequence — post-flow is only required for aluminum GTAW; premature torch removal has no effect on stainless steel

110. A GTAW welder using DCEN with a pointed EWCe-2 tungsten achieves a sharp tip. The same welder switches to AC for aluminum GTAW with the same tungsten. After striking the arc, the tip transforms into a ball. What causes this change?

A. During the electrode-positive half-cycle of AC, arc energy is directed at the tungsten tip, melting it into the hemispherical ball that is the stable end form for AC aluminum GTAW

B. Aluminum's cathodic cleaning current concentrates at the tungsten tip, transferring thermal energy backward through the electrode body

C. The high-frequency stabilization current in AC GTAW heats the tungsten more than an equivalent DC current of the same average value

D. Aluminum GTAW requires AC polarity to prevent tungsten evaporation — the balled tip is evidence of adequate electrode protection

111. A modern square-wave AC GTAW machine allows adjustment of the EN/EP balance percentage. Which statement correctly describes the trade-off between increasing EN versus increasing EP balance?

A. Higher EP percentage increases penetration but reduces the cathodic cleaning band width — used for aluminum with heavy oxide contamination

B. Higher EN percentage increases cathodic cleaning while reducing penetration — used specifically on heavily oxidized aluminum plate

C. Higher EN percentage increases penetration and reduces electrode thermal loading but narrows the cathodic cleaning band; higher EP percentage widens the cleaning band but increases electrode heat loading

D. The EP/EN balance has no effect on cleaning or penetration characteristics — it affects only the frequency of the AC waveform cycle

112. After completing a GTAW root pass on a 316L stainless steel pipe joint with argon back purging, the welder inspects the inside of the pipe. The root bead surface and surrounding base metal show a dark blue-black coloration extending 5 to 10 mm on both sides of the bead. What does this indicate and what action is required?

A. Silver-straw coloration — this is an excellent purge quality result and the pipe may proceed directly to the next pass

B. Gold to light gold — marginally acceptable purge quality that can proceed with documentation of the result

C. Dark blue — acceptable for non-critical structural stainless applications with quality record notation only

D. Dark blue-black coloration indicates severely inadequate back purge and heavy chromium oxidation — the root must be removed and rewelded under correct purge conditions

113. A GTAW procedure for aluminum 6061-T6 requires pre-weld cleaning with a dedicated stainless steel brush. One week after the brush is first used on a joint, a second welder uses the same brush on a different area. What quality concern does the second use introduce?

A. No concern — stainless steel brushes may be freely shared since they do not contaminate aluminum surfaces with reactive compounds

B. Contamination from the first welding operation may be embedded in the brush bristles and transfer to the new joint area, causing porosity or inclusion-type defects in the subsequent weld

C. The bristles work-harden after first use and become less effective at mechanically removing the aluminum oxide layer

D. The second welder should use a carbon steel brush since reusing a stainless steel brush on aluminum introduces iron contamination

114. A GTAW welder replaces the standard collet body with a gas lens assembly in the torch. What specific improvement does the gas lens provide?

A. The gas lens's wire mesh screens transform turbulent shielding gas into a coherent laminar flow stream, providing more effective and stable shielding coverage at greater standoff distances and with larger cup diameters

B. The gas lens increases the delivered gas flow rate by reducing the restriction in the delivery path through the torch body

C. The gas lens preheats the argon shielding gas before it exits the cup, increasing arc stability at very low amperages

D. The gas lens electronically monitors and adjusts the gas flow rate in real time as the welding current changes during the pass

115. For an open-root pipe joint on 76 mm diameter 4 mm wall carbon steel pipe in the 6G position, a fabricator chooses between GTAW and SMAW E6010 for the root pass only. Which quality advantage of GTAW applies specifically to this thin-wall small-diameter pipe application?

A. GTAW is required by applicable codes for all carbon steel pressure pipe root passes under 100 mm nominal bore

B. GTAW is preferred because its higher deposition rate completes the thin-wall root pass faster than E6010 SMAW

C. GTAW's precise low-amperage arc and separate filler addition provide superior control of root bead profile and reduced burn-through risk on thin-wall small-diameter pipe

D. GTAW automatically provides better root pass mechanical properties because no electrode coating compounds contribute to the deposit chemistry

116. During GTAW of stainless steel, a welder introduces the filler rod end directly into the front edge of the pool on each addition, then withdraws the rod slightly between additions. What specific risk does withdrawing the hot rod end beyond the argon shielding envelope create?

A. The rod cools too rapidly and becomes brittle, cracking on contact with the thermal shock of the pool on the next addition

B. The hot stainless steel rod end oxidizes in the atmosphere between additions, forming an oxide surface on the next-dip filler end

C. The rod end re-melts during approach to the pool, producing an uncontrolled large addition from the re-melted ball

D. The hot stainless rod tip oxidizes to form a chromium oxide ball that enters the pool as a solid inclusion on the next filler addition

117. A standard GTAW machine with high-frequency arc initiation is compared to a machine requiring scratch-start initiation for stainless steel pipe welding. What quality advantage does HF start specifically provide?

A. HF start initiates the arc without tungsten-to-work contact, eliminating tungsten contamination of the weld metal at the arc start point

B. HF start heats the tungsten to a higher operating temperature before arc initiation, producing better arc stability throughout the complete pass

C. HF start prevents porosity at arc starts by fully ionizing the shielding gas column before the arc is established at the joint

D. HF start is mandated by code for all stainless steel GTAW applications — scratch start is only permitted on carbon and low-alloy steel

118. A GTAW welder completing a multi-pass 316L stainless steel pipe weld is working to a WPS specifying 175°C maximum interpass temperature. Why is this specific limit critical for austenitic stainless steel?

A. Above 175°C the argon shielding becomes too hot to provide effective atmospheric protection on subsequent passes

B. Sustained high interpass temperatures in the sensitization range (450-850°C) cause chromium carbide precipitation at grain boundaries, depleting chromium and reducing corrosion resistance in the HAZ

C. Above 175°C the austenitic microstructure begins transforming to martensite, increasing hardness and cold cracking susceptibility

D. The 175°C limit prevents thermal distortion — elevated interpass temperatures cause progressive dimensional instability in stainless pipe joints

119. A GTAW welder is setting up to weld 2205 duplex stainless steel using DCEN polarity. Which tungsten type and tip preparation is correct for this application?

A. EWP (pure tungsten) with a balled tip — the composition of duplex stainless requires the AC cathodic cleaning mode

B. EWTh-2 (thoriated, red band) with a pointed tip — thoriated tungsten provides superior arc-starting on high-alloy stainless

C. EWCe-2 (ceriated, grey band) with a sharply pointed tip — preferred for DCEN on all steel types, providing excellent arc starting without radioactive material concerns

D. EWZr-1 (zirconiated, white band) with a balled tip — zirconiated tungsten is required for all duplex stainless GTAW applications

120. A GTAW procedure for 12 mm wall stainless steel uses 50/50 Ar/He shielding gas rather than 100% argon. What specific advantage does the helium addition provide on this thick section?

