

# **PRACTICE EXAM 5: RED SEAL 310S SIMULATION (125 QUESTIONS)**

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1. The WHMIS 2015 pictogram showing a flame symbol over a black bar identifies products that are:

- A. Toxic and may cause adverse health effects after long-term exposure
- B. Reactive and may release hazardous gases on contact with water
- C. Flammable, including flammable liquids, gases, solids, and aerosols
- D. Compressed gases held at high pressure inside the container

2. Before raising a vehicle on a four-post drive-on hoist, the technician should:

- A. Verify the vehicle's manufacturer-recommended lift points and use lift adapters where required
- B. Position the lift arms at the front and rear bumpers for maximum stability
- C. Place the lift arms at any convenient location on the rocker panels
- D. Center the vehicle with the front wheels touching the front of the runways

3. When jump-starting a vehicle with a discharged battery, the final cable connection should be:

- A. The positive cable on the donor vehicle's battery positive terminal
- B. The positive cable on the discharged vehicle's battery positive terminal
- C. The negative cable on the donor vehicle's battery negative terminal
- D. The negative cable on the discharged vehicle's engine block or chassis ground

4. A shop's hazardous material spill kit should contain absorbent material, PPE, disposal bags, and:

- A. A water hose to dilute the spill rapidly before it spreads
- B. A spill report form to document the incident for regulatory compliance
- C. A chemical neutralizer for all chemical types stored in the shop
- D. A vacuum cleaner to remove the absorbed spilled material

5. What is the most important daily maintenance task for a shop air compressor?

- A. Check and refill the compressor lubricating oil to the maximum level
- B. Inspect the drive belt tension and adjust if necessary daily
- C. Drain accumulated moisture from the air receiver tank
- D. Wipe down the exterior compressor surfaces with a damp cloth

6. When using oxyacetylene welding equipment, what is the maximum acetylene working pressure permitted?

- A. 30 psi for any cutting or welding operation in the shop
- B. 15 psi to prevent unstable decomposition of the acetylene gas
- C. 50 psi when using a heavy-duty cutting torch attachment
- D. 100 psi only when the acetylene cylinder is fully charged

7. Transportation of Dangerous Goods (TDG) regulations apply when:

- A. Hazardous materials are being transported on public roads, rail, or water
- B. Hazardous materials are stored in the workplace beyond a 24-hour period
- C. Hazardous materials are being used by employees during shop operations
- D. Hazardous materials are being purchased from the supplier for inventory

8. A customer requests a repair that is not recommended by the manufacturer's procedure but is within the shop's capability. The shop should:

- A. Refuse the work entirely and ask the customer to take the vehicle elsewhere
- B. Perform the repair without documentation since the customer requested it
- C. Charge a higher labour rate to cover the increased liability of the repair
- D. Document the customer's specific request and any associated risk acknowledgment

9. A complete repair order must include the customer's concern, the cause identified, and:

- A. The technician's hourly labour rate for the specific repair task
- B. The correction or repair performed to address the customer's concern
- C. The vehicle's odometer reading converted to kilometres from miles
- D. The shop owner's signature authorizing the completion of the work

10. The most common firing order for an inline four-cylinder engine is:

- A. 1-2-3-4 in sequential cylinder order from front to rear
- B. 1-4-2-3 to balance crank loading at lower speeds only

- C. 1-3-4-2 to balance crankshaft loading and reduce vibration
- D. 1-2-4-3 to match the camshaft timing on overhead-cam designs

11. A "full-floating" piston pin design means the pin:

- A. Rotates freely in both the piston pin bore and the connecting rod small end
- B. Is pressed tightly into the connecting rod small end with no free movement
- C. Is held in place by a press fit between the piston and the crankshaft
- D. Floats inside the piston only and is pressed into the connecting rod

12. Which type of camshaft drive system is most common on modern overhead-cam engines?

- A. A gear-driven camshaft drive used on diesel truck engines only
- B. A V-belt drive system used on older overhead-cam engines
- C. A pushrod and rocker system without a separate camshaft drive
- D. A timing chain or toothed timing belt depending on the manufacturer

13. On a variable valve timing (VVT) system, the oil control valve (OCV) controls:

- A. Engine oil pressure delivered to the main bearings during operation
- B. Oil flow direction to and from the camshaft phaser to advance or retard timing
- C. Engine oil temperature to maintain optimum viscosity for the engine
- D. Oil pump output volume in response to engine load and RPM demand

14. Hydraulic valve lifters automatically compensate for which condition during engine operation?

- A. Changes in engine vacuum at different throttle positions and engine loads
- B. Variations in engine oil pressure during normal driving conditions
- C. Thermal expansion of valvetrain components and normal valve seat wear
- D. Differences in fuel quality from one fill-up to another fuel station

15. Roller rocker arms differ from conventional sliding rocker arms by:

- A. Using a needle bearing roller tip that rolls on the valve stem to reduce friction
- B. Operating at higher hydraulic pressure than conventional sliding rocker arms
- C. Being constructed from aluminum instead of cast iron for weight reduction
- D. Requiring more frequent valve clearance adjustment than sliding rocker arms

16. What is the typical angle of an intake valve seat in a modern automotive engine?

- A. 90 degrees so the valve closes square to the cylinder head face
- B. 30 degrees to provide the maximum flow area through the valve seat
- C. 15 degrees for smooth airflow during the valve open period
- D. 45 degrees, with multi-angle seats often added for improved flow

17. Excessive valve guide wear typically produces which symptom?

- A. Decreased engine compression on the affected cylinder readings
- B. Blue oil smoke from the exhaust, particularly at startup and deceleration
- C. Engine misfire only at idle that disappears at higher engine speeds
- D. Reduced engine oil pressure indicated by the oil pressure gauge

18. Modern automotive head gaskets are most commonly constructed of:

- A. Multi-layer steel (MLS) with embossed sealing beads at critical areas
- B. Compressed asbestos fibre with a steel core for high temperature resistance
- C. Copper plate with embossed sealing rings around each cylinder bore
- D. Solid rubber gaskets coated with high-temperature sealant compound

19. A hydraulic engine mount differs from a conventional rubber engine mount by:

- A. Using compressed air pressure inside the mount housing for support
- B. Containing a steel spring that absorbs all vibration in the mount
- C. Operating with vacuum from the engine intake manifold for damping
- D. Containing hydraulic fluid that provides better vibration damping than rubber alone

20. The harmonic balancer (crankshaft pulley damper) functions to:

- A. Maintain accurate timing for the camshaft drive belt or chain
- B. Drive all engine accessories through the front of the crankshaft

- C. Damp out torsional vibrations along the length of the crankshaft
- D. Provide a reference point for the crankshaft position sensor

21. A "gerotor" style engine oil pump uses which design?

- A. Two intermeshing toothed gears that trap and move oil through the pump
- B. An inner rotor with external lobes mating with an outer rotor with internal lobes
- C. Spring-loaded vanes that slide in and out of a slotted shaft within the rotor
- D. A reciprocating piston driven by an eccentric on the engine crankshaft

22. On a modern vehicle, the electric engine cooling fan is most commonly controlled by:

- A. The PCM, based on coolant temperature, A/C demand, and vehicle speed
- B. A direct thermal switch in the radiator outlet that closes at a calibrated temperature
- C. The driver, through a manual switch mounted on the dashboard cluster
- D. A vacuum-operated diaphragm linked to the engine intake manifold

23. A vehicle has inadequate heat output despite a properly operating thermostat and full coolant level. The most likely cause is:

- A. A failed engine cooling fan motor not running at low speed
- B. A failed A/C system causing heater core temperature problems
- C. Engine coolant viscosity too high in cold weather conditions
- D. A restricted heater core requiring cleaning or replacement

24. What is the primary advantage of a constant-tension (spring) hose clamp over a worm-gear hose clamp?

- A. The clamp can be tightened more securely than a worm-gear clamp
- B. The clamp costs less than the equivalent worm-gear clamp design
- C. The clamp maintains constant clamping force as the hose expands and contracts with temperature
- D. The clamp is easier to install and remove without specialized tools

25. On a turbocharged engine, the boost pressure sensor (MAP sensor on a turbo application) is located:

- A. Upstream of the turbocharger inlet to monitor intake atmospheric pressure
- B. In the intake manifold downstream of the throttle body and intercooler
- C. Inside the turbocharger housing near the exhaust wheel for hot side data
- D. In the exhaust manifold before the turbocharger inlet for back pressure

26. On a modern electronic throttle body, the throttle position sensor (TPS) signal is most commonly:

- A. An analog voltage signal proportional to throttle plate angle, typically 0.5 to 4.5 V
- B. A digital pulse-width modulated signal between zero and twelve volts amplitude
- C. A frequency signal in cycles per second proportional to throttle plate angle
- D. A constant five-volt reference signal with no variation by throttle position

27. On a Hall-effect camshaft position sensor, the output signal is:

- A. A constant DC voltage that varies in amplitude with cam speed
- B. An analog AC sinusoidal voltage that varies with camshaft speed
- C. A frequency-modulated signal centered on the reference voltage value
- D. A digital square wave that switches as the trigger wheel teeth pass the sensor

28. Modern OBD-II systems detect engine misfire primarily by monitoring:

- A. The exhaust oxygen sensor voltage during normal closed-loop operation
- B. The engine intake manifold pressure during the compression strokes
- C. The crankshaft acceleration patterns through the crankshaft position sensor
- D. The spark plug voltage readings on each cylinder during ignition events

29. Low-Speed Pre-Ignition (LSPI) is a phenomenon affecting which type of engines?

- A. Diesel engines operating in stop-and-go traffic conditions during city driving
- B. Direct-injection gasoline engines, particularly turbocharged units at low RPM with high torque
- C. Carbureted engines with worn ignition timing components and high mileage
- D. Hybrid electric engines during the transition from electric to engine power modes

30. Diesel exhaust fluid (DEF) freezes at approximately what temperature?

- A. -40 °C (the same temperature at which most diesel fuel gels)
- B. -25 °C, which is similar to most 50/50 antifreeze mixtures used today

