# PRACTICE EXAM 6: ASE L3 SIMULATION (45 Questions)

1. A hybrid vehicle has set a code indicating an HV isolation fault. This code most commonly indicates that:

A. The 12 V auxiliary battery has dropped below the minimum threshold for operation

B. The high-voltage battery pack has exceeded its maximum allowable state of charge

C. Insulation resistance between an HV conductor and chassis ground has fallen below spec

D. The inverter coolant temperature has risen above the maximum allowable operating limit

2. Class 0 rubber insulating gloves used for hybrid HV service work are rated for use up to:

A. 1,000 volts AC and must be electrically tested every six months

B. 500 volts AC and must be electrically tested every twelve months

C. 7,500 volts AC and must be electrically tested every twenty-four months

D. 17,000 volts AC and must be electrically tested every three months

3. Two technicians are discussing high-voltage warning labels on a hybrid vehicle. Technician A says the orange-and-black HV warning labels indicate where the technician may safely cut or splice the cable. Technician B says the labels identify locations where dangerous voltages are present and special precautions are required. Who is correct?

A. Technician A only

B. Technician B only

C. Both A and B

D. Neither A nor B

4. The coolant used in a hybrid vehicle's power electronics cooling loop differs from standard engine coolant in that it must:

A. Contain a higher concentration of ethylene glycol than conventional engine coolant uses

B. Operate at a much higher temperature range to match the inverter heat output specifications

C. Provide additional corrosion protection for aluminum engine block passages and head surfaces

D. Maintain low electrical conductivity to prevent leakage current paths inside the inverter

5. On a Toyota-style power-split hybrid, the motor-generator that is most often used to start the internal combustion engine and to act as a generator during normal operation is:

A. MG1, connected to the sun gear of the planetary gear set inside the transaxle

B. MG2, connected to the ring gear and to the final drive output of the transaxle

C. Both MG1 and MG2, sharing starter duties equally in continuously alternating cycles

D. The conventional 12-volt starter motor mounted on the engine block bell housing

6. On most hybrid vehicles, the manual service disconnect (service plug) is located:

A. Inside the engine compartment near the inverter assembly mounting bracket bolts

B. Under the steering column near the brake pedal bracket above the carpet panel

C. On or near the high-voltage battery pack, often accessed through a removable cover

D. Behind the rear bumper cover above the muffler heat shield mounting clip area

7. The pre-charge resistor in a hybrid vehicle's HV system serves to:

A. Limit the current flowing through the 12-volt control circuit during normal driving

B. Reduce voltage spikes when the regenerative braking system sends energy to the pack

C. Charge the inverter bus capacitors gradually before the main contactors fully close

D. Discharge the inverter bus capacitors safely after the service plug has been removed

8. A hybrid vehicle has set codes indicating an inverter overtemperature condition. Before condemning the inverter, the technician should:

A. Replace the engine coolant thermostat and verify the engine reaches full operating temperature

B. Inspect the inverter coolant loop, pump, hoses, and radiator for restriction, air, or pump failure

C. Replace the 12-volt auxiliary battery and clear the codes before attempting any further testing

D. Drive the vehicle hard for several minutes to allow the system to perform a self-calibration

9. Electric power steering on a hybrid vehicle uses an electric motor that draws current from:

A. The high-voltage battery pack directly through an isolated three-phase orange cable

B. A dedicated 48-volt auxiliary battery mounted next to the main HV battery enclosure

C. The engine-driven alternator output regulated through a separate steering control module

D. The 12-volt system, which is in turn supplied from the HV pack via the DC-DC converter

10. Compared to lithium-ion, nickel-metal hydride (NiMH) hybrid battery cells:

A. Have lower energy density and a more pronounced memory effect when partially cycled

B. Have higher energy density and require active liquid cooling to manage cell temperature

C. Use a flammable lithium-based electrolyte that requires specialized fire suppression methods

D. Operate at a nominal cell voltage of 3.7 volts and require strict balancing during charging

11. A technician is performing an isolation resistance test on a hybrid vehicle's HV system using an OEM-approved megohmmeter. The test should be performed:

A. With the HV system fully energized and the vehicle in ready mode during the measurement

B. After the HV system has been properly disabled and the inverter bus capacitors have discharged

C. With the 12-volt battery disconnected but the HV service plug still installed and locked in place

D. During engine cranking so that the system is under load while the resistance reading is taken

12. The DC-to-DC converter on a hybrid vehicle most commonly fails in a mode that produces:

A. A code for high-voltage isolation loss between the converter input and chassis ground

B. An immediate fire originating in the high-voltage cable between the battery and inverter

C. A loss of regenerative braking function without affecting any other system on the vehicle

D. A discharged 12-volt battery, control module shutdowns, and a vehicle that will not start

13. Regenerative braking effectiveness on a hybrid vehicle is reduced when the:

A. Engine is operating at idle and the catalytic converter has reached normal temperature

B. Vehicle is being driven at highway speed on a level road with the cruise control engaged

C. High-voltage battery is near full state of charge or pack temperature is at the upper limit

D. Driver applies moderate brake pressure during deceleration from city driving speed range

14. A scan tool used on hybrid vehicles must be capable of:

A. Accessing OEM-specific hybrid modules including battery, inverter, and motor control units

B. Reprogramming the high-voltage battery pack contactors using generic CAN bus commands

C. Performing isolation resistance tests at 500 volts DC through the OBD-II diagnostic connector

D. Discharging the inverter bus capacitors automatically during HV system service procedures

15. When routing a replacement orange high-voltage cable on a hybrid vehicle, the technician must:

A. Allow the cable to contact metal body panels for shielding from radiated electromagnetic energy

B. Use ordinary nylon zip ties wrapped tightly around the cable to secure it to nearby brake lines

C. Route the cable across the exhaust system to take advantage of the heat shielding already in place

D. Follow the OEM-specified routing and use the original mounting clips and protective conduit

16. A digital multimeter used to verify zero voltage on a hybrid HV system must be rated at minimum:

A. CAT I 300 V because the readings are taken with the system already de-energized for safety

B. CAT II 600 V because hybrid systems are considered low-voltage receptacle-level circuits

C. CAT III 600 V because the readings are not on a primary distribution circuit during testing

D. CAT III 1000 V because hybrid HV systems can produce dangerous transients above 600 volts

17. Two technicians are discussing the procedure for bleeding air from a hybrid vehicle's inverter cooling loop. Technician A says the loop can be filled and bled using the same procedure as a conventional engine cooling system. Technician B says the loop usually requires an OEM-specific procedure that may include a vacuum fill tool or an electric pump activation through a scan tool. Who is correct?

A. Technician A only

B. Technician B only

C. Both A and B

D. Neither A nor B

18. A hybrid vehicle's engine refuses to auto-stop at traffic lights even though it does so on other trips. The most likely cause is that:

A. The 12-volt battery state of charge is low or the cabin temperature is outside the allowable range

B. The HV battery contactors have welded shut and cannot be commanded open by the control module

C. The DC-DC converter has failed and is unable to supply current to the 12-volt accessory system

D. The traction motor resolver has lost its calibration and requires a relearn procedure with a scan tool

19. A hybrid vehicle's HV battery uses a liquid thermal management system. The most common purpose of this system is to:

A. Recover heat from the battery pack and route it to the cabin heating core in cold weather

B. Convert excess electrical energy into thermal energy that can be stored for later vehicle use

C. Maintain cell temperature within an optimal range for performance, efficiency, and long life

D. Keep the battery pack pressurized to prevent atmospheric moisture from entering the modules

20. Two technicians are discussing the high-voltage interlock loop (HVIL). Technician A says the HVIL is part of the HV circuit and carries the same voltage as the orange cables. Technician B says the HVIL is a low-voltage signal loop that commands the contactors open when an HV connector is disturbed. Who is correct?