A. Helium reduces the oxidation potential of the shielding atmosphere, further protecting the stainless HAZ chromium

B. Helium reduces the arc voltage requirement, allowing the machine to operate at lower OCV for reduced electrical shock risk

C. Helium's lower density provides better arc zone coverage since it rises away from the weld pool more slowly than argon

D. Helium's high thermal conductivity increases arc heat transfer to the base metal, producing higher effective heat input and better fusion on the thick section without requiring amperage increases that would raise interpass temperature

121. After a SAW production run on structural plate, the unfused flux remaining in the weld area is collected by the flux recovery system. What must be done before the recovered flux is returned to the hopper?

A. Screen to remove fines, spatter fragments, and slag particles, then dry if moisture exposure occurred before returning it with fresh flux additions

B. Return it directly to the hopper — SAW flux is 100% reusable without any processing, screening, or drying

C. Discard all recovered flux — code requirements prohibit reuse of any flux that has passed through the arc zone

D. Submit a representative sample for chemistry analysis by spectrometry before the lot may be approved for return to the hopper

122. A SAW operator runs two test beads at identical wire feed speed and travel speed but increases arc voltage from 28 V to 34 V between beads. What change in bead profile is expected?

A. The higher voltage bead will be deeper and narrower since higher voltage corresponds directly to higher amperage in SAW

B. The higher voltage bead will be wider and flatter with a higher width-to-depth ratio, since voltage primarily controls arc length and bead width in SAW

C. The higher voltage bead will be narrower since increased arc constriction at high voltage focuses energy more tightly into the plate

D. The bead profiles will be nearly identical since voltage and WFS are interdependent controls that cancel when only voltage is changed

123. A SAW procedure operating at DCEP with 700 A, 30 V, and 400 mm/min is proposed to switch to DCEN at identical settings to increase productivity. What effect does switching from DCEP to DCEN produce?

A. DCEN produces deeper penetration and lower deposition rate — the primary current heats the base metal more than the electrode wire

B. DCEN produces lower penetration and lower deposition rate — the change in polarity reduces heat input to both the plate and the wire proportionally

C. DCEN produces higher deposition rate and reduced penetration — more electrical energy concentrates at the electrode wire, melting it faster while reducing base metal heating

D. DCEN and DCEP produce equivalent deposition and penetration at the same amperage — polarity has no effect on SAW output characteristics

124. A fabrication shop is implementing tandem (two-wire) SAW for structural beam web-to-flange fillet welding. Which statement correctly describes the primary production advantage of tandem SAW over single-wire SAW?

A. Tandem SAW produces a flatter bead profile requiring less grinding before painting compared to single-wire SAW

B. Tandem SAW eliminates flux recovery needs since the second arc consumes all residual unfused flux from the first arc

C. Tandem SAW uses half the electrical power of single-wire SAW since the two wires share the available power output

D. Tandem SAW achieves 2 to 3 times the deposition rate and travel speed of single-wire SAW, providing a major productivity advantage on high-volume long structural weld applications

125. A pressure vessel fabricator is selecting between fused flux and bonded flux for a multi-pass SAW procedure on 80 mm carbon steel plate. Which statement correctly describes the most significant operational difference?

A. Fused flux's vitrified glass structure resists moisture absorption and allows recovery and reuse with minimal drying, whereas bonded flux is more moisture-sensitive and requires careful storage and active drying after humidity exposure

B. Bonded flux is more moisture-resistant since the organic binders seal the flux granule surfaces against atmospheric moisture absorption

C. Fused flux cannot incorporate alloying additions into its chemistry, whereas bonded flux allows alloying compounds to be blended into the granule binder

D. Bonded flux is preferred for multi-pass procedures since its organic binders regenerate protective properties after each subsequent arc pass

Practice Exam 3: Answer Key and Explanations

1. C — Substitution ranks above administrative controls and PPE in the hierarchy of controls. Changing to a lower-manganese filler metal eliminates the hazard at its source rather than managing exposure after it is generated. Monitoring is not a control measure — it detects but does not reduce exposure.

2. B — Providing workplace-specific worker training is an employer obligation under WHMIS 2015 because employers control workplace conditions and exposure scenarios. Providing the SDS and applying supplier labels are supplier obligations. The training requirement exists because generic product information must be adapted to site-specific hazards and tasks.

3. A — The 4:1 rule places the base 1 unit out for every 4 units of working height. For 4.8 m: 4.8 ÷ 4 = 1.2 m. This approximately 75-degree angle balances stability against sliding at the base and tipping at the top of the ladder.

4. D — With three legs at 0 degrees from vertical, no angle factor applies — each leg carries an equal share. 3,600 kg ÷ 3 = 1,200 kg per leg. This is the minimum SWL each sling must be rated for under the stated rigging geometry.

5. C — The 30-minute fire watch period runs from the last hot work in the zone, not from the original start. New welding in the same fire zone resets the timer because new ignition sources have been introduced and the fire risk period has restarted. The fire watch cannot stand down until 30 minutes have elapsed after all hot work in the zone truly ends.

6. B — A confined space is defined by three design criteria: large enough to enter, limited means of entry and exit, and not designed for continuous occupancy. This vessel meets all three by design. The classification triggers the entry requirement before atmospheric conditions are even assessed — it does not depend on what the vessel contains.

7. D — Section 11 (Toxicological Information) provides clinical health effect data by exposure route, including acute symptoms from inhalation, time-to-effect, and target organs affected. Section 8 provides threshold values only; Section 2 provides hazard classifications. Neither describes the acute clinical effects needed to determine probable cause of incapacitation in an emergency.

8. A — Skin resistance drops from approximately 10,000 Ω dry to under 1,000 Ω when wet. At 75 VDC with wet skin resistance of 1,000 Ω, Ohm's Law gives approximately 75 mA through the body — exceeding the 50 mA cardiac fibrillation threshold. The damp environment is the specific amplifying factor that converts OCV from a manageable to a lethal hazard.

9. C — A fire watch boundary must extend to cover every area where spatter, embers, or radiant heat from the hot work can reach. If the 10-metre boundary stops short of a flammable storage cabinet at 12 metres, a smoldering fire originating in that gap has no fire watch coverage. The consequence of an unchecked fire reaching chemical storage is directly attributable to the incomplete boundary definition.

10. B — The pre-use inspection sequence must be guard first (confirms the safety mechanism is functional), then grinder RPM vs. wheel maximum rating (machine RPM must not exceed wheel's rated maximum), then ring test (confirms the wheel is structurally sound before mounting). All three must be completed before the wheel is mounted — mounting first and then checking creates the exposure this sequence is designed to prevent.