- C. 0 °C, exactly the same as pure water freezes at sea level pressure
- D. -11 °C (12 °F), which is why DEF tanks include heating elements for cold climates

31. Black smoke from a diesel engine exhaust typically indicates:

- A. Incomplete combustion from excessive fuel or restricted air intake
- B. Engine oil entering the combustion chamber past worn piston rings
- C. Engine coolant entering the combustion chamber through head gasket
- D. Normal operation of a healthy diesel engine under heavy load conditions

32. A high-speed CAN bus typically uses two terminating resistors of what value, located at:

- A. 60-ohm resistors at the gateway module and at the OBD-II port
- B. 120-ohm resistors in series at the OBD-II port for one end
- C. 120-ohm resistors at each end of the bus, often inside two end-node modules
- D. 240-ohm resistors at the master control module only on the CAN

33. The LIN (Local Interconnect Network) bus is typically used in vehicles for:

- A. Safety-critical applications like airbag deployment and ABS modulation
- B. Low-cost, low-speed control of subsystems like power windows and door locks
- C. High-bandwidth multimedia distribution between the head unit and amplifiers

D. Cellular telematics communication with the manufacturer's remote servers

34. The MOST (Media Oriented Systems Transport) network is used primarily for:

A. Multimedia and infotainment data including audio, video, and navigation in luxury vehicles

B. Engine and transmission control communication on heavy-duty truck applications

C. Emissions diagnostic communication with the regulatory scan tools

D. ABS and electronic stability control safety-critical data on luxury vehicles

35. During Bluetooth pairing between a phone and a vehicle infotainment system, security is provided by:

A. A passkey or PIN code that must be confirmed on both devices before pairing

B. The vehicle's VIN being broadcast to the phone for verification matching

C. A direct cable connection between the phone and the vehicle infotainment

D. Manual entry of the vehicle's licence plate into the phone's settings

36. Modules on a CAN network enter "sleep mode" to reduce battery drain when:

A. The engine is running but the vehicle is stopped with the brake applied

B. The vehicle is being driven at constant speed during highway operation

C. The vehicle has been parked with the ignition off and no wake-up events occur

D. The scan tool is connected and actively communicating with the modules

37. OBD-II "freeze frame" data captured at the time of a DTC is most useful for diagnosis because it:

- A. Stores video footage of the moment the failure was detected by the system
- B. Records the engine operating conditions present when the fault was first detected
- C. Identifies which specific module reported the trouble code to the system
- D. Provides the exact GPS location where the vehicle was during the fault

38. After replacing a module that stores VIN data on a modern vehicle, the technician must:

- A. Drive the vehicle for at least 100 km before any diagnostic codes will clear
- B. Reset the OBD-II readiness monitors using a generic OBD-II scan tool
- C. Manually enter the VIN into the new module using a punch-style label maker
- D. Program the VIN into the new module using a manufacturer-capable scan tool

39. On a vehicle equipped with a central gateway module, an external scan tool can access individual modules only:

- A. Through the gateway, which routes requests to the appropriate vehicle module
- B. By bypassing the gateway with a direct connection to each individual module
- C. After disabling the gateway's security access through a master reset button
- D. Through a separate wireless connection bypassing the vehicle's wired network

40. Some modern DTCs include a priority or severity indicator that tells the technician:

- A. The exact location in the vehicle where the fault occurred originally
- B. Whether the fault is critical (MIL flashing) or less urgent for repair priority
- C. The specific dollar cost estimate to repair the fault detected by the system
- D. The total number of times the fault has occurred since the last code clear

41. Modern vehicles are increasingly requiring authentication for module reprogramming because:

- A. The manufacturer wants to limit which technicians are permitted to use scan tools
- B. The scan tool manufacturers charge a fee for each programming event performed
- C. Programming consumes excessive battery power that the vehicle must replenish
- D. Unauthorized programming changes can introduce security vulnerabilities and unsafe operation

42. Most modern vehicle CAN networks use which physical topology arrangement?

- A. A star topology, with all modules connecting to a central gateway hub
- B. A ring topology, with modules connected in a closed loop arrangement
- C. A linear (bus) topology, with modules connected as branches to a backbone
- D. A mesh topology, with each module connected directly to every other module

43. A scan tool's "data recording" or "flight recorder" feature is most useful for diagnosing:

- A. Intermittent faults that cannot be reproduced during a static service bay test
- B. Steady-state engine performance problems at constant cruise conditions

- C. Permanent DTCs that have been confirmed through multiple drive cycles
- D. Module configuration errors after a control module replacement service

44. The hydraulic clutch system most commonly uses which fluid?

- A. ATF (automatic transmission fluid) matching the transmission type
- B. Brake fluid (DOT 3 or DOT 4 depending on the application)
- C. Power steering fluid from the vehicle's reservoir as backup
- D. Engine oil drawn from the lubrication system supply line

45. On a clutch with no hydraulic adjuster, excessive clutch pedal free play typically indicates:

- A. Air trapped in the clutch hydraulic system from a recent service
- B. A worn clutch master cylinder requiring service or replacement
- C. A failed throwout bearing that has lost its operating clearance
- D. Worn clutch disc friction material requiring clutch replacement

46. Self-adjusting (SAC) clutch pressure plates maintain consistent pedal effort by:

- A. Using a hydraulic pressure compensator inside the master cylinder housing
- B. Adjusting the throwout bearing position automatically with each clutch operation
- C. Compensating for friction disc wear via a wedge or ramp mechanism inside the pressure plate
- D. Increasing the pedal force as the disc wears to maintain torque capacity

47. A dual clutch transmission (DCT) achieves quick gear changes by:

- A. Using two hydraulic torque converters operating simultaneously in series
- B. Combining a manual gearbox with an electric motor for shift assist function
- C. Sharing the input shaft with an automatic transmission gear train design
- D. Having two separate clutches handle odd and even gears, with the next gear pre-selected

48. In a wet dual clutch transmission, the clutches operate:

- A. In a vacuum chamber to reduce parasitic friction during operation
- B. Submerged in ATF or specialized DCT fluid that lubricates and cools them
- C. In open air with cooling fins on the clutch housing for heat rejection
- D. Inside a sealed pressurized helium chamber for thermal management

49. A first-gear ratio of 3.62:1 means that the input shaft rotates:

- A. At one-third the speed of the output shaft and provides minimum torque to the wheels
- B. At the same speed as the output shaft with maximum mechanical efficiency
- C. At three-fifths the speed of the output shaft and reduces torque proportionally
- D. 3.62 times for each rotation of the output shaft and multiplies torque by 3.62

50. During manual transmission rebuild, synchronizer rings (blocker rings) should be inspected for:

- A. Tooth condition, friction surface wear, and a specific gap to the matching gear
- B. Magnetic polarity at each tooth location around the ring's circumference
- C. Specific resistance values when measured with an ohmmeter across each tooth
- D. Hardness on the Rockwell C scale at each individual tooth on the synchronizer

51. The reverse light switch on a manual transmission is most commonly located:

- A. On the clutch master cylinder body where reverse gear is selected mechanically
- B. Inside the steering column adjacent to the ignition switch wiring harness
- C. On the transmission case where the reverse shift rail mechanically actuates it
- D. Inside the transmission fluid pan, submerged in the gear lubricant fluid

52. A torque converter clutch (TCC) that engages and then immediately disengages, causing a "shudder" sensation, most commonly indicates:

- A. Failed transmission valve body solenoid for the TCC lockup function
- B. Contaminated transmission fluid or a worn TCC friction surface inside the converter
- C. Excessive engine vibration entering the driveline through the engine mounts
- D. Low transmission fluid level requiring topping off to the correct level

53. To test an automatic transmission shift solenoid in the shop, the technician should:

- A. Drive the vehicle and verify the shift occurs at the expected RPM in each gear
- B. Replace the suspect solenoid pack as a complete assembly with new parts

- C. Apply transmission line pressure through a hand pump and observe operation
- D. Measure resistance across the solenoid with an ohmmeter and verify against spec

54. On a typical RWD axle, the differential carrier (third member or "pumpkin") houses:

- A. The transmission output shaft and the front of the driveshaft assembly
- B. The transfer case and the rear differential side gears and pinion gears
- C. The ring gear, pinion gear, and the differential side gears with spider gears
- D. The wheel bearings, brake rotors, and the axle shaft splines at the wheel

55. A "crush sleeve" used during pinion bearing preload setup:

- A. Is replaced every time the pinion is removed because it deforms during torque setting
- B. Provides shim adjustment that can be added or removed as needed during setup
- C. Is constructed of stainless steel for chemical resistance during use
- D. Is reusable indefinitely if removed carefully without bending during service

56. The splines at the inner end of an axle shaft on a typical RWD vehicle engage with:

- A. The brake rotor hub assembly at the outer end of the axle housing
- B. The transmission output shaft directly inside the transfer case housing
- C. The pinion bearing race inside the differential carrier opening
- D. The differential side gear inside the differential carrier assembly

57. The grease used inside a constant velocity (CV) joint is:

- A. Standard wheel bearing grease matching the wheel bearing application
- B. Lithium-based chassis grease used at other suspension lubrication points
- C. A specialized molybdenum disulfide CV joint grease formulated for extreme pressure
- D. Engine oil applied through a grease fitting on the CV joint outer housing

58. A continuous whining noise that changes pitch with vehicle speed (not engine speed) most likely indicates:

- A. A worn engine bearing requiring engine teardown and inspection
- B. A worn differential gear, axle bearing, or other drivetrain component
- C. A failed power steering pump requiring replacement of the pump
- D. A failing A/C compressor clutch bearing during system operation

59. Most modern part-time 4WD transfer cases use which type of lubricant?

- A. ATF (automatic transmission fluid) or the manufacturer's specific transfer case fluid
- B. Gear oil GL-5 in the 75W-90 viscosity range for high-load applications
- C. Engine oil drawn from the engine lubrication system through external lines
- D. Lithium-based grease packed into the case during initial assembly only

