

PRACTICE EXAM 4: RED SEAL 310S

SIMULATION (125 QUESTIONS)

1. A technician spills a small amount of battery electrolyte on their bare forearm during service. What is the most appropriate immediate response?

- A. Wipe the affected area thoroughly with a clean shop rag
- B. Flush the area with running water for at least 15 minutes
- C. Apply baking soda paste directly to the skin to neutralize
- D. Cover with bandage and continue working normally

2. Fire requires three elements to sustain combustion: heat, fuel, and which third element?

- A. A spark or electrical ignition source
- B. A confined space to contain the reaction
- C. Oxygen or another oxidizing agent
- D. Pressure greater than normal atmospheric

3. Before entering a confined space such as a fuel tank for repair, the technician must:

- A. Test the atmosphere for oxygen content and hazardous gases
- B. Wear standard safety glasses and leather work gloves
- C. Notify the customer that the work has started
- D. Disconnect the vehicle battery for the entry

4. Which respirator type is required when servicing brake or clutch components that may contain asbestos fibres?

- A. A standard dust mask rated for nuisance dust only
- B. A surgical-grade paper mask with elastic ear loops
- C. A half-mask respirator with organic vapour cartridges
- D. A P100 (HEPA-rated) particulate filter respirator

5. To reduce risk of back injury when lifting heavy components in the shop, the technician should:

- A. Bend at the waist and lift using arm strength primarily
- B. Bend at the knees and keep the load close to the body
- C. Wear a heavy back brace at all times during shifts
- D. Lift quickly to minimize the duration of strain

6. A shop must provide an emergency eyewash station capable of delivering continuous fluid flow for a minimum of:

- A. 15 minutes of continuous flow at proper pressure
- B. 5 minutes of continuous flow at proper pressure
- C. 60 seconds of high-volume flush at high pressure
- D. 60 minutes of continuous flow without interruption

7. A licensed hazardous waste hauler is removing used motor oil and oil filters from the shop. The legal document accompanying the transfer is called:

- A. The shop's internal inventory tracking document
- B. The customer's repair order showing the service done
- C. The vehicle owner's authorization for waste disposal
- D. The hazardous waste manifest signed by both parties

8. When using a portable extension ladder to access an elevated shop area, the base of the ladder should be positioned to create what angle relative to the floor?

- A. 45 degrees from horizontal (1:1 base-to-height ratio)
- B. 90 degrees from horizontal (vertical against the wall)
- C. 75 degrees from horizontal (1:4 base-to-height ratio)
- D. 60 degrees from horizontal (1:2 base-to-height ratio)

9. A technician finds a used hypodermic needle in a customer vehicle's interior during cleaning. What is the appropriate response?

- A. Place the needle in a puncture-resistant sharps container
- B. Wrap it in shop rags and dispose in regular trash bin
- C. Flush the needle down the shop sink with hot water
- D. Set it aside on the workbench until end of shift

10. During the intake stroke of a four-stroke gasoline engine, what is the state of the intake and exhaust valves?

- A. Both intake and exhaust valves are open simultaneously

- B. Both intake and exhaust valves are fully closed
- C. Intake closed and exhaust open as piston descends
- D. Intake open and exhaust closed as piston descends

11. What is the primary advantage of a V-configuration engine block over an inline configuration of the same displacement?

- A. Lower production cost per unit during manufacturing
- B. Shorter overall engine length for compact mounting
- C. Higher peak torque output at all operating speeds
- D. Improved cooling characteristics in all conditions

12. On a typical engine crankshaft, the journal that supports the connecting rod big end is called:

- A. The connecting rod journal (or crank pin) journal
- B. The main bearing journal mounted in the block
- C. The pilot journal at the front of the crankshaft
- D. The thrust journal controlling axial crankshaft movement

13. Engine crankshaft main bearings and connecting rod bearings are most commonly:

- A. Tapered roller bearings carrying axial thrust loads
- B. Sealed ball bearings lubricated with grease for life
- C. Plain (sleeve) bearings lubricated by pressurized oil

D. Needle bearings rolling on hardened journal surfaces

14. What is the purpose of the bypass valve in an engine oil filter?

A. To reduce oil pressure during high engine RPM operation

B. To vent trapped air from the filter housing on start

C. To prevent oil pressure from exceeding safe values

D. To allow oil to bypass the filter when restricted

15. What primary characteristic distinguishes a full synthetic engine oil from a conventional petroleum-based oil?

A. Synthetic oil is dyed a different colour for identification

B. Synthetic oil has uniform molecular structure for stability

C. Synthetic oil contains environmentally biodegradable additives

D. Synthetic oil has a lower flash point during operation

16. Why is a coolant flush preferred over a simple drain-and-fill when servicing the cooling system?

A. Drain-and-fill leaves residual old coolant and contaminants in the block

B. Drain-and-fill requires specialized equipment not commonly available

C. Drain-and-fill voids most manufacturer warranties on the cooling system

D. Drain-and-fill cannot be performed on engines with aluminum blocks

17. Modern serpentine belt drives most commonly use which type of tensioner?

- A. A manual screw-type adjuster requiring periodic adjustment
- B. An air-actuated pneumatic tensioner with cabin control
- C. A hydraulic tensioner pressurized by engine oil flow
- D. A spring-loaded automatic tensioner maintaining constant force

18. A used engine air filter element shows uniform light darkening with no oily staining or tears. This indicates:

- A. The filter has been contaminated by engine oil blow-by
- B. The filter has reached the end of its service life
- C. Normal dust accumulation consistent with service life
- D. Water ingestion has occurred from an intake leak

19. On a modern returnless fuel injection system, the fuel filter is most commonly located:

- A. Inline at the engine bay near the fuel rail inlet
- B. Inside the fuel tank as part of the pump module
- C. At the fuel pressure regulator on the engine intake
- D. Under the vehicle at the frame rail midpoint

20. Installing a spark plug with a heat range that is too hot (rejects heat too slowly) can produce which symptom?

- A. Pre-ignition or detonation damaging the piston crown
- B. Excessive carbon fouling of the spark plug firing tip
- C. Cracked insulator from cold-start thermal shock damage
- D. Excessive primary current draw from the ignition coil

