PRACTICE EXAM 9: ASE L3 SIMULATION (45 Questions)

Time Limit: 2 hours | Passing target: 80% or higher on simulation practice

1. A technician has removed the service disconnect from a hybrid vehicle's battery pack and placed it in a safe location away from the vehicle. To prevent another person from reinstalling the disconnect during service, the technician should:

A. Place a warning sign in the work area noting that HV service is in progress on the vehicle

B. Notify the service writer that the vehicle is currently undergoing high-voltage service work

C. Lock the vehicle doors and place the keys in a designated location away from the work bay

D. Apply a lockout/tagout device to the service disconnect socket on the battery pack housing

2. After removing the service disconnect and waiting the specified time, the technician verifies zero voltage at the inverter HV bus. The proper "live-dead-live" verification procedure requires the technician to:

A. Test the meter on a known live source, then the HV bus, then the known live source again

B. Test the HV bus on both polarities, then verify the meter battery with a 9-volt cell tester

C. Test the bus voltage three times in succession and average the three readings together

D. Test the inverter casing for ground continuity, then the bus, then ground continuity again

3. A typical NiMH hybrid battery module is composed of multiple cylindrical cells connected in series. The nominal voltage of each individual NiMH cell is approximately:

A. 1.0 volt under load and 1.5 volts open circuit at normal operating temperature

B. 1.2 volts at normal operating temperature and nominal state of charge condition

C. 2.0 volts when fully charged and 1.5 volts at minimum discharge state of charge

D. 3.6 volts under all operating conditions including charge and discharge cycles

4. A hybrid vehicle will not operate in EV-only mode even when the battery is fully charged and the cabin climate demand is low. Of the following, the most likely cause is:

A. The 12-volt auxiliary battery has dropped below the minimum threshold for HV system operation

B. The HV battery contactors have welded closed and cannot disconnect the pack from the inverter

C. The engine coolant temperature is below the threshold that allows engine-off propulsion mode

D. The regenerative braking circuit has failed to send any energy back to the battery pack at all

5. After replacing brake pads on a hybrid vehicle, the brake pedal feels different and the regen blend seems inconsistent. The technician should:

A. Perform the OEM brake bleed/initialize procedure including any required stroke sensor calibration

B. Replace the master cylinder because the new brake pads have changed the hydraulic balance point

C. Drive the vehicle for several hundred miles to allow the brake-by-wire system to self-relearn

D. Replace the brake fluid completely and refill with a DOT 5 silicone-based brake fluid product

6. A scope is used to observe the three-phase AC output of a hybrid inverter under load. A normal waveform should show:

A. A pure square wave on each phase with sharp rise and fall times during the on/off cycles

B. A constant DC voltage equal to the battery pack voltage with minimal ripple at the output

C. A sawtooth wave at the line frequency with no apparent variation across the three phases

D. A pulse-width modulated waveform that approximates a sine wave when filtered by the motor

7. A hybrid vehicle has set a code for HV cable shielding circuit malfunction. The most likely failure point is:

A. The orange outer insulation jacket has hardened and lost its dielectric strength rating value

B. A shield grounding strap has corroded or detached at one of the cable termination points

C. The inner conductor has broken inside the cable while the outer jacket remains visibly intact

D. The cable has been routed too close to the engine harness causing capacitive coupling issues

8. A hybrid vehicle has set a code for HVIL open and will not enter ready mode. After visually inspecting all orange HV connectors and finding them fully seated and locked, the technician should next:

A. Replace the hybrid control module because all visible connectors are confirmed fully seated

B. Use a wiring diagram to identify HVIL pin locations and back-probe each connector for continuity

C. Disconnect the 12-volt battery for 30 minutes to perform a system reset of all hybrid modules

D. Replace the high-voltage battery pack assembly as a complete unit since HVIL routes through it

9. A traction motor (MG2) is suspected of an internal short between phases. The proper test method to confirm this fault is to:

A. Measure phase-to-phase resistance among the three motor leads and compare to OEM specification

B. Measure the motor's static resistance at room temperature using a standard digital multimeter

C. Spin the motor by hand and listen for any abnormal noises coming from the bearing assembly

D. Apply 12 volts DC to one phase and check for current flow through the other two phase leads

10. A hybrid vehicle has been in a collision and is leaking what appears to be coolant from the inverter cooling system. The first responder or technician should:

A. Continue normal extrication procedures since coolant leaks have no relationship to the HV system

B. Pour absorbent material on the leaking coolant to neutralize any electrical conductivity it carries

C. Treat the leaking coolant with caution and avoid skin contact because it may carry leakage current

D. Connect a chassis ground wire to the leaking coolant to safely drain any electrical potential remaining

11. A hybrid vehicle's battery management system (BMS) reports that one cell in a NiMH module has significantly higher internal resistance than its neighbors. Over time, this condition will most likely cause:

A. The 12-volt auxiliary battery to overcharge whenever the HV system enters its charge mode

B. The inverter to fail prematurely because of unbalanced phase loading from the motor coils

C. The regenerative braking circuit to overcharge the failing cell during deceleration events

D. The failing cell to heat excessively during high-current charging and discharging operations

12. Two technicians are discussing high-voltage face protection. Technician A says a full face shield rated for arc flash should be worn whenever HV connections are being made or broken under load. Technician B says safety glasses alone provide sufficient eye protection for any hybrid HV service task. Who is correct?

A. Technician A only

B. Technician B only

C. Both A and B

D. Neither A nor B

13. DC fast charging (Level 3) supplies a plug-in hybrid or electric vehicle with:

A. High-frequency AC current that is rectified inside the vehicle by the onboard charger module

B. Three-phase AC current that is converted to single-phase by the vehicle's onboard charger unit

C. Direct current that bypasses the onboard charger and connects directly to the HV battery pack

D. A combination of AC and DC that alternates between the two during the entire charging cycle

14. A hybrid vehicle's electric coolant pump for the power electronics cooling loop is suspected of failure. The most direct test method is to:

A. Pinch the upper inverter coolant hose and feel for pulsating flow inside the rubber tube

B. Command the pump on with a scan tool and verify operation by feel, sound, or current draw

C. Disconnect the pump and bench test it by applying 12 volts directly to its electrical terminals

D. Replace the pump as a maintenance item since the cost of testing exceeds the cost of replacement

15. A hybrid vehicle illuminates a "Check Hybrid System" warning lamp along with a "Stop Vehicle and Park Safely" message. The technician should:

A. Reset the message by disconnecting the 12-volt battery briefly and then reconnecting it again

B. Drive the vehicle to the shop normally since the warning lamp does not indicate an HV hazard

C. Continue driving until the next scheduled maintenance interval to address the warning then

D. Treat the warning as a serious fault, retrieve codes immediately, and avoid further driving

16. The phenomenon known as memory effect in nickel-metal hydride hybrid battery cells is best described as:

A. A reduction in usable capacity when cells are repeatedly cycled within a narrow charge range

B. A complete loss of voltage output that occurs when cells reach the end of their service life

C. An increase in internal resistance caused by exposure to extreme cold temperature conditions

D. A condition in which cells refuse to accept charge after sitting for extended storage periods

17. A hybrid vehicle's service information specifies a 10-minute capacitor discharge wait time after removing the service plug. The technician should:

A. Wait only 2 minutes because newer hybrids discharge faster than the published service times

B. Wait exactly 5 minutes because all hybrid manufacturers have a uniform discharge time standard

C. Wait the full 10 minutes as specified, then verify zero voltage with a CAT III rated meter

D. Skip the wait entirely if the service procedure also requires removing the inverter HV cables

18. The total nominal pack voltage of a typical second-generation (2004–2009) Toyota Prius NiMH battery is approximately:

A. 144 volts DC based on 120 cells in series at 1.2 volts per cell at nominal operating condition

B. 273 volts DC based on the original first-generation Prius cell configuration connected in series

C. 201.6 volts DC based on 168 cells in series at 1.2 volts per cell at nominal condition state

D. 350 volts DC based on a lithium-ion configuration with much higher per-cell nominal voltage

19. In a series hybrid, energy flowing from the fuel tank to the wheels passes through:

A. The engine and a single mechanical clutch directly to the drive wheels with minimal losses

B. The engine, a generator, the inverter, the drive motor, and finally to the drive wheels overall

C. The engine and a continuously variable transmission directly to the drive wheels with no conversion

D. The engine, the planetary gear set, the differential, and finally to the drive wheels mechanically

20. In the event of a complete brake-by-wire system failure on a hybrid vehicle, the brake system should:

A. Default to direct hydraulic operation of the front brakes from the master cylinder for emergency stopping

B. Disable all braking until the system has been diagnosed and repaired by a qualified technician at a shop

C. Switch automatically to regenerative braking only with no friction brake operation available at all

D. Apply maximum continuous brake pressure to all four wheels until the vehicle comes to a full stop

21. During steady-state highway cruise on a Toyota power-split hybrid, the typical power flow involves:

A. The HV battery alone, with the engine off and MG2 providing all of the propulsion to the wheels

B. The engine alone, with both motor-generators disconnected from the wheels by clutch packs

C. The engine charging the HV battery continuously while MG2 alone provides propulsion to the wheels

D. The engine driving the wheels through the PSD with MG1 producing electricity that supplements MG2

22. The internal bleed-down resistors inside a hybrid inverter are designed to:

A. Limit the maximum bus voltage during regenerative braking to protect the IGBTs from damage

B. Reduce electromagnetic interference radiated from the inverter assembly to acceptable levels

C. Discharge the bus capacitors to a safe voltage after the main contactors are commanded open

D. Heat the inverter during cold-weather startup to bring the IGBTs to operating temperature

23. Lithium-ion cell thermal runaway is best described as:

A. A normal temperature increase that occurs during high-current charging or discharging events

B. An exothermic chain reaction in which a damaged cell releases energy that propagates to nearby cells

C. A condition in which the battery management system fails to detect cell over-temperature events

D. A protective shutdown in which the BMS opens the main contactors to prevent further heating

24. A scan tool displays minimum and maximum cell voltages from a lithium-ion hybrid battery pack as 3.78 V and 3.95 V respectively. The cell voltage delta of 0.17 V indicates:

A. A pack imbalance that exceeds typical specifications and warrants further investigation by the technician

B. A normal pack condition that requires no action because all cell voltages are within the healthy range

C. A failed scan tool that is reporting inaccurate values; the technician should retry with another tool

D. A normal charging condition that will resolve itself after the next regenerative braking event

25. A hybrid manufacturer specifies a particular coolant for the power electronics loop. Using standard ethylene-glycol engine coolant in this loop will most likely result in:

A. Improved heat transfer because engine coolant has higher specific heat than the specified coolant

B. No issue at all because both coolants share the same chemical properties and protection additives

C. Reduced corrosion protection inside the inverter cold plate due to incompatible chemistry interactions

D. Eventual HV isolation faults because engine coolant has higher electrical conductivity than required

26. When the service plug is removed from a hybrid HV battery pack, the integrated low-voltage interlock signal:

A. Sends a command to the HV battery to discharge through internal bleed resistors immediately

B. Energizes the main contactor coils to lock them in the closed position for safety isolation

C. Tells the hybrid control module that the pack is being serviced so contactors remain open

D. Increases the audio system volume to maximum to warn occupants that service is in progress

27. A hybrid vehicle's orange HV cable has been damaged in a minor accident. The recommended repair procedure is to:

A. Replace the cable as a complete assembly with the OEM-specified replacement part from a dealer

B. Splice the damaged section using a heat-shrink splice rated for 600 volts AC service conditions

C. Apply self-fusing silicone tape over the damaged area and clamp the cable back into its routing

D. Cut out the damaged section and bypass it with a parallel jumper rated for the same current

28. A plug-in hybrid is in the middle of a Level 2 charging session when the AC supply is interrupted briefly and then restored. The vehicle should:

A. Discontinue charging permanently and require a manual reset before any subsequent charging session begins

B. Re-establish the pilot signals with the EVSE and resume the charging session automatically after handshake

C. Switch immediately to DC fast charging mode using the same connector and the same charging cable

D. Sound a continuous audible alarm until the customer comes to the vehicle to acknowledge the interruption

29. A scan tool displays "HV battery voltage at inverter: 0 volts" while the vehicle is in ready mode and operating normally. The most likely fault is:

A. A welded main contactor allowing battery voltage to reach the inverter even when commanded off

B. A failed inverter IGBT short circuit preventing battery voltage from reaching the bus capacitors

C. A discharged 12-volt auxiliary battery causing all hybrid system modules to brown out at idle

D. A failed voltage sensor or open circuit in the inverter voltage monitoring sensing pathway

30. A hybrid vehicle's electric A/C compressor has failed and the system has been contaminated with conventional PAG oil during a prior service event. The most appropriate corrective action is to:

A. Flush the entire A/C system and replace the compressor, accumulator, and orifice tube or expansion valve

B. Add a PAG-to-POE oil neutralizer additive to the system to chemically convert any contamination present

C. Continue using the system with the existing PAG oil since both oils provide equivalent lubrication properties

D. Replace only the compressor itself and leave the existing PAG oil in the lines and other system components

31. Passive cell balancing in a hybrid battery pack works by:

A. Transferring charge from higher-voltage cells to lower-voltage cells using switched DC-DC circuits

B. Heating the highest-voltage cells with internal heating elements to bring them down to nominal level

C. Discharging the highest-voltage cells through bleed resistors to dissipate excess charge as heat

D. Disconnecting overcharged cells from the pack until the lower cells catch up to the same voltage level

32. Hybrid drive motors are typically cooled by:

A. A dedicated ambient air-cooling system with a fan that pulls air across the motor casing externally

B. A liquid coolant loop that circulates through internal motor passages or around the stator housing

C. Convection cooling through the surrounding transaxle fluid without any forced circulation at all

D. Direct contact with refrigerant from the vehicle's air conditioning system through a heat exchanger

33. Before reinstalling a hybrid vehicle's service disconnect after completing repairs, the technician must:

A. Disconnect the 12-volt battery and wait 30 minutes for all hybrid modules to fully reset themselves

B. Cycle the ignition through three start cycles to allow the BMS to perform a self-diagnostic routine

C. Drive the vehicle in EV-only mode for at least one full mile to allow regenerative braking initialization

D. Verify all HV connections are properly torqued, fully seated, and the system is ready for power-up

34. A hybrid vehicle's engine auto-stop function will not activate when stopping at a traffic light. Of the following, the most likely cause is:

A. The HV battery state of charge is too low, causing the BMS to require continuous engine operation

B. The driver-side door is open while the vehicle is stopped at the traffic light intersection ahead

C. The vehicle's audio system volume is set above a programmed threshold for normal cabin operation

D. The exterior ambient temperature is between 60°F and 80°F, the typical sweet spot for auto-stop

35. An IGBT inside a hybrid inverter has failed in a short-circuited state. This condition will most likely cause:

A. The hybrid system to continue operating normally because the other IGBTs can compensate for the loss

B. A loss of cabin heat output because the IGBT is part of the heater control circuit downstream of the bus

C. An immediate inverter fuse or contactor opening due to overcurrent in the affected phase circuit

D. A gradual reduction in fuel economy over thousands of miles as the inverter efficiency degrades

36. A hybrid vehicle's NiMH battery pack uses cabin-air cooling. The customer complains of high battery temperature warnings during summer driving. The technician should first check:

A. The engine cooling system thermostat for proper operation and full thermostat opening behavior

B. The HV battery pack contactors for proper closing behavior during normal hybrid system startup

C. The exhaust system catalytic converter for proper light-off temperature during cold starts only

D. The battery cooling fan, ducts, and intake screen for blockage, debris, or fan motor failure issues

37. The high-voltage interlock loop on a typical hybrid vehicle is routed through:

A. Only the main HV battery service disconnect plug and no other HV components in the system

B. Each high-voltage connector along the orange cable path, forming a continuous series loop

C. Only the inverter and the DC-DC converter modules, bypassing the rest of the HV components

D. The vehicle's body control module and the radio antenna ground point for signal monitoring

38. The "one-hand rule" used during high-voltage diagnostic work refers to the practice of:

A. Keeping one hand behind the back or in a pocket while working near energized HV components

B. Using only one rubber insulating glove on the dominant hand to maintain manual dexterity for testing

C. Touching only one HV component at a time with a single insulated tool to limit possible exposure

D. Operating a scan tool with one hand while taking measurements with the other hand simultaneously

39. Inside a typical hybrid service disconnect plug, the technician will usually find:

A. A computer chip that signals the vehicle's hybrid control module that service is in progress

B. A small lithium-ion battery that powers the interlock signal during pack service operations

C. A high-current fuse that protects the HV system from short circuits during normal vehicle operation

D. A pressure switch that detects when the HV battery is venting gas during a thermal runaway event

40. The recommended sequence for de-energizing a hybrid HV system is:

A. Wait for capacitor discharge, remove service disconnect, place vehicle in park, turn ignition off

B. Place vehicle in park, turn ignition off, remove service disconnect, then wait for capacitor discharge

C. Remove service disconnect first, then place vehicle in park, wait for discharge, turn ignition off

D. Turn ignition off, remove service disconnect, place vehicle in park, then wait for capacitor discharge

41. When a hybrid drive motor operates in regenerative braking mode, the inverter:

A. Disconnects the motor from the HV bus to prevent the motor from drawing any current at all

B. Continues to deliver three-phase AC power to the motor at the same frequency as before regen

C. Switches the motor windings to a short-circuit configuration to provide maximum braking torque

D. Functions as a rectifier, converting the AC generated by the motor back into DC for the bus

42. The 12-volt auxiliary battery in many hybrid vehicles differs from a conventional flooded lead-acid battery in that it is typically:

A. An AGM (absorbed glass mat) sealed battery designed for deep-cycle service without sloshing electrolyte

B. A larger flooded lead-acid battery with extra capacity to support the hybrid control modules at startup

C. A lithium-ion battery with the same chemistry as the high-voltage pack to maintain compatibility

D. A nickel-metal hydride battery scaled down from the main HV battery for cost reduction purposes

43. When diagnosing a hybrid HV system fault, the technician should always start by:

A. Removing the HV service disconnect plug and beginning component-level testing immediately

B. Replacing the most likely failed component based on the customer's description of the symptom

C. Retrieving DTCs from all related modules and reviewing freeze frame data before any disassembly

D. Disconnecting the 12-volt battery to perform a system-wide reset of all hybrid related controllers

44. A hybrid vehicle's HV battery cooling fan runs at low speed continuously even while parked with the ignition off. This is:

A. A definite fault that indicates the cooling fan relay is stuck closed and requires immediate replacement

B. Normal operation if the battery temperature is elevated; the fan can run after key-off to cool the pack

C. A definite fault that indicates a leaking HV battery cell that is releasing gas through the vent system

D. Normal operation only for the first 30 seconds after key-off, after which the fan should always shut off

45. State of health (SOH) for a hybrid HV battery refers to:

A. The current temperature of the battery pack expressed as a percentage of its maximum allowable value

B. The instantaneous voltage of each cell expressed as a percentage of the nominal cell voltage rating

C. The state of charge of the battery pack expressed as a percentage of its full capacity rating

D. The remaining usable capacity of the battery expressed as a percentage of its original capacity

ANSWER KEY – PRACTICE EXAM 9 (Q1–Q45)

1. D — Lockout/tagout applied to the service disconnect socket is the OSHA- and NFPA 70E-required step to prevent re-energization during service. Signs and notifications do not physically stop another person from reinstalling the plug; only a lock and tag on the energy-isolating device itself do. The service plug socket is that device on a hybrid HV system.