A. Technician A only

B. Technician B only

C. Both A and B

D. Neither A nor B

21. A hybrid vehicle exhibits intermittent loss of propulsion accompanied by a check hybrid warning lamp. The best initial diagnostic step is to:

A. Replace the high-voltage battery pack since intermittent power loss almost always points to a cell fault

B. Replace the inverter assembly because intermittent loss of propulsion points to an IGBT switching failure

C. Disconnect the 12-volt battery for 30 minutes to perform a system-wide reset before any other testing

D. Retrieve all DTCs, freeze frame data, and module data from every hybrid-related module with a scan tool

22. Before any high-voltage service work, the technician should establish a safety boundary around the vehicle that:

A. Prevents unqualified personnel from entering the work area while HV components are exposed

B. Restricts ventilation in the work area to contain any battery off-gassing from leaking modules

C. Allows technicians from other repair bays to walk freely through the area to view the procedure

D. Requires a continuous ground wire to be connected between the vehicle and the building structure

23. Active cell balancing in a lithium-ion hybrid battery pack works by:

A. Discharging the highest-voltage cells through bleed resistors at all times when at rest

B. Heating high-voltage cells with internal heating elements to bring them to nominal level

C. Transferring charge from higher-voltage cells to lower-voltage cells using switched circuitry

D. Disconnecting the lowest-voltage cells from the pack when their internal resistance climbs

24. A plug-in hybrid's onboard charger (OBC) is the component that:

A. Converts AC input from the EVSE into the DC voltage needed to charge the HV battery

B. Converts DC voltage from the HV battery into 120-volt AC household power for accessories

C. Detects whether the EVSE is delivering Level 1 or Level 2 power through the proximity pilot

D. Controls the proximity and control pilot signals on the J1772 connector during disconnect

25. Two technicians are discussing the lubricant used in a hybrid transaxle that contains MG1 and MG2 immersed in the same housing as the gears. Technician A says ordinary GL-5 gear oil is correct. Technician B says any ATF spec'd for a conventional automatic transmission is acceptable. Who is correct?