11. D — The removal criterion is 10% of original cross-section. 10 mm − 8.0 mm = 2.0 mm loss. 2.0 ÷ 10 = 20% reduction — twice the maximum allowable. Immediate removal is required. Chain link failure under load is sudden and unannounced — no continued use at reduced capacity is permitted once the removal criterion is exceeded.

12. A — The safe lift uses five components that collectively eliminate the bending moment on the lumbar vertebrae: close approach, shoulder-width stance, knee-and-hip bend with neutral spine, firm grip, and leg-muscle drive throughout the lift. Bending at the waist (option B) concentrates compressive and shear forces directly on lumbar discs, which is the mechanism behind the majority of lifting-induced back injuries.

13. C — The right to refuse applies when a worker has reasonable cause to believe work creates an imminent danger. The absence of a flammable gas test in a vessel with confirmed prior solvent storage is a specific, identifiable, unremediated hazard — not a vague concern. This constitutes reasonable grounds for refusal under OHS legislation, independent of what the other atmospheric readings show.

14. B — Tight-fitting respirators depend entirely on a complete, uninterrupted facepiece-to-skin seal to force all inhaled air through the filter medium. A full beard breaks this seal continuously along the jaw and chin, allowing fume-laden air to bypass the filters without restriction. No fitting procedure, cartridge upgrade, or work practice corrects a beard seal failure — the respirator provides no protection as worn.

15. D — For a 3-piece elbow, cuts = 3 − 1 = 2. Cut angle = 45° ÷ (2 × 2) = 45° ÷ 4 = 11.25°. The formula must be applied fresh for each elbow configuration — the same piece count with a different total angle produces a different cut angle than the equivalent 3-piece 90° elbow.

16. A — The compressed gas cylinder pictogram under WHMIS 2015 communicates two specific physical hazards: explosion if the cylinder is heated (contents expand, shell can rupture), and projectile hazard if the valve is damaged or sheared. Neither flammability nor asphyxiation are communicated by this particular pictogram — those have their own distinct pictograms.

17. B — Journeyperson mentoring under the Red Seal OA requires explaining the underlying cause-effect principles behind quality defects, not just redirecting to documentation or increasing supervised repetition. Understanding why cold base metal at arc starts prevents fusion — and what preheat and technique modifications counteract it — gives the apprentice the diagnostic knowledge to prevent similar problems independently on future joints.

18. C — A vernier caliper exposed to a 150°C component is itself elevated in temperature through contact heat transfer. Storing the instrument before it stabilizes at room temperature locks in a thermally displaced dimensional state. The instrument must return to ambient temperature before zero verification and storage to ensure calibration accuracy at operating conditions.

19. D — Argon is chemically inert but physically denser than air (atomic weight 40 versus air's approximately 29). In an enclosed space, argon displaces oxygen by settling and accumulating without any chemical reaction, odor, or visible warning. The resulting oxygen-deficient atmosphere can cause sudden unconsciousness — the space must be ventilated and oxygen confirmed above 19.5% before re-entry.

20. A — True offset = $\sqrt{(250^2 + 250^2)} = \sqrt{(62{,}500 + 62{,}500)} = \sqrt{125{,}000} = 353.6$ mm. Travel = $353.6 \times 1.414 = 499.9 \approx 500$ mm. The true offset is the hypotenuse of the right triangle formed by the two offset components; the 1.414 factor is the travel-to-offset multiplier for 45-degree fittings.

21. B — The notation +0.00/−0.25 is a unilateral tolerance specifying the dimension may only decrease from nominal, never increase. Maximum = 50.00 mm (zero positive tolerance); minimum = 50.00 − 0.25 = 49.75 mm. This type of tolerance is used for shaft fits where the shaft must remain at or below nominal to clear the mating bore.

22. C — In AWS A2.4 symbology: below the reference line = arrow-side V-groove (45° angle, 3 mm root opening); semicircle above opening away from reference line = back weld pass on the other side after the primary groove weld is complete; "PWHT" in the tail = post-weld heat treatment required. The back weld is a post-completion pass — it is not a backing material placed before welding begins.

23. D — A PJP weld leaves a planned unfused root zone that creates a geometric stress concentration notch. When the joint experiences cyclic tensile stresses perpendicular to the weld axis, this notch acts as a ready-made fatigue crack initiation site — a condition CJP welds avoid entirely. CSA W59 restricts PJP use in cyclically loaded joints specifically for this reason.

24. A — For a 4-piece elbow, cuts = 4 − 1 = 3. Cut angle = $45° \div (2 \times 3) = 45° \div 6 = 7.5°$. Reducing the total angle while increasing the piece count both lower the miter cut angle — this 4-piece 45° elbow at 7.5° requires markedly shallower miters than an equivalent 3-piece 90° elbow at 22.5°.

25. B — The governing limit under AWS D1.1 is the lesser of 3/32 inch (2.4 mm) or t/4. For 16 mm plate: t/4 = 4 mm. The lesser value is 2.4 mm. The 3 mm pore exceeds 2.4 mm — reject. The word "lesser" in the code is the operative element; the more restrictive limit governs, not the more lenient one.

26. D — CE of 0.68% significantly exceeds the difficult weldability threshold of approximately 0.55%. Combined with 50 mm plate thickness (high heat sink → fast HAZ cooling → hard martensite) and Grade 690W's quenched-and-tempered microstructure, the cold cracking risk is severe. A minimum preheat of 175°C or higher is required to keep the HAZ cooling rate below the critical martensite-forming rate.

27. C — Fabricating from a superseded revision produces a component that does not conform to the current approved design. In this case, a 100 mm nozzle installed where 150 mm is required creates a measurable non-conformance requiring rework. Revision discrepancies are never resolved by verbal confirmation or by proceeding with the known-outdated document.

28. A — Charpy V-notch tests measure absorbed fracture energy at a defined temperature. Results exceeding the code minimum at −50°C confirm the weld metal and HAZ microstructures have adequate ductility to resist brittle fracture initiation at that service temperature. This is the qualification purpose — not to measure tensile strength, heat input, or hydrogen content.

29. B — Presetting works with the physics of thermal contraction by using weld shrinkage to pull the joint toward the correct alignment. The result is correct geometry without the high locked-in residual stresses that rigid restraint produces by preventing natural shrinkage movement. The residual-stress versus visible-distortion trade-off is the key engineering consideration when choosing between the two methods.

30. C — Planar defects oriented parallel to the weld axis lie parallel to the X-ray beam in RT, producing minimal absorption contrast — they are effectively invisible on film. UT with beam angles directed perpendicular to the defect plane produces strong specular reflections. Multiple transverse scan angles ensure at least one beam angle crosses the defect plane regardless of the specific fusion-line orientation within the thick section.

31. A — The back weld symbol (semicircle on the other side of the joint) and the backing symbol (rectangle) specify fundamentally different operations at different times. The back weld is deposited after the primary groove weld is complete; backing material is placed before welding begins to support the root pass pool. Confusing these two symbols leads to incorrect sequencing and scope of work.