2. A — Live-dead-live verifies that the meter is functional both before and after the critical zero-voltage reading on the HV bus. Confirming the meter on a known live source brackets the dead reading so the technician knows the meter wasn't quietly broken when zero was read. This is the foundational verification step for any HV de-energization.

3. B — 1.2 volts is the nominal NiMH cell voltage at normal operating temperature and state of charge. Total module and pack voltages are calculated from this value — for example, a Gen 2 Prius pack is 168 cells × 1.2 V = 201.6 V. Knowing the per-cell value is essential for interpreting BMS data.

4. C — Engine coolant temperature below the EV-mode threshold blocks engine-off operation because the catalyst must remain hot enough to meet emissions standards and the engine warm enough to restart smoothly. The system runs the engine to keep these conditions satisfied. Customers often describe this as "won't enter EV mode" on cold mornings.

5. A — Brake-by-wire systems require an OEM bleed and initialization procedure, often including pedal stroke sensor calibration, after any brake hydraulic work. Skipping the procedure leaves the controller with stale calibration data, producing the inconsistent regen blend the customer describes. The initialization step is not optional.

6. D — A hybrid inverter outputs pulse-width modulated voltage that the motor's inductance filters into a near-sinusoidal current. Observing a clean PWM envelope on the scope confirms the IGBTs are switching correctly. Square waves, DC, or sawtooth waveforms would all indicate malfunction.

7. B — HV cable shielding is grounded at the cable terminations, and a corroded or detached shield ground strap is the most common cause of shielding-circuit codes. The remaining cable is usually intact; the connection at the end is the weak link. Repair typically involves cleaning or replacing the strap and its termination point.

8. B — When all HV connectors appear seated, the next step is to back-probe the HVIL pins per the wiring diagram to verify continuity along the loop. An open inside a connector or a broken signal wire can produce the code even when the connector body looks normal. Replacing parts before verifying the loop electrically is unsupported by data.

9. A — Phase-to-phase resistance among the three motor leads is the standard test for inter-phase faults in a three-phase traction motor. The three readings should be nearly equal; a low or unbalanced reading indicates a shorted winding. A standard DMM on simple ohms can detect significant imbalance but not insulation breakdown, which requires a megohmmeter.

10. C — Coolant from a power electronics loop can carry leakage current if HV isolation has been compromised in the crash, so contact must be avoided until the system is verified de-energized. Treating it as ordinary engine coolant has caused first-responder injuries. The dielectric coolant itself is not normally conductive, but a damaged inverter can change that.

11. D — A cell with elevated internal resistance dissipates more power as heat under load because $P = I^2R$. Repeated high-current charge and discharge events heat the failing cell disproportionately, accelerating its degradation and risking thermal damage to adjacent cells. This is why BMS internal resistance trending is a key diagnostic.

12. A — A full face shield rated for arc flash is required PPE whenever HV connections are made or broken under load, because an arc fault can release thermal and pressure energy far beyond what safety glasses can stop. Safety glasses alone are inadequate for live HV work. Most hybrid work is performed de-energized, but live work demands the higher-rated face protection.

13. C — DC fast charging delivers direct current straight to the HV battery pack, bypassing the vehicle's onboard charger entirely. Because rectification happens in the off-board station, much higher power levels are practical than with AC charging. The OBC is not in the current path during Level 3 charging.

14. B — Bidirectional control through the scan tool is the most direct way to test an electric coolant pump because it commands the pump on through the normal control circuit. Verification is by feel, sound, hose temperature, or current draw on the supply lead. This isolates the pump from intermittent control logic without unnecessary disassembly.

15. D — A "Stop Vehicle and Park Safely" message indicates a fault serious enough that continued operation could damage the system or endanger the occupants. The technician must retrieve codes

immediately and avoid driving the vehicle further until the cause is identified. Treating this warning casually is a serious safety lapse.

16. A — Memory effect in NiMH cells is a reversible reduction in usable capacity that develops when cells are repeatedly cycled within a narrow charge range, causing the cell to "remember" the limited window. Full deep discharge and recharge cycles can recover the lost capacity. The phenomenon is more pronounced in NiCd but is also present in NiMH chemistry.