21. A "coil-near-plug" ignition system differs from coil-on-plug by:

- A. Using only a single ignition coil for the entire engine
- B. Mounting all coils inside the valve cover under the cam
- C. Using short individual high-tension leads from coil to plug
- D. Operating at higher primary voltages than coil-on-plug

22. Which of the following is a primary cause of engine knock (detonation)?

- A. Spark plug gap set slightly tighter than specification
- B. Engine coolant temperature below normal operating range
- C. Engine oil viscosity slightly higher than recommended
- D. Fuel octane rating too low for the engine's compression ratio

23. Which diagnostic method most reliably locates a vacuum leak in a modern intake manifold system?

- A. Smoke testing with low-pressure smoke introduced into the intake
- B. Spraying water on suspected leak areas with engine idling

- C. Listening for hissing sounds with a mechanic's stethoscope
- D. Tightening all hose clamps to manufacturer torque specification

24. What is the most important precaution when cleaning a modern electronic throttle body?

- A. Use only compressed air to blow away the visible debris
- B. Avoid damaging the protective coating on the throttle plate
- C. Remove the throttle position sensor before any cleaning
- D. Lubricate the throttle shaft with white grease after cleaning

25. On a modern OBD-II vehicle, ignition timing is controlled by:

- A. A mechanical centrifugal advance mechanism in the distributor
- B. A vacuum-operated diaphragm linked to intake manifold vacuum
- C. The PCM, based on inputs from multiple engine sensors
- D. The driver through a dashboard-mounted adjustment knob

26. Before performing a wet compression test on a cylinder reading low, the technician should first:

- A. Perform a dry compression test and record the baseline reading
- B. Disable the fuel injectors at the fuel rail connector circuit
- C. Add a teaspoon of oil to the cylinder before all readings
- D. Disconnect all spark plug wires from the ignition coils

27. A wideband oxygen sensor differs from a traditional zirconia (narrowband) sensor primarily by:

- A. Operating at a significantly lower temperature than zirconia
- B. Using a different ground reference inside the exhaust pipe
- C. Producing a digital pulse-width signal rather than analog
- D. Reporting actual air-fuel ratio rather than only rich or lean

28. A scan tool reports misfire counts only at cylinder #3, with no other DTCs present. After confirming compression is within specification on all cylinders, the next diagnostic step is:

- A. Replace the engine fuel pump assembly preventively
- B. Swap the cylinder #3 coil and plug with another cylinder
- C. Replace the catalytic converter assembly preventively
- D. Adjust the engine base ignition timing manually

29. What does a diesel fuel's cetane number describe about its combustion characteristics?

- A. The fuel's tendency to ignite quickly under compression
- B. The fuel's resistance to detonation under high pressure
- C. The fuel's energy content per unit volume in BTU
- D. The fuel's sulphur content affecting emission output

30. During passive (continuous) regeneration of a diesel particulate filter, what enables the trapped soot to oxidize at normal operating temperatures?

- A. Active heating by an electrical element inside the DPF
- B. A manual command from the driver during highway operation
- C. Post-injection of fuel to raise the exhaust temperature
- D. NO₂ produced by the upstream oxidation catalyst burns the soot

31. On a typical naturally-aspirated gasoline engine, what is the approximate minimum acceptable compression reading at cranking speed?

- A. Approximately 60 psi minimum at cranking speed
- B. Approximately 200 psi minimum at cranking speed
- C. Approximately 125 psi minimum (varies by engine)
- D. Approximately 400 psi minimum at cranking speed

32. On a high-speed CAN bus in the recessive (logic 1) state, what voltage levels should CAN-H and CAN-L display?

- A. CAN-H at 3.5V and CAN-L at 1.5V with differential signal
- B. CAN-H and CAN-L both at approximately 2.5 volts
- C. CAN-H at 5.0V and CAN-L at 0.0V signal steady
- D. CAN-H at 0.0V and CAN-L at 5.0V signal steady

33. What is the primary function of the Unified Diagnostic Services (UDS) protocol on modern vehicles?

- A. Standardized diagnostic communication layered on top of CAN

- B. Reduced-power emergency communication during low voltage
- C. Wireless diagnostic protocol for over-the-air software updates
- D. Manufacturer-specific encrypted code for theft prevention

34. When a scan tool first connects to the DLC on a modern vehicle, which pins are used for ISO 15765 (CAN) communication?

- A. Pin 4 (chassis ground) and Pin 5 (signal ground)
- B. Pin 16 (battery positive) and Pin 4 (chassis ground)
- C. Pin 2 (J1850 bus +) and Pin 10 (J1850 bus -)
- D. Pin 6 (CAN-H) and Pin 14 (CAN-L) for ISO 15765

35. OBD-II Mode 03 (service \$03) retrieves which type of diagnostic codes?

- A. Permanent codes that cannot be cleared by the scan tool
- B. Confirmed (stored) emissions-related trouble codes detected
- C. Pending codes from a single incomplete drive cycle event
- D. Manufacturer-specific enhanced codes outside the standard

36. OBD-II Mode 07 (service \$07) retrieves which type of diagnostic codes?

- A. Permanent codes that resist clearing through scan tool
- B. Confirmed codes after multiple drive cycles have failed
- C. Pending codes from a single drive cycle failure detected

D. Calibration ID and software version information data

37. In a standard OBD-II diagnostic trouble code such as P0301, what does the third character (3) indicate?

A. The subsystem affected (fuel, ignition, emission, etc.)

B. The severity rating of the fault for repair priority

C. The drive cycle number when the fault was detected

D. The number of times the fault has been recorded

38. After replacing the body control module (BCM) on a modern vehicle, which configuration step is typically required?

A. Drive the vehicle through an OBD-II readiness drive cycle

B. Disconnect the battery for 60 minutes to clear values

C. Replace the central gateway module simultaneously with BCM

D. Configure the BCM with vehicle-specific VIN and option data

39. Module software reflashing is most commonly required as a service procedure for which reason?

A. To restore a module that has lost its calibration over time

B. To address a TSB or recall fix from the manufacturer

C. To reset the OBD-II readiness monitors automatically

D. To clear emissions-related diagnostic trouble codes only

40. On most North American vehicles, what are the wire colors used for the CAN-H and CAN-L conductors in the harness?

- A. CAN-H is red and CAN-L is black on most vehicles
- B. CAN-H is yellow and CAN-L is green on most vehicles
- C. CAN wire colors vary by manufacturer with no universal standard
- D. CAN-H is white-with-stripe and CAN-L is plain white

41. A vehicle's telematics system (such as OnStar or FordPass) uses which communication method to connect to the manufacturer's servers?