32. D — The governing limit under CSA W59 is the lesser of 3 mm or 10% of the thinner plate. For 19 mm plate: 10% = 1.9 mm. Since 1.9 mm < 3 mm, the 1.9 mm limit governs. The 2.6 mm measurement exceeds 1.9 mm — the joint must be re-fitted. Using the 3 mm absolute value as the governing criterion on thin plate is the most common disposition error at this question type.

33. B — $V = \pi \times r^2 \times h = 3.1416 \times 700^2 \times 3{,}000 = 3.1416 \times 490{,}000 \times 3{,}000 = 4{,}618{,}152{,}000\ mm^3 \div 1{,}000{,}000\ mm^3/L = 4{,}618.15\ L \approx 4{,}618$ litres. The calculation uses the inside radius (1,400 ÷ 2 = 700 mm) since the question asks for internal volume, applied to the standard cylinder volume formula $V = \pi r^2 h$.

34. C — CSA W59 bases the minimum fillet weld size on the thicker of the two connected parts at the joint. For 6 mm and 18 mm plate, the thicker plate (18 mm) governs. The intent is to ensure the minimum weld provides adequate fusion into the thicker member, which requires a larger minimum weld than the thinner plate alone would dictate.

35. A — A crack initiating at the weld toe and propagating into the HAZ is a toe crack — the most common form of hydrogen-induced cold cracking in structural welding. The weld toe is the highest stress concentration point, and the hard, potentially martensitic HAZ directly beneath is most susceptible. Under the combined conditions of hydrogen, residual stress, and susceptible microstructure, toe cracks initiate in the hours to days following welding.

36. D — Tack welds incorporated into the final joint are subject to identical metallurgical risks as the production weld — rapid cooling, martensite formation, and hydrogen-induced cold cracking. A514 Q&T steel at 30 mm thickness is among the most cold-crack-susceptible structural steels. Tack welds placed without preheat consistently crack, and those cracks can propagate undetected into the production weld after fill passes are deposited over them.

37. B — In standard orthographic projection, solid lines represent edges visible from the current view direction; dashed lines represent edges and features that exist in the part but are obscured by intervening geometry. A dashed line at a specific elevation in the side view identifies a feature that exists at that height but cannot be seen from that viewing direction.

38. C — Liquid penetrant capillary action requires the full specified dwell time to allow the penetrant to enter tight discontinuities by capillary force. Without the dwell time, penetrant in fine cracks does not accumulate in sufficient volume to bleed back through the developer and form a detectable indication. The result is a clean surface appearance over a cracked area — a false negative, which is the most serious class of inspection failure.

39. D — The code specifies 1 hour per 25 mm or fraction thereof — the "fraction thereof" provision rounds up every partial interval to a full interval. For 62 mm: 62 ÷ 25 = 2.48, which covers three intervals (0-25, 26-50, 51-62). Three intervals × 1 hour = 3 hours minimum. Using 2 hours would leave the third partial interval (51-62 mm) uncovered, making it non-compliant.

40. A — CSA W59 acceptance criteria permit undercut up to 1.0 mm depth on fillet welds under standard structural loading configurations. The 0.7 mm measured undercut falls within this limit and is accepted. The more restrictive 0.4 mm and 0.25 mm limits apply under pressure vessel codes such as ASME, not standard structural welding.

41. C — Substituting PJP for CJP changes the joint's effective load-carrying area, its fatigue performance classification, and its structural design basis. This is a structural design modification that belongs exclusively to the engineer of record. Making this change without engineering authorization voids the structural design intent and may constitute an unauthorized modification under the applicable building code.

42. B — Pipe saddle templates are developed by graphical intersection: the branch circumference is divided into equal segments; each segment point is projected onto the main pipe cylinder to find its intersection; the cut depth at each division is measured; and these depths are plotted on the flat branch stretchout to produce the saddle curve. This method generates the exact cut profile that allows the branch to conform to the main pipe surface.

43. D — Piping porosity (worm holes) forms when gas is continuously evolved from a specific zone in the solidifying cap pass, escaping before the pool surface closes over it and creating an elongated tunnel perpendicular to the weld face. On RT, this appears as a continuous columnar dark line running through the weld thickness — the defining characteristic that distinguishes piping porosity from all other types.

44. A — Centreline solidification cracks form because the last metal to solidify in a deep, narrow weld pool concentrates low-melting-point sulfide and phosphide segregants along the centreline grain boundaries, which fracture under solidification contraction stress. SAW welds on high-sulfur structural steel with high depth-to-width ratios are particularly susceptible. RT shows these as fine, irregular linear indications along the exact weld metal centreline.

45. C — Welding over incompletely removed slag physically traps it beneath the next weld pass as a permanent slag inclusion. The inclusion cannot be removed by any subsequent welding operation and is detected on RT as an irregular elongated dark zone at the pass boundary. Complete interpass cleaning is

the only effective prevention — there is no corrective technique after the fact other than excavation and rewelding.

46. B — In AWS A2.4 symbology: the number to the left of the fillet triangle = leg size (12 mm); fillet symbol below the reference line = arrow-side weld; weld-all-around circle = continuous deposition completely around the full joint perimeter. Together these specify a 12 mm leg fillet weld deposited continuously and without interruption around the entire nozzle-to-shell connection perimeter.

47. A — Scale 1:10 means 1 unit on the drawing represents 10 units on the actual object — the drawing is one-tenth actual size. Actual dimension = drawing measurement × 10 = 43 mm × 10 = 430 mm. Although dimensions should always be taken from the stated dimension on the drawing, the 1:10 multiplier principle is the underlying scale concept being tested.

48. D — Base metal type and strength class are essential variables in CSA W59, ASME Section IX, and most applicable welding codes. A PQR qualified on Grade 350W demonstrates mechanical property adequacy for 350 MPa-class base metal only — the deposit has not been tested to confirm it meets the higher mechanical property requirements of Grade 480W. The existing PQR must be reviewed for code coverage or supplemented with new qualification testing before Grade 480W production work begins.

49. C — Cylinder color is a secondary identifier only. The primary identification of cylinder contents must come from the label, valve markings, and cap label. In Canada, both oxygen and some other industrial gas cylinders use green as a standard color, making color alone an unreliable identification method. Connecting two oxygen cylinders to a fuel gas regulator is immediately life-threatening.

50. B — OFC tip selection is based on the plate thickness being cut. Tip 5 is rated for 50-75 mm and covers the 75 mm plate at its upper boundary as the primary selection. An undersized tip (Tip 4, rated only to 50 mm) cannot supply sufficient cutting oxygen volume for reliable full-thickness penetration through 75 mm structural plate.

51. A — PAC operates entirely through thermal energy at plasma temperatures exceeding 20,000°C, melting and physically expelling material regardless of its chemistry. OFC requires iron to oxidize in the cutting oxygen stream — a reaction the stable aluminum oxide layer prevents by coating and blocking the base metal. PAC bypasses the oxidation requirement entirely, making it effective on aluminum and all other materials regardless of surface oxide stability.

