

PRACTICE EXAM 3: ASE L3 SIMULATION (45 Questions)

1. A technician is preparing to disable the high-voltage system on a hybrid vehicle before replacing the inverter assembly. Which step should be performed first in the de-energization procedure?

- A. Remove the service plug from the HV battery pack housing
- B. Turn the ignition off and remove the key from the vehicle
- C. Disconnect the 12V auxiliary battery negative cable terminal
- D. Verify zero voltage at the inverter input terminals with a CAT III meter

2. A technician is testing a 200V nominal NiMH hybrid battery pack containing 30 modules. The measured pack voltage at the service disconnect is 234V at full charge. Which statement best describes this reading?

- A. The pack is undercharged and needs to be conditioned through the scan tool
- B. The pack voltage is too high and indicates an overcharge condition exists
- C. The reading is normal because module open-circuit voltage is about 7.8V each
- D. The pack should read exactly 200V at rest regardless of state of charge level

3. Required PPE for working on a high-voltage hybrid system during de-energization includes Class 0 rubber insulating gloves with leather protector covers. What is the maximum AC use voltage rating for Class 0 insulating gloves?

- A. 1,000 volts AC maximum use voltage rating
- B. 500 volts AC maximum use voltage rating
- C. 7,500 volts AC maximum use voltage rating
- D. 17,000 volts AC maximum use voltage rating

4. A hybrid vehicle is brought in with DTC P0AFA "Hybrid Battery Pack Voltage Sense A/B Correlation." All cell modules read within specification when individually measured. Which condition is the most likely cause of this fault?

- A. Failed 12V auxiliary battery affecting the hybrid control module power
- B. Open in the high-voltage service disconnect interlock signal circuit
- C. Contaminated electrolyte in one of the NiMH battery cell modules
- D. Open or high-resistance connection in a battery voltage sense wire

5. The inverter assembly on a hybrid vehicle uses IGBT transistors to convert DC to AC for the drive motor. What is the primary purpose of the boost converter located between the HV battery and the inverter?

- A. Step down battery voltage to a safer level for the motor stator windings
- B. Increase the DC bus voltage to optimize motor efficiency under high loads
- C. Filter electromagnetic interference generated by IGBT switching transitions
- D. Convert single-phase AC output to three-phase AC current for the drive motor

6. An MG2 motor/generator on a Toyota Hybrid Synergy Drive transaxle shows a resistance reading of 0.05 ohms between two of its three phase terminals, while the third phase reads 5.2 ohms to either of the others. What is the most likely cause?

- A. A shorted winding between two of the three motor phase coils
- B. Normal three-phase winding resistance readings for this type of motor
- C. An open winding fault in the third phase of the stator assembly
- D. Excessive insulation resistance present in all three phase windings

7. The electric A/C compressor on a hybrid vehicle requires a specific type of refrigerant lubricant. Why is this oil different from the oil used in conventional belt-driven A/C compressor systems?

- A. The oil must be thinner so it flows through smaller internal compressor passages

- B. The oil contains conductive additives that dissipate static charge from refrigerant
- C. The oil must have high dielectric properties to insulate internal motor windings
- D. The oil contains corrosion inhibitors specific to aluminum compressor components

8. A hybrid vehicle's 12V auxiliary battery is discharging repeatedly even though the vehicle is driven daily. The DC-DC converter output measures 14.2V steady when the vehicle is in READY mode. What should be checked next?

- A. Replace the 12V auxiliary battery with a higher amp-hour AGM-rated unit
- B. Check the HV battery state of charge while the vehicle is parked overnight
- C. Inspect the inverter cooling system for restricted coolant flow or air locks
- D. Check for parasitic drain and key-off current draw on the 12V auxiliary system

9. During an HV system de-energization, after removing the service plug, the technician must wait a manufacturer-specified time period before verifying zero voltage. Why is this waiting period required?

- A. Capacitors in the inverter and converter must discharge through internal bleed resistors
- B. The hybrid control module must complete its diagnostic shutdown and learning routine
- C. The cooling system must purge any residual coolant from the inverter heat exchanger
- D. The 12V auxiliary system needs time to reset all volatile control module memory data

10. A lithium-ion hybrid battery pack has individual cell voltages ranging from 3.6V to 3.9V at rest. The battery management system reports a "Cell Imbalance" code. What does this condition indicate?