- A. A wired Ethernet connection through the OBD-II port
- B. Bluetooth pairing with the driver's smartphone always
- C. Wi-Fi connection to public access points along the route
- D. A cellular network connection through an embedded modem

42. In a modern vehicle network architecture, the central gateway module serves what primary purpose?

- A. Provides backup electrical power if the main battery fails
- B. Routes messages between different network protocols and segments
- C. Stores all diagnostic trouble codes for emissions reporting
- D. Manages the connection between battery and starter motor

43. Modern vehicle modules use "seed-key" security access during programming. This process involves:

- A. The module sending a random number that the scan tool must respond to with the correct calculated key
- B. A physical USB security key inserted into the scan tool during programming
- C. A biometric fingerprint scan of the technician at the scan tool
- D. A static password typed by the technician into the scan tool

44. After clutch service, the flywheel friction surface shows minor heat scoring and discoloration. What is the appropriate service approach?

- A. Apply assembly lubricant to the friction surface before install
- B. Reuse the flywheel as is, since light scoring is normal wear
- C. Sand the scored areas with abrasive paper to smooth the surface
- D. Resurface or replace the flywheel per manufacturer specifications

45. When installing a new clutch disc and pressure plate assembly, why is a clutch alignment tool essential to the procedure?

- A. To compress the pressure plate diaphragm during the install
- B. To pull the pilot bearing from the crankshaft for replacement
- C. To verify the throwout bearing clearance after final installation
- D. To center the clutch disc on the pilot bearing so the transmission input shaft can enter

46. After replacing a clutch slave cylinder, which method is typically used to remove air from the clutch hydraulic system?

- A. Cycle the ignition key from off to on ten times in sequence
- B. Pressure bleed or gravity bleed at the slave cylinder bleeder screw
- C. Pump the clutch pedal 50 times rapidly with the reservoir capped
- D. Drive the vehicle for 100 km to settle the air bubbles naturally

47. On a typical modern automatic transmission with no dipstick, ATF fluid level is verified by:

- A. Inspecting through a fill plug at a specified fluid temperature
- B. Pumping fluid out until the level stabilizes at an overflow tube
- C. Counting the time required to fill the transmission from empty
- D. Measuring pressure at a test port with the engine idling

48. A vehicle's automatic transmission slips during 2–3 upshifts only at heavy throttle, while shifting normally at light throttle. The most likely cause is:

- A. A failed throttle position sensor reading high voltage
- B. A stuck-open shift solenoid for the 2–3 gear position
- C. A worn input shaft bearing inside the transmission case
- D. A worn 2–3 clutch pack inside the transmission

49. A torque converter stall test produces engine RPM significantly higher than the manufacturer's specification. The most likely cause is:

- A. Engine power output has decreased below specifications

- B. A worn one-way stator clutch slipping inside the converter
- C. A failed transmission cooler restricting return fluid flow
- D. Excessive transmission band adjustment causing binding

50. On a modern automatic transmission, the speedometer signal is most commonly produced by:

- A. A mechanical cable driven by the transmission output shaft
- B. A pulse generator on a speedometer cable adapter assembly
- C. The vehicle speed sensor (VSS) at the transmission output
- D. The ABS wheel speed sensors transmitted through the network

51. What is the typical maximum operating angle of an outer constant velocity (CV) joint at full steering lock?

- A. Approximately 45 to 50 degrees maximum at full lock
- B. Approximately 90 degrees maximum at full steering lock
- C. Approximately 15 to 20 degrees maximum at full lock
- D. Approximately 75 to 80 degrees maximum at full lock

52. On a sliding-yoke style driveshaft (RWD vehicle), what is the function of the slip yoke at the transmission end of the shaft?

- A. Provides the universal joint pivot point for steering angles
- B. Allows the driveshaft to rotate at variable angular velocities

- C. Permits the driveshaft to change length as the suspension travels
- D. Connects the parking brake mechanism to the differential housing

53. Which type of limited-slip differential uses speed-sensitive resistance produced by a viscous silicone fluid?

- A. A clutch-type LSD using friction discs and springs
- B. A viscous coupling LSD using shear of silicone fluid
- C. A helical-gear (Torsen) LSD using gear-tooth friction
- D. An electronic LSD using brake-based traction control

54. On a part-time 4WD truck, which mechanism is most commonly used to engage 4WD from the cabin on modern light-duty vehicles?

- A. A manual transfer-case stick shifter on the cabin floor
- B. Hydraulic pressure routed from the brake master cylinder
- C. An electric shift motor commanded by a dashboard switch
- D. A vacuum-operated actuator on the transfer case housing

55. On a 4WD vehicle with automatic locking front hubs, the front hubs engage automatically when:

- A. The transfer case engages 4WD and the front shafts begin to rotate
- B. The vehicle reaches a calibrated speed threshold during driving
- C. The brake pedal is depressed firmly during low-speed driving

D. The vehicle is shifted into reverse for at least three seconds

56. On a two-piece RWD driveshaft, the center support bearing serves what primary purpose?

A. Provides slip yoke spline alignment with the transmission output

B. Marks the proper driveshaft installation orientation visually

C. Allows the front-to-rear driveshaft balance to be adjusted

D. Supports the midpoint of the driveshaft and dampens vibration

57. A Haldex AWD coupling uses what mechanism to engage torque transfer to the rear axle?

A. A mechanical centrifugal clutch activated by output speed

B. A hydraulically-actuated wet clutch pack under electronic control

C. A viscous silicone coupling that engages with sustained slip

D. A magnetically-engaged dry clutch with permanent magnets

58. To accurately measure driveshaft working angles for vibration diagnosis, the technician uses:

A. A torque wrench applied at multiple driveshaft locations

B. A dial indicator clamped to the transmission output shaft

C. A digital inclinometer or magnetic angle gauge on machined surfaces

D. A laser alignment tool calibrated to the chassis reference plane

59. On a rear-wheel-drive vehicle with independent rear suspension, the rear half-shafts include CV joints at both ends because:

- A. The differential housing rotates relative to the half-shaft itself
- B. The CV joints reduce manufacturing costs over U-joint designs
- C. The half-shafts must be removable for routine brake service
- D. The wheel hub moves through suspension travel relative to the differential

60. A customer changes the rear differential gear ratio from 3.42:1 to 3.73:1 to improve towing capability. What is the primary effect of this change?