60. On a two-piece driveshaft, the front and rear U-joints must be phased (aligned) so that:

- A. The U-joint operating angles are exactly perpendicular to the driveshaft tube
- B. The U-joints both reach maximum operating angle at the same time
- C. The U-joints are 90 degrees out of phase to minimize speed variation
- D. The U-joint yokes are in the same plane so the speed variations cancel during rotation

61. In a parallel electrical circuit, when one branch fails (opens), what happens to the other branches?

- A. All other branches stop operating because the circuit is broken at the source
- B. The remaining branches operate at lower voltage than designed for the load
- C. The other branches continue to operate normally because they have separate paths
- D. The remaining branches operate at higher current than their design rating allows

62. The function of an engine-to-chassis ground strap is to:

- A. Provide a low-resistance path for ground current from the engine to chassis
- B. Insulate the engine from the chassis to prevent electrical interference
- C. Conduct heat away from the engine block to the chassis members
- D. Serve as a backup for the negative battery cable during normal operation

63. A vehicle's battery cables are sized large because they must:

- A. Withstand the high temperatures present in the engine compartment area
- B. Carry hundreds of amps of starter current with minimal voltage drop

- C. Resist mechanical damage from vibration and contact with chassis members
- D. Provide redundancy in case of partial cable failure during operation

64. A battery's reserve capacity (RC) rating describes:

- A. The maximum current the battery can deliver for one full hour of continuous use
- B. The cold cranking ability of the battery at  $-18^{\circ}\text{C}$  for at least 30 seconds
- C. The maximum voltage the battery can produce during heavy current discharge events
- D. How many minutes the battery can supply 25 amps before voltage drops below 10.5 V

65. The diode rectifier bridge inside an alternator converts:

- A. DC current from the battery into AC current required by alternator stator windings
- B. High voltage AC current into low voltage DC current for accessory operation
- C. Three-phase AC current from the stator windings into pulsating DC current
- D. Mechanical rotation into electrical voltage through electromagnetic induction

66. On older fuel-injected vehicles with mechanical throttle bodies, idle speed is controlled by:

- A. An idle air control (IAC) valve bypassing air around the closed throttle plate
- B. A throttle position sensor signal to the PCM that adjusts the throttle plate
- C. A vacuum-operated diaphragm linked to the engine's intake manifold pressure
- D. A mechanical adjustment screw on the throttle linkage that opens the throttle

67. After replacing the throttle body on a modern electronic throttle vehicle, the technician must:

- A. Disconnect the battery for 30 minutes to allow the PCM to forget old values
- B. Perform the manufacturer's idle relearn procedure using the scan tool
- C. Drive the vehicle for at least 50 km to allow the PCM to adapt the new throttle
- D. Replace the PCM simultaneously with the throttle body assembly always

68. A poor ground connection at the ABS module typically produces which symptom?

- A. Constant ABS pump motor operation while the vehicle is in motion
- B. The ABS warning light staying off even when actual faults are present
- C. Normal brake operation with no apparent symptoms or DTCs reported
- D. ABS warning light illumination with multiple sensor-related DTCs being logged

69. On a six-way power seat, the seat track motor is most commonly:

- A. A linear actuator with a steel cable and pulley driving the seat track
- B. A hydraulic cylinder driven by a remote pump in the seat base
- C. A small DC motor driving the track through a worm gear or screw drive
- D. A pneumatic actuator using vacuum from the engine intake manifold

70. To repair a broken grid line on a rear window electric defroster, the technician uses:

- A. Standard solder applied with a hot iron directly to the glass surface
- B. A specialized conductive paint or repair compound rated for window glass
- C. Copper wire soldered between the broken ends of the grid line on glass
- D. Aluminum foil tape applied across the break to bridge the grid line

71. Adequate airflow through the A/C condenser is critical because:

- A. The condenser releases the heat absorbed by the refrigerant during the cycle
- B. The condenser cools the refrigerant before it returns to the compressor inlet
- C. Airflow through the condenser drives the A/C compressor through the belt
- D. The airflow keeps the refrigerant in vapour form throughout the entire system

72. In an A/C system using a thermal expansion valve (TXV), the receiver-drier:

- A. Cools the refrigerant before it reaches the metering device on the high side
- B. Provides the primary metering of refrigerant into the evaporator core
- C. Compresses the refrigerant from low side to high side pressure
- D. Filters debris and absorbs moisture from the refrigerant on the high side

73. In an A/C system using a fixed orifice tube (instead of a TXV), the metering device is:

- A. A variable-opening valve that adjusts to evaporator superheat conditions
- B. Located in the high-pressure return line at the back of the compressor

- C. A fixed-diameter restriction in the line entering the evaporator on the low side
- D. A two-stage spring valve that opens progressively with system pressure

74. During an A/C performance test in a typical service bay, vent outlet temperature should drop to approximately:

- A. 25 to 30 °C below the ambient temperature outside the vehicle
- B. 10 to 15 °C below the ambient temperature outside the vehicle
- C. The exact freezing point of water for safe cabin air cooling effect
- D. Above the cabin temperature to dehumidify the air conditioning supply

75. Modern A/C compressors are protected from operation under certain conditions by:

- A. A low-pressure cut-off switch and a high-pressure cut-off switch on the system
- B. A built-in mechanical clutch that automatically slips at high temperatures
- C. A pressure relief valve that vents refrigerant directly to atmosphere
- D. A magnetic field sensor that disengages the compressor at high RPM

76. Modern vehicle blower motors with variable fan speed most commonly use which control method?

- A. A multi-position rotary switch controlling several blower motor speeds directly
- B. A vacuum-operated control allowing fan speeds based on intake vacuum levels
- C. A series of fixed resistors that drop voltage at each speed setting level
- D. A variable-speed PWM (pulse-width modulation) controller for infinite speeds

77. The recirculation door (recirc/fresh air) in an HVAC case:

- A. Controls the airflow between the defrost and the floor outlets in the dash
- B. Adjusts the temperature of air exiting through the vents at the dashboard
- C. Selects between fresh outside air and recirculated cabin air at the intake
- D. Determines whether the A/C compressor will engage during a service event

78. A glove box light that stays on with the glove box closed typically indicates:

- A. The bulb itself has failed in the closed position internally
- B. A failed glove box door switch (sticking in the closed-circuit position)
- C. The BCM has incorrectly programmed the glove box light circuit
- D. The body wiring has a short to ground on the glove box light circuit

79. Modern vehicle USB power ports typically provide:

- A. Five volts DC at a current rated by the port (often 2.1 A or higher)
- B. Twelve volts DC at the same rating as the auxiliary power outlets
- C. One hundred twenty volts AC inverted from the vehicle's electrical system
- D. Variable voltage based on the load device's specific demand requirements

80. A battery terminal connection with significant corrosion buildup typically causes:

- A. The battery to discharge rapidly while the vehicle is parked unattended
- B. The alternator to overcharge the battery while the engine is running
- C. The starter to crank the engine at higher than normal cranking speeds
- D. Voltage drop across the corroded connection, reducing cranking and charging performance

81. On a vehicle with a "smart" battery sensor (IBS) clamped to the negative battery terminal, the sensor monitors:

- A. Battery temperature only, to compensate for cold-weather performance changes
- B. Battery voltage only, to detect a discharged battery requiring service replacement
- C. Battery current, voltage, and temperature for accurate state-of-charge determination
- D. Battery specific gravity through magnetic field detection of acid concentration

82. In a modern A/C system, the oil that lubricates the compressor:

- A. Is stored in a separate reservoir on the compressor housing for the system
- B. Mixes with the refrigerant and circulates throughout the entire A/C system
- C. Is delivered by a small mechanical oil pump driven by the compressor shaft
- D. Sits stationary inside the compressor and never circulates outside the housing

83. A high-intensity discharge (HID) headlight bulb produces light by:

- A. Heating a tungsten filament inside a glass envelope until incandescent
- B. Passing current through a semiconductor LED junction emitting photons

- C. Burning a mixture of gases inside the bulb envelope continuously
- D. Creating an electrical arc between two electrodes through xenon gas vapour

84. Ceramic brake pads differ from semi-metallic pads primarily by:

- A. Producing less brake dust, operating quieter, and being gentler on rotor surfaces
- B. Operating with much higher friction coefficient at all temperatures than semi-metallic
- C. Being lighter in weight than the equivalent semi-metallic brake pad set
- D. Requiring shorter break-in (bedding) procedure than semi-metallic pads

85. A brake fluid moisture tester measures water content because:

- A. Water content directly correlates with the fluid's chemical pH level value
- B. Water content indicates the fluid's electrical conductivity to the brake system
- C. Water content lowers the boiling point of brake fluid, increasing vapour lock risk
- D. Water content reduces the fluid's freezing point in cold weather

86. Compared to manual pump bleeding, pressure bleeding of brakes:

- A. Requires two technicians working together to operate the equipment safely
- B. Maintains constant fluid pressure at the master cylinder, simplifying the bleeding process
- C. Uses a vacuum pump connected to the bleeder screw at each wheel of the vehicle
- D. Cannot remove air from the ABS hydraulic modulator on modern vehicles

87. Bench bleeding a master cylinder before installation:

- A. Removes trapped air from the master cylinder so on-vehicle bleeding is faster
- B. Calibrates the master cylinder's output pressure to the brake system specifications
- C. Verifies that the master cylinder is mechanically free from internal damage
- D. Pre-charges the master cylinder with brake fluid additive for the installation

88. To test brake booster vacuum supply, the technician should:

- A. Disconnect the booster vacuum line and check that engine vacuum is present
- B. Apply a vacuum gauge directly to the brake booster supply line and start the engine
- C. Hold the brake pedal down with the engine off and start it; the pedal should rise
- D. Hold the brake pedal down with the engine off and start it; the pedal should drop slightly

89. After replacing the rear brake shoes on a drum brake vehicle, the parking brake cable should be:

- A. Disconnected entirely and operated only by the service brake pedal pressure
- B. Set so the parking brake handle requires maximum effort to fully engage the brake
- C. Adjusted so the parking brake fully engages within the manufacturer's specified handle travel range
- D. Greased generously with high-temperature wheel bearing grease at each end