17. C — The OEM-specified discharge time exists because the inverter's internal bleed resistors require that much time to bring bus capacitor voltage to a safe level. Cutting the time short risks contact with stored charge. After waiting the full time, verification with a CAT III meter confirms the bus is actually dead.

18. C — The second-generation Prius pack contains 168 NiMH cells in series at a nominal 1.2 V each, producing 201.6 V. This was the standard configuration through Gen 3 as well. Knowing the expected pack voltage is essential for interpreting BMS readings and diagnosing low-voltage faults.

19. B — In a series hybrid, all motive power passes through the electrical chain: engine drives a generator, the generator feeds the inverter (and optionally the battery), and the inverter supplies the drive motor that turns the wheels. The engine has no mechanical link to the wheels. Each conversion step has losses, which is why series hybrids work best when battery storage smooths the load.

20. A — Hybrid brake systems include a direct hydraulic failsafe path so that loss of brake-by-wire control still allows the driver to stop the vehicle using master cylinder pressure on the front brakes. This preserves stopping capability for emergencies. Regulatory and OEM design standards mandate this fallback.

21. D — At steady highway cruise, the Toyota power-split routes most engine torque through the planetary carrier to the wheels mechanically, while MG1 acts as a generator on the sun gear and feeds electricity that MG2 (on the ring gear) adds to the output. This split-power flow is the defining feature of the architecture. Pure electric and pure mechanical extremes occur only briefly during transients.

22. C — The internal bleed-down resistors are permanently wired across the bus capacitors to bring residual voltage to a safe level after the main contactors open. They are the reason the OEM-specified wait time exists. Without bleed resistors, capacitor charge could remain dangerous for hours after shutdown.

23. B — Thermal runaway in a lithium-ion cell is a self-propagating exothermic reaction: a damaged cell heats, decomposes its electrolyte and electrode materials, releases more heat, and ignites neighboring cells. Once started, it can be very difficult to stop. This is why packs are designed with thermal barriers and venting to limit propagation.

24. A — A 170 mV delta between minimum and maximum lithium-ion cells exceeds typical pack imbalance specifications, which are usually held under 50 mV at rest. Imbalance of this magnitude indicates one or more cells aging or failing. Trending cell-level voltages and following OEM procedures locates the affected modules.

25. D — Engine coolant has higher electrical conductivity than the specialized dielectric coolant used in power electronics loops, so it creates leakage current paths between HV bus components and the coolant jacket. Over time the isolation monitor sees the leakage and sets an isolation fault. Using the wrong coolant is one of the most damaging service errors on a hybrid.

26. C — The interlock signal in the service plug is a low-voltage circuit that tells the hybrid control module the pack is being serviced; the module keeps the main contactors commanded open until the plug is reinstalled. This is what makes service plug removal a safe isolation step. The plug body physically opens the HV path, and the interlock ensures the contactors stay open as well.

27. A — Damaged HV cables cannot be field-spliced, taped, or jumpered because the insulation and shielding systems are engineered as a unit and must maintain rated dielectric strength along the entire length. The OEM repair procedure is to replace the cable as a complete assembly. Any improvised repair will eventually fail and cause an isolation fault.

28. B — A momentary AC supply interruption causes the EVSE to drop the control pilot, and on restoration the vehicle and EVSE re-handshake and resume the charging session automatically. This is part of the J1772 protocol. The customer typically sees only a brief charging interruption and not a permanent stop.

29. D — A vehicle running in ready mode must have HV present at the inverter input; a scan tool reading of 0 V therefore indicates a sensor or wiring fault in the inverter voltage monitoring circuit, not a real absence of voltage. Acting on the false reading without verification with an external meter risks misdiagnosis. Confirming pack output with a proper meter resolves the question quickly.

30. A — PAG oil is incompatible with electric A/C compressor windings; once it has contaminated the system, the only reliable remedy is a complete flush plus replacement of the compressor, accumulator, and orifice tube or expansion valve. Additives cannot reverse the contamination. Leaving PAG in the system guarantees repeat compressor failure.