- A. The pack is fully discharged and requires a complete deep-cycle recharge sequence
- B. One or more cells have different states of charge relative to the rest of the pack
- C. The battery cooling fan motor has failed creating a serious thermal runaway risk
- D. The high-voltage interlock loop has been compromised by an internal wiring fault

11. A planetary gear set in a power-split hybrid transaxle uses three main components to combine power from the engine and two motor/generators. Which component is typically driven by the engine in a Toyota Hybrid Synergy Drive transaxle?

- A. The ring gear which directly drives the differential and final drive output
- B. The sun gear which is mechanically connected to the smaller MG1 generator
- C. The pinion gears which mesh between the sun gear and the outer ring gear
- D. The planetary carrier which holds the pinion gears in their orbital position

12. An inverter on a hybrid vehicle uses an electric coolant pump that operates independently of the engine cooling system. What is the most common DTC trigger when this electric inverter coolant pump fails?

- A. Cell module temperature high fault inside the HV battery pack assembly area
- B. High-voltage interlock loop open circuit at the inverter access cover connector
- C. Inverter temperature high or inverter thermal protection mode activation code
- D. DC-DC converter output low voltage during periods of high-current load demand

13. An electric A/C compressor on a Prius is being diagnosed. The scan tool shows the compressor commanded ON at 4,000 RPM but the compressor is not running. The HV system is operating normally. What is the next best diagnostic step?

- A. Check insulation resistance from each compressor phase terminal to chassis ground
- B. Replace the A/C compressor assembly with a new updated factory replacement unit
- C. Recharge the refrigerant system to verify the low-pressure cutoff switch operation
- D. Reset all hybrid control module adaptive memory through the dealer scan tool menu

14. The brake-by-wire system on a regenerative braking hybrid vehicle uses a pedal stroke simulator assembly. What is the primary function of the stroke simulator in this electronic braking system?

- A. Convert mechanical pedal motion into an electrical signal sent to the brake ECU

- B. Provide normal pedal feel feedback to the driver while the system is in regen mode
- C. Apply hydraulic pressure to the rear brake caliper pistons during light braking events
- D. Measure pedal travel speed to determine emergency or panic braking driver inputs

15. Two technicians are discussing high-voltage cable repair on a hybrid vehicle. Technician A says splicing of orange high-voltage cables is acceptable using heat-shrink connectors rated for HV use. Technician B says any damaged HV cable must be replaced as a complete factory assembly. Who is correct?

- A. Technician A only is correct in this discussion
- B. Both Technician A and Technician B are correct
- C. Technician B only is correct in this discussion
- D. Neither Technician A nor Technician B is correct

16. A NiMH hybrid battery pack shows one module with consistently lower voltage than the others during heavy discharge cycles. The internal resistance of the suspect module is measured at 45 milliohms while the surrounding modules measure 18 milliohms. What action is most appropriate?

- A. Charge the entire pack to maximum SOC and recheck module voltage balance
- B. Run a complete battery conditioning cycle three times to recover lost capacity
- C. Add distilled water to the suspect module through the recombination vent caps
- D. Replace the high-resistance module or service the affected section of the pack

17. A Honda IMA (Integrated Motor Assist) system uses a single motor/generator located between the engine and transmission. During vehicle acceleration, the motor draws current from the HV battery pack. What component controls the AC frequency delivered to this motor?

- A. The brushed slip ring and carbon brush assembly on the rear of the motor housing
- B. The motor power inverter unit that converts HV battery DC into three-phase AC current
- C. The mechanical commutator built into the motor's rotor lamination stack assembly
- D. The hybrid battery control module through direct pulse-width modulation switching

18. The DC-DC converter in a hybrid vehicle steps down HV battery voltage to maintain charge on the 12V auxiliary battery. If the DC-DC converter output is measured at 11.8V with the vehicle in READY mode, what is the most likely concern?

- A. The DC-DC converter is failing and not providing the correct regulated output voltage
- B. The 12V auxiliary battery has reached its fully charged state and is rejecting current
- C. The HV battery state of charge is too low for the DC-DC converter to function properly
- D. The hybrid control system has entered a default mode due to a thermal protection fault

19. An electric A/C compressor receives three-phase AC power similar to a hybrid drive motor. If a technician measures continuity between any compressor phase terminal and the compressor housing, what does this reading indicate?

- A. Normal operation since the phase windings are isolated from compressor housing ground
- B. The compressor has a minor refrigerant leak that may be repaired using leak sealant
- C. A failed compressor with internal motor winding insulation breakdown to housing ground
- D. The phase filter capacitor has discharged and needs to be re-energized before testing

20. A hybrid vehicle exhibits a no-start condition in READY mode. The 12V battery is good, the service disconnect is properly installed, and there are no HV interlock loop codes. The scan tool shows the HV main contactor commanded ON but contactor feedback indicates OFF. What is the next step?

