PRACTICE EXAM 19: ASE L3 SIMULATION (45 Questions)

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

1. A hybrid vehicle has been involved in a roadside accident requiring rescue extrication. First responders arrive at the scene and need to disable the HV system before performing extrication operations on the trapped occupant. What is the most appropriate action regarding the HV system?

A. Locate and cut the manufacturer-designated emergency disconnect or first-responder loop wire identified in the rescue guide

B. Disconnect both terminals of the 12V auxiliary battery to completely de-energize the entire HV system for safety

C. Push the vehicle to a safe location away from traffic and wait for the HV battery to discharge naturally over time

D. Remove the HV battery service plug from underneath the vehicle to disable the entire HV system before extrication

2. A hybrid vehicle's lithium-ion HV battery cell has its capacity tested using a controlled discharge test procedure. The cell is rated at 50 Ah from the factory, but the controlled discharge test measures only 38 Ah of usable capacity. What is the cell's calculated State of Health (SOH) value?

A. 50% state of health calculated from the rated capacity and the measured capacity values during the test procedure

B. 62% state of health calculated from the rated capacity and the measured capacity values during the test procedure

C. 70% state of health calculated from the rated capacity and the measured capacity values during the test procedure

D. 76% state of health calculated from the rated capacity and the measured capacity values during the test procedure

3. A hybrid vehicle uses a synchronous reluctance motor design rather than a permanent magnet motor or induction motor. What is one key operational characteristic of synchronous reluctance motor technology that distinguishes it from other motor types?

A. Synchronous reluctance motors require rare-earth magnets in the rotor for proper torque generation during motor operation

B. Synchronous reluctance motors produce torque through magnetic reluctance variation in the salient-pole rotor structure design

C. Synchronous reluctance motors operate using slip frequency similar to induction motor designs in normal vehicle operation events

D. Synchronous reluctance motors require brushes and a commutator for proper rotor magnetization during normal motor operation

4. A hybrid vehicle's HV bus contains large film capacitors that filter the DC voltage at the inverter input. During HV system de-energization, these capacitors are designed to discharge through internal bleed resistors. If these bleed resistors fail in an open-circuit condition, what is the most likely consequence?

A. The capacitors will discharge faster than the normal specification time due to lack of resistance limiting the discharge path

B. The capacitors will charge to a higher voltage than the normal operating voltage during HV system operation events

C. The capacitors retain dangerous voltage levels longer than the manufacturer-specified discharge time creating a shock hazard

D. The HV system isolation monitoring circuit will detect the failed bleed resistors and set an appropriate DTC for diagnosis

5. A hybrid vehicle's electric A/C compressor has experienced an internal winding short to the compressor housing during operation. After replacing the compressor, what additional system inspection is the most important to perform beyond the compressor replacement?

A. Inspect HV system isolation and check for chassis ground leakage from the failed compressor event before vehicle return

B. Inspect the refrigerant lines for damage from the failed compressor event and replace any damaged sections as needed

C. Inspect the receiver/drier for moisture absorption from the failed compressor event and refill the system oil completely

D. Inspect the condenser cooling fan motor for any damage from the failed compressor event during normal operation runs

6. A hybrid vehicle's electric power steering motor draws current from the 12V auxiliary system through a high-current relay. The technician suspects the relay has developed high contact resistance under load. What test method would most directly diagnose this specific condition?

A. Measure the steering wheel position sensor signal voltage during steering operation in normal driving mode with the engine running

B. Use a scan tool to view the EPS torque sensor data display during a steering input event with the ignition key in the run position

C. Replace the suspect relay with a known-good unit and observe whether EPS performance improves during normal driving operation

D. Measure voltage drop across the relay contacts under load using a multimeter set to DC volts during EPS operation event

7. A hybrid vehicle technician is using a low-impedance multimeter to test HV system voltages. What is the primary advantage of a low-impedance multimeter compared to a conventional high-impedance digital multimeter for this application?

A. Low-impedance meters are more accurate for measuring small DC voltages on hybrid vehicle electrical systems in the shop

B. Low-impedance meters can measure AC voltages at higher frequencies than high-impedance meters during testing procedures

C. Low-impedance meters prevent false readings from induced or ghost voltages on disconnected circuits during HV testing work

D. Low-impedance meters do not require battery power to operate during HV system testing procedures in the service bay

8. A hybrid vehicle's HV battery cell-balancing system uses an active balancing topology with bidirectional DC-DC converters between cells. What is one operational advantage of bidirectional active balancing over conventional passive bleed-resistor balancing?

A. Bidirectional active balancing operates only during vehicle operation while passive operates only during vehicle rest periods

B. Bidirectional active balancing transfers charge from high-voltage cells to low-voltage cells without dissipating energy as heat

C. Bidirectional active balancing requires less wiring and overall complexity than passive bleed-resistor balancing designs for the pack

D. Bidirectional active balancing cannot be performed during vehicle charging events for safety reasons during the charge cycle

9. A hybrid drive motor has been replaced with a new factory unit. After mechanical installation is complete, the technician needs to verify or set the resolver-to-rotor offset alignment. Which procedure is typically required to verify or set this alignment after motor replacement?