52. D — The sequence ensures complete defect removal is confirmed before new weld metal is deposited over the area. CAC-A removes the defective metal; wire brushing clears the carbon-enriched surface layer that would mask MT indications; MT confirms the groove is defect-free; then the back weld is deposited over confirmed-clean base metal. Any other sequence risks rewelding over incompletely removed defects.

53. C — A neutral OFC flame is identified by a sharp, bright, well-defined inner cone with no visible carburizing feather between the inner cone tip and the outer envelope. Balanced proportions of oxygen and fuel produce this flame condition. A carburizing flame shows an extra feather between the cone and envelope; an oxidizing flame shows a shortened, pointed cone with a slightly bluish tint.

54. B — Cold saws operate at very low cutting speeds with precision-ground teeth, producing a cut surface comparable in quality to a machined surface — geometrically square, burr-free, and free of any heat-affected zone. These three characteristics are precisely the requirements for mechanical test specimen and inspection coupon end-face preparation where cut-face quality directly affects test results.

55. A — OFC sustains an exothermic iron-oxygen oxidation reaction, not a melting operation. For this reaction to initiate and self-sustain, the steel surface must reach approximately 870°C — visible as a bright orange-red glow. At only 8 seconds of preheat, the surface has not yet reached this temperature. The operator must continue heating until the correct glow is achieved before the cutting lever is pressed.

56. C — The nozzle bore constricts plasma gas into a focused, circular plasma column. When worn to an oval shape, the plasma column is forced into the matching oval cross-section, widening and destabilizing it. This produces a wider, less-focused kerf with an increased bevel angle and worsened dross formation — the predictable quality consequences of a deteriorated nozzle orifice geometry.

57. D — For systematic, controlled removal of a 120 mm long, approximately 8 mm deep defect in 32 mm structural plate, an 8 mm electrode at 200-300 A provides the right groove cross-section for the defect dimensions with adequate depth and width control. The 13 mm electrode is oversized for precise defect-boundary excavation; the 5 mm electrode would require many more passes for the required removal volume.

58. B — The intentional design difference in thread direction between oxygen (right-hand) and fuel gas (left-hand) fittings makes cross-connection physically impossible. If a fuel gas hose could connect to an oxygen regulator or vice versa, the resulting mixed-gas system could detonate on ignition. Incompatible threads are a passive safety engineering control that prevents cross-connection regardless of operator error or inattention.

59. A — The grinder's rated RPM must equal or not exceed the wheel's maximum rated RPM before any wheel is mounted. Without a readable data plate, the grinder's RPM cannot be confirmed. Overspeeding a 125 mm cut-off wheel can cause catastrophic disintegration — the kinetic energy of the resulting fragments is sufficient to cause fatal injuries. The grinder must be identified before any wheel is mounted.

60. C — In automated PAC with voltage-based height control, arc voltage is directly proportional to the distance between the nozzle and the workpiece. A rising arc voltage indicates the standoff has increased — the torch is riding higher above the plate. With more distance to travel before contacting the plate, the plasma column spreads into a wider, more divergent cone, producing a wider kerf and greater bevel angle.

61. D — In a flashback, flame is burning inside the torch body. The immediate and only correct first action is to cut off the gas supply by closing both torch needle valves — this starves the internal combustion and allows the flame to extinguish. Any other action (increasing pressure, submerging, or directing the flame) continues to feed or redirect the burning and will not resolve the flashback.

62. B — Arc blow in CAC-A results from magnetic field asymmetry between the arc and the work lead return path. As the operator moves further from the work lead, the asymmetric pull strengthens and backward arc blow increases. Moving the work lead to the far end of the beam reverses this dynamic — the operator now gouges toward the lead, the magnetic field symmetry is restored, and the deflection is eliminated.

63. A — Acetylene burned in oxygen produces a maximum flame temperature of approximately 3,160°C; propane in oxygen produces approximately 2,800°C — approximately 360°C lower. This lower thermal output means propane delivers less energy per unit time to the steel surface, requiring proportionally more time to raise the steel to the 870°C iron ignition temperature needed to initiate and sustain the cutting reaction.

64. C — Air plasma contains approximately 21% oxygen. At PAC arc temperatures, oxygen reacts aggressively with chromium at the stainless steel cut edge, forming chromium oxide and locally depleting chromium below the approximately 10.5% minimum required for corrosion passivity. Nitrogen plasma, being chemically inert, eliminates this oxidation reaction entirely, preserving the corrosion-resistant passive layer at the cut surface.

65. D — Every guillotine shear cut produces three characteristic zones: rollover at the upper entry edge (plastically deformed), burnish zone in the middle (smooth contact face), and fracture zone at the lower

exit edge (rough and damaged). The deformed and fractured zones contain work-hardened, metallurgically damaged metal that will not fuse cleanly when used directly as groove weld faces. These zones must be removed by grinding or machining.

66. B — Nearly vertical drag lines at the top of the cut indicate the oxidation reaction is keeping pace with torch travel at the entry side. Progressive backward curvature toward the bottom indicates the reaction front is falling increasingly behind the torch position with depth. This pattern is the diagnostic signature of travel speed exceeding the rate at which the iron-oxygen cutting reaction can penetrate through the full 60 mm thickness.

67. C — At a 15-degree electrode angle (nearly horizontal), the arc force vector is directed almost entirely laterally along the plate surface rather than vertically into it. This spreads the melting zone across a wide surface area to a shallow depth rather than driving the arc downward. The recommended 35-45 degree angle provides sufficient downward component for useful groove depth while maintaining adequate forward travel progress.

68. A — High-speed dross forms when the torch advances faster than the plasma jet can complete the melting and expulsion cycle. Molten metal at the kerf bottom is abandoned by the rapidly advancing torch and re-solidifies while still in contact with the cut edge, forming a metallurgical bond — producing hard, tenacious dross that requires grinding to remove. This bonded characteristic distinguishes it from low-speed dross, which is soft and easily brushed away.

69. D — Standard safety requirements (OSHA, CGA, CSA) require a minimum 6-metre separation between oxygen and fuel gas cylinders when no qualifying fire-resistant barrier is installed. A qualifying barrier requires a minimum 1.5 m height and 30-minute fire resistance rating. At 4.5 m, the separation falls short of the 6 m requirement, making this storage arrangement non-compliant regardless of the outdoor setting.

70. B — CAC-A requires DCEP (electrode positive) for all standard applications including aluminum. DCEP concentrates arc energy at the workpiece, providing stable, effective material removal. AC is not the standard power source for CAC-A on any material; the cathodic cleaning concept relevant to GTAW aluminum does not apply to the CAC-A gouging process.