90. In an ABS hydraulic modulator, the inlet and outlet solenoids are typically:

- A. Mechanical pressure-relief valves that open at a calibrated pressure threshold
- B. Normally open and normally closed two-position valves controlling fluid flow
- C. Variable-position proportional valves that vary opening over a wide range
- D. Hydraulically-pilot-operated valves driven by master cylinder pressure directly

91. The yaw rate sensor used by the ESC system is most commonly located:

- A. Near the vehicle's center of gravity, often under the center console or floor
- B. At each wheel hub to measure the individual wheel rotation rates accurately
- C. In the steering wheel hub near the airbag clock spring assembly
- D. Inside the ABS hydraulic modulator unit at the brake fluid passages

92. A bent steering knuckle is most accurately diagnosed by:

- A. Visual inspection alone, since significant bends are always obvious
- B. Comparing brake disc thickness measurements left and right
- C. Comparing camber and SAI alignment readings against the manufacturer's spec
- D. Tapping the knuckle with a hammer and listening for hairline cracks

93. Rubber strut spring isolators (sometimes called spring seats):

- A. Provide the primary damping force for the suspension on the vehicle
- B. Allow the strut shaft to rotate during steering input from the driver

- C. Adjust the vehicle's ride height by changing the spring's mounting position
- D. Cushion the contact between the coil spring and the strut, reducing noise and wear

94. A worn sway bar end link bushing typically produces which symptom?

- A. A continuous whining noise that changes pitch with vehicle road speed
- B. A clunking or rattling noise over uneven road surfaces and small bumps
- C. The steering wheel pulling consistently to one side during normal driving
- D. Excessive tire wear on the outside edges of both front tires

95. On a vehicle with a pressed-in sealed wheel bearing and a separate hub flange, the axle nut is typically:

- A. Torqued to manufacturer specification, often a high torque value with torque-plus-angle
- B. Tightened only to a finger-tight position to prevent over-torquing the bearing
- C. Replaced with a new self-locking nut every time the axle is removed
- D. Adjusted while the wheel is rotating to set bearing preload precisely

96. On a hub-centric wheel mounting, the wheel is centered on the hub by:

- A. The pattern of the lug nuts as they tighten down evenly around the wheel
- B. A separate center cap pressed into the wheel center after installation
- C. The friction between the wheel flange and the brake rotor surface
- D. A precise center hole in the wheel matching the center pilot diameter of the hub

97. A tire with a load index of 95 has a maximum load capacity per tire of:

- A. Approximately 415 kg per tire when fully inflated to the maximum pressure
- B. Approximately 950 kg per tire when fully inflated to the maximum pressure
- C. Approximately 690 kg per tire when fully inflated to the maximum pressure
- D. Approximately 1,250 kg per tire when fully inflated to the maximum pressure

98. A tire with a speed rating of "H" is rated for sustained speeds up to:

- A. 190 km/h (118 mph) as the safe sustained operating maximum speed
- B. 210 km/h (130 mph) as the safe sustained operating maximum speed
- C. 240 km/h (149 mph) as the safe sustained operating maximum speed
- D. 270 km/h (168 mph) as the safe sustained operating maximum speed

99. "Plus-sizing" a tire and wheel combination means:

- A. Increasing wheel diameter and reducing tire sidewall height while keeping overall diameter approximately the same
- B. Increasing both the wheel diameter and the tire sidewall height for off-road use
- C. Decreasing the wheel diameter and increasing the tire sidewall for ride comfort
- D. Adding additional tire pressure to compensate for the heavier wheel material

100. "Toe-out on turns" (also called Ackermann angle) refers to:

- A. The total toe angle being negative (toed outward) when measured at rest
- B. The deliberate toe-out adjustment built into the alignment specifications
- C. The toe-out that develops as the tires wear unevenly over time and miles
- D. The geometry where the inside wheel turns at a sharper angle than the outside during turns

101. "Camber gain" in a suspension design refers to:

- A. The fixed camber setting specified by the manufacturer for new vehicles
- B. The amount of positive camber lost during severe braking from high speeds
- C. The change in camber angle as the suspension compresses during cornering or bumps
- D. The amount of camber adjustment available through normal alignment service

102. Steering axis inclination (SAI) is:

- A. The angle of the steering axis (line between upper and lower ball joints) from vertical, viewed from the front
- B. The angle of the steering wheel column relative to the floor of the vehicle
- C. The angle between the steering wheel and the front wheels during turns
- D. The angle of the tie rod ends relative to the rack-and-pinion assembly

103. When machining a brake rotor on an on-vehicle brake lathe, the technician must:

- A. Remove the rotor from the hub before machining to ensure accurate cuts
- B. Calibrate the lathe to compensate for any lateral runout in the hub assembly

- C. Use a slower feed rate than off-vehicle lathes for better surface finish quality
- D. Apply cutting fluid continuously to the rotor surface throughout the cut operation

104. After installing a new flexible brake hose at the caliper banjo fitting, the technician should:

- A. Torque the banjo bolt by feel using the technician's accumulated experience
- B. Torque the bolt to maximum value to ensure no leaks are possible
- C. Torque the banjo bolt to manufacturer specification using new copper washers
- D. Apply Teflon thread sealant to the banjo bolt threads before tightening

105. Drum brake return springs are often color-coded because:

- A. The colors indicate the manufacturer's brand and model of brake hardware
- B. The colors match the brake shoe material for proper assembly tracking
- C. The colors identify the brake fluid type compatible with the springs
- D. The colors identify the specific spring tension needed for proper operation

106. Pressure bleeding equipment for brakes typically operates at:

- A. 60 to 80 psi at the bleeder screw at each wheel of the vehicle
- B. Less than 5 psi to prevent damage to the master cylinder seals
- C. Approximately 10 to 15 psi at the master cylinder reservoir cap during bleeding
- D. Above 100 psi to forcefully purge air from the entire brake system

107. A seat belt pretensioner activates during a crash by:

- A. Pyrotechnically retracting the seat belt to remove slack and pull occupant into the seat
- B. Mechanically locking the seat belt retractor in place to prevent further movement
- C. Releasing the seat belt entirely so the occupant can exit the vehicle quickly
- D. Inflating an airbag inside the seat belt webbing for cushioning effect

108. A knee airbag is designed to:

- A. Protect the occupant's head from impact with the steering wheel column area
- B. Position the occupant's lower body to maintain proper restraint geometry during impact
- C. Inflate around the occupant's knees to prevent contact with the dashboard at all
- D. Provide protection during rear-end collision events to the lower body region

109. An Event Data Recorder (EDR) on a modern vehicle records:

- A. The vehicle's GPS location at all times while the ignition is on
- B. The driver's biometric data for insurance and tracking purposes
- C. Vehicle operating parameters during the few seconds before, during, and after a crash event
- D. Audio and video footage from inside the cabin during operation

110. An active hood (pop-up hood) system on some modern vehicles is designed to:

- A. Open the hood automatically when the engine overheats during operation
- B. Lock the hood in place during high-speed driving to prevent vibration noise
- C. Provide additional cooling airflow to the engine compartment area
- D. Lift the rear of the hood during a pedestrian impact to cushion the impact

111. When replacing a power window regulator that is integrated with the motor, the technician must:

- A. Verify the window motor pulse-counting calibration after installation per manufacturer
- B. Adjust the window glass position with manual mechanical stops to set the limits
- C. Reprogram the BCM with a new VIN to accept the new window regulator unit
- D. Lubricate the new regulator track with engine oil before installation in the door

112. Cleaning a vehicle's sunroof drain tubes is necessary because:

- A. The drains supply lubrication to the sunroof track mechanism through a small tube
- B. Blocked drains prevent the sunroof from opening fully during operation
- C. Blocked drains cause water from the sunroof seal to leak into the cabin instead of draining
- D. The drains require periodic flushing to maintain the sunroof's electrical system

113. After replacing a rear-view (back-up) camera on a modern vehicle, calibration may be required to:

- A. Pair the camera wirelessly with the driver's smartphone for remote viewing
- B. Align the camera image and overlay guidelines with the actual vehicle steering angle

- C. Configure the camera to recognize the driver's facial features for security
- D. Activate the camera's night vision mode for low-light driving conditions

114. An auto-dimming rearview mirror uses which sensor input to control darkening?

- A. A photodiode (light sensor) measuring rearward glare versus ambient light forward
- B. A radar sensor measuring the distance to the vehicle behind on the road
- C. A pressure sensor detecting the driver's adjustment of the mirror angle
- D. A GPS sensor calculating sunset and sunrise times at the vehicle's location

115. A heads-up display (HUD) projects information onto:

- A. A separate auxiliary screen mounted on top of the dashboard cluster
- B. The interior rearview mirror surface for driver visibility while driving
- C. The vehicle's infotainment center display screen at the dashboard
- D. The windshield glass surface, allowing the driver to read without looking down

116. When replacing a liftgate motor on a vehicle with programmed open height memory, the technician must:

- A. Re-learn the liftgate's open height limits using the manufacturer's procedure after installation
- B. Replace the entire liftgate assembly as the motor cannot be replaced separately
- C. Disconnect the battery for 30 minutes to allow the BCM to forget the old motor
- D. Connect a special diagnostic harness to the BCM during the entire procedure

117. A series hybrid configuration differs from a parallel hybrid because:

- A. The engine provides all propulsion while the electric motor only assists during acceleration
- B. The engine drives a generator that produces electricity; the wheels are driven only by the electric motor
- C. The engine and motor are connected through a CVT for variable power split
- D. The series hybrid does not use a battery pack for energy storage between cycles

118. An EV with a heat pump HVAC system improves winter range because:

- A. The heat pump generates heat by burning a small amount of gasoline fuel
- B. The heat pump uses solar panels on the roof to provide cabin heat
- C. The heat pump moves existing heat (e.g., from battery, motor, or ambient air) more efficiently than resistance heating
- D. The heat pump only operates when the battery is fully charged from the grid