A. Use the OEM scan tool to perform a "resolver offset learn" or motor calibration routine after motor installation is complete

B. Drive the vehicle for 100 miles to allow the inverter to self-calibrate during normal vehicle operation after motor installation

C. Measure the rotor position with a mechanical dial indicator while comparing to scan tool data values during motor installation

D. Disconnect the motor from the inverter and manually rotate the rotor to verify mechanical alignment markers on the motor housing

10. A hybrid vehicle's inverter contains an individual current sensor on each motor phase output. The technician finds DTCs stored for "Phase U Current Sensor Performance" and "Phase V Current Sensor Performance" but no DTC for the phase W current sensor. What is the most likely common cause of both DTCs?

A. The motor itself has failed windings in phases U and V causing both current sensors to fail simultaneously during operation

B. The inverter coolant system has been contaminated affecting only the U and V phase circuits internally during normal operation

C. The HV battery is providing incorrect voltage causing the U and V current sensors to misread during vehicle driving events

D. A common power supply or reference voltage feeding both U and V current sensors has failed affecting both sensors at once

11. A hybrid vehicle uses a heat pump A/C system with an electric A/C compressor. During cold weather operation in heating mode, system performance degrades significantly over time. The technician finds the outdoor heat exchanger is heavily frosted on the fins. What system function should activate to address this frosting condition?

A. The heat pump system should reverse refrigerant flow to actively cool the outdoor heat exchanger during normal operation

B. The compressor should shut down completely until the outdoor heat exchanger thaws naturally through ambient air warming

C. The heat pump defrost cycle should activate periodically to remove accumulated frost from the outdoor heat exchanger surface

D. The PTC heater should operate at maximum power to provide all required cabin heat during the frost accumulation event

12. A hybrid vehicle's 12V auxiliary battery is being load tested with a carbon pile tester in the service bay. The battery is rated at 600 CCA and tests at 12.6V at rest. Under a 200A load applied for 15 seconds, the battery voltage holds at 12.2V. What does this load test result indicate?

A. Acceptable battery performance because voltage held well above 9.6V during the load test on a battery in good condition

B. Marginal battery performance requiring additional charging before retesting under heavier load conditions in the service bay

C. Failed battery requiring immediate replacement based on the voltage reading during the heavy load test in the service bay

D. The carbon pile tester is reading incorrectly because 12.2V under any load condition indicates a meter malfunction during testing

13. A hybrid technician notices that the orange HV cables in a hybrid vehicle have different markings on the cable jackets. One set is marked "DC" and another set is marked "AC" near the cable end connectors. What is the significance of these specific markings on the HV cables?

A. Both cables carry the same type of current and the markings are for production identification only during manufacturing

B. The DC marking indicates direct current cables between the battery and inverter while the AC marking indicates AC current cables to the motor

C. The DC marking indicates a damaged cable that requires replacement while the AC marking indicates a cable in good condition

D. The AC marking indicates an older cable design that has been superseded by newer DC-rated cables in current production

14. A hybrid vehicle's HV battery uses a refrigerant-cooled thermal management system that shares refrigerant with the cabin A/C system. The technician finds the HV battery is overheating during DC fast charging. The cabin A/C is operating normally with proper cooling output. What is the most likely cause of the battery overheating?

A. The refrigerant charge is too high in the entire system causing reduced cooling capacity to the battery thermal management loop

B. The battery thermal management mode requires manual activation by the technician through the scan tool during DC fast charging

C. The cabin A/C system is using all available refrigerant capacity preventing the battery cooling system from receiving adequate flow

D. A failed battery refrigerant solenoid valve or restricted refrigerant flow specifically to the battery cooling loop during operation

15. A hybrid drive motor's three-phase stator winding insulation is being tested with a HiPot (high potential) tester at 1500V AC for 1 second. The motor passes the test without any dielectric breakdown or excessive leakage current measurement. What does this HiPot test specifically verify about the motor?

A. The stator winding insulation can withstand the applied test voltage without dielectric breakdown failure during the test event

B. The stator winding resistance is within specification at the manufacturer's stated values during normal motor operating conditions

C. The motor will operate at proper torque output during normal vehicle operation in the drivetrain system after the test

D. The motor's bearings are in good condition based on the applied voltage withstand test results during the test event in the shop

16. A hybrid vehicle's DC-DC converter is being inspected for a customer complaint of 12V battery discharge. The technician finds the converter operates correctly at low electrical load conditions but the output voltage drops significantly at high electrical load conditions. The HV input voltage is correct and stable. What is the most likely cause of this load-dependent voltage drop behavior?

A. The HV battery state of charge is too low to support the DC-DC converter operation during heavy 12V electrical load events

B. The 12V auxiliary battery has internal damage preventing proper acceptance of charging current from the DC-DC converter unit

C. Degraded internal components such as failing capacitors or aged switching devices in the converter affecting load response capability

D. The hybrid control module is intentionally reducing DC-DC output to protect the HV battery from excessive load demand currents

17. A hybrid vehicle's electric A/C compressor operates at variable speed based on the cooling demand requested by the climate control module. The hybrid control module commands the compressor operating speed via what type of signal sent to the compressor inverter?

A. PWM signal directly from the climate control module to the compressor motor windings to set the compressor operating speed

B. Serial communication command (such as CAN or LIN) from the climate control module to the compressor inverter control unit

C. Voltage signal proportional to compressor speed sent from the climate control module directly to the compressor motor windings

D. Frequency signal proportional to compressor speed sent from the climate control module directly to the compressor motor windings

18. A hybrid vehicle technician is using a megohmmeter to test HV system isolation after a major repair. The OEM specifies a test voltage above the system's normal operating voltage range. What is the primary reason for testing at a voltage higher than the system's normal operating voltage during the isolation test?