71. C — Mechanized PAC controls standoff, travel speed, and torch angle with machine precision throughout every cut on every part. A ±0.5 mm dimensional tolerance across 500 parts is a production accuracy requirement that cannot be met by manual technique due to inevitable operator variation in

torch angle, standoff, and speed accumulating across a full production run. Mechanized systems maintain the required parameter consistency from the first part to the five-hundredth.

72. A — E6010's high-cellulose coating generates substantial gas volume from thermal decomposition, creating a forceful, deeply penetrating arc that physically disrupts and burns through moderate surface contamination including mill scale and light rust. E7018's low-hydrogen chemistry is the most sensitive of the three types to surface contamination — moisture and rust introduce hydrogen into the otherwise low-hydrogen deposit. E6013 offers intermediate tolerance.

73. D — A Voltage Reducing Device (VRD) electronically drops the OCV to below 35 V when no arc is being struck, dramatically reducing electrocution risk during electrode changes and repositioning in wet environments. The full OCV is only enabled when the arc is actually struck. VRDs are the specific engineering control designed for SMAW in wet confined spaces and underwater-adjacent environments.

74. B — E6010's cellulosic chemistry, DCEP polarity, and high gas-generation rate create a forceful, deeply penetrating arc that can maintain a keyhole at the open root of a pipe joint. The keyhole technique requires a small, controlled opening in the root gap through which a bead is deposited from below — a technique uniquely supported by E6010's arc characteristics. E7018's slag system fills and builds rather than creating the penetrating keyhole required.

75. C — Vertical-down welding with fast-freeze electrodes such as E6013 produces shallower penetration and lower mechanical properties than vertical-up because the pool travels faster (gravity-assisted) over a relatively cooler base metal surface. These characteristics are acceptable for thin sheet metal but make vertical-down unsuitable for CJP structural connections where full penetration and qualified mechanical properties are mandatory.

76. A — Duty cycle is expressed as a percentage of a 10-minute period. 60% = maximum 6 minutes arc-on per 10-minute period at the rated amperage. Seven minutes arc-on represents 70% duty cycle, which exceeds the 60% machine rating. Operating above the rated duty cycle overheats transformer windings, rectifier components, or switching elements, risking equipment damage and potential fire.

77. D — AWS D1.1 limits atmospheric exposure of low-hydrogen electrodes removed from a holding oven to a maximum of 4 hours before reconditioning at 260-430°C for at least 1 hour is required, or before discarding. At 75% relative humidity, moisture absorption into the flux coating begins immediately upon removal from the oven. Beyond 4 hours, the low-hydrogen classification cannot be assumed to be maintained.

78. B — In the overhead position, gravity continuously pulls the molten pool downward and away from the joint. Reducing amperage produces a smaller, lower-mass pool that solidifies faster relative to its weight, allowing surface tension to hold it against the overhead joint face without dripping. Standard flat-position amperage produces a pool mass that exceeds the surface tension holding force, resulting in dripping, icicles, and irregular bead profile.

79. C — The backstep restart technique prevents cold laps and porosity by preheating the cold base metal and solidified weld end before fusion is demanded of them. Starting 20-25 mm ahead of the crater and welding backward brings the approaching arc heat to the cold stop-point before the arc reaches it. Re-establishing fusion through the crater before continuing forward ensures the restart zone is completely and continuously fused.

80. D — Crater cracks are solidification cracks that form in the shrinkage cavity of an unfilled crater when the arc is stopped abruptly. Filling the crater completely before breaking the arc eliminates the concave shrinkage geometry that concentrates solidification stress and initiates the crack. The fill motion — circular or back-and-forth — builds the crater flush, removing the stress-concentrating geometry before the pool freezes.

81. A — E9018-B3 deposits weld metal with approximately 2.25% Cr and 1% Mo, matching the chemistry of P22 chrome-moly alloy steel used in elevated-temperature pressure vessel and piping service. This specific Cr-Mo combination provides creep resistance — the ability to resist gradual plastic deformation under sustained high-temperature load — and retained tensile and yield strength at 550°C service temperature. PWHT after welding tempers the deposit to fully optimize these elevated-temperature mechanical properties.

82. B — E7018 basic (lime-type) slag is more viscous and adherent than the titania slags produced by E6013 or E7024. It bonds more aggressively to the bead surface and requires thorough mechanical removal to clear completely before the next pass. Any portion left behind is much more likely to trap as a rigid, non-fusible inclusion beneath the next deposit than the more fluid, self-releasing titania slags.

83. C — Overlap (cold lap) is the defect where molten weld metal flows beyond the weld toe and lies on the adjacent base metal surface without fusing into it, producing the rounded, unfused boundary the question describes. In horizontal fillet welding, the lower toe is the most susceptible location because gravity directs the pool onto a cooler surface that has not been raised to fusion temperature — the classic mechanism for lower-toe cold lap formation.

84. D — Work angle controls arc force distribution between the two members of a fillet joint. When the vertical plate leg is oversized, too much arc energy is being directed toward the vertical plate. Rotating the work angle toward the horizontal plate redistributes arc force and heat between the two surfaces, correcting the leg imbalance by increasing horizontal plate fusion and deposition.

85. A — The 12 kg inverter versus 120 kg transformer represents a 90% weight reduction — the dominant practical advantage for field repair work requiring movement between job locations. Modern inverter machines are not limited to AC output; they operate on DCEP, DCEN, and AC. Duty cycle and OCV limitations are similar between machine types.

86. B — E6010's key advantage for open-root pipe welding is its cellulosic coating chemistry's high gas-generating capacity. The gas evolution (CO2, CO, and water vapor) from the burning coating creates a forceful, deeply penetrating arc that maintains the keyhole — a small controlled opening through the root gap through which the root pass is deposited to achieve complete root fusion. E7018's slag system fills gaps but cannot support the keyhole technique required for open-root work.

87. D — At significantly excessive amperage, the arc delivers more thermal energy to the base metal toes than the joint geometry can absorb, overheating and melting the base metal surface beyond the toe line (producing undercut). The excess arc energy simultaneously increases turbulence at the electrode tip, producing increased spatter from metal expulsion. The combination of undercut and heavy spatter is the predictable, characteristic presentation of over-amped SMAW.

88. C — The practical maximum electrode diameter for overhead E7018 SMAW is 3.2 mm. This size produces a pool adequate for depositing an 8 mm leg over two passes while remaining small enough for surface tension to hold the pool against the joint face without dripping. The 4.0 mm electrode produces too large a pool for reliable overhead position control, and the 2.5 mm electrode would require more passes than necessary for efficient production.

89. A — In AWS A5.4 stainless electrode classifications, the "L" designator specifies a maximum carbon content of 0.04% in the weld metal deposit. Low carbon prevents chromium carbide precipitation during the weld thermal cycle — sensitization — which depletes chromium at grain boundaries and creates intergranular corrosion susceptibility in the HAZ and weld metal. The "-16" suffix indicates a lime-titania coating operable on both AC and DCEP.