119. The High-Voltage Interlock Loop (HVIL) is tested by:

- A. Connecting a high-voltage source to verify the system can handle full load current
- B. Applying mechanical force to each HV connector to verify mechanical strength
- C. Verifying continuity through the small low-voltage loop that runs through each HV connector
- D. Measuring the resistance of the high-voltage cables themselves under load

120. In North America in 2025–2026, the three main DC fast charging connectors are:

- A. J1772 (Type 1), Mennekes (Type 2), and the GB/T China connector
- B. SAE J1772, NEMA 14-50, and the Tesla mobile connector for travel
- C. Mennekes (Type 2), CCS Combo 2, and the GB/T China connector
- D. CCS Combo 1, CHAdeMO, and NACS (Tesla-derived North American Charging Standard)

121. EV battery capacity (range) gradually decreases over time primarily due to:

- A. Mechanical wear of the battery cell internal components from vibration
- B. Chemical changes within the cells, accelerated by high temperatures and rapid charging
- C. Loss of electrolyte through evaporation from the sealed cell housings
- D. Static electrical buildup that the BMS cannot dissipate during operation

122. An EV's displayed range estimate ("guess-o-meter") is calculated primarily from:

- A. Recent driving history, current battery state-of-charge, and current driving conditions
- B. The manufacturer's official EPA-rated range divided by the percent state of charge
- C. The vehicle's exact GPS-tracked previous trips and time of year for the route
- D. The driver's personal driving profile downloaded from the manufacturer's server

123. Thermal runaway in a lithium-ion battery is dangerous because:

- A. The battery's electrolyte freezes and cannot conduct charge through the cells
- B. The battery loses charging capability but does not pose any safety risk to people

- C. A single cell failure can cascade to adjacent cells, producing intense heat and possibly fire
- D. The high-voltage system shuts down completely without warning to the driver

124. Tools used for high-voltage work on EVs and hybrids must be rated for:

- A. At least 600 V AC for general electrical work in the shop environment
- B. At least 1,000 V DC, marked with the standard "1000V" insulation rating
- C. Standard automotive use, since EV systems are protected by the BMS
- D. Up to 5,000 V to handle any possible voltage spike during operation

125. The pre-charge resistor in an EV's high-voltage system:

- A. Provides backup power to the BMS during a main battery failure event
- B. Limits the maximum charging current accepted from a DC fast charger
- C. Maintains a small trickle charge to the auxiliary 12V battery from the HV pack
- D. Limits inrush current to the inverter capacitors when the main contactors close

## Practice Exam 5: Answer Key and Explanations

1. C — The flame-over-bar pictogram identifies flammable products, including flammable liquids, gases, solids, and aerosols. The pictogram alerts handlers to ignition risks and triggers requirements for proper storage away from heat sources and ignition. Recognizing the flame pictogram on sight is essential because flammable materials are present throughout every automotive shop.

2. A — Manufacturer-recommended lift points are reinforced areas designed to support the vehicle's weight without bending body panels or damaging components. Using bumpers, rockers, or unsupported

areas risks crushing the lift point, which is both a safety hazard and an expensive body repair. The vehicle owner's manual or a lift point chart identifies these locations.

3. D — The final connection should be to the engine block or chassis ground on the discharged vehicle, away from the battery. Connecting at the battery's negative terminal would create a spark adjacent to hydrogen gas that may have accumulated above the battery, potentially igniting it. The chassis ground location separates the spark from any flammable battery vapours.

4. B — A spill report form is essential because regulatory authorities require documentation of any hazardous material spill, including type, quantity, location, response actions, and disposal. Even small spills must be recorded to demonstrate environmental compliance. The other items in the kit address the spill physically; the report documents the incident formally.

5. C — Moisture accumulates in the air receiver tank from condensation as compressed air cools, and undrained moisture corrodes the tank internally and contaminates pneumatic tools downstream. Draining the tank daily extends tank life and protects every air-powered tool in the shop. Most modern compressors include an automatic drain, but manual verification is still recommended daily.

6. B — Acetylene is unstable above approximately 15 psi (about 100 kPa) and can decompose explosively at higher pressures, even without an ignition source. The 15 psi working pressure limit is a critical safety boundary specified by every gas welding standard. Exceeding it risks a violent explosion that can destroy the cylinder and injure anyone nearby.

7. A — TDG regulations apply specifically to the transportation of dangerous goods on public roads, rail, water, or air. While in storage or use at the workplace, WHMIS regulations apply instead. The two regulatory frameworks complement each other but cover different stages of the hazardous material lifecycle.

8. D — Documenting the customer's specific request and any risk acknowledgment protects both the shop and the customer. The written record establishes what was requested, what was disclosed about risks, and that the customer agreed to proceed. Without documentation, the shop may face liability claims if the non-recommended repair leads to a future problem.

9. B — A complete repair order documents the "3 Cs": Concern (customer complaint), Cause (what was wrong), and Correction (what was done to fix it). The correction is the repair work performed and is

essential for warranty claims, future diagnosis, and customer transparency. Missing any of the 3 Cs leaves the documentation incomplete.

10. C — Most inline four-cylinder engines fire in the order 1-3-4-2, which balances loading on the crankshaft by alternating between front and rear cylinder pairs. The firing order is determined by the camshaft and ignition timing design and is specific to each engine. Always confirm the firing order from the manufacturer's specifications when servicing ignition components.

11. A — A full-floating piston pin rotates freely in both the piston pin bore and the connecting rod small end, retained in the piston by snap rings (circlips). This design distributes wear across both surfaces and is common in high-performance and heavy-duty applications. Press-fit pins are simpler but concentrate wear at the connecting rod small end.

12. D — Modern overhead-cam engines use either a timing chain or a toothed (cogged) timing belt to drive the camshaft from the crankshaft. Chains are typically lifetime components in well-maintained engines, while belts have specified replacement intervals (often 100,000-160,000 km). Both must maintain precise timing relationships between cam and crank for the engine to run correctly.

13. B — The oil control valve (OCV) directs pressurized engine oil to one side of the camshaft phaser or the other, advancing or retarding cam timing as commanded by the PCM. The phaser changes the cam-to-crank relationship to optimize valve timing for the current engine load and speed. A failed OCV is a common cause of VVT-related DTCs and rough running.

14. C — Hydraulic lifters use engine oil pressure to maintain zero clearance in the valvetrain, automatically compensating for thermal expansion as the engine warms and for normal valve seat wear over time. This eliminates the need for periodic mechanical adjustment that solid lifters require. A noisy hydraulic lifter typically indicates oil pressure or contamination problems.

15. A — Roller rocker arms use a needle bearing roller tip that rolls on the valve stem (or cam lobe), greatly reducing friction compared to sliding rockers. The reduced friction improves fuel economy and reduces valvetrain wear. Roller rockers are now standard on most production engines.

16. D — Standard valve seat angle is 45 degrees, the geometric compromise that provides good sealing and adequate flow area. Performance applications often use multi-angle seats (e.g., 30-45-60 degree cuts) to smooth the airflow transition into the chamber. The seat angle is one of the parameters specified during cylinder head reconditioning.

17. B — Worn valve guides allow excessive lateral movement of the valve stem, letting oil from the valve cover area pass down the guide into the combustion chamber. The result is blue oil smoke, especially at startup (when oil has accumulated) and during deceleration (when intake vacuum is highest). Worn guides are repaired by replacement or by knurling/honing depending on wear severity.

18. A — Modern head gaskets are multi-layer steel (MLS) with embossed sealing beads around each cylinder, oil passage, and coolant passage. The layered steel construction handles modern engines' high compression and thermal cycling much better than older composite or copper designs. MLS gaskets must be installed dry without sealants unless the manufacturer specifies otherwise.

19. D — Hydraulic engine mounts contain a fluid-filled chamber (often with an internal flow restriction) that provides damping in addition to the basic rubber isolation. The fluid handles high-frequency vibration that rubber alone transmits to the chassis. Failed hydraulic mounts leak their fluid and degrade to perform only as basic rubber mounts.

20. C — The harmonic balancer damps torsional vibrations (twist) along the crankshaft caused by the firing impulses of each cylinder. Without the damper, these vibrations would accumulate and eventually break the crankshaft. The damper uses an outer ring connected to the inner hub through a rubber elastomer that absorbs and dissipates the vibration.

21. B — A gerotor pump uses an inner rotor with external lobes mating with an outer rotor with internal lobes. As the rotors turn (with their centers offset), the spaces between them expand on the inlet side and contract on the outlet side, pumping oil. Gerotor pumps are common in modern engines because they're compact and efficient.

22. A — Modern electric cooling fans are PCM-controlled based on multiple inputs: engine coolant temperature, A/C refrigerant pressure, vehicle speed, and ambient conditions. The PCM can run the fan at variable speeds (with PWM control) for noise and efficiency optimization. Simple thermal switches were used on older systems but lack the flexibility of PCM control.

23. D — Inadequate heat output with normal thermostat operation and proper coolant level points to a restricted heater core. Sediment or scale builds up inside the heater core's small passages, reducing coolant flow through it. A flush of the heater core often restores heat; severely blocked cores require replacement.

24. C — Constant-tension spring clamps maintain consistent clamping force as the hose expands with heat and contracts when cool, while worm-gear clamps stay at whatever position they were tightened to. The constant force prevents the clamp from becoming loose during thermal cycling, reducing the chance of coolant leaks. Spring clamps are standard on modern cooling system hoses.

25. B — The boost pressure sensor (often a MAP sensor) is located in the intake manifold downstream of the throttle body and intercooler, measuring the actual pressure entering the cylinders. This is the boost the engine actually sees, after all losses through the intake plumbing. Some systems use a second pre-throttle sensor for additional diagnostic capability.

26. A — Modern TPS sensors output an analog voltage proportional to throttle plate angle, typically 0.5V at closed throttle and 4.5V at wide-open. The PCM reads this voltage and uses it for fuel, timing, and transmission calibration. Most electronic throttle bodies actually have two TPS sensors for redundancy and cross-checking.