A. Testing at a lower voltage would not detect any insulation weakness present in the HV system circuitry during the testing event

B. Testing at a lower voltage would damage the megohmmeter during measurement of healthy HV insulation in the system during the test

C. Testing at the system operating voltage would only confirm proper operation but not identify any insulation weaknesses present

D. Testing above the normal operating voltage stresses the insulation to identify weaknesses before they cause in-service failure events

19. A hybrid vehicle's HV battery pack contains 96 lithium-ion cells connected in series with passive cell balancing using bleed resistors. During regular charging events, the technician finds that several specific cells consistently reach the maximum cell voltage limit before the rest of the pack. What is the most likely cause of this behavior?

A. The affected cells have reduced capacity compared to the other cells and reach full charge voltage first during charging events

B. The bleed resistors have failed open in the affected cells preventing proper voltage balancing during the charging process events

C. The BMM has failed and is incorrectly reporting cell voltages for the affected cells during the charging process in the shop

D. The cell sensing wires for the affected cells have high resistance affecting the voltage measurements during charging events

20. A hybrid vehicle's inverter uses IGBT modules with antiparallel diodes (also called freewheeling diodes) connected across each IGBT. What is the primary purpose of these antiparallel freewheeling diodes in the inverter circuit design?

A. The diodes block reverse current flow from the motor back through the IGBT modules during normal motor operation events

B. The diodes provide rectification of AC voltage from the motor back to DC voltage for the HV battery during normal operation

C. The diodes provide a path for inductive current to continue flowing when the IGBT switches off during normal switching cycles

D. The diodes reduce switching losses in the IGBT modules during normal three-phase output operation in the inverter assembly

21. A hybrid vehicle's electric A/C compressor is being inspected after a customer complaint of intermittent cooling performance. The technician finds the refrigerant charge is correct, the compressor is receiving correct three-phase power, and there are no winding faults. The scan tool shows the compressor speed varies erratically during operation. What is the most likely cause?

A. Failed evaporator temperature sensor causing the climate control module to incorrectly command compressor speed during operation

B. Failed condenser cooling fan motor causing high head pressure that erratically affects compressor operation during normal use

C. Failed cabin air temperature sensor causing the climate control module to demand inconsistent cooling output from the compressor

D. Failed pressure sensor or intermittent communication fault between the climate module and the compressor inverter control unit

22. A hybrid vehicle's HV system has been de-energized following the OEM procedure. The technician needs to confirm zero voltage at the inverter input terminals. The multimeter reads 5V instead of zero after waiting the manufacturer-specified discharge time. What is the most appropriate next action?

A. Wait additional time for residual capacitor discharge to complete while continuing to monitor the voltage reading carefully

B. Continue with the service work since voltages below 60V are considered safe for direct technician contact in HV service work

C. Replace the inverter assembly because the residual voltage indicates a complete failure of the internal capacitor discharge resistors

D. Apply an external discharge resistor directly to the inverter terminals to force the residual voltage to zero quickly for safety

23. A hybrid vehicle's NiMH HV battery has been operating in a consistently hot climate for many years of service. The technician finds the pack capacity is significantly degraded compared to original specifications. What is the most common aging mechanism for NiMH battery cells operating in hot conditions?

A. SEI layer formation on the cell anode that consumes available lithium during electrochemical reactions during normal cell operation

B. Increased self-discharge rate and electrolyte loss through evaporation accelerating cell degradation during operation in hot climates

C. Lithium plating on the anode surface during charging events in hot conditions reducing usable cell capacity over the service life

D. Cathode material dissolution into the electrolyte during high-temperature operation reducing the cell capacity over time in service

24. A hybrid drive motor's three-phase stator windings are being tested with an LCR meter to measure winding inductance values. The technician finds that one specific phase has significantly lower inductance than the other two phases of the same motor. What does this measurement indicate about the affected motor phase?

A. Normal manufacturing tolerance variation in stator winding inductance for typical hybrid motor production runs at the factory

B. The motor windings are completely open-circuit and the LCR meter is reading only stray inductance values from cable harness

C. Shorted turns in the phase with lower inductance reducing the effective winding inductance below normal specification values

D. The motor windings have unusually high resistance which decreases the measured inductance of the windings during the test

25. A hybrid vehicle's boost converter contains an inductor that experiences current ripple during normal operation. The inductor is rated for 50A continuous current with a 100A peak current rating. During heavy acceleration, the current sensor reads 60A average current with 130A peak current. What does this measurement indicate about the operating conditions?

A. Normal operation with current readings well within both the continuous and the peak current rating specifications for the inductor

B. The current sensor is malfunctioning because current cannot exceed the rated 50A continuous current specification for the inductor

C. The HV battery is providing excessive current beyond the boost converter component capability during heavy acceleration in the vehicle

D. The inductor is being operated beyond its peak current rating during heavy acceleration which may cause inductor damage over time

26. A hybrid vehicle uses a heat pump A/C system with R-1234yf refrigerant from the factory. The refrigerant identifier device shows the refrigerant currently in the system is 95% R-1234yf and 5% R-134a from contamination. What action is required to address this refrigerant contamination?