- A. Replace the hybrid battery pack assembly as a complete factory replacement unit
- B. Perform a forced HV system pre-charge cycle through the scan tool special function
- C. Check the inverter assembly for an internal phase-to-phase short circuit condition
- D. Test the HV main contactor coil resistance and the contactor control circuit wiring

21. During HV system de-energization on a hybrid vehicle, the technician verifies that capacitor discharge has occurred at the inverter. Which voltage level at the inverter HV input terminals is generally considered safe before further service work?

- A. Below 12 volts DC measured across the inverter HV input bus terminals
- B. Half of the nominal HV pack voltage on either positive bus terminal
- C. Equal to system 12V battery voltage at all HV bus measurement points
- D. Approximately 60 volts DC remaining as residual capacitor float voltage

22. A lithium-ion HV battery cell has a nominal voltage of 3.7V. A hybrid battery pack consists of 96 of these cells connected in series. What is the approximate nominal pack voltage measured at the main HV bus?

- A. 288 volts DC at the service plug connector terminal contacts
- B. 320 volts DC measured across the main HV contactor pole pair
- C. 355 volts DC at the high-voltage main bus output connections
- D. 444 volts DC at the inverter input filter capacitor pack terminals

23. A hybrid vehicle's regenerative braking system is not capturing energy during deceleration. The friction brakes still operate normally and stop the vehicle without issue. Which condition would most likely cause this specific symptom?

- A. Worn brake pads on the front friction brake caliper assembly units
- B. HV battery state of charge is too high to accept additional regenerative energy
- C. Low brake fluid level in the brake master cylinder reservoir fluid chamber
- D. Failed wheel speed sensor on the rear non-driven axle wheel hub assembly

24. The boost converter in a Toyota Prius can raise the HV battery voltage from approximately 200V up to as high as 650V for drive motor operation. What is the primary advantage of providing this voltage boost stage?

- A. The boost reduces heat generation in the inverter IGBT switching transistor modules
- B. The boost extends the overall service life of the HV battery cell module assemblies
- C. The boost is required to drive HV accessories like the electric A/C compressor motor

D. The boost allows the motor to develop more power without increasing its physical size

25. An electric A/C compressor on a hybrid uses POE (polyol ester) refrigerant oil rather than PAG oil. What contamination concern is most critical when servicing this electric compressor refrigerant system?

A. Even trace amounts of moisture or PAG oil can reduce the oil's dielectric strength

B. POE oil expansion when heated requires a smaller total refrigerant charge amount

C. POE oil leaves residue in service equipment that contaminates conventional A/C systems

D. POE oil reacts with aluminum lines and requires special copper tubing replacement

26. A hybrid vehicle is brought in with an illuminated MIL and a DTC indicating "Hybrid System Malfunction." The scan tool shows the vehicle is in limp-home mode with reduced power. Which of the following should be done first?

A. Clear all stored codes from memory and road-test the vehicle to verify the concern

B. Check for related and pending DTCs and review the freeze frame data information

C. Replace the hybrid control module and reprogram with the latest software calibration

D. Disconnect the HV battery service plug to reset the entire hybrid control system

27. A NiMH hybrid battery service is being performed. The technician needs to discharge a removed battery module before disposal. What is the correct procedure for safely discharging a removed NiMH battery module?

A. Short the module terminals directly using a heavy gauge copper jumper cable

B. Allow the module to self-discharge for 30 days inside a sealed storage container

C. Drain the electrolyte through the vent caps using an approved acid disposal unit

D. Connect the module to an approved discharge resistor designed for hybrid battery use

28. A planetary gear set is used in a power-split hybrid transaxle. The sun gear is held stationary while the planet carrier is driven by the engine. In this configuration, what is the rotational relationship of the ring gear relative to the planet carrier?

- A. The ring gear rotates in the opposite direction at half the speed of the carrier
- B. The ring gear remains stationary because the sun gear is locked in this condition
- C. The ring gear rotates in the same direction but at a higher speed than the carrier
- D. The ring gear rotates in the opposite direction at the same speed as the input shaft

29. A DC-DC converter on a hybrid vehicle is suspected to be the cause of a discharged 12V battery condition. The technician measures the converter output at 12.3V in READY mode and the input HV side reads correct pack voltage. Which is the most appropriate next step?