27. D — A Hall-effect camshaft position sensor produces a digital square-wave output that switches on/off as the trigger wheel's teeth pass the sensing element. The digital signal is clean, noise-resistant, and works at any speed including engine cranking. Hall-effect sensors have largely replaced variable-reluctance sensors on modern engines.

28. C — OBD-II misfire detection works by monitoring crankshaft acceleration patterns through the CKP sensor. A misfiring cylinder produces a momentary deceleration of the crank during what should be its power stroke; the PCM detects this and counts misfires per cylinder. This is why a healthy CKP signal is essential to accurate misfire reporting.

29. B — LSPI is a phenomenon specific to direct-injection gasoline engines, particularly turbocharged units operating at low RPM with high torque demand (like accelerating from low speed in high gear). Oil droplets and fuel mixture in the chamber can pre-ignite, causing severe combustion knock that can damage pistons. Modern engine oils with reduced calcium content and proper additives help reduce LSPI.

30. D — DEF (a 32.5% urea solution) freezes at approximately -11 °C (12 °F), which is why modern DEF systems include heating elements in the tank, lines, and injector. The heaters thaw frozen DEF on cold mornings before the SCR system needs it. DEF lines and tanks are insulated to retain heat during the drive.

31. A — Black smoke from a diesel exhaust indicates incomplete combustion from a fuel-air imbalance — either excessive fuel injection or restricted air intake. Common causes include a clogged air filter, failed turbocharger, sticky injector, or sensor fault. Black smoke is fuel particles that couldn't burn completely due to inadequate oxygen.

32. C — High-speed CAN buses use 120-ohm terminating resistors at each end of the bus, typically inside two end-node modules. The resistors match the bus impedance and prevent signal reflections that would corrupt data. The parallel combination of the two 120-ohm resistors produces the 60-ohm bus impedance measured between CAN-H and CAN-L with the network powered off.

33. B — LIN is a single-wire, low-cost, low-speed (20 kbps maximum) network used for non-critical subsystems like power windows, door locks, mirrors, and seat motors. It uses a master-slave architecture and is much simpler and cheaper than CAN. LIN networks are typically slaves to a CAN-connected master like the BCM.

34. A — MOST is a fiber-optic network designed for multimedia distribution in luxury vehicles, carrying digital audio, video, navigation, and infotainment data. The optical signals are immune to electromagnetic interference and provide high bandwidth, but the system is expensive and is gradually being replaced by Ethernet on newer vehicles. Mercedes, BMW, and Audi were primary adopters.

35. A — Bluetooth pairing security typically uses a passkey or PIN code displayed on the vehicle and entered or confirmed on the phone (or vice versa). This prevents unauthorized pairing by requiring physical access to both devices simultaneously. After initial pairing, the devices remember each other and reconnect automatically.

36. C — CAN modules enter sleep mode when the vehicle has been parked with ignition off and no wake-up events are detected. In sleep mode, modules draw only a small fraction of their active current, extending battery life during long parking periods. The BCM (or gateway) typically monitors wake-up sources and brings the network back online when needed.

37. B — Freeze frame data captures the engine's operating conditions at the moment the DTC was set: RPM, load, coolant temperature, fuel trim, vehicle speed, and other parameters. This snapshot lets the technician understand the conditions that caused the fault, which is essential for reproducing intermittent problems during diagnosis. Freeze frame is one of the most valuable OBD-II diagnostic features.

38. D — After replacing a module that stores VIN data (PCM, BCM, instrument cluster, etc.), the VIN must be programmed into the new module using a manufacturer-capable scan tool. The VIN is used for security functions, parts identification, telematics, and emissions reporting. Failure to program the VIN can cause anti-theft system lockout and various module communication issues.

39. A — On gateway-equipped vehicles, all external scan tool access is routed through the gateway, which authenticates the tool and routes requests to the appropriate modules. The gateway enforces security and prevents direct external connections to safety-critical modules. Generic scan tools may have limited capability through the gateway compared to manufacturer scan tools with appropriate credentials.

40. B — Modern DTC structures include status bits indicating severity, such as whether the fault should illuminate the MIL steady, flash the MIL (indicating a misfire so severe it could damage the catalyst), or simply log the code without illuminating. These priority indicators help technicians prioritize repairs and indicate the urgency of corrective action. Flashing MIL with active misfire requires immediate attention.

41. D — Authentication for module reprogramming is increasingly required because unauthorized changes can introduce cybersecurity vulnerabilities (including remote attacks) and create unsafe operating conditions if calibrations are altered improperly. Manufacturers are responding to regulatory and security threats by requiring tools to authenticate before performing programming. The right-to-repair debate continues to influence how authentication is implemented.

42. C — Most CAN networks use a linear (bus) topology with a backbone wire to which modules connect as branches (stubs). This topology requires only two terminating resistors at the ends of the backbone. The topology is simple, low-cost, and supports the network's broadcast nature where any module's message is received by all others.

43. A — Data recording (flight recorder) captures scan tool data over time, often triggered by a specific event. This is most useful for intermittent faults that don't appear during static service-bay testing — the technician sets up the recorder, has the customer drive normally, and reviews the data when the fault reoccurs. Many faults that defy direct observation can be solved through patient flight-recorder analysis.

44. B — Hydraulic clutch systems use brake fluid (DOT 3 or DOT 4) because the same hydraulic principles apply and the components are designed for those fluid characteristics. ATF and power steering fluid have different viscosity and chemical compatibility profiles and will damage clutch hydraulic seals. The clutch master cylinder reservoir often shares the brake fluid reservoir on some vehicles.

45. D — On a non-adjusting hydraulic clutch system, excessive pedal free play develops as the clutch disc friction material wears thinner. As the disc wears, the diaphragm fingers move closer to the throwout bearing, eventually allowing increased free play before the throwout bearing engages. This is the classic indicator of clutch wear nearing the replacement point.

46. C — Self-adjusting clutch (SAC) pressure plates use a wedge or ramp mechanism inside the pressure plate to compensate for disc wear, maintaining consistent diaphragm finger height and clamp load throughout the disc's service life. The result is consistent pedal effort from new through worn condition. SAC clutches typically last longer than conventional designs because their clamp force doesn't degrade with wear.

47. D — A DCT uses two separate clutches that handle alternating gears: one for odd gears (1, 3, 5, 7) and one for even gears (2, 4, 6) plus reverse. While driving in one gear, the transmission pre-selects the next gear on the other shaft; the actual shift is just a quick exchange of clutches, taking milliseconds. The result is much faster shifts than a traditional automatic.

48. B — Wet DCTs submerge the clutch packs in ATF or specialized DCT fluid, which lubricates and cools the friction surfaces. Wet clutches handle high torque and dissipate heat effectively, making them suitable for high-power applications. Dry DCTs (like older VW DSG 7-speed units) are more efficient but limited to lower torque ratings.

49. D — A gear ratio of 3.62:1 means the input shaft rotates 3.62 times for every one rotation of the output shaft. The engine speed multiplied by the gear ratio gives wheel rotation rate (after the final drive), and torque is multiplied by 3.62 going from input to output. Higher numerical ratios mean more torque multiplication and lower output speed.

50. A — Synchronizer (blocker) rings are inspected for tooth condition (chips, wear), friction surface condition (the cone that contacts the gear), and the specific gap to the gear when pressed onto the matching cone surface. A worn ring won't bring the gear up to speed quickly enough, producing the gear grind sound during shifting. Rings are inexpensive and routinely replaced during transmission rebuild.

51. C — The reverse light switch is mounted on the transmission case where the reverse shift rail mechanically actuates it when reverse gear is engaged. The switch closes the reverse light circuit, illuminating the rear-facing reverse lamps. A failed reverse switch is a common cause of inoperative reverse lights.

52. B — TCC shudder during engagement is most commonly caused by contaminated transmission fluid (water, debris, oxidized fluid) or a worn TCC friction surface inside the converter. The friction surface can no longer make smooth, full contact, producing the shudder vibration. A fluid change with the manufacturer-specified ATF often resolves the symptom; severe wear requires converter replacement.

53. D — Bench testing a shift solenoid involves measuring resistance with an ohmmeter and comparing to specification (typically 5-25 ohms depending on solenoid type). Open or shorted resistance values confirm a failed solenoid. The technician can also energize the solenoid with a power probe and listen/feel for the click of operation.

54. C — The differential carrier (third member, "pumpkin") houses the ring gear, pinion gear, side gears, and spider gears. The carrier transmits torque from the driveshaft to the axle shafts while allowing differential action (different wheel speeds during cornering). The carrier bolts into the axle housing or is integral to it depending on design.

55. A — A crush sleeve is a one-time-use spacer that deforms (crushes) as the pinion nut is tightened, applying bearing preload. Once crushed, it cannot be restored, so the sleeve must be replaced every time the pinion is disturbed. Shimmed designs (used on heavier-duty axles) allow reuse of components but require more setup work.

56. D — The inner end splines of the axle shaft engage with the differential side gear, which receives torque from the spider gears (and ultimately the ring gear). The side gear is one of the two output gears in the differential, distributing torque to each axle independently. The outer end of the axle drives the wheel hub through bearings and seals.

57. C — CV joint grease is a specialized moly (molybdenum disulfide) grease formulated for the extreme pressure conditions inside a CV joint, where ball bearings transmit torque through high contact stresses. Standard chassis grease or wheel bearing grease can't handle CV joint conditions and will cause premature joint failure. The grease is packaged with each CV boot kit.

58. B — A whine that changes pitch with vehicle speed (not engine speed) is driveline-related: differential gear noise, axle bearing wear, transmission output shaft bearing, or wheel bearing. The key diagnostic is that it tracks wheel speed rather than engine speed. Driving the vehicle and listening with a chassis-ear or similar tool localizes the noise source.