90. B — Work angle determines the distribution of arc force and heat between the two joint members of a fillet weld. Tilting the electrode toward the vertical plate concentrates arc energy on that surface, increasing its leg dimension while reducing the horizontal plate's share. A 60-degree work angle toward

the vertical plate produces the unequal-leg weld described, with the vertical leg longer than the horizontal.

91. D — The E70T-4 classification under AWS A5.20 specifies a self-shielded wire operating on DCEN polarity, designed for flat and horizontal positions only. The position limitation is encoded in the classification — the digit in the position-designator location indicates the applicable welding positions. T-4's high deposition rate and DCEN self-shielded characteristics make it a specialized production wire for non-critical flat and horizontal structural work.

92. C — Aluminum wire expands significantly more than steel wire of the same diameter when heated by feed friction through the liner and contact tip, because aluminum has a higher coefficient of thermal expansion. A contact tip bored to match the wire diameter exactly (as one would size for steel) causes the expanding aluminum wire to seize in the bore. Sizing the tip for the next larger wire diameter provides the needed clearance to prevent seizure during welding.

93. A — Self-shielded FCAW core compounds — aluminum, barium fluoride, calcium carbonate, and similar materials — thermally decompose in the arc, generating CO2 and CO gases that displace oxygen and nitrogen from the arc zone, while the metallic aluminum and barium compounds act as deoxidizers and denitrifiers to scavenge residual reactive gases from the pool. The combined gas shield and chemical deoxidation replaces the function of externally supplied shielding gas.

94. B — On a CV GMAW machine, voltage is the primary control for arc length. Increasing voltage from 22 V to 26 V lengthens the arc column, spreading concentrated heat energy over a wider area, producing a flatter, wider bead profile. The increased arc length also raises the effective heat input per unit length of weld deposited.

95. D — AWS A5.18 classifies both solid and metal-cored carbon steel filler metals. The letter "C" in the classification E70C-6M specifically designates a composite (metal-cored) electrode. The letter "S" in ER70S-6 designates solid wire construction. This single letter distinction within the same numbering system is the AWS classification differentiator between the two wire types.

96. C — In AWS A5.20, the "M" suffix indicates that the wire's arc performance and mechanical test values were established using a 75/25 Ar/CO2 mixed shielding gas. Without the "M" suffix, E70T-1 classification testing uses 100% CO2. Substituting a T-1M wire with 100% CO2 shielding may produce different arc characteristics and mechanical properties than the published M-suffix classification values.

97. B — Birdnesting results from a feeding obstruction in the liner or conduit that the drive rolls cannot overcome. With insufficient clamping tension, the rolls slip when they encounter resistance, allowing wire to unspool but not advance, causing it to accumulate and tangle between the rolls and the obstruction. Increasing clamping tension alone without addressing the liner restriction will not resolve the underlying cause.

98. A — E70T-4 is a self-shielded, DCEN, flat-and-horizontal-position wire optimized for high deposition rate rather than toughness or all-position capability. These characteristics make it specifically appropriate for high-volume, non-code or low-criticality structural fabrication in flat and horizontal positions where production efficiency governs the electrode selection decision.

99. D — Stainless steel weld metal deposited under high-CO_2 or high-O_2 shielding gas undergoes surface chromium oxidation at welding temperatures, creating a chromium-depleted zone that loses its passive, corrosion-resistant properties. A high-argon, low-oxidant blend such as 98/2 Ar/O_2 provides the arc stability needed for spray transfer while limiting chromium oxidation to acceptable levels throughout the deposit surface.

100. C — E71T-1 wire uses a rutile (titania) slag system engineered with a coefficient of thermal expansion deliberately different from steel. As the weld cools, differential contraction at the slag-steel interface generates sufficient stress to cause the slag to pop free spontaneously. This self-releasing behavior is a designed characteristic of T-1 wire and is its primary interpass cleaning efficiency advantage over basic (T-5) slag systems.

101. B — Wire "cast" describes the natural circular curvature diameter when a free length of wire is released from the spool — it reflects the winding radius. A tight 600 mm cast means the wire retains strong curvature, consistently contacting one side of the contact tip bore and causing accelerated asymmetric tip wear, feed resistance, and arc instability. A larger cast (1,500 mm) reflects less retained curvature and more predictable feeding behavior.

102. A — Self-shielded FCAW core compounds — particularly the aluminum and barium-based ingredients in T-8 wires — can absorb atmospheric moisture through the cut wire end during extended open storage. When the moisturized wire enters the arc, the moisture decomposes and releases hydrogen into the deposited weld metal. Elevated diffusible hydrogen increases the risk of hydrogen-induced cold cracking in susceptible base metals and causes porosity in the deposit.

103. C — Inductance in a CV GMAW power source controls the rate of current rise (dI/dt) when the wire contacts the pool during short circuit transfer. High inductance slows the current rise, reducing the

explosive energy of the arc re-ignition event (pinch-off) that ejects spatter from the wire tip. The result is a softer, more controlled arc with measurably reduced spatter — the practical outcome for which inductance adjustment is made in production GMAW.

104. D — Metal-cored MCAW wire contains only metallic powders in its core with no flux compounds, producing minimal to no slag residue on the bead surface. FCAW flux-cored wire produces a complete slag cover requiring mechanical removal between passes and thorough cleaning before painting. For multi-pass structural work with a pre-paint cleaning requirement, MCAW's near-zero slag output directly reduces interpass and pre-paint labor.

105. B — Spray transfer at standard CV settings produces a large, highly fluid pool that cannot be controlled in vertical-up position — it sags and runs. Short circuit transfer at low voltage and WFS produces a small, fast-freezing pool manageable in vertical-up position. Pulsed spray achieves controlled one-droplet-per-pulse transfer also viable in all positions. Globular transfer is avoided in all positions due to its erratic, spatter-heavy arc characteristics.

106. A — On a CV GMAW machine, arc voltage is held approximately constant by the power source through the self-regulating arc principle. When WFS increases, more wire arrives per unit time; the machine must supply additional current to melt this increased wire volume at the fixed arc voltage. Therefore, WFS directly and proportionally controls the effective welding amperage — the foundational operating principle of CV GMAW.

107. D — ER70S-6 contains elevated Si and Mn deoxidizers specifically formulated to manage the more oxidizing 100% CO_2 environment. However, 100% CO_2 is significantly more oxidizing than 75/25 Ar/CO_2, consuming the deoxidizers more aggressively. If the base metal has surface contamination or the wire's deoxidant balance is marginal for the increased CO_2 activity, CO gas from incomplete deoxidation remains trapped in the solidifying pool, producing the scattered porosity observed.

108. C — ER309L is specifically formulated for dissimilar metal joints between austenitic stainless steel and carbon or low-alloy steel. Its higher alloy content (approximately 23% Cr, 13% Ni) provides sufficient alloy buffer to maintain a stable austenitic weld metal microstructure even with significant dilution from the carbon steel side — which would convert a standard ER308L deposit to a potentially crack-susceptible mixed microstructure.