A. The mixture is acceptable for system operation but should be noted in the service records for warranty tracking purposes

B. Recover and properly dispose of the contaminated refrigerant, then evacuate and recharge the system with new R-1234yf refrigerant

C. Add additional R-1234yf refrigerant to the system to dilute the contamination below 1% concentration for normal system operation

D. The system can continue to operate with the contamination since both refrigerants have similar properties for system operation

27. A hybrid vehicle's brake-by-wire system uses a high-pressure hydraulic accumulator that is charged by an electric pump. The technician finds the electric pump operates continuously even when the accumulator gauge shows full pressure has been reached. What is the most likely cause of this continuous pump operation?

A. Failed accumulator pressure sensor providing incorrect feedback to the brake control module about actual accumulator pressure

B. Failed brake pedal stroke sensor causing the brake system to request continuous accumulator pressure during normal driving

C. Failed wheel speed sensors causing the system to incorrectly anticipate emergency braking events during normal vehicle driving

D. Failed regenerative braking system causing the friction brake system to operate at higher pressure than normal specifications

28. A hybrid vehicle technician is preparing to test HV system insulation resistance after a repair. The OEM specifies a minimum insulation resistance of 100 ohms per volt of system voltage. For a 350V HV system, what is the minimum acceptable insulation resistance reading on the megohmmeter?

A. 0.005 megohms minimum acceptable insulation resistance for the 350V hybrid system per the OEM specification for service work

B. 0.018 megohms minimum acceptable insulation resistance for the 350V hybrid system per the OEM specification for service work

C. 0.035 megohms minimum acceptable insulation resistance for the 350V hybrid system per the OEM specification for service work

D. 0.500 megohms minimum acceptable insulation resistance for the 350V hybrid system per the OEM specification for service work

29. A hybrid vehicle's HV battery pack uses individual cell monitoring with a daisy-chain communication system between cell monitoring ICs. If one cell monitoring IC fails completely in the middle of the daisy-chain communication network, what is the most likely effect on the overall pack monitoring system?

A. Only the affected cell will have lost monitoring capability while all other cells continue to be monitored normally by the BMM

B. The BMM will compensate for the failed IC by interpolating cell voltages from the adjacent cells in the chain during operation

C. The cells immediately adjacent to the failed IC will be overcharged because they are no longer monitored by the BMM during operation

D. All cells downstream of the failed IC will lose communication with the BMM through the broken daisy-chain communication path

30. A hybrid drive motor is connected to an inverter that uses Field-Oriented Control (FOC) for precise motor control. What is the primary advantage of FOC compared to conventional scalar control of an AC motor in this application?

A. FOC eliminates the need for any rotor position feedback signal during normal motor operation in the vehicle driving conditions

B. FOC enables precise independent control of motor torque and flux providing excellent dynamic response across the operating range

C. FOC reduces the number of IGBT switches required in the inverter compared to scalar control designs for the same output power

D. FOC operates the motor at higher voltages than scalar control improving efficiency at all motor speeds during normal operation

31. A hybrid vehicle's inverter is being analyzed during operation. The technician uses a high-current probe and oscilloscope to view the current waveform on one motor phase output. The waveform shows a sinusoidal current with a peak-to-peak amplitude of 200A. What is the approximate RMS current value in this motor phase during the observation?

A. 71 amperes RMS approximate current in the motor phase during the observed operating condition based on the peak-to-peak measurement

B. 100 amperes RMS approximate current in the motor phase during the observed operating condition based on the peak-to-peak measurement

C. 141 amperes RMS approximate current in the motor phase during the observed operating condition based on the peak-to-peak measurement

D. 200 amperes RMS approximate current in the motor phase during the observed operating condition based on the peak-to-peak measurement

32. A hybrid vehicle's HV battery management module is reporting the pack state of charge as 75% on the dashboard display. The technician questions whether this SOC reading is accurate given recent driving patterns. How does the BMM typically determine the state of charge value during operation?

A. The BMM measures pack voltage at rest only and compares to a lookup table to determine the state of charge value during operation

B. The BMM counts the number of charging cycles since the last full charge event to determine the current state of charge value

C. The BMM uses multiple methods including voltage measurement, current integration (coulomb counting), and battery modeling techniques

D. The BMM uses only the highest individual cell voltage in the pack to determine the overall pack state of charge value during operation

33. A hybrid vehicle technician is using a CAT III rated multimeter for HV system testing. During testing of an HV circuit, the meter's input fuse blows due to a measurement error by the technician during the test. What is the most appropriate action regarding fuse replacement?

A. Replace the meter fuse with any commercially available fuse of similar amperage rating immediately to continue the testing work

B. Replace the meter fuse with the exact OEM-specified replacement fuse rated for the CAT III safety classification of the meter

C. Bypass the meter fuse with a piece of wire to continue testing immediately and complete the planned service work efficiently

D. Discard the meter completely and replace it with a new CAT III meter since meter fuses cannot be safely replaced once blown

34. A hybrid vehicle's drive motor produces electromagnetic interference during operation that affects the vehicle radio reception and other electronics. What component in the hybrid drive system is typically responsible for reducing this EMI from coupling into other vehicle systems?

A. The HV battery management module includes integrated EMI filtering circuits for the entire vehicle electrical system during operation

B. The DC-DC converter provides EMI filtering for both the 12V and HV electrical systems simultaneously during normal operation

C. The drive motor itself includes built-in EMI suppression elements in the stator winding insulation system during the original construction

D. The inverter assembly includes input EMI filters with chokes and capacitors specifically designed to reduce EMI emissions from switching

35. A hybrid vehicle's electric A/C compressor has been replaced after a confirmed failure. The technician notes the new replacement compressor came with a specified amount of POE oil pre-charged from the factory. The system retained approximately 30 ml of POE oil in the condenser and refrigerant lines after compressor removal. What is the correct action regarding the oil charge?