- A. Engine RPM at any given vehicle speed will increase
- B. Vehicle top speed will increase proportionally on highway
- C. Vehicle fuel economy will improve at highway cruise speeds
- D. Engine torque multiplication to the wheels will decrease

61. What is the primary function of an electrical capacitor in an automotive circuit?

- A. Provides resistance proportional to the applied voltage
- B. Generates inductive voltage during current direction changes
- C. Stores electrical charge and releases it when needed
- D. Prevents reverse-direction current flow through the circuit

62. A vehicle's coolant temperature sensor most commonly uses which type of internal element?

- A. A positive temperature coefficient (PTC) thermistor element
- B. A negative temperature coefficient (NTC) thermistor element
- C. A Hall-effect sensor producing a digital pulse output
- D. A magnetic reluctance sensor with AC voltage output

63. A Hall-effect sensor produces what type of output signal in response to a passing magnet?

- A. Variable AC voltage proportional to the magnet's speed
- B. Variable resistance that changes with magnetic field strength
- C. A capacitance change responding to changes in flux
- D. A digital on-off voltage signal switched by the magnetic field

64. A variable reluctance (magnetic pickup) sensor produces what type of output signal as a metal target rotates past?

- A. A constant DC voltage signal with no movement of the target
- B. A digital square wave signal at a constant amplitude
- C. A variable AC voltage that increases in amplitude with speed
- D. A pulse-width modulated signal at constant frequency only

65. On a flooded lead-acid battery, what specific gravity reading at 25°C indicates a fully charged battery?

- A. Approximately 1.265 to 1.285 specific gravity at full charge

- B. Approximately 1.000 specific gravity (the same as water)
- C. Approximately 0.860 specific gravity at full charge
- D. Approximately 2.000 specific gravity at full charge

66. A modern alternator pulley often includes an overrunning alternator decoupler (OAD). What is its purpose?

- A. To increase alternator output during heavy electrical loads
- B. To allow the alternator rotor to coast during engine deceleration
- C. To lock the alternator pulley if the drive belt breaks suddenly
- D. To electrically insulate the pulley from the rotor shaft

67. On a typical starter motor, the pinion gear engages with the engine ring gear by what mechanism?

- A. Centrifugal force as the starter motor reaches operating speed
- B. A hydraulic actuator powered by the engine oil pressure system
- C. The driver depressing the clutch pedal during the start event
- D. The solenoid shift fork pushing the pinion outward into mesh

68. Headlight aim adjustment is verified using which equipment?

- A. A measuring tape between the headlight and a parking wall
- B. A digital level placed flat on top of the headlight assembly
- C. A headlight aiming device or wall pattern at a specified distance

D. Visual comparison against the second headlight beam pattern

69. On a vehicle with electronic throttle control, the cruise control system commands the desired speed through:

- A. The PCM's throttle actuator motor controlling the throttle plate
- B. A mechanical vacuum servo pulling on the throttle cable linkage
- C. A hydraulic actuator pulling the throttle pedal toward the floor
- D. A direct connection to the fuel pump module's delivery rate

70. A vehicle's anti-theft alarm sounds when the doors are locked using the key fob, but does not sound when the doors are locked manually. The most likely cause is:

- A. A failed key fob battery that requires replacement
- B. A failed door pin switch or latch tamper sensor circuit
- C. A failed BCM requiring complete module replacement
- D. A failed glass-breakage sensor in the cabin headliner

71. A power liftgate motor uses which type of feedback to know its current position during travel?

- A. Multiple infrared sensors mounted at the rear bumper area
- B. A linear potentiometer mounted to the liftgate hinge assembly
- C. A pressure sensor inside the gas strut assembly itself
- D. Hall-effect sensors counting motor armature rotation pulses

72. On a cycling-clutch A/C system, the low-pressure cycling switch closes the compressor clutch circuit when:

- A. The high-side pressure rises above a calibrated threshold value
- B. The cabin temperature drops below the set point on the dash
- C. The low-side pressure rises above a calibrated threshold value
- D. The evaporator core temperature rises above the freezing point

73. In a properly functioning A/C system, refrigerant exits the condenser in what phase?

- A. A low-pressure vapour ready for the compressor inlet stage
- B. A high-pressure liquid ready for the metering device entry
- C. A low-pressure liquid that has expanded through the metering device
- D. A high-pressure vapour at the temperature of the compressor outlet

74. A typical cabin air filter consists of:

- A. Pleated paper or synthetic media, often with activated carbon
- B. Washable foam filter that can be re-oiled and reinstalled
- C. Fine wire mesh designed to filter ultra-fine particles only
- D. A solid plastic baffle that deflects air around debris

75. On a manual HVAC system, what is the function of the mode (mix/blend) door inside the case?

- A. Selects fresh outside air or recirculated cabin air at the intake
- B. Controls the speed of the blower motor through resistor stages
- C. Directs airflow between the defrost, vent, and floor outlets
- D. Mixes refrigerant between high-side and low-side circuits

76. On most modern climate control systems, selecting "defrost" mode automatically activates which additional system?

- A. The A/C compressor engages to remove moisture from the air
- B. The engine cooling fan switches to maximum speed setting
- C. The cabin heater core valve closes for raised temperature
- D. The blower motor returns to its minimum speed setting

77. On most vehicles, the heated outside mirrors typically operate:

- A. Only when the driver presses a dedicated heated-mirror button
- B. Continuously while the ignition switch is in the run position
- C. Whenever the headlights are turned on during night driving
- D. When the rear window defroster is activated by the driver

78. What is the most reliable method for splicing automotive wires together in a location exposed to vibration and moisture?