- A. Replace the DC-DC converter assembly since the output voltage is below specification
- B. Charge the 12V auxiliary battery to full SOC and recheck DC-DC converter output again
- C. Inspect the HV battery cooling system for restricted airflow through the pack vents
- D. Reset the hybrid control module adaptive memory to relearn the DC-DC output target

30. The electric A/C compressor on a hybrid vehicle is integrated with the HV system. When servicing the compressor, the technician must ensure that the system is properly grounded. What is the primary reason for verifying compressor ground integrity?

- A. The compressor housing serves as the return path for the three-phase motor current
- B. A poor ground can cause induced voltage on the case creating a serious shock hazard
- C. The ground strap completes the refrigerant pressure sensor reference signal circuit
- D. The compressor uses the engine block as a heat sink to dissipate winding excess heat

31. A hybrid vehicle's 12V auxiliary system is being diagnosed for a parasitic drain. The technician measures 350 mA of drain with all modules in sleep mode. The acceptable specification is 50 mA maximum. What is the most appropriate next step in the diagnostic procedure?

- A. Replace the 12V auxiliary battery with a fresh fully charged AGM-rated unit
- B. Disconnect the HV service plug and recheck the parasitic drain reading again
- C. Allow the vehicle to sit overnight and recheck the drain after all modules sleep

D. Pull fuses one at a time to isolate the circuit responsible for the excessive drain

32. Two technicians are discussing high-voltage cable inspection on a hybrid vehicle. Technician A says the orange jacketing must be inspected for cracks, abrasions, or pinches at every service interval. Technician B says only the cable end connectors and grommets require routine inspection. Who is correct?

- A. Technician A only is correct in this scenario discussion
- B. Both Technician A and Technician B are correct on this point
- C. Technician A only is correct regarding inspection coverage area
- D. Neither Technician A nor Technician B is correct in this case

Wait, I need to recheck — answer should be C, and C says "Technician A only" which doesn't work because I had A as Technician A only too. Let me redo:

32. Two technicians are discussing high-voltage cable inspection on a hybrid vehicle. Technician A says only the orange cable end connectors require routine visual inspection during service. Technician B says the entire orange jacket must be inspected for cracks, abrasions, or pinch damage. Who is correct?

- A. Technician A only is correct in this discussion scenario
- B. Both Technician A and Technician B are correct in their statements
- C. Technician B only is correct in this discussion scenario
- D. Neither Technician A nor Technician B is correct in their statements

33. A lithium-ion hybrid battery pack is being diagnosed for a "Battery Pack Deterioration" code. The pack capacity measures 65% of original rating after a controlled discharge test. Which condition is the most likely root cause of this capacity loss?

- A. The battery management system has not completed a full calibration learning cycle
- B. Normal aging and lithium plating from repeated high-rate charging and discharging
- C. Contamination of the electrolyte from moisture intrusion through the pack vent
- D. Open-circuit condition in one of the cell voltage sense wires of the harness

34. A Toyota Hybrid Synergy Drive transaxle uses two motor/generators (MG1 and MG2). Which motor/generator is primarily responsible for starting the internal combustion engine and managing engine speed during hybrid operation?

- A. MG1 starts the engine and manages engine speed by reacting against the planetary sun gear
- B. MG2 starts the engine and provides the main propulsion torque to the ring gear output
- C. MG1 provides primary propulsion while MG2 manages regenerative braking only
- D. Both motor/generators share the engine starting load equally through a planetary gear

35. A power-split hybrid uses a high-voltage step-up converter (boost converter). The boost converter contains a large inductor, IGBT, diode, and filter capacitor. If the boost converter inductor develops shorted windings, what symptom is most likely to occur?

- A. The DC-DC converter output to the 12V system will read above 16V at all times
- B. The electric A/C compressor will run at maximum speed with no temperature input
- C. Reduced motor power output along with DTCs related to converter output voltage
- D. The HV battery will fail to recharge during regenerative braking deceleration events

36. An electric A/C compressor on a hybrid vehicle is being replaced after an insulation resistance test failure. After installation, what additional service procedure is required that is NOT typically performed on a conventional belt-driven A/C system?

- A. Evacuate the refrigerant system for 45 minutes to remove all moisture and air
- B. Charge the system with the specified refrigerant amount by precise weight measurement
- C. Perform a leak check using nitrogen gas pressure before introducing refrigerant
- D. Flush the system with approved solvent if compressor windings show contamination

37. A hybrid vehicle's regenerative braking is functioning intermittently. The brake pedal feel is inconsistent and the scan tool shows occasional faults related to the brake stroke sensor. Which condition is the most likely cause of these intermittent braking concerns?