A. Drain the appropriate amount of oil from the new compressor to maintain the correct total system oil charge per OEM specification

B. Install the new compressor without modification since the residual oil amount is negligible to the overall system oil charge level

C. Add additional POE oil to the system to ensure proper lubrication during initial compressor break-in period operation in the vehicle

D. Replace the new compressor with one that contains less factory oil to compensate for the retained residual oil in the system lines

36. A hybrid vehicle uses a 400V lithium-ion HV battery with a usable energy capacity of 60 kWh. The vehicle has an EPA-rated electric driving range of 240 miles under standard test conditions. What is the approximate energy consumption rate of this vehicle during normal driving?

A. 100 watt-hours per mile of vehicle range based on the rated energy capacity and EPA range during normal vehicle operation

B. 200 watt-hours per mile of vehicle range based on the rated energy capacity and EPA range during normal vehicle operation

C. 250 watt-hours per mile of vehicle range based on the rated energy capacity and EPA range during normal vehicle operation

D. 400 watt-hours per mile of vehicle range based on the rated energy capacity and EPA range during normal vehicle operation

37. A hybrid vehicle's HV charging system uses a Type 2 (Mennekes) connector for AC charging from a Level 2 EVSE. The connector has multiple pins including L1, L2, L3, N, PE, CP, and PP for various signal and power functions. What is the specific function of the CP pin in this connector?

A. CP carries the protective earth (ground) connection between the EVSE charging station and the vehicle chassis ground system

B. CP carries the control pilot signal that handshakes communication between the EVSE charging station and the vehicle onboard charger

C. CP carries one phase of the AC power from the EVSE charging station to the vehicle's onboard charging system during charging

D. CP carries the proximity pilot signal indicating the charging connector is mechanically latched to the vehicle inlet during the cha

38. A hybrid vehicle is being inspected after a customer complaint of reduced power output during normal operation. The drive motor has been operating in service for over 10 years. The technician finds the motor's permanent magnets show evidence of demagnetization during testing. What is the most likely cause of this magnet demagnetization?

A. Long-term operation at elevated temperatures has gradually demagnetized the rotor permanent magnets over the vehicle service life

B. Manufacturing defects in the rotor magnets that have only appeared after extended hybrid vehicle service operation in the field

C. Excessive vibration during normal vehicle operation has loosened the rotor magnets within the rotor structure during service

D. Coolant contamination has reacted chemically with the rotor magnets reducing their magnetic strength over the service life of the motor

39. A hybrid vehicle technician is required to maintain a tool kit that includes both insulated tools and personal protective equipment for HV service work. What is the recommended testing interval for Class 0 rubber insulating gloves used in hybrid vehicle HV service work?

A. Test gloves annually only when worn condition is visibly noticed during normal shop service work on hybrid vehicles in the bay

B. Test gloves quarterly only when used for HV service work involving energized HV components in the shop service bay area

C. Test gloves monthly without exception regardless of usage frequency during normal shop service work on hybrid vehicles

D. Test gloves every six months per OSHA requirements for electrical PPE used in service work involving energized HV components

40. A hybrid vehicle's heat pump A/C system experiences a fault during cold weather operation. The technician finds the four-way reversing valve is mechanically stuck in the cooling mode position rather than switching to heating mode. What is the most likely cause of this stuck reversing valve condition?

A. Refrigerant overcharge in the system has caused the reversing valve to bind during cold weather operation in the vehicle

B. The cabin air temperature sensor has failed and is preventing the climate module from changing system modes during operation

C. Contaminants in the refrigerant or compressor oil have caused the reversing valve solenoid or slide to stick in the cooling position

D. The system is operating normally because heat pump systems do not actually use four-way reversing valves in EV applications

41. A hybrid vehicle's HV battery is being charged using a Level 2 AC charging station from a residential garage installation. The charging station delivers 6.6 kW of charging power at 240V AC single-phase. What is the approximate AC charging current being delivered to the vehicle onboard charger?

A. 14 amperes AC charging current at the EVSE charging station providing 6.6 kW of charging power at 240V AC to the vehicle

B. 28 amperes AC charging current at the EVSE charging station providing 6.6 kW of charging power at 240V AC to the vehicle

C. 40 amperes AC charging current at the EVSE charging station providing 6.6 kW of charging power at 240V AC to the vehicle

D. 80 amperes AC charging current at the EVSE charging station providing 6.6 kW of charging power at 240V AC to the vehicle

42. A hybrid drive motor uses a hybrid control strategy that combines Hall sensor input at low motor speeds with sensorless back-EMF detection at high motor speeds. What is the typical transition speed range where the control system switches from Hall sensors to sensorless back-EMF control?

A. The transition typically occurs between 100 to 500 RPM as back-EMF becomes reliable for position sensing during normal motor operation

B. The transition typically occurs between 2000 to 3000 RPM during normal vehicle operation in hybrid mode under typical driving conditions

C. The transition typically occurs between 5000 to 7500 RPM during peak hybrid vehicle operation events under heavy load conditions

D. The transition does not actually occur because sensorless control is not used at all in modern hybrid vehicle motor applications

43. A hybrid vehicle's DC-DC converter operates from a 380V HV input to produce a 14V output for the 12V auxiliary battery system. The technician needs to verify the conversion ratio is correct for diagnostic purposes. What is the approximate step-down ratio of this DC-DC converter during normal operation?