- A. Twisting the wire ends together and wrapping with electrical tape

- B. A solder splice covered with adhesive-lined heat-shrink tubing
- C. A wire-nut connector twisted onto the bare wire ends together
- D. Insertion of stripped wires into a butt connector without crimping

79. A loose or corroded terminal at a connector typically causes which type of electrical fault?

- A. Open circuit allowing no current flow at any time during operation
- B. Direct short to ground bypassing the connected load completely
- C. High resistance causing voltage drop under current-flow conditions
- D. Reversed polarity damaging the connected electrical component

80. A vehicle's charging system warning light illuminates while driving. What does this typically indicate about the system condition?

- A. The charging voltage has dropped below the threshold value
- B. The battery is fully charged and overcharging is occurring
- C. The alternator is producing maximum output continuously
- D. The voltage regulator is operating at the normal output range

81. What does a battery's "group size" specification primarily indicate?

- A. The battery's specific cold cranking amperage rating
- B. The battery's manufacturing date code for the warranty term
- C. The battery's specific gravity at the full state of charge

D. The battery's physical dimensions and terminal layout

82. On an R-134a A/C system, the low-side service port is typically distinguished from the high-side service port by:

A. The thread direction (left-handed versus right-handed) on the port

B. A smaller diameter and a different connector style than high-side

C. The colour of the dust cap only (red versus blue) on the port

D. Both ports are identical and may be used interchangeably

83. On an automotive wiring schematic, a symbol resembling a sawtooth zigzag line typically represents which component?

A. An inductor coil with a specified inductance value

B. A capacitor with dielectric storage between two plates

C. A resistor with a specified ohm value in the circuit

D. A diode allowing current flow in only one direction

84. A customer's brake pedal travels excessively before pressure builds, requiring nearly full travel to stop the vehicle. After verifying fluid level is correct, the most likely cause is:

A. Excessive brake booster vacuum supply pressure at the booster

B. Master cylinder pushrod adjusted too short at the brake pedal

C. Worn brake pad friction material on multiple wheel positions

D. Air trapped in the hydraulic system or rear self-adjusters out of adjustment

85. A small amount of petroleum-based fluid (engine oil or ATF) has been mistakenly added to a vehicle's brake master cylinder reservoir. What is the required service action?

- A. Flush the system and replace all rubber components throughout
- B. Drain the reservoir and refill with correct DOT brake fluid
- C. Flush the brake system with denatured alcohol thoroughly
- D. Continue normal operation since brake fluids are similar

86. On most modern vehicles with a diagonal-split brake system, the typical brake bleeding sequence begins at:

- A. The brake closest to the master cylinder for easy bleeder access
- B. All four wheels simultaneously through a pressure bleeder unit
- C. The brake furthest from the master cylinder (typically right rear)
- D. The two front wheels first, before bleeding the rear wheels

87. On a hybrid or electric vehicle that lacks engine vacuum, the brake booster typically uses:

- A. A small reservoir of stored compressed air for power assist
- B. An electric vacuum pump or an electrohydraulic actuator assembly
- C. The high-voltage motor's regenerative braking torque only
- D. A purely mechanical lever requiring high driver pedal effort

88. In a typical leading-trailing drum brake design, the leading shoe is so named because:

- A. It is positioned higher in the brake drum than the trailing shoe
- B. It is mounted on the leading face of the brake backing plate
- C. It has more friction material than the trailing shoe on it
- D. It leads in the direction of drum rotation, becoming self-energizing

89. A leaking rear wheel cylinder on a drum brake produces which characteristic symptom?

- A. Brake fluid leakage onto the inside of the brake drum and shoes
- B. Increased brake pedal effort required during normal braking
- C. Brake pedal pulsation during normal brake pedal application
- D. Reduced front brake performance during emergency braking

90. A rear drum brake parking brake handle that pulls excessively far before engaging the brake most commonly indicates:

- A. A failed brake master cylinder requiring complete replacement
- B. Air trapped within the rear brake hydraulic supply circuit
- C. Worn rear brake shoes needing adjustment or replacement service
- D. A failed brake booster vacuum supply line from the engine

91. What component within an ABS hydraulic modulator pressurizes the brake fluid during an ABS event?

- A. The vehicle's engine-driven hydraulic pump assembly only

- B. An electric motor driving an internal hydraulic pump assembly
- C. A reservoir of pre-stored brake fluid kept under pressure
- D. The driver's brake pedal force on the master cylinder pushrod

92. During an electronic stability control event, what action does the ESC module typically take to correct a skidding vehicle?

- A. Cuts the engine power completely to all four driven wheels
- B. Increases the steering effort to limit driver steering input
- C. Disengages the transmission gear automatically during the event
- D. Applies the brakes at individual wheels and may also reduce engine torque

93. On older RWD vehicles with recirculating ball steering, the steering gear converts steering wheel rotation to:

- A. Pitman arm motion through a worm gear and sector gear inside the box
- B. Direct rack motion through a pinion gear meshed at the rack
- C. Hydraulic pressure through a rotary valve at the input shaft
- D. An electronic signal sent to the steering control module

94. To adjust the front toe alignment on a vehicle with rack-and-pinion steering, the technician:

- A. Adjusts the eccentric bolts at the lower control arm to chassis pivot
- B. Adjusts shims between the steering knuckle and the front strut

- C. Rotates the tie rod adjuster sleeve between inner and outer tie rod ends
- D. Adjusts the steering rack mounting bolts at the subframe position

95. When disassembling a MacPherson strut assembly to replace internal components, what tool is essential for technician safety?