- A. Open or intermittent connection in the brake stroke sensor signal wiring harness
- B. Low HV battery state of charge limiting available regenerative braking capacity
- C. Worn brake pads creating excessive pedal travel during all brake applications
- D. Failed wheel speed sensor signal preventing the ABS module from allowing regen

38. Two technicians are discussing hybrid vehicle towing procedures. Technician A says any hybrid vehicle can be flat-towed with all four wheels on the ground for short distances. Technician B says many hybrids must be transported on a flatbed because the drive wheels cannot rotate freely without damaging the transaxle. Who is correct?

- A. Technician A only is correct based on universal hybrid towing standards
- B. Technician B only is correct based on transaxle design considerations
- C. Both Technician A and Technician B are correct in their statements made
- D. Neither Technician A nor Technician B is correct on hybrid towing procedure

39. A NiMH hybrid battery pack is being load-tested using a dealer-level diagnostic tool. The test reveals that internal resistance is significantly higher in three modules clustered at the same end of the pack. What is the most likely root cause of this localized degradation pattern?

- A. Manufacturing defect present in those three modules from the time of original assembly
- B. Cell voltage sense wire damage at the affected end of the battery pack assembly
- C. Inadequate cooling airflow distribution causing thermal stress at one end of the pack
- D. Software calibration error in the battery management module's balancing algorithm

40. A hybrid transaxle is being inspected after a "MG2 Temperature High" DTC was retrieved. The inspection reveals dark, burnt-smelling transaxle fluid. What is the most likely cause of this condition and DTC?

- A. Normal aging of the transaxle fluid which requires service every 50,000 miles
- B. External contamination from a leaking radiator allowing coolant into the transaxle
- C. Worn planetary gear bearings creating metal contamination in the fluid passages

D. Overloaded MG2 operation creating excessive heat that has degraded the fluid

41. A boost converter on a hybrid vehicle uses a large capacitor to filter the output DC voltage. The vehicle exhibits intermittent power loss and the scan tool shows fluctuating DC bus voltage readings. Which component is the most likely cause of this symptom?

- A. The HV main contactor exhibiting high resistance from contact arcing damage
- B. The boost converter output filter capacitor losing capacitance and ripple control
- C. The HV battery service disconnect plug developing high resistance at the pins
- D. The drive motor stator windings developing intermittent open circuit conditions

42. An electric A/C compressor on a hybrid vehicle has been replaced. The technician notes that the new compressor came pre-charged with a specific quantity of POE oil. What action is required regarding the oil charge in the system?

- A. Drain old oil from system components and adjust new oil charge to specification
- B. Add the full original system oil charge to the new compressor before installation
- C. Install the compressor as received and add additional oil through the service port
- D. Flush all system components with refrigerant oil flush before charging the new oil

43. A hybrid vehicle's auxiliary 12V system uses the DC-DC converter as its primary charging source. During a cold start in READY mode, the technician observes that the DC-DC converter output is 12.6V instead of the expected 14.0V for the first 30 seconds. What is the most likely explanation?

- A. The DC-DC converter has failed and must be replaced for proper system operation
- B. The 12V auxiliary battery has a shorted internal cell preventing full charge voltage
- C. The HV battery state of charge is too low to support DC-DC converter operation
- D. Normal cold-temperature operation as the DC-DC converter warms to operating temp

44. A Honda IMA hybrid vehicle exhibits poor fuel economy along with a "Battery Module Deterioration" DTC. The scan tool shows the battery is not providing assist or accepting regenerative charge. Which condition is most likely responsible for this concern?

- A. Failed motor power inverter creating reduced three-phase output to the drive motor
- B. Open in the HV interlock loop circuit preventing main contactor closure on startup
- C. Degraded NiMH battery pack capacity with elevated internal resistance in the cells
- D. Software calibration error in the engine control module's hybrid coordination logic

45. A technician is preparing to remove an HV battery pack from a hybrid vehicle for service. After de-energization and verification of zero voltage, what additional safety precaution should be taken before disconnecting the battery pack?

- A. Connect a discharge resistor across the battery pack terminals for thirty minutes
- B. Wear Class 0 rubber insulating gloves and use insulated tools during all removal steps
- C. Disconnect the engine cooling fan to prevent accidental thermal management activation
- D. Allow the pack to cool to ambient temperature before any disconnection is performed

FULL ANSWER KEY WITH EXPLANATIONS

1. B — Turn the ignition off and remove the key. The first step in any HV de-energization procedure is to ensure the vehicle is fully shut down with no possibility of accidental restart. Removing the key prevents READY mode activation that would re-energize the HV bus. Only after the vehicle is keyed off do you don PPE, disconnect the 12V battery, remove the service plug, and verify zero voltage.