A. 10:1 step-down ratio from HV input voltage to the 14V output during normal converter operation in service in the vehicle

B. 18:1 step-down ratio from HV input voltage to the 14V output during normal converter operation in service in the vehicle

C. 25:1 step-down ratio from HV input voltage to the 14V output during normal converter operation in service in the vehicle

D. 27:1 step-down ratio from HV input voltage to the 14V output during normal converter operation in service in the vehicle

44. Two technicians are discussing proper HV battery pack disposal procedures at the end of service life. Technician A says HV battery packs can be discarded in standard automotive scrap metal streams after disconnecting all electrical cables from the pack assembly. Technician B says HV battery packs require specialized disposal through approved hazardous waste recyclers due to their chemistry composition and stored energy content. Who is correct?

A. Technician A only is correct on HV battery disposal procedures at the end of service life for the hybrid vehicle and pack

B. Technician B only is correct on HV battery disposal procedures at the end of service life for the hybrid vehicle and pack

C. Both Technician A and Technician B are correct on HV battery disposal procedures and standards used in the automotive industry

D. Neither Technician A nor Technician B is correct on HV battery disposal procedures and standards used in the automotive industry

45. A hybrid drive motor's stator core temperature is monitored by an NTC thermistor embedded directly in the windings. The thermistor reads approximately 5,000 ohms of resistance at room temperature (25°C). If the stator winding heats up to approximately 80°C during heavy load operation, what does the thermistor resistance most likely read at this elevated temperature?

A. Approximately 8,000 ohms which is higher than the room temperature value during normal motor operation events under load

B. Approximately the same 5,000 ohms because NTC thermistors do not change resistance significantly with temperature changes

C. Approximately 1,000 to 1,500 ohms which is lower than the room temperature value during the elevated temperature operation

D. Approximately zero ohms because NTC thermistors short-circuit at temperatures above 50°C during normal motor operation in vehicles

FULL ANSWER KEY WITH EXPLANATIONS — PRACTICE EXAM 19

1. A — Manufacturer-designated first-responder loop wires are the OEM emergency disconnect points designed to safely de-energize the HV system without exposing responders to direct HV contact. Cutting the designated loop wire opens the HV interlock, commanding the main contactors to open immediately. This is the only safe field method for emergency HV system shutdown at an accident scene.

2. D — State of health equals measured capacity divided by rated capacity, so 38 Ah ÷ 50 Ah = 0.76 or 76%. SOH is the standard metric used to track battery degradation over the service life of the pack. A 76% SOH indicates the cell has lost 24% of its original capacity and is approaching the typical end-of-life threshold of around 70%.

3. B — Synchronous reluctance motors produce torque through magnetic reluctance variation in the salient-pole rotor structure as it aligns with the rotating stator field. The rotor contains no magnets and no windings, only shaped iron laminations creating paths of low and high reluctance. This design eliminates rare-earth magnet dependency and simplifies rotor construction.

4. C — Bleed resistors are the only intentional path for the bus capacitors to discharge after the HV system is de-energized. With the resistors failed open, the capacitors retain voltage far longer than the manufacturer-specified wait time, creating an electrocution hazard during what should be safe service work. Technicians must always verify zero voltage before any HV contact.

5. A — A winding-to-housing short creates a leakage path from the HV bus to chassis ground that compromises HV system isolation. After replacing the failed compressor, the technician must verify that no residual damage or contamination is providing a continuing isolation fault elsewhere in the system. Failure to confirm proper isolation can leave a shock hazard active even after the failed component is replaced.

6. D — A voltage drop test under load measures the actual voltage lost across the relay contacts while current is flowing, directly revealing contact resistance under real operating conditions. Normal relay contacts drop only millivolts under load, while corroded or burned contacts drop significantly more voltage. This test pinpoints contact issues without requiring component removal or substitution.

7. C — Low-impedance multimeters load the circuit during measurement, eliminating the small induced voltages that high-impedance meters can pick up from adjacent energized circuits. This prevents technicians from being misled by "ghost voltage" readings that suggest a circuit is live when it is actually safe. Low-impedance meters are the appropriate choice for HV safety verification.

8. B — Active balancing uses small DC-DC converters to move charge from higher-voltage cells to lower-voltage cells, conserving the energy rather than burning it off as heat through bleed resistors. This is more efficient and faster than passive balancing, especially on larger high-energy packs. The trade-off is increased BMS complexity and cost.

9. A — The OEM scan tool initiates a learn routine that commands the inverter through the procedure required to determine the precise electrical alignment between the resolver feedback and the rotor's magnetic position. Without this learn, the inverter applies stator current at the wrong rotor angles, reducing torque output and increasing current draw. Most OEMs require this procedure after motor or inverter replacement.

10. D — When two related sensors set simultaneous DTCs while a third related sensor remains unaffected, the common factor between the two failing sensors is the most likely cause. Phase U and V current sensors typically share power supplies and reference voltages on the inverter PCB. A single power supply or reference failure can explain both DTCs while leaving the W sensor functional.

11. C — Heat pump systems extract heat from outside air, causing condensation that freezes on the outdoor heat exchanger fins in cold weather. The defrost cycle temporarily reverses refrigerant flow to melt the accumulated frost using heat from the indoor heat exchanger. Without periodic defrost, ice buildup blocks airflow and shuts down the heating function entirely.