- A. A two-jaw bearing puller for removal of the strut bearing
- B. A coil spring compressor to safely compress the spring before disassembly
- C. A torque wrench rated to high values for the strut bolts
- D. A pneumatic impact wrench for the upper strut mount nut

96. On a vehicle equipped with a front steering damper, the damper functions to:

- A. Damp out vertical bumps during normal driving conditions
- B. Provide the primary steering wheel return-to-center force
- C. Adjust the front-wheel toe angle automatically by speed
- D. Damp out road shock and oscillation through the steering linkage

97. What is the primary advantage of a monotube gas-charged shock absorber over a conventional twin-tube design?

- A. Improved heat dissipation and resistance to internal fluid foaming
- B. Lower production cost in high-volume manufacturing processes
- C. Smaller overall body diameter allowing tighter packaging

D. Externally adjustable damping rate through a tunable knob

98. On a modern vehicle with active wheel speed sensors, the sensor and tone ring are most commonly:

A. Located on the brake caliper for direct rotation sensing of the rotor

B. Integrated into the wheel bearing and hub assembly as one unit

C. Mounted to the axle shaft inside the differential housing

D. Connected to the transmission output shaft for vehicle speed

99. Lug studs on a typical modern North American vehicle have what thread direction?

A. Left-hand threads on the right side of the vehicle assembly

B. Right-hand threads only on the front wheels of the vehicle

C. Right-hand threads on all four wheel positions of the vehicle

D. Left-hand threads on the driver-side wheels of the vehicle

100. What is the difference between static balance and dynamic balance of a wheel-tire assembly?

A. Static balance applies to older bias-ply tires; dynamic balance applies only to modern radial tires

B. Static balance is performed with the wheel still mounted on the vehicle hub

C. Static balance corrects imbalance in one plane; dynamic balance corrects imbalance in two planes

D. Static balance and dynamic balance describe the same procedure on the balancer

101. What is the typical recommended inflation pressure for a compact "donut" temporary spare tire?

- A. Approximately 32 psi, the same as the regular tires on the vehicle
- B. Approximately 80 psi for maximum load-bearing capacity at speed
- C. Approximately 20 psi for a soft, comfortable ride during use
- D. Approximately 60 psi to support the vehicle for safe limited-distance use

102. During tire replacement on a vehicle equipped with direct TPMS, which components from the TPMS service kit should be replaced regardless of sensor condition?

- A. The valve core, grommet seal, and washer at the sensor stem
- B. The entire TPMS sensor assembly including battery and circuit board
- C. The wheel weight retention clips at the rim mounting position
- D. The dust cap covering the valve stem assembly only

103. Lateral wheel runout (side-to-side wobble) measured at the rim flange should typically be:

- A. Up to 1 mm of runout acceptable on aluminum alloy wheels
- B. Up to 3 mm of runout acceptable on stamped steel wheels
- C. Less than approximately 0.5 mm to prevent driveline vibration
- D. Up to 5 mm of runout if the tire balance compensates for it

104. A clunking noise that occurs when steering at low speeds, especially as the steering wheel reaches the lock position, is most likely caused by:

- A. A worn engine mount allowing the engine to shift in the bay
- B. A worn lower ball joint developing internal play under load
- C. Loose lug nuts on the affected front wheel position
- D. A worn strut bearing or strut top mount allowing the strut to bind on rotation

105. When installing a new brake hose with a banjo-style fitting at the caliper, the technician must:

- A. Install new copper (or specified) sealing washers on both sides of the banjo fitting
- B. Reuse the original copper washers along with added thread sealant
- C. Apply Teflon thread tape to the banjo bolt threads for the seal
- D. Tighten the banjo bolt to maximum torque to ensure a leak-free seal

106. What is the most accurate method for tightening wheel lug nuts to the manufacturer's specification?

- A. Using a calibrated impact gun set to the specified torque output
- B. Using a calibrated torque wrench in a star (cross) pattern sequence
- C. Tightening firmly by hand and then with an extension bar lever
- D. Tightening to feel using the technician's accumulated experience

107. A vehicle's SRS warning lamp illuminates after a battery replacement. The technician suspects no actual SRS fault exists. What is the appropriate diagnostic step?

- A. Clear the warning lamp with a generic OBD-II scan tool quickly
- B. Disconnect the battery again for 30 minutes to reset the system

- C. Connect a manufacturer-capable scan tool and read the SRS module DTCs
- D. Replace the SRS airbag control module since the lamp indicates failure

108. A side curtain airbag includes a rollover sensor input that triggers deployment when:

- A. The vehicle experiences a frontal impact above a calibrated threshold
- B. The vehicle experiences high sustained lateral cornering forces
- C. The vehicle's wheel speed sensors detect significant wheel motion
- D. The vehicle exceeds a specific tilt angle or rotation rate threshold

109. Frontal impact sensors that initiate driver and passenger airbag deployment are most typically located:

- A. At the front of the vehicle behind the front bumper on sensor brackets
- B. Inside the steering wheel hub near the driver-side airbag module
- C. On the seat mounting brackets directly under the front seats
- D. Inside the dashboard near the passenger airbag inflator housing

110. A vanity mirror LED on a sun visor has stopped illuminating. The most likely cause is:

- A. The visor assembly must be replaced as a complete unit replacement
- B. The LED bulb itself has failed or the door switch is defective
- C. The BCM requires reprogramming for the LED function
- D. The vehicle's headliner needs replacement to access the wiring

111. On a minivan equipped with a power sliding door, what mechanism typically detects an obstruction during the closing operation?

- A. Optical sensors mounted at the upper corner of the door frame
- B. A pressure-sensitive contact strip along the door's leading edge
- C. Motor current sensing that detects increased mechanical resistance
- D. Ultrasonic distance sensors positioned along the door track

112. A power running board that automatically deploys when a door opens typically uses which mechanism?

- A. A hydraulic actuator driven from the vehicle's brake fluid system
- B. A spring-loaded mechanism with a manual lock release mechanism
- C. A vacuum-operated diaphragm fed from the engine intake manifold
- D. An electric motor driving a worm gear or linkage mechanism

113. A vehicle's power convertible top fails to operate, with no audible motor activity. After verifying the convertible top relay and fuse are intact, the next diagnostic step is:

- A. Test the convertible top safety interlock switches that confirm the latches are released
- B. Replace the convertible top hydraulic pump motor as a preventive repair
- C. Inspect the wiring harness for damage at all body pass-through grommets
- D. Adjust the convertible top latches and stops for proper position