2. C — The reading is normal because module open-circuit voltage is about 7.8V each. NiMH modules contain six 1.2V cells in series, giving a nominal 7.2V per module but reading 7.8V to 8.0V at full charge. With 30 modules in series, a fully charged pack reading of approximately 234V ($30 \times 7.8V$) is normal and expected at rest.

3. A — 1,000 volts AC maximum use voltage. ASTM D120 and OSHA classify rubber insulating gloves by voltage class: Class 00 (500V), Class 0 (1,000V), Class 1 (7,500V), Class 2 (17,000V), Class 3

(26,500V), and Class 4 (36,000V). Class 0 gloves are the standard required PPE for hybrid HV systems operating below 1,000V.

4. D — Open or high-resistance connection in a voltage sense wire. P0AFA correlation faults compare two independent battery voltage measurement sources. When individual modules test within specification but the correlation fault persists, the issue is almost always in the sense circuit wiring or connector providing the voltage feedback signal, not the battery itself.

5. B — Increase the DC bus voltage to optimize motor efficiency under high loads. The boost converter steps battery voltage up (typically 200V to as high as 650V) so the inverter can drive the motor with greater efficiency and power at high speeds. Higher bus voltage means lower current for the same power, reducing IGBT and motor heating.

6. A — A shorted winding between two of the three motor phase coils. A reading of 0.05 ohms between two phases indicates those windings have shorted together, bypassing most of the winding resistance. The third phase reading of 5.2 ohms to either is roughly normal phase-to-phase resistance, confirming only two phases are involved in the short.

7. C — The oil must have high dielectric properties to insulate internal motor windings. Electric A/C compressors circulate refrigerant oil through the integrated motor windings, so the oil must be electrically non-conductive. POE (polyol ester) oil with high dielectric strength is required; conventional PAG oil is conductive enough to cause motor faults.

8. D — Check for parasitic drain on the 12V auxiliary system. With the DC-DC converter producing a normal 14.2V output during READY mode, the charging side is working correctly. The next logical step is to find what's drawing current from the 12V battery during key-off conditions, which is the parasitic drain test.

9. A — Capacitors in the inverter and converter must discharge through internal bleed resistors. Large DC bus capacitors store substantial energy and remain dangerously charged for several minutes after the HV source is removed. Manufacturer-specified wait times allow the internal bleed resistors to safely discharge these capacitors before the technician verifies zero voltage.

10. B — One or more cells have different states of charge relative to the rest of the pack. Cell imbalance means individual cell voltages do not match across the pack, indicating SOC differences. The battery

management system normally balances cells, but persistent imbalance suggests a weak cell or a failure in the balancing circuitry that cannot keep up.

11. D — The planetary carrier holds the pinion gears in their orbital position. In a Toyota HSD power-split device, the engine drives the planetary carrier, MG1 connects to the sun gear, and MG2 plus the final drive output connect to the ring gear. This arrangement allows the engine speed to be decoupled from vehicle speed.

12. C — Inverter temperature high or thermal protection mode activation. The inverter coolant pump circulates coolant through the IGBT module heat sinks. When the pump fails, coolant flow stops and the inverter rapidly overheats under load, triggering thermal protection codes and often reducing power output to protect the IGBTs.

13. A — Check insulation resistance from each compressor phase terminal to chassis ground. Before condemning an electric A/C compressor, you must confirm the windings are not shorted to ground, which would also trigger HV isolation faults. Insulation resistance testing using a megohmmeter rules out winding-to-case shorts and confirms whether the compressor truly needs replacement.

14. B — Provide normal pedal feel feedback to the driver during regen mode. In brake-by-wire systems, the pedal is typically decoupled from the hydraulic system during regenerative braking. The stroke simulator uses a spring or fluid resistance to give the driver familiar pedal feel even though pedal motion is being read electronically rather than directly applying hydraulic pressure.

15. C — Technician B only is correct. Manufacturers do not permit field splicing of HV cables because any splice introduces resistance, potential insulation weakness, and EMI shielding compromises. Damaged HV cables must be replaced as complete factory assemblies with proper shielding, connectors, and OEM specifications maintained throughout.