12. A — Acceptable battery load test performance requires the voltage to remain above 9.6V at the test load for 15 seconds. A 200A load on a 600 CCA battery is well below the half-CCA test load, and holding 12.2V indicates excellent battery condition with minimal internal resistance. The battery passes the load test with significant margin and requires no replacement.

13. B — HV cables carrying DC current flow between the HV battery and inverter input, while AC cables carry the three-phase output from the inverter to the drive motor. The "DC" and "AC" markings help technicians quickly identify which cable serves which function for diagnostic and service work. Both cable types are colored orange because they all carry dangerous high voltage.

14. D — When the cabin A/C operates normally but the battery cooling does not, the shared refrigerant supply is healthy, and the fault must be in the branch specific to the battery cooling loop. A failed solenoid valve or restricted line in the battery chiller circuit prevents refrigerant from reaching the battery heat exchanger. The cabin A/C function isolates the problem to the battery-side components.

15. A — HiPot testing applies a voltage well above operating voltage for a short duration to confirm the insulation can withstand transient overvoltages without breaking down. Passing this test means the dielectric strength of the stator insulation is adequate to prevent breakdown during normal operation, including transients. The test verifies insulation integrity but does not measure resistance values or mechanical condition.

16. C — Load-dependent voltage droop with healthy input and stable HV bus points to degradation inside the converter itself. Electrolytic capacitors dry out, switching devices degrade, and circuit components age in ways that reduce the converter's ability to maintain regulation under load. The internal components must be inspected or the converter must be replaced.

17. B — Modern variable-speed electric A/C compressors receive their speed commands through serial communication networks (typically CAN or LIN bus) from the climate control module to the compressor inverter. The inverter then translates these digital commands into the appropriate three-phase output to drive the compressor motor. Digital communication allows precise multi-step speed control unavailable with simpler signaling methods.

18. D — Testing above operating voltage applies dielectric stress that reveals insulation weaknesses before they fail catastrophically in service. Testing at or below operating voltage cannot detect marginal insulation that holds at lower stress but breaks down under operational transients. The margin between test voltage and operating voltage determines how much safety margin the test actually verifies.

19. A — Cells with reduced capacity reach full charge voltage before higher-capacity cells because they hold less energy per volt of charge. When the BMS limits charging at the maximum cell voltage threshold, the smaller cells reach the limit first while the larger cells remain partially charged. This is a classic indicator of cell aging or manufacturing variation across the pack.

20. C — IGBTs cannot conduct current in the reverse direction, so when an IGBT switches off while the motor inductance is still pushing current, the freewheeling diode provides the necessary return path. Without these diodes, switching off the IGBT would generate destructive voltage spikes as the inductor tries to maintain current flow. Every IGBT in a motor inverter requires an antiparallel freewheeling diode.

21. D — Erratic compressor speed with proper power and correct refrigerant charge points to a control or feedback problem rather than a mechanical or refrigerant issue. A failing pressure sensor sends erratic input to the controller, or an intermittent communication link disrupts the speed commands sent to the compressor. Both produce the symptom of inconsistent compressor operation despite healthy hardware.

22. A — Residual capacitor discharge sometimes takes longer than the typical specified time, especially in cold conditions or with aged bleed resistors. Continued monitoring with the multimeter is the safe approach because the voltage should gradually decline toward zero. Touching the HV bus at 5V is not safe, and bypassing the natural discharge with external resistors creates additional risk.

23. B — NiMH cells in hot conditions suffer accelerated electrolyte loss through evaporation past the vent seals, and elevated temperatures dramatically increase the self-discharge rate. Both effects combine to reduce the cell's ability to store and deliver charge over the service life. This aging mechanism is distinct from lithium-ion aging, which is dominated by SEI growth and lithium plating.

24. C — Shorted turns inside a phase winding effectively reduce the number of active turns in the magnetic circuit, which reduces the winding's effective inductance. Resistance may remain similar to the other phases if only a few turns are shorted, but inductance drops noticeably. LCR measurement is more sensitive to this fault than simple resistance testing alone.

25. D — Component current ratings represent maximum allowable values, and operating at 130A peak exceeds the inductor's 100A peak rating. Continued operation at peak currents above rated values causes accelerated thermal aging, possible magnetic saturation, and eventual component failure. The technician should investigate why operating conditions exceed component design limits.

26. B — Refrigerant contamination at 5% R-134a in an R-1234yf system exceeds the threshold for acceptable contamination, and the mixture cannot be properly serviced because the refrigerant blend is no longer pure. Industry practice requires recovery of contaminated refrigerant for proper disposal, followed by evacuation and recharging with new R-1234yf refrigerant. Operating with contaminated refrigerant reduces performance and creates regulatory compliance issues.

27. A — The brake control module commands the pump on when the accumulator pressure sensor reports a low reading and off when the sensor reports full pressure. If the sensor falsely reports low pressure even when the accumulator is actually full, the controller will run the pump continuously trying to reach the target pressure. Verifying or replacing the pressure sensor is the most direct diagnostic step.

28. C — Minimum insulation resistance equals the OEM specification multiplied by the system voltage, so 100 ohms × 350V = 35,000 ohms or 0.035 megohms. This is the threshold below which the HV system isolation is considered insufficient for safe operation. Any reading below this value indicates a leakage path that must be located and repaired.