59. A — Modern part-time 4WD transfer cases typically specify ATF or a manufacturer-specific transfer case fluid (such as GM's Auto-Trak II). The fluid is selected to work with the chain drive, clutch packs (if any), and synchronizers inside the transfer case. Using the wrong fluid can cause clutch slip, harsh engagement, or accelerated wear.

60. D — Two-piece driveshaft U-joints must be phased so the front and rear yokes are in the same plane (the U-joint cup ears align). This phasing ensures that the inherent speed variations introduced by each U-joint cancel each other rather than adding together. Improper phasing causes severe driveline vibration at highway speeds.

61. C — In a parallel circuit, each branch has its own path to ground; when one branch opens, only that branch's load stops working while others continue normally. This is why one burned-out tail light bulb doesn't affect the others — each bulb is on its own parallel branch. Series circuits are the opposite: one failure stops the entire circuit.

62. A — Engine-to-chassis ground straps provide a low-resistance path for current returning from the engine's electrical loads (starter, alternator output through the engine block, sensors) to the chassis ground and back to the battery negative terminal. Loose, corroded, or missing straps cause voltage drops, hard starting, and electronic issues. They are often forgotten during engine service but critical for reliability.

63. B — Battery cables must carry hundreds of amps during cranking with minimal voltage drop, which requires very large cross-sectional area conductors (typically 1 AWG to 4 AWG). Even small resistance in the cables drops significant voltage at 200+ amps of starter current. Undersized or corroded cables are a common cause of slow cranking complaints.

64. D — Reserve capacity is defined as how many minutes the battery can supply 25 amps before voltage drops below 10.5 V. The test simulates an alternator failure: how long can the battery run the essential vehicle loads before they become unreliable? Higher RC ratings indicate longer "limp home" capability if the charging system fails.

65. C — The diode rectifier bridge converts the three-phase AC current produced by the alternator's stator windings into pulsating DC current needed for the vehicle's electrical system. Six diodes (one positive and one negative per phase) work together to rectify the AC. A failed diode produces AC ripple in the DC output, which can damage electronics over time.

66. A — Pre-electronic throttle vehicles used an Idle Air Control (IAC) valve, a stepper motor or solenoid that controlled airflow through a passage bypassing the throttle plate. The PCM adjusted the IAC position to maintain target idle RPM under varying loads (A/C compressor, alternator). Electronic throttle eliminated the need for a separate IAC because the throttle plate itself can be opened slightly to control idle.

67. B — After throttle body replacement on an electronic throttle vehicle, the PCM must learn the new throttle plate's closed position and its full sweep. The manufacturer's idle relearn (or throttle adaptation) procedure is performed with the scan tool. Skipping this step causes erratic idle, hesitation, or check-engine warnings.

68. D — A poor ABS module ground produces high resistance in the module's electrical path, which causes the module to misread sensor inputs and set multiple DTCs (often appearing as several wheel speed sensor faults simultaneously). The ABS warning light illuminates due to the perceived sensor failures. Ground repair often resolves all the codes at once.

69. C — Power seat motors are small DC motors driving the seat track through a worm gear or screw drive arrangement. The worm gear is self-locking, holding the seat position when the motor stops. Position feedback potentiometers report the seat's current position to the memory seat module if equipped.

70. B — Broken rear defroster grid lines are repaired using a specialized conductive paint or repair compound formulated for the specific application. The compound bridges the break electrically while bonding to the glass. Standard solder won't adhere to glass; copper wire works but is unsightly and difficult to apply.

71. A — The condenser is the high-side heat exchanger where the refrigerant releases the heat it absorbed in the evaporator and additional heat from the compression process. Without adequate airflow, the condenser can't release this heat, causing high-side pressure to rise excessively and reducing system cooling capacity. A clogged condenser fin pack or failed cooling fan are common causes of poor A/C performance.

72. D — The receiver-drier is located on the high-pressure side of TXV-equipped A/C systems, between the condenser and the metering device. It contains a desiccant that absorbs any moisture in the system and a filter that catches debris. Moisture in an A/C system causes ice blockages, acid formation, and component failure, making the receiver-drier critical for long-term reliability.

73. C — A fixed orifice tube is a small-diameter restriction in the line entering the evaporator, located on the low-pressure side. The orifice creates the pressure drop needed to atomize the refrigerant for efficient evaporator absorption. Unlike a TXV, the orifice tube has no moving parts and cannot adjust to changing conditions; an accumulator on the low side handles residual liquid that doesn't evaporate.

74. B — A healthy A/C system should produce vent temperatures 10-15 °C below ambient at moderate conditions, with greater drops possible at high blower speeds and lower humidity. Performance below this range indicates a system problem (low refrigerant, restricted airflow, contaminated system). Performance tests are conducted with the doors open, blower on high, and engine at moderate RPM.

75. A — Modern A/C systems use a low-pressure cut-off switch (preventing operation if refrigerant is low) and a high-pressure cut-off switch (preventing operation if condenser flow is restricted). Both switches protect the compressor from damage caused by inadequate lubrication (low refrigerant carries less oil) or excessive pressure. Some systems also include a thermal limit switch on the compressor body.

76. D — Variable blower control on modern HVAC systems uses PWM (pulse-width modulation), where a fast-switching transistor varies the average voltage applied to the blower motor. This provides infinitely variable fan speeds (not just 3-4 steps), better efficiency than resistor-based systems, and eliminates the heat generated by the resistor pack. The PWM controller is often integrated into the HVAC module.

77. C — The recirculation door at the HVAC intake selects between fresh outside air (drawn through the cowl) and recirculated cabin air. Recirculation is used to maximize cooling in hot weather or to prevent outside contaminants (smoke, exhaust) from entering. The door is operated by a small electric actuator on most modern vehicles.

78. B — A glove box light stuck on with the box closed typically indicates the door switch (similar to a door pin switch but for the glove box) is failed in the closed-circuit position. Replacing the small switch resolves the issue. A continuously on light is a small parasitic load that contributes to battery drain over time.

79. A — Standard USB ports provide 5V DC at currents specified per port (typically 2.1 A or higher for charging tablets and phones). Modern fast-charge ports may support higher voltages through USB-C Power Delivery. The 5V output is regulated by the port's internal circuitry from the vehicle's 12V supply.

80. D — Corroded battery terminals add resistance to the circuit, causing voltage drop under load. Cranking suffers because the starter doesn't receive full voltage; charging suffers because the alternator can't push current into the battery against the resistance. Visual inspection of terminals and regular cleaning is one of the most basic and effective preventive maintenance tasks.

81. C — An Intelligent Battery Sensor (IBS) measures current (through a shunt), voltage, and temperature continuously. From these three inputs, the BCM or dedicated battery module calculates state-of-charge and state-of-health accurately. The IBS data is essential for vehicles with start-stop systems, regenerative charging strategies, and load shedding to protect the battery.

82. B — A/C compressor lubricating oil mixes with the refrigerant and circulates throughout the entire A/C system, lubricating every component as the refrigerant flows. This is why refrigerant leaks also lose oil, and why a low-refrigerant system can damage the compressor through inadequate lubrication. The oil must match the refrigerant type (PAG for R-134a and R-1234yf; POE for some R-1234yf systems).

83. D — HID bulbs create an electrical arc between two electrodes inside a sealed quartz envelope containing xenon gas and metal halide salts. The intense arc emits very bright, blue-white light at much higher efficiency than incandescent halogen. HID systems require a ballast to step up voltage (typically 25,000 V to strike the arc, then around 85V to sustain it).

84. A — Ceramic brake pads produce less brake dust, operate quieter, and are gentler on rotor surfaces than semi-metallic pads. They're more expensive and may have slightly lower initial bite when cold. Ceramic pads are the choice for daily-driver vehicles where appearance, comfort, and rotor life matter; semi-metallic remains common for performance and heavy-duty applications.

85. C — Brake fluid moisture testers measure water content because water absorption progressively lowers the fluid's boiling point. The standard 3% water threshold corresponds to the wet boiling point used in DOT ratings. Fluid with high water content boils during heavy braking, creating vapour lock that compresses under pedal pressure and produces brake fade or complete loss of pedal.

86. B — Pressure bleeding uses a pressurized reservoir adapter that maintains constant fluid pressure at the master cylinder, simplifying the bleeding process and eliminating the need for a helper. The technician simply opens each bleeder in sequence and watches fluid flow until clear. The constant supply prevents the master cylinder from running dry.

87. A — Bench bleeding removes trapped air from the master cylinder by pumping fluid through it on the bench, with hoses routed from the output ports back to the reservoir. With the master cylinder air-free before installation, on-vehicle bleeding only needs to address air in the lines and calipers, dramatically reducing total bleeding time.

88. D — The booster vacuum test is performed by holding the brake pedal down with the engine off (which gradually depletes booster vacuum), then starting the engine. A functioning booster causes the pedal to drop slightly as vacuum returns and the booster assists. No pedal movement indicates lost booster function or no vacuum supply.

89. C — Parking brake cable adjustment should bring the brake to full engagement within the manufacturer's specified handle travel range (typically 4-7 clicks). Too loose: the brake won't hold. Too tight: the brake drags during driving, causing excessive wear and heat. Always adjust to specification after rear brake service, especially after replacing shoes or pads.

90. B — ABS modulator inlet and outlet solenoids are normally open and normally closed two-position valves. During an ABS event, the modulator cycles these valves to apply (normal flow), hold (inlet closed), or release (outlet open to return fluid to the reservoir) brake pressure at individual wheels independently of the driver's input. The two-position simplicity makes the modulator reliable and fast.

91. A — The yaw rate sensor measures rotational acceleration about the vehicle's vertical axis and is typically located near the vehicle's center of gravity (under the center console or floor) for accurate readings. Modern designs often combine yaw rate, lateral acceleration, and longitudinal acceleration into a single sensor cluster. The location is precise enough that some installations require recalibration after replacement.

92. C — A bent steering knuckle changes the relationship between the wheel and the chassis, which shows up most clearly in camber and SAI alignment readings. Comparing left and right SAI is particularly diagnostic because SAI is set by the knuckle's geometry and is normally identical side-to-side. Significant SAI differences point to a bent knuckle, strut, or other structural damage.