31. C — Passive cell balancing discharges the highest-voltage cells through small bleed resistors built into the BMS, dissipating excess charge as heat to bring cells back to a common level. It is simpler and cheaper than active balancing but less efficient because it wastes energy. Most modest-capacity hybrid packs use passive balancing.

32. B — Hybrid drive motors generate substantial heat at high current and must be cooled by a liquid coolant loop, typically routed through internal motor passages or jackets around the stator. Air cooling alone cannot remove the heat at full power. The same loop that cools the inverter often cools the motor on integrated transaxles.

33. D — Before reinstalling the service disconnect, the technician must verify every HV connection is properly torqued, fully seated, and that the system is ready to power up safely. A loose or unseated connector after service can cause an HVIL fault, an arc, or an isolation fault. The verification step is part of the documented service procedure.

34. A — Low HV battery state of charge inhibits auto-stop because the system needs sufficient charge to restart the engine and to power accessories during the stop. The BMS keeps the engine running to recharge the pack. Customers who never let the battery recover often see this complaint.

35. C — A short-circuited IGBT creates a low-impedance phase fault that draws excessive current the instant the contactor closes. Protection devices — fuses, contactors, or both — open immediately to limit damage. The vehicle becomes inoperative and a hard inverter fault code is set.

36. D — Air-cooled NiMH packs depend on unrestricted airflow through the cabin air intake, the ducting, the fan, and the pack exit. Blocked intake screens, debris in ducts, or a failed fan are by far the most common causes of high battery temperature warnings in summer. Cleaning the air path resolves most of these cases.

37. B — The HVIL is a continuous series loop that passes through every orange HV connector on the vehicle, so disturbing any connector breaks the loop and signals the contactors to open. This is the protection mechanism that lets technicians safely separate HV connections. Routing the loop through every connector is what makes it effective.

38. A — The one-hand rule is the safety practice of keeping one hand behind the back or in a pocket while working near energized HV components, so any accidental shock cannot complete a current path across the chest. Heart-line currents are the most dangerous. This practice is taught alongside PPE and de-energization procedures.

39. C — Most hybrid service plugs contain a high-current fuse in addition to the disconnect contacts, providing pack-level short-circuit protection during normal operation and physical isolation during service. The fuse opens if a downstream short draws fault current. Inspecting the fuse is part of any service plug replacement.

40. B — The correct sequence is park, ignition off, remove service disconnect, then wait the specified capacitor discharge time, then verify zero voltage with a meter. Each step is a prerequisite for the next. Performing them out of order can leave the system energized at a stage where the technician believes it is safe.

41. D — In regen, the motor produces three-phase AC, and the inverter's IGBTs (or their body diodes) operate as a rectifier, converting the AC back into DC that flows onto the bus and into the battery. The same hardware functions as inverter under acceleration and as rectifier under regen. This dual-direction capability is what makes regenerative braking possible.

42. A — Many hybrids use AGM (absorbed glass mat) 12-volt batteries because they tolerate the deep cycling demanded by frequent engine auto-stops and HV system wake-ups, and they will not spill electrolyte when mounted in unconventional locations. AGM construction also gives the vibration resistance needed for hybrid duty. Replacement with a standard flooded battery shortens life dramatically.

43. C — Hybrid HV diagnosis always begins with retrieval of DTCs from every related module and review of freeze frame data, because that data narrows the search before any disassembly or component

testing is done. Acting before reviewing the data is parts-cannon diagnosis. The data-first rule applies even to symptoms that seem obvious.

44. B — The battery cooling fan can continue running at low speed after key-off if the BMS sees an elevated pack temperature, to bring the pack back into its safe range before the vehicle is next started. This is normal protective behavior. The fan shuts off automatically when the pack reaches target temperature.

45. D — State of health (SOH) is defined as the remaining usable capacity of a battery expressed as a percentage of its original new-battery capacity, a measure of how much the pack has aged. SOH is distinct from state of charge (SOC), which is the present level of charge in the available capacity. SOH trending tracks battery degradation over the vehicle's life.