29. D — A daisy-chain communication network passes signals from one IC to the next in series, so a failure anywhere in the chain breaks communication to all downstream ICs. The BMM loses cell voltage data from every cell connected after the failed IC, not just the cell at the failed IC itself. This makes daisy-chain architectures vulnerable to single-point failure modes.

30. B — Field-oriented control mathematically decomposes motor current into independent torque-producing and flux-producing components, allowing the inverter to precisely manage each separately in real time. This produces excellent torque response, smooth operation across the entire speed range, and high efficiency. Scalar control cannot achieve this independent control and has inferior dynamic response.

31. A — RMS current for a sinusoidal waveform equals the peak amplitude divided by the square root of two, and peak amplitude is half of the peak-to-peak value. With 200A peak-to-peak, peak is 100A, and $100 \div \sqrt{2} = 70.7$A RMS, which rounds to approximately 71A. This is the equivalent DC current that would produce the same heating in a resistive load.

32. C — Battery management modules combine voltage measurement, current integration (coulomb counting), and battery model calculations to estimate SOC accurately under all operating conditions. Voltage alone is unreliable during charge or discharge due to internal resistance effects, while coulomb counting drifts over time without recalibration. Combining methods provides the most accurate SOC determination throughout the operating range.

33. B — Meter input fuses are precisely sized for the meter's specific CAT III safety rating, and substituting incorrect fuses defeats the meter's overvoltage protection. Only the exact OEM-specified fuse maintains the meter's CAT III certification for safe HV measurement work. Using any other fuse risks meter explosion under fault conditions.

34. D — The inverter is the primary EMI source in a hybrid drive system because its high-frequency IGBT switching creates broad-spectrum noise. Manufacturers include input EMI filters with common-mode chokes and bypass capacitors to suppress conducted emissions from leaving the inverter housing. These filters prevent inverter noise from coupling into vehicle radio and other electronic systems.

35. A — Refrigerant systems must maintain the correct total oil charge regardless of compressor replacement, so retained oil in the condenser and lines must be accounted for during compressor replacement. The technician drains an equivalent amount from the new compressor to keep the system total at the OEM specification. Excessive oil reduces refrigerant flow and overall cooling capacity.

36. C — Energy consumption per mile equals total energy capacity divided by total range, so 60 kWh ÷ 240 miles = 0.25 kWh/mile or 250 Wh/mile. This metric allows direct comparison of vehicle efficiency across different battery sizes and ranges. It is the EV equivalent of "miles per gallon" used to assess electric drivetrain efficiency.

37. B — The control pilot (CP) line is the signaling wire that handles all communication between the EVSE and the vehicle, including charge readiness, current limits, and ground fault detection. The EVSE uses pulse-width modulation on the CP signal to communicate available current capacity to the vehicle's onboard charger. Without a valid CP handshake, charging cannot begin.

38. A — Rare-earth permanent magnets lose magnetic strength gradually when exposed to elevated temperatures over extended periods of operation. Each operating cycle that approaches the magnet's maximum temperature reduces the magnetic flux slightly, and these effects accumulate over years of service. Vehicles operated in hot climates or with stressed cooling systems show this aging mechanism earlier than others.

39. D — OSHA 29 CFR 1910.137 requires retest of in-service rubber insulating gloves every six months. The retest verifies the gloves still meet their voltage rating and have not developed pinholes or other dielectric defects. Skipping this testing interval can leave the technician with gloves that fail under HV exposure.

40. C — Reversing valves use a precision-machined slide actuated by a small solenoid pilot to switch refrigerant flow direction. Contaminants in the refrigerant or compressor oil can settle in the valve, causing the slide to stick or the solenoid to lose its actuating force. Either condition prevents the valve from switching modes when commanded by the climate control module.

41. B — Current equals power divided by voltage, so 6,600W ÷ 240V = 27.5A, which rounds to approximately 28A. This is the AC current the EVSE delivers to the vehicle's onboard charger during Level 2 charging. Most Level 2 home installations are wired with 30A or 40A breakers to allow this charging rate plus margin.

42. A — Back-EMF amplitude is proportional to motor speed, so at very low RPM the back-EMF signal is too small to reliably extract position information. The transition from Hall sensors to sensorless control typically occurs in the 100–500 RPM range as the back-EMF signal becomes large enough for accurate position detection. Below this range, the system requires Hall sensors for reliable commutation.

43. D — The step-down ratio equals input voltage divided by output voltage, so 380V ÷ 14V = approximately 27.1, which rounds to a 27:1 ratio. This represents how much voltage reduction the converter must achieve from HV input to 12V output. Higher input voltage requires a larger step-down ratio, and the converter design must accommodate this ratio efficiently.

44. B — HV battery packs contain hazardous materials and significant stored energy, and disposal is regulated under federal hazardous waste rules. Approved recyclers handle the chemistry safely and recover valuable materials such as cobalt, nickel, and lithium for reuse in new battery production. Discarding HV packs in standard scrap streams violates environmental regulations and creates fire and chemical hazards.

45. C — NTC thermistors have a negative temperature coefficient, meaning resistance decreases as temperature increases. From 25°C to 80°C is a significant temperature rise, and typical automotive NTC thermistors with 5,000 ohms at room temperature drop to roughly 1,000–1,500 ohms at 80°C following an exponential decay curve. This characteristic allows the controller to determine winding temperature directly from the resistance reading.