93. D — Rubber spring isolators cushion the contact between the steel coil spring and the strut assembly (and upper mount), reducing the noise of spring movement and preventing wear of the contact surfaces. Worn or missing isolators allow the spring to clunk against the mount during suspension travel. They are inexpensive and typically replaced whenever struts are serviced.

94. B — Worn sway bar end link bushings produce clunking or rattling noises over uneven surfaces, especially small bumps that articulate the suspension asymmetrically. The bushings allow play between the sway bar and the suspension control arm, and the play creates noise as forces reverse. End links are inexpensive and easy to replace.

95. A — Axle nuts on vehicles with pressed-in sealed bearings are typically torqued to a high specification (often 150-300 Nm or more), sometimes with a torque-plus-angle method. The high torque preloads the bearing and prevents the axle from rotating relative to the hub. Using an impact gun is not recommended; a proper torque wrench (or torque-plus-angle wrench) is required.

96. D — Hub-centric wheels are centered on the hub by a precise center hole in the wheel matching the hub's center pilot diameter. The wheel slides over this pilot, ensuring perfect centering regardless of lug nut tightening. Lug-centric wheels rely on the lug nuts to center the wheel, which is less precise and more prone to wheel runout.

97. C — A load index of 95 corresponds to approximately 690 kg per tire when inflated to its maximum pressure. The load index is a numerical code that maps to a specific load capacity in a standardized table (95 = 690 kg, 96 = 710 kg, etc.). Always verify the load index meets or exceeds the vehicle's load requirements when selecting replacement tires.

98. B — A speed rating of "H" corresponds to 210 km/h (130 mph) sustained operation. Other common ratings are S (180 km/h), T (190 km/h), V (240 km/h), W (270 km/h), and Y (300 km/h). Like load index, the speed rating must meet or exceed the vehicle's design requirements.

99. A — Plus-sizing increases the wheel diameter while reducing the tire's sidewall height (aspect ratio), keeping the overall tire diameter approximately the same. This maintains speedometer accuracy and clearances while improving handling and aesthetics. The math involves balancing wheel diameter, tire width, and aspect ratio to keep total diameter within about 3% of the original.

100. D — Toe-out on turns (Ackermann geometry) is the geometric relationship where the inside front wheel during a turn rotates through a sharper angle than the outside wheel. This is necessary because the inside wheel traces a smaller-radius circle than the outside wheel during cornering. The geometry is built into the steering linkage and prevents tire scuffing during turns.

101. C — Camber gain is the change in camber angle as the suspension compresses (or extends), making the wheel tilt inward or outward at the top. Suspension designers tune camber gain to keep the

tire's contact patch maximized through the suspension travel during cornering. Performance suspensions often have significant negative camber gain to improve cornering grip.

102. A — Steering axis inclination (SAI) is the angle between vertical and the steering axis (the line through the upper and lower ball joints, or the strut centerline). SAI provides steering wheel return-to-center force and is set by the suspension geometry. SAI is typically not adjustable but is measured during alignment as a diagnostic for bent components.

103. B — On-vehicle brake lathes machine the rotor in place on the hub. The technician must first calibrate the lathe to compensate for any lateral runout in the hub assembly, ensuring the cut is made perpendicular to the actual hub rotation rather than the rotor's static orientation. This eliminates runout-induced pulsation after machining.

104. C — Banjo bolt installation requires manufacturer-specified torque and new copper washers on both sides of the banjo fitting. Used copper washers can't seal reliably; new soft copper crushes properly under torque to create a leak-free seal. Thread sealants are inappropriate for these flat-sealing fittings.

105. D — Drum brake return spring colors identify the specific spring tension (force rating) needed for that particular application. Different vehicles or different positions within the same drum brake require different spring tensions. Using the wrong spring causes adjustment problems or shoes that don't return fully when the brake releases.

106. C — Pressure bleeding equipment operates at approximately 10-15 psi at the master cylinder reservoir cap. This is enough to maintain constant fluid flow through each bleeder while remaining below the pressure that could damage the master cylinder's seals or pop off the reservoir cap. The low operating pressure is also why pressure bleeders are safe and easy to use.

107. A — Seat belt pretensioners use a small pyrotechnic charge to pull the seat belt webbing tight at the moment of impact, removing slack and positioning the occupant correctly in the seat for airbag deployment. The combination of pretensioner and airbag provides the integrated occupant protection that modern restraint systems require. Deployed pretensioners must be replaced; they are single-use devices.

108. B — Knee airbags inflate from the lower dashboard and contact the occupant's knees, positioning the lower body and pelvis to maintain proper restraint geometry. The proper geometry keeps the

occupant from sliding under the lap belt ("submarining") during the high-deceleration crash event. Knee airbags also reduce knee and lower-leg injuries from contact with the dashboard.

109. C — The Event Data Recorder (EDR) is required equipment on modern vehicles, recording vehicle operating parameters (speed, brake application, throttle, steering, accelerometer, seat belt status, etc.) during the few seconds before, during, and after a crash. EDR data is used by accident investigators, insurance companies, and manufacturers to understand crash events. EDR data is the driver's property under most regulations.

110. D — Active hood systems lift the rear edge of the hood during a frontal pedestrian impact, creating space between the hood and the hard engine components below. The space cushions the pedestrian's head impact, reducing injury severity. The hood lifts through a small pyrotechnic actuator triggered by the impact-sensing system.

111. A — After replacing a power window regulator/motor, the window's pulse-counting calibration must be reset so the BCM knows the upper and lower limits and can recognize pinch protection events. The manufacturer's procedure typically involves running the window through its full travel several times with specific timing. Without calibration, the window may not auto-up correctly or pinch protection may malfunction.

112. C — Sunroof drain tubes carry water from the sunroof seal area down through the body and out at the rocker panel or floor. When the drains block (debris, leaves, ice), water has no outlet and instead drips into the cabin headliner or floor. Periodic cleaning with compressed air or a flexible wire keeps the drains clear.

113. B — After back-up camera replacement, calibration may be required to align the camera image's overlay guidelines (the trajectory lines that show the vehicle's path) with the actual vehicle steering angle and dimensions. Without calibration, the guidelines may show inaccurate paths, making the camera less useful or misleading. The procedure uses scan tool commands and sometimes targets placed behind the vehicle.

114. A — Auto-dimming mirrors use a photodiode (forward-facing) measuring ambient light and a second photodiode (rearward-facing) measuring glare from headlights behind. When rearward light exceeds forward light, the mirror's electrochromic gel darkens to reduce glare. The mirror returns to bright when the rearward glare diminishes.

115. D — HUD systems project information (speed, navigation, ADAS warnings) onto the windshield glass surface in the driver's line of sight, allowing the driver to read the information without looking down at the cluster. The projector is typically located in the dashboard top, projecting up through an opening onto the glass. Some HUD designs use a separate combiner glass instead of the windshield.

116. A — When replacing a liftgate motor on a system with programmed open height memory, the technician must re-learn the liftgate's open height limits using the manufacturer's procedure. This sets the upper travel limit and any custom positions the user has programmed. Without the re-learn, the liftgate may over-travel or fail to open to the correct height.

117. B — In a series hybrid, the engine drives a generator that produces electrical power, and the wheels are driven only by the electric motor. The engine never directly drives the wheels — it only generates electricity for the motor or battery. This contrasts with parallel hybrids (Prius-style), where both engine and motor can drive the wheels directly.

118. C — A heat pump uses the refrigeration cycle in reverse to move existing heat from one source (battery, motor, drivetrain, or ambient air) into the cabin, requiring far less energy than resistive electric heating. The efficiency advantage (often 2-3× better) directly translates to extended EV range in cold weather. Heat pumps are increasingly standard on EVs sold in cold climates.

119. C — The HVIL is a low-voltage (typically 12V) loop that runs through every high-voltage connector in series. When all connectors are properly mated, the loop is continuous; if any connector is disconnected (or damaged), the loop opens and the BMS sees the loss of continuity, which triggers immediate disconnection of the HV system. Testing is done with a meter measuring continuity through the loop.

120. D — The three main DC fast charging connectors in North America are CCS Combo 1 (the J1772-based combo connector), CHAdeMO (Japanese standard, declining), and NACS (the Tesla-derived standard adopted by most manufacturers in 2024-2026). NACS is rapidly becoming the dominant standard as more manufacturers adopt it for new vehicles.

121. B — EV battery capacity decreases over time due to chemical changes within the cells: solid electrolyte interface (SEI) layer growth, lithium plating, electrolyte decomposition, and active material loss. High temperatures and frequent DC fast charging accelerate these processes. Modern BMS systems use thermal management and charging algorithms to slow degradation, but some capacity loss is inevitable.

122. A — The range estimator uses recent driving history (last 20-50 km of energy consumption), current battery state-of-charge, and current conditions (climate, terrain, driving mode) to predict remaining range. Because conditions can change, the displayed range is an estimate that updates continuously. Aggressive driving or sudden HVAC use can drop the estimate quickly.

123. C — Thermal runaway in a lithium-ion cell produces intense heat that can ignite the electrolyte and propagate to adjacent cells in cascade. A single failed cell can rapidly become a pack-wide fire that is extremely difficult to extinguish, since the lithium-based chemistry generates its own oxygen and reignites readily. This is why pack thermal management and cell isolation matter for safety.

124. B — Tools for HV work must be rated to at least 1,000 V DC (marked "1000V" on the insulation). Standard automotive tools, even those marked for high voltage, may not have the required insulation thickness. The 1,000V rating provides margin above the typical 400V-800V EV pack voltage and ensures safety during inadvertent contact with energized components.

125. D — When the main HV contactors close, the inverter's large filter capacitors initially appear as a short circuit (uncharged caps draw enormous current). The pre-charge resistor in series with a smaller pre-charge contactor limits this inrush current to a safe level for a few hundred milliseconds, allowing the capacitors to charge to pack voltage. Once charged, the main contactors close and the pre-charge circuit is bypassed.