A. Technician A only

B. Technician B only

C. Both A and B

D. Neither A nor B

26. The stator of a typical hybrid traction motor is constructed of:

A. A solid cast iron core with stamped copper terminals to handle the high motor current loads

B. Laminated steel with three sets of insulated copper windings arranged for three-phase operation

C. A wound aluminum coil with permanent neodymium magnets mounted on the inside core surfaces

D. A single helical winding of copper wire wrapped continuously around a ceramic insulator core

27. A J1772 charging connector for plug-in hybrids carries:

A. DC current only, in the range of 50–500 amps depending on the charging session level

B. Three-phase AC current for direct connection to commercial 480-volt charging stations

C. Single-phase AC current along with control pilot and proximity pilot signal pins for the EVSE

D. Both AC and DC current simultaneously, switched internally by the onboard charging module

28. A hybrid vehicle's ground fault detection circuit monitors:

A. Insulation resistance between each HV bus conductor and the vehicle chassis ground

B. The voltage difference between the two terminals of the 12-volt auxiliary battery only

C. Current flow through the chassis grounding strap that bonds the engine to the body

D. The position of the HV main contactors using a Hall-effect sensor mounted nearby

29. A hybrid HV battery pack typically incorporates a vent line that:

A. Allows fresh outside air to enter the pack continuously during normal vehicle operation

B. Carries engine exhaust around the battery enclosure to warm the modules in cold weather

C. Routes A/C refrigerant through the pack to cool individual modules during heavy operation

D. Routes any battery off-gassing safely to a designated location outside the passenger cabin

30. As a hybrid traction motor's rotational speed increases, the inverter must:

A. Decrease the frequency of the three-phase AC output supplied to the motor stator windings

B. Maintain a constant frequency regardless of motor speed to preserve smooth torque output

C. Increase the frequency of the three-phase AC output to match the rotor's mechanical speed

D. Disconnect the motor from the bus once the maximum allowable RPM threshold is exceeded

31. A hybrid vehicle uses an electric A/C compressor instead of a belt-driven compressor because:

A. Electric compressors use less expensive refrigerant than conventional belt-driven systems do

B. Cabin cooling must continue when the engine auto-stops at traffic lights and other stops

C. The high-voltage system requires a high refrigerant flow rate for the inverter cooling loop

D. Electric compressors operate at much lower pressure than belt-driven mechanical compressors

32. A hybrid vehicle's DC-to-DC converter is shorted internally. The most likely customer complaint is:

A. The vehicle accelerates more aggressively than normal under light throttle pedal input

B. The headlamps brighten noticeably when the regenerative braking system is activated

C. The cabin heater output drops significantly even though the engine is warm and idling

D. The vehicle becomes inoperative because the 12-volt system loses charge and modules shut off

33. The function of the pre-charge contactor circuit in a hybrid HV system is to:

A. Slowly bring the inverter bus voltage up to battery level before the main contactor closes

B. Disconnect the HV battery automatically whenever the vehicle exceeds highway speed limits

C. Provide a redundant high-voltage path that bypasses the main contactor in case of failure

D. Trigger an audible warning whenever the inverter detects an HV system isolation fault

34. The proximity pilot pin on a J1772 charging connector signals to the vehicle that:

A. The high-voltage battery has reached its target state of charge and charging may stop

B. The EVSE is supplying maximum available current for the duration of the entire session

C. The charging connector is physically inserted, allowing the vehicle to inhibit propulsion

D. The vehicle has detected an isolation fault and is requesting the EVSE to terminate power

35. Two technicians are discussing the shielding around a hybrid vehicle's three-phase orange HV cables. Technician A says the metal shielding is purely decorative and has no functional purpose. Technician B says the shielding contains electromagnetic interference and provides a path for fault current detection. Who is correct?

A. Technician A only

B. Technician B only

C. Both A and B

D. Neither A nor B

36. A hybrid vehicle with a driveability complaint is checked with a generic OBD-II scan tool. The tool reports no codes, yet the hybrid warning lamp is illuminated on the dash. The technician should:

A. Clear the dash warning lamp with the generic tool and release the vehicle to the customer

B. Replace the instrument cluster because the lamp is illuminated with no DTCs available

C. Replace the hybrid battery pack as a precaution since the warning lamp typically points to a battery issue

D. Use an enhanced/OEM-level scan tool to access hybrid-specific module codes the generic tool cannot read

37. A welded main contactor in a hybrid HV battery pack will most commonly be diagnosed by:

A. A scan tool showing measured HV pack voltage at the inverter input with the system commanded off

B. A loud popping noise audible inside the cabin during normal vehicle acceleration and braking

C. The dashboard fuel gauge showing erratic readings whenever the vehicle is driven over rough roads

D. A code indicating that the 12-volt auxiliary battery has dropped below the minimum threshold

38. A typical hybrid HV battery module contains multiple cells connected in series so that:

A. Each cell operates at a fraction of the rated voltage to reduce overall module output stress

B. The total module voltage is the sum of the individual cell voltages connected end-to-end

C. The total module current is the sum of the individual cell currents added in parallel paths

D. Cells can be charged independently of one another by the battery management system at any time

39. A hybrid vehicle has set a single intermittent DTC. The most useful information for diagnosing this code is found in:

A. The owner's manual section describing routine maintenance intervals and service procedures

B. The vehicle identification number decoded into engine, transmission, and option content fields

C. The freeze frame data captured at the moment the DTC was set by the originating control module

D. The historical mileage and date stamp of the most recent oil change performed on the vehicle

40. A typical OEM specification for the minimum acceptable isolation resistance between an HV conductor and chassis ground on a hybrid vehicle is approximately:

A. 10 ohms or higher at any nominal HV pack voltage applied during the resistance test

B. 100 ohms per volt of pack voltage, measured with an approved megohmmeter test device

C. 1 ohm per volt of pack voltage when the pack is fully discharged before the resistance test

D. 0.1 ohms per volt of pack voltage when the pack is partially charged during operation

41. Hybrid vehicle coolant used in the inverter and motor cooling loop is typically:

A. Identical to the engine coolant and may be freely shared between the two loops at any time

B. A high-conductivity glycol mix designed to dissipate heat efficiently across the cold plates

C. A salt-water-based solution that provides excellent thermal transfer at low operating cost

D. A low-conductivity, dielectric-rated coolant specifically formulated for power electronics use

42. Following a serious collision involving a hybrid vehicle, the first responder or technician should:

A. Cut all orange high-voltage cables immediately to ensure the system cannot deliver power

B. Treat the vehicle as if all HV cables and components are still energized until verified de-energized

C. Pour large quantities of water onto the HV battery pack to discharge any remaining stored energy

D. Connect a jumper wire between the HV positive terminal and chassis ground to drain the pack

43. The resolver mounted on a hybrid drive motor provides the inverter with information about:

A. The temperature of the rotor and stator assembly during all phases of motor operation

B. The total current flowing through the three-phase windings during periods of high torque

C. The angular position and rotational speed of the motor rotor relative to the stator

D. The mechanical torque output delivered to the transmission output shaft during driving

44. After replacing a high-voltage component on a hybrid vehicle, the technician must:

A. Drive the vehicle for at least 100 miles before performing any post-repair verification at all

B. Clear all stored codes and immediately release the vehicle without any verification steps

C. Wait 24 hours before powering up the system to allow the new component to acclimate properly

D. Perform isolation resistance testing, a full system scan, and a road test to verify proper operation

45. The high-voltage interlock loop (HVIL) on a hybrid vehicle commands the main HV contactors to open when:

A. Any HV connector along the loop is disturbed or unseated during normal vehicle operation

B. The 12-volt auxiliary battery voltage exceeds the maximum threshold programmed in the module

C. The vehicle's audio system is operated continuously above its maximum rated volume setting

D. The hybrid system exceeds the engine speed limit programmed into the powertrain control module

## ANSWER KEY — PRACTICE EXAM 6 (Q1–Q45)

**1. C** — An HV isolation fault code is triggered when insulation resistance between an HV bus conductor and chassis ground drops below the manufacturer's threshold. The ground fault detection circuit continuously monitors this resistance to detect leakage paths that could energize the chassis. Setting this code commands the contactors open as a protective measure to prevent shock hazard.

**2. A** — Class 0 rubber insulating gloves are rated for use on circuits up to 1,000 V AC per ASTM D120. OSHA 1910.137 requires that rubber insulating gloves be electrically tested every six months when in service. Using out-of-test or out-of-class gloves removes the dielectric protection required for safe HV work.

**3. B** — Orange-and-black HV warning labels exist solely to alert workers to dangerous voltage and required precautions; HV cables and assemblies must never be cut, spliced, or modified. The labels mark hazard zones, not access points. Ignoring the label can result in fatal shock or arc-flash injury.

**4. D** — Inverters and motors are cooled with a coolant formulated to maintain very low electrical conductivity, preventing leakage current paths from forming between HV bus bars, windings, and the coolant jacket. Standard ethylene-glycol engine coolant is too conductive and will eventually cause an isolation fault. This is why hybrid power-electronics loops use a separate dedicated coolant.

**5. A** — In a Toyota-style power-split, MG1 is connected to the sun gear of the planetary set and functions both as the engine starter and as a generator during normal operation. MG2 is the primary traction motor connected to the ring gear and final drive. Confusing the two leads to misdiagnosis of no-start and charging concerns.