16. D — Replace the high-resistance module or service the affected section. A module measuring 45 milliohms when others measure 18 milliohms is electrically degraded beyond what charging or conditioning can recover. The high internal resistance creates heat, voltage drop under load, and pack imbalance — the only correct repair is replacement of that module or pack section.

17. B — The motor power inverter unit converts HV battery DC into three-phase AC. The IMA motor is a three-phase AC machine, and the inverter/MPI controls both the frequency (which determines motor

speed) and the current (which determines torque). All AC motor frequency control in hybrids is performed by the inverter through pulse-width modulation of the IGBTs.

18. A — The DC-DC converter is failing and not providing correct regulated output. In READY mode with the HV system active, the DC-DC converter should produce approximately 14V to charge the 12V auxiliary battery. An output of 11.8V indicates the converter is not regulating properly and is failing to maintain the 12V system, which will lead to battery discharge.

19. C — A failed compressor with internal motor winding insulation breakdown to ground. Phase windings in a healthy electric A/C compressor are isolated from the metal housing. Any continuity from a phase terminal to the housing indicates the motor's insulation has broken down, creating a ground fault that will trip HV isolation monitoring and requires compressor replacement.

20. D — Test the HV main contactor coil resistance and control circuit wiring. When the control module commands the contactor closed but the feedback shows it remains open, the contactor itself isn't responding to the command. Testing the coil resistance and control circuit identifies whether the coil is open, the wiring is faulty, or the contactor mechanically failed.

21. A — Below 12 volts DC measured across the inverter HV input bus terminals. After the service plug is removed and the manufacturer-specified wait time has elapsed, the inverter capacitors should have discharged to a safe level. Most OEMs consider less than 12V across the DC bus as the threshold confirming the capacitors are safely discharged and service may proceed.

22. C — 355 volts DC at the high-voltage main bus output connections. A series-connected lithium-ion pack voltage equals the cell count times the nominal cell voltage. With 96 cells at 3.7V each, the nominal pack voltage is $96 \times 3.7 = 355.2\text{V}$, which is the typical figure for many compact-vehicle hybrid and PHEV battery packs.

23. B — HV battery state of charge is too high to accept additional energy. Regenerative braking captures kinetic energy by using the motor as a generator to charge the HV battery. When the battery is already at high SOC, the BMS prevents further charging to avoid overcharge damage, and the system shifts entirely to friction braking even though pedal feel may remain normal.

24. D — The boost allows the motor to develop more power without increasing its physical size. By stepping voltage up, the same motor can produce significantly more peak power because power equals

voltage times current. A smaller, lighter motor running at higher voltage can match the output of a much larger motor running at battery voltage alone, saving weight and space.

25. A — Even trace amounts of moisture or PAG oil can reduce the oil's dielectric strength. POE oil is extremely hygroscopic and absorbs moisture rapidly when exposed to air. Both moisture and cross-contamination from PAG oil drop the oil's dielectric strength, which can cause the electric compressor's motor windings to short to the housing through the refrigerant circuit.

26. B — Check for related and pending DTCs and review freeze frame data. The first diagnostic step for any hybrid system fault is to gather all the information the vehicle has already captured. Related codes, pending codes, and freeze frame data identify the conditions present when the fault was set and direct the technician toward the most likely root cause before any parts are replaced.

27. D — Connect the module to an approved discharge resistor designed for hybrid use. NiMH battery modules must be discharged in a controlled manner before disposal or recycling to prevent fire and shock hazards. OEM-approved discharge resistors safely dissipate the module's energy over time without short-circuiting the cells or creating thermal runaway conditions.

28. C — The ring gear rotates in the same direction but at a higher speed than the carrier. When the sun gear is held stationary and the carrier is driven, the planetary gears walk around the fixed sun gear, causing the ring gear to rotate in the same direction as the carrier but faster — this is the overdrive configuration of a planetary gear set.

29. A — Replace the DC-DC converter assembly since output voltage is below specification. A DC-DC converter output of 12.3V in READY mode is too low to charge the 12V auxiliary battery, since the battery itself will float at approximately 12.6V when fully charged. With confirmed HV input present, low output voltage points directly to a failed converter.

30. B — A poor ground can cause induced voltage on the case creating a serious shock hazard. The electric A/C compressor operates on high voltage, and ground integrity is essential to keep the housing at chassis potential. A degraded ground allows induced or leakage voltage to appear on the case, which is a shock hazard and will also trigger HV isolation faults.