109. B — GTAW argon post-flow serves two functions: protecting the hot weld metal from atmospheric oxidation while it remains above approximately 400°C, and cooling and shielding the tungsten electrode. Removing the torch before post-flow completes exposes both surfaces to atmospheric oxygen

while above their respective oxidation thresholds — the weld surface discolors, and the tungsten oxidizes, requiring re-grinding before the next arc start can be made cleanly.

110. A — In AC GTAW, the electrode-positive half-cycle directs arc energy at the tungsten tip (approximately 30-35% of the total energy in balanced AC). This concentrated energy melts the pointed tip geometry into the hemispherical ball that is the stable operating form for AC aluminum GTAW. The ball size is controlled by adjusting the AC balance — excessive EP time causes the ball to grow beyond the stable surface-tension-limited size and eventually spit.

111. C — The EN half-cycle concentrates arc energy at the workpiece, producing deeper penetration and lower electrode thermal loading. The EP half-cycle concentrates arc energy at the electrode, generating the cathodic bombardment that breaks up and removes the aluminum oxide surface layer. More EN favors penetration and electrode life; more EP widens the cathodic cleaning band but increases electrode thermal loading. Balancing between the two optimizes both outcomes for the specific job.

112. D — Back purge quality on stainless steel root passes is assessed by bead color: silver/straw = excellent; gold = marginal; blue = poor and typically unacceptable; dark blue-black = severely oxidized and completely unacceptable. Dark blue-black coloration on 316L means the chromium at the root surface has been massively oxidized, the passive layer is destroyed, and the root cannot fulfill its corrosion-resistance design intent. The root must be removed and rewelded under correct purge conditions.

113. B — Aluminum GTAW cleaning brushes must be dedicated to aluminum only and kept free of all contamination. A brush used on a previous welding job may have embedded weld spatter, oxidized aluminum compounds, or surface residue in its bristles. When applied to the new joint area, these contaminants are mechanically driven into the freshly cleaned aluminum surface and become sources of porosity, inclusions, or fusion defects in the weld.

114. A — The gas lens contains one or more fine wire mesh screens in the torch body that transform the turbulent, helical gas flow from the supply hose into a coherent, uniform laminar stream exiting the cup. Laminar shielding flow provides more effective, extended coverage than turbulent flow. This allows larger cup diameters to be used effectively and permits longer work-to-cup distances without loss of shielding quality — both advantages for difficult joint access and critical weld quality applications.

115. C — GTAW's independently controlled low-amperage arc and separate filler rod addition provide precise simultaneous control over heat input and deposition rate. On 4 mm wall, 76 mm diameter pipe, these controls allow the welder to maintain the small, controlled pool needed to prevent burn-through

while producing a consistent internal bead geometry. SMAW with E6010 is faster and the industry standard for larger-bore, heavier-wall pipe but is less forgiving on the small pool margins of thin-wall small-bore applications.

116. D — When the hot stainless steel filler rod end is withdrawn beyond the argon shielding envelope between additions, atmospheric oxygen contacts the hot chromium-bearing surface, immediately forming a chromium oxide ball at the rod tip. On the next filler addition, this solid oxide ball is deposited directly into the weld pool as a solid inclusion — a rejectable defect on all applicable codes. The rod end must remain continuously within the shielding gas envelope between every filler addition.

117. A — HF arc initiation establishes the arc through a high-voltage ionization spark across the shielding gas gap, without any tungsten-to-workpiece contact. Scratch start requires the tungsten to physically touch the work surface to initiate ionization, depositing tungsten particles from the electrode tip into the weld metal at the contact point. On stainless steel where tungsten inclusions are always rejectable, HF start eliminates this contamination source at every arc start.

118. B — Austenitic stainless steels sensitize when the HAZ is held in the temperature range of approximately 450-850°C. In this range, chromium combines with carbon to precipitate chromium carbides at austenite grain boundaries, locally depleting chromium below the approximately 10.5% threshold for passivity and creating zones susceptible to intergranular corrosion. The 175°C maximum interpass temperature limit minimizes cumulative HAZ time in the sensitization range during multi-pass welding.

119. C — EWCe-2 (ceriated tungsten, grey band) is the modern preferred choice for DCEN applications on all steel types including duplex stainless steel. It provides excellent arc starting, good arc stability, and longer service life compared to thoriated tungsten, without the radioactive material handling concerns associated with EWTh-2. A sharply pointed tip is prepared for all DCEN applications to concentrate the arc at the tip and maximize penetration control.

120. D — Helium has significantly higher thermal conductivity than argon. When added to the shielding gas blend, helium increases the rate of heat transfer from the arc plasma to the base metal without requiring an amperage increase. On 12 mm wall stainless steel, this translates to deeper penetration and better sidewall fusion at heat input levels that maintain the 175°C maximum interpass temperature limit — an important advantage when argon alone cannot achieve adequate fusion at safe thermal conditions.

121. A — Recovered SAW flux must be processed before reuse. Fines generated by arc action change the current-carrying characteristics of the flux; slag fragments and spatter must be screened out to

prevent inclusions in subsequent welds; and humidity exposure requires drying to restore flux chemistry integrity. Returning unprocessed flux can introduce multiple defect types including porosity, slag inclusions, and chemistry variations.

122. B — In SAW, voltage and wire feed speed (amperage) are the two primary independent controls. Voltage governs arc length and bead width — higher voltage produces a longer arc, a broader arc cone, and a wider, flatter bead. Amperage (controlled by WFS and stickout) governs penetration depth. The bead at 34 V will be measurably wider and flatter than at 28 V at identical WFS and travel speed.

123. C — As in SMAW, SAW current polarity distributes arc energy between electrode and workpiece. DCEP concentrates more energy at the workpiece — deeper penetration, lower deposition rate. DCEN concentrates more energy at the electrode wire — higher wire melt-off rate (higher deposition rate), shallower penetration. Switching from DCEP to DCEN at the same amperage increases deposition rate by approximately 25-30% while reducing penetration — the specific reason DCEN is selected for cladding and overlay applications where base metal dilution must be minimized.

124. D — Tandem SAW operates two independently controlled wire-arc systems simultaneously in the same weld zone. The combined wire melting rate achievable with two arcs produces 2 to 3 times the deposition rate and travel speed of a comparable single-wire setup. For high-volume, long structural welds such as continuous beam web-to-flange fillets, this productivity multiplier is the primary technical and economic justification for the additional equipment investment.

125. A — Fused SAW flux is manufactured by melting all constituent materials together and re-solidifying the mixture into a homogeneous glass-like material. This vitrified, non-porous structure inherently resists moisture absorption, allowing recovery and reuse with minimal drying requirements. Bonded flux uses an organic or hydraulic binder that retains a granular, porous structure and is significantly more moisture-sensitive, requiring active drying after any humidity exposure before production use.