**6. C** — The manual service disconnect is mounted on or next to the high-voltage battery pack, typically behind a removable cover in the trunk, under a rear seat, or in a battery enclosure access panel. Locating it there allows the technician to physically open the pack's internal series circuit at its source. This mechanical disconnect is the foundation of HV de-energization.

**7. C** — The pre-charge resistor limits inrush current as the inverter bus capacitors charge from zero up to battery voltage, after which the main contactor closes onto an already-equalized bus. Without pre-charge, the surge current would arc and weld the main contactor contacts. The circuit protects both the contactor and the capacitor bank during every power-up.

**8. B** — Inverter overtemperature codes point to inadequate heat removal far more often than to inverter component failure itself. Coolant pump failure, air pockets, blocked radiator passages, or low coolant level all produce these codes. Verifying the cooling system before replacing the inverter saves an expensive misdiagnosis.

**9. D** — Electric power steering motors on hybrids draw current from the 12-volt system, which is in turn supplied by the HV battery through the DC-DC converter. EPS does not require an orange HV feed because the steering motor's power demand is modest. This arrangement preserves steering assist even during engine auto-stop.

**10. A** — NiMH cells have roughly half the energy density of lithium-ion cells and exhibit a more pronounced memory effect when partially cycled. They are heavier and bulkier for a given capacity but tolerate forced-air cooling and are robust against abuse. These differences explain why newer designs are shifting toward lithium-ion.

**11. B** — Isolation resistance testing must be performed with the HV system properly disabled and the inverter bus capacitors fully discharged so the megohmmeter is not subjected to live HV and the reading is valid. Testing on a live system risks damaging the meter and injuring the technician. The de-energized state also gives an uncontaminated reading.

**12. D** — A failed DC-to-DC converter can no longer charge the 12-volt auxiliary battery; modules brown out, the HV system cannot be commanded on, and the vehicle becomes inoperative. This is a common hybrid no-start pattern that mimics a dead 12-volt battery. Verifying DC-DC output is part of any hybrid no-start diagnostic procedure.

**13. C** — Regenerative braking is reduced or disabled when the HV battery is at or near full state of charge or when pack temperature is at the upper limit, because the battery cannot safely accept additional charge. The BMS limits regen and the brake controller compensates with more friction braking. Drivers may notice this as a slight change in pedal feel.

**14. A** — Hybrid diagnosis requires a scan tool capable of accessing OEM-specific modules including the battery, inverter, and motor control units, where almost all hybrid-specific DTCs and live data live. Generic OBD-II tools see only generic powertrain codes and miss the diagnostic information that matters. Without OEM-level access, hybrid-specific concerns cannot be diagnosed.

**15. D** — A replacement HV cable must be routed exactly per OEM specification, using the original mounting clips, conduit, and standoff brackets, to prevent abrasion, heat damage, and EMI coupling. Improvised routing or generic fasteners can cause insulation damage and isolation faults. The OEM routing has been engineered to keep HV away from sharp edges, hot surfaces, and signal wiring.

**16. D** — Hybrid HV systems can produce dangerous voltage transients well above their nominal operating level, so the multimeter must be rated CAT III at 1000 V minimum to safely contain those transients within the meter body. A lower-category meter can flash over internally and expose the technician to the full bus voltage. The category rating is a safety specification, not an accuracy claim.

**17. B** — Power-electronics cooling loops contain intricate paths through the inverter, motor cooler, and electric pump that trap air more readily than an engine cooling system. OEM bleed procedures typically require a vacuum fill tool or scan-tool-commanded pump activation to purge the loop. Skipping this procedure leaves air pockets that cause overheating and code-setting.

**18. A** — Auto-stop is inhibited by a long list of conditions, the most common of which are a low 12-volt battery state of charge and a cabin climate demand outside the allowable range. The system needs reliable 12 V to restart and may suppress auto-stop to preserve cabin comfort. Customers often report intermittent auto-stop without a stored DTC.