114. A retractable tonneau cover on a pickup truck bed includes pinch protection. This safety feature:

- A. Prevents the cover from extending beyond the cab area at all
- B. Locks the cover automatically when the truck is driving forward
- C. Reverses the cover direction automatically when an obstruction is detected
- D. Limits the cover travel speed during the closing operation only

115. A lidar (light detection and ranging) sensor on a modern ADAS-equipped vehicle is typically located:

- A. Behind the rear bumper for use in blind-spot detection only
- B. At the roof, grille, or other forward-facing high mounting position
- C. Inside the cabin above the driver's seat for driver monitoring
- D. At the wheel hubs for distance measurement to the road surface

116. A driver attention monitoring system on a modern vehicle typically uses:

- A. A pressure sensor on the steering wheel rim detecting hand contact
- B. A camera in the dashboard pointed toward the rear cargo area
- C. An accelerometer measuring vehicle motion patterns over time
- D. A camera with infrared illumination tracking eye gaze and movement

117. A 48V mild hybrid system primarily provides which benefit compared to a conventional 12V vehicle?

- A. Engine start-stop, regenerative capture, and brief electric torque assist

- B. Pure electric propulsion for distances up to 50 kilometres
- C. Direct AC charging from public Level 2 charging stations
- D. A lower-compression-ratio engine optimized for fuel economy

118. A typical lithium-ion cell in an EV battery operates within what voltage range from fully discharged to fully charged?

- A. Approximately 1.5 V to 1.8 V from discharged to fully charged
- B. Approximately 2.5 V to 4.2 V from discharged to fully charged
- C. Approximately 6.0 V to 8.4 V from discharged to fully charged
- D. Approximately 12 V to 14 V from discharged to fully charged

119. EV battery pack cells are typically connected in what overall arrangement to achieve high pack voltage and high pack capacity?

- A. All cells in parallel only to maximize available current capacity
- B. All cells in series only to maximize available pack voltage output
- C. Random pattern based on each cell's manufacturer-printed capacity
- D. Groups of cells in parallel (modules) with modules in series

120. EV traction motor stator windings are typically cooled by:

- A. Air drawn through ducts at the front of the motor housing assembly
- B. Engine coolant routed from the internal combustion engine cooling system

- C. A dedicated liquid coolant loop, often shared with the inverter housing
- D. Natural convection from the motor case to the surrounding air

121. A plug-in hybrid electric vehicle (PHEV) differs from a conventional hybrid (HEV) primarily by:

- A. Having a larger battery that can be charged from an external grid source
- B. Using only an electric motor with no internal combustion engine present
- C. Having no charging capability through the vehicle's regenerative braking
- D. Using a smaller battery pack than a conventional hybrid vehicle uses

122. A hydrogen fuel cell electric vehicle (FCEV) generates electrical power by:

- A. Burning hydrogen gas in a modified internal combustion engine cylinder
- B. An electrochemical reaction between hydrogen fuel and oxygen producing water
- C. Storing hydrogen at extreme pressure and releasing it through a turbine
- D. Catalytically converting hydrogen to gasoline within the fuel cell stack

123. Vehicle-to-grid (V2G) capability allows an electric vehicle to:

- A. Wirelessly charge another nearby electric vehicle's battery
- B. Communicate with traffic systems for autonomous driving routes
- C. Receive over-the-air software updates while driving
- D. Discharge stored battery energy back into the electrical grid

124. The battery management system (BMS) in an EV communicates with the vehicle's other modules using which network?

- A. A dedicated proprietary single-wire bus only for the BMS
- B. The standard low-speed body CAN bus shared with comfort modules
- C. A high-speed CAN bus, often a dedicated battery network segment
- D. Wi-Fi communication routed through the cellular telematics unit

125. Before disconnecting any high-voltage components on an EV or hybrid, the technician must verify that the high-voltage system is de-energized by:

- A. Visually checking that the orange high-voltage cables are not damaged
- B. Measuring zero high-voltage at the inverter or battery terminals with a Category III/IV rated meter after waiting the manufacturer's capacitor discharge time
- C. Listening to confirm that the high-voltage cooling pump has stopped operating
- D. Cycling the ignition key off and on three times to clear stored voltage

Practice Exam 4: Answer Key and Explanations

1. B — Flush the area with running water for at least 15 minutes. Battery electrolyte is dilute sulphuric acid that continues to damage tissue as long as it remains on the skin. Continuous water flushing dilutes and removes the acid faster than any chemical neutralization, and 15 minutes is the minimum specified by Canadian first-aid standards.

2. C — Oxygen is the third element of the fire triangle. Combustion is an oxidation reaction, so without an oxidizer (almost always atmospheric oxygen) fuel cannot burn even with heat present. Removing any one of the three elements — heat, fuel, or oxygen — extinguishes the fire, which is the basis for every fire-suppression strategy in the shop.

3. A — Atmospheric testing for oxygen content and hazardous gases is the mandatory first step before confined-space entry. Fuel tanks may contain oxygen-deficient atmospheres and flammable vapours that cannot be detected by smell or sight. Provincial confined-space regulations require atmospheric testing and continuous monitoring during entry.

4. D — P100 (HEPA-rated) particulate respirators capture asbestos fibres at the required filtration efficiency. Asbestos fibres are extremely fine and cause progressive lung disease over decades of accumulated exposure, while nuisance dust masks pass these fibres through. Provincial regulations require P100 respirators (along with other controls) for any work involving suspected asbestos brake or clutch materials.

5. B — Bend at the knees and keep the load close to the body. The load close to the body keeps the moment arm short, reducing the rotational force on the lumbar spine. Bending at the knees transfers the lifting effort to the strong leg muscles rather than the lower-back muscles, which are vulnerable to strain.

6. A — 15 minutes of continuous flow is the duration standard set by ANSI Z358.1 and adopted by Canadian workplace safety regulations. The duration is calibrated to dilute and remove chemical contaminants from the eye before tissue damage progresses. A station that flows for less than 15 minutes is non-compliant and leaves contaminants on the eye.