31. D — Pull fuses one at a time to isolate the circuit responsible for the excessive drain. With 350 mA of parasitic drain versus a 50 mA spec, the next step is to isolate the offending circuit by sequentially pulling

fuses while watching the drain measurement. When the current drops to normal, the fuse pulled identifies the circuit containing the fault.

32. C — Technician B only is correct. The orange jacket protects the conductor and shielding inside, and any abrasion, crack, or pinch can compromise insulation and lead to HV isolation faults or shock hazards. Inspecting only the connectors and grommets misses the majority of the cable run where damage often occurs.

33. B — Normal aging and lithium plating from repeated high-rate charging and discharging. Lithium-ion cells gradually lose capacity through normal use as the SEI layer thickens and lithium plates on the anode. A capacity reading of 65% after extended service is typical of aging chemistry and is the most common cause of pack deterioration codes in older Li-ion HV batteries.

34. A — MG1 starts the engine and manages engine speed by reacting against the sun gear. In Toyota Hybrid Synergy Drive, MG1 is connected to the planetary sun gear and is responsible for cranking the engine during start events and varying engine speed during driving. MG2 connects to the ring gear and provides primary propulsion torque to the wheels.

35. C — Reduced motor power output along with DTCs related to converter output voltage. A shorted boost converter inductor cannot store and release energy properly, so the converter cannot step the battery voltage up to the higher motor bus voltage. This results in reduced available power for the drive motor and triggers DTCs related to low or fluctuating DC bus voltage.

36. D — Flush the system with approved solvent if compressor windings show contamination. When an electric A/C compressor fails with winding insulation breakdown, oil and refrigerant in the system may be contaminated by burnt insulation and conductive debris. The system must be flushed with approved solvent to remove all contamination before the new compressor is installed, or the new unit will fail.

37. A — Open or intermittent connection in the brake stroke sensor signal wiring harness. Intermittent stroke sensor faults paired with inconsistent pedal feel point directly to a wiring or connector issue in the sensor circuit. The brake control module relies on a clean stroke sensor signal to coordinate regen and friction braking, and intermittent signal loss causes the system to fall back to friction-only braking.

38. B — Technician B only is correct. Many hybrid transaxles are mechanically connected to the drive wheels at all times through the motor/generators and planetary gearing. Rotating these wheels with the

vehicle powered off means MG2 and other components spin without oil pumping and lubrication, which can cause damage — flatbed transport is the safe method.

39. C — Inadequate cooling airflow distribution causing thermal stress at one end. NiMH pack degradation that is localized to a cluster of modules at one physical location of the pack is almost always a thermal management issue. Modules at the end of the cooling airflow path receive less cooling, run hotter under load, and degrade faster than the modules at the cooling inlet end.

40. D — Overloaded MG2 operation creating excessive heat that has degraded the fluid. A "MG2 Temperature High" DTC combined with burnt, dark transaxle fluid indicates the motor has been operating beyond its thermal limits. The heat has thermally degraded the fluid, which also serves as the motor's cooling and lubrication medium, accelerating further damage.

41. B — The boost converter output filter capacitor losing capacitance and ripple control. A failing output filter capacitor cannot smooth the DC bus voltage, leading to fluctuating voltage readings and intermittent power loss to the inverter and drive motor. Capacitor degradation is a common failure mode in high-current DC bus filtering applications on hybrid vehicles.

42. A — Drain old oil from system components and adjust new oil charge to specification. When replacing an electric A/C compressor, the oil charge must be balanced — the new compressor contains a specified amount of POE oil, and any oil retained in the condenser, evaporator, or lines must be accounted for. Drain residual oil and adjust the new compressor's oil charge to match the system specification.

43. D — Normal cold-temperature operation as the DC-DC converter warms to operating temp. Many hybrid DC-DC converters intentionally limit output voltage during initial cold operation to protect the 12V battery and converter electronics. Output ramps up to the full 14V regulation target as the converter reaches operating temperature, so a brief low-output period at startup is normal.

44. C — Degraded NiMH battery pack with elevated internal resistance in the cells. Honda IMA "Battery Module Deterioration" codes are typically set when the BMS detects that internal resistance has increased to the point where the pack can no longer accept regen or deliver assist current effectively. This is the classic failure mode for aging NiMH packs in IMA-equipped vehicles.

45. B — Wear Class 0 rubber insulating gloves and use insulated tools during all removal steps. Even after de-energization and zero-voltage verification, the battery pack itself still contains stored chemical

energy and exposed terminals may become live during disassembly. Class 0 gloves and insulated tools provide essential protection against accidental short circuits and any residual voltage encountered.