**19. C** — Liquid thermal management on an HV battery exists to keep cell temperature within an optimal operating window — typically 20–40 °C — for best performance, energy efficiency, and cycle life. Cells outside that window deliver less power, accept less regen, and age faster. Temperature control is critical to meeting warranty life on the pack.

**20. B** — The high-voltage interlock loop is a low-voltage signal circuit routed through every orange HV connector; when the loop opens, the hybrid control module immediately commands the main contactors open. The loop itself carries milliamps of signal current, not HV. Its purpose is to protect technicians by disconnecting HV the instant a connector is disturbed.

**21. D** — The first step in any hybrid driveability concern is a comprehensive retrieval of DTCs, freeze frame data, and module data from every hybrid-related controller. Replacing parts without that information is parts-cannon diagnosis and routinely leads to expensive misdiagnoses. Data-driven diagnostics are non-negotiable on hybrid systems.

**22. A** — A safety boundary marked by cones, signs, or barriers prevents unqualified personnel from entering the work zone where HV components may be exposed. This is required by OSHA, NFPA 70E, and OEM service procedures. Unauthorized contact with energized HV components is the most common cause of shop HV injuries.

**23. C** — Active cell balancing transfers charge from higher-voltage cells to lower-voltage cells through switched DC-DC circuitry, redistributing energy rather than wasting it. Passive balancing, by contrast, dissipates excess cell charge through bleed resistors as heat. Active balancing is more efficient and is increasingly common on larger lithium-ion packs.

**24. A** — The onboard charger rectifies and regulates incoming AC from the EVSE into the DC voltage required to charge the HV battery pack. Its capacity sets the maximum Level 1 and Level 2 charging speed. A failed OBC results in no AC charging even when the EVSE is connected and signaling correctly.

**25. D** — Hybrid transaxles with immersed motor-generators require a specially formulated low-electrical-conductivity ATF (such as Toyota WS) that protects motor windings from leakage current. Conventional ATF and GL-5 gear oil are both incompatible — conventional ATF is too conductive and gear oil lacks the friction and electrical specs required. Using the wrong fluid can cause shorted windings and motor failure.

**26. B** — A typical hybrid traction motor stator is built from laminated steel with three sets of insulated copper windings arranged 120° apart for three-phase operation. The laminations limit eddy-current losses, and the three winding sets create the rotating magnetic field that drives the rotor. This construction supports the high-frequency switching commanded by the inverter.

**27. C** — The J1772 connector carries single-phase AC current together with control pilot and proximity pilot signals between the EVSE and the vehicle. It is used for Level 1 and Level 2 AC charging only; DC fast charging uses CCS or CHAdeMO connectors. Understanding the pin functions is essential for diagnosing charging concerns.

**28. A** — The ground fault detection circuit continuously monitors insulation resistance between each HV bus conductor and chassis ground. When the resistance falls below threshold, the module sets an isolation code and commands the contactors open. This monitor is the front line of HV occupant and technician safety.

**29. D** — HV battery packs include a vent line that safely routes any off-gassing — particularly from a cell thermal event or electrolyte vaporization — to a designated location outside the passenger cabin. The vent protects occupants from toxic or flammable gases. A pinched or rerouted vent line creates a serious cabin safety hazard.

**30. C** — As motor rotational speed increases, the inverter increases the frequency of the three-phase AC output proportionally so the rotating stator field stays synchronized with the rotor. Frequency and speed must track each other for the motor to produce smooth torque. This is the fundamental principle of variable-frequency drive operation.

**31. B** — Electric A/C compressors are used so cabin cooling can continue when the engine auto-stops at traffic lights and other low-speed events. A belt-driven compressor would stop with the engine and the cabin would warm up quickly. Maintaining cabin comfort through auto-stop is a key enabler of hybrid fuel economy.

**32. D** — A shorted DC-to-DC converter can no longer charge the 12-volt battery, and the 12-volt system loses charge until modules begin to shut down and the vehicle becomes inoperative. The customer often describes this as a dead battery or a vehicle that will not start. Confirming DC-DC output is essential in this diagnostic pattern.

**33. A** — The pre-charge circuit slowly brings the inverter bus voltage up to battery level through a resistor before the main contactor closes onto an equalized bus. Without pre-charge, the inrush current into the bus capacitors would weld the main contactor contacts on the first power-up. The pre-charge stage protects both the contactor and the power electronics.

**34. C** — The proximity pilot pin tells the vehicle that the J1772 connector is physically inserted, which the vehicle uses to inhibit propulsion so it cannot drive away while plugged in. The signal is independent of the control pilot, which negotiates current capacity. The PP function is what prevents drive-away damage to the charge cord.

**35. B** — The metal shielding around three-phase HV cables contains electromagnetic interference generated by inverter switching and provides a controlled return path that the isolation monitoring system uses to detect ground faults. The shield is functional, not cosmetic. Damaging or disconnecting the shield creates EMI issues and can defeat the GFD circuit.

**36. D** — A hybrid warning lamp with no generic OBD-II codes almost always means the relevant codes are stored in hybrid-specific modules that the generic tool cannot read. An enhanced or OEM-level scan tool is required to access those modules. Clearing the lamp or replacing parts without that data is poor practice.

**37. A** — A welded main contactor leaves HV pack voltage continuously present at the inverter input, even when the hybrid control module has commanded the contactors open. The scan tool displaying measured HV at the inverter with the system commanded off is the classic diagnostic indicator. This condition is a serious safety hazard and prohibits further HV work until corrected.

**38. B** — Cells connected in series add their individual voltages, so the module's total voltage equals the sum of the cells. Current through a series string is the same in every cell, not the sum. Understanding this is essential for interpreting module voltage readings during diagnosis.

**39. C** — Freeze frame data captures the vehicle's operating conditions at the exact moment the DTC was set — coolant temp, vehicle speed, load, SOC, and other parameters that may not be present during the current key cycle. For an intermittent code, freeze frame is often the only window into the conditions that caused the fault. Reading and interpreting freeze frame is central to hybrid diagnostics.

**40. B** — A commonly cited minimum acceptable isolation resistance on a hybrid HV system is approximately 100 ohms per volt of pack voltage, measured with an OEM-approved megohmmeter. Below that threshold, the leakage path could allow dangerous current onto the chassis. OEM specifications may be tighter, but 100 Ω/V is the generally accepted floor.

**41. D** — Power-electronics cooling loops use a low-conductivity, dielectric-rated coolant specifically formulated so leakage paths cannot form between HV bus bars and the coolant jacket. Using engine coolant in this loop will eventually trigger an isolation fault. The coolant is a safety-critical component, not a generic heat-transfer fluid.

**42. B** — After a serious collision, the first responder or technician must treat all HV cables and components as energized until verified de-energized with the proper procedure and a CAT III meter. Damage may have left contactors stuck closed or HV exposed. Cutting cables, pouring water, or improvising drains are unsafe and can be fatal.

**43. C** — The resolver provides the inverter with continuous, high-resolution feedback on the rotor's angular position and rotational speed relative to the stator. The inverter uses this information to synthesize the three-phase output in synchronization with the rotor magnets. Without accurate resolver input, the motor cannot produce smooth torque.

**44. D** — Post-repair verification on any HV component requires isolation resistance testing, a full system scan to confirm no codes, and a road test to verify functional operation under realistic conditions.

Releasing the vehicle without all three steps is unsafe and risks a comeback. Verification is part of the repair, not optional.

**45. A** — The HVIL is a low-voltage signal loop routed through every orange HV connector; disturbing or unseating any connector along the loop opens the circuit and immediately commands the main contactors open. This protects technicians and first responders from contacting live conductors. The loop's response is what makes orange connector disconnection a safe step.