7. D — A hazardous waste manifest is the legal tracking document required when waste leaves a generator (the shop) for transport and disposal. It records waste type, quantity, generator, and hauler, signed by both parties for accountability. The manifest creates the "cradle-to-grave" paper trail mandated by Canadian environmental and provincial hazardous waste regulations.

8. C — A 1:4 base-to-height ratio (approximately 75 degrees from horizontal) is the standard safe ladder angle. Steeper angles increase the risk of tipping backward; shallower angles increase the risk of the base sliding out. The 1:4 rule means the base sits one unit out from the wall for every four units of vertical height to the support point.

9. A — Puncture-resistant sharps containers prevent needle-stick injuries during disposal. Used needles may carry bloodborne pathogens (HIV, hepatitis B and C), and a single puncture can transmit infection. Provincial health-and-safety regulations require sharps containers for any biohazard sharps regardless of how they ended up in the vehicle.

10. D — During the intake stroke, the intake valve is open and the exhaust valve is closed as the piston descends, drawing the air-fuel charge into the cylinder. This is one of the four discrete strokes of the Otto cycle, with valve overlap occurring only briefly at the transition between exhaust and intake. Understanding the four-stroke cycle is foundational to all engine diagnostics.

11. B — A V-engine is significantly shorter than an inline engine of the same displacement because the cylinders are stacked in two banks rather than a single row. The shorter length allows transverse mounting in front-wheel-drive vehicles and shorter overall hood lengths, both critical for modern packaging. The trade-off is added complexity from two cylinder heads, two cam drives, and a more complex intake.

12. A — The connecting rod journal (also called the crank pin) is the offset journal on the crankshaft where the connecting rod big end attaches. Main bearing journals are concentric with the crankshaft's centerline and ride in the block's main bearings, while rod journals are offset to create the engine's stroke. Identifying journals correctly is essential when measuring crankshaft wear or sizing replacement bearings.

13. C — Plain (sleeve) bearings, typically with babbitt or aluminum-tin overlays, are the standard for engine crankshaft and connecting rod applications. They support enormous loads with low friction by riding on a thin film of pressurized engine oil — the bearing surface never actually contacts the journal in a healthy engine. Loss of oil pressure or oil film failure destroys these bearings within seconds.

14. D — The bypass valve allows oil to skip a blocked filter so the engine isn't starved of lubrication. A heavily contaminated or cold-thickened filter can develop enough pressure differential to open the bypass, sending unfiltered oil to the bearings. This protects against catastrophic oil starvation, but a neglected filter eventually allows debris to circulate, which is why regular oil changes matter.

15. B — Synthetic oil molecules are uniformly sized through controlled chemical synthesis, while conventional oil contains a range of molecule sizes from refined crude. The uniformity gives synthetics better viscosity stability across temperature extremes, slower thermal breakdown, and longer service life. The performance advantage matters most in extreme cold, high-temperature, or extended-interval applications.

16. A — A simple drain-and-fill leaves approximately 40 to 50 percent of the old coolant in the engine block, heater core, and cooling passages. The residual coolant dilutes the new fluid and continues degrading the corrosion inhibitors, defeating the purpose of the service. A proper flush removes most of the old coolant and any accumulated debris before the new coolant is installed.

17. D — Spring-loaded automatic tensioners apply constant force to the belt regardless of wear, thermal expansion, or belt stretch. The internal spring takes up slack continuously, eliminating the periodic manual adjustments required on older designs. A tensioner that has lost spring force is a common failure point and should be replaced whenever a serpentine belt is renewed after several years of service.

18. C — Uniform light darkening with no oily staining or tears is the normal appearance of an air filter that has captured ordinary road dust through its service interval. Oil contamination indicates blow-by from a failed PCV system; tears indicate impact damage. Air filter condition is judged against the manufacturer's service interval, not by appearance alone.

19. B — Returnless fuel systems place the fuel filter inside the tank as part of the fuel pump module assembly, often integrated with the pressure regulator. The location eliminates external fuel lines and reduces leak points, and on many modern designs the filter is rated for the vehicle's full service life. Replacement requires dropping the tank or accessing the pump through a service hatch.

20. A — A "too hot" plug rejects heat too slowly, allowing the firing tip to reach pre-ignition temperatures before the spark fires. Pre-ignition causes uncontrolled combustion that can melt piston crowns and damage engine internals. Selecting the manufacturer's specified heat range is critical because the calibration matches the engine's heat-transfer characteristics.

21. C — Coil-near-plug uses individual coils for each cylinder but connects them to the plug with a short high-tension lead, rather than mounting the coil directly on top of the plug (coil-on-plug). This compromise design fits applications where engine packaging doesn't allow a coil to sit directly on each plug. Diagnostic procedures must account for the additional lead between coil and plug.

22. D — Low octane fuel ignites under compression before the spark plug fires, producing the multiple flame fronts that cause detonation (knock). Octane resistance to auto-ignition must match the engine's compression ratio, so high-compression and turbocharged engines need higher octane to prevent knock. Other detonation causes include excessive intake-air temperature, combustion-chamber deposits, and over-advanced ignition timing.

23. A — Smoke testing with low-pressure smoke pressurizes the intake and produces visible smoke leaking from the exact location of any vacuum leak. The smoke appears at hidden cracks, failed gaskets, and small leaks that water spray, listening, or torque checks would miss. The method is fast and effective on intake manifolds, EVAP systems, exhaust systems, and turbo boost piping.

24. B — Modern throttle bodies often have a non-stick coating on the throttle plate that prevents carbon adhesion; aggressive cleaning agents or abrasive scrubbing damages this coating. After the coating is damaged, deposits build faster than before, accelerating idle problems and shortening throttle body life. Use only manufacturer-approved cleaners on a soft cloth or brush.

25. C — On all modern OBD-II vehicles, the PCM electronically controls ignition timing using inputs from the crankshaft sensor, camshaft sensor, engine load (MAF or MAP), coolant temperature, knock sensor, and others. There is no mechanical advance system. Timing is calibrated for every operating condition and can be retarded instantly in response to knock or other faults.

26. A — A wet compression test isolates ring leakage from valve leakage and is performed only after a dry compression test has shown low readings. Oil is added to the cylinder before the second test; if compression rises significantly, the leak was past the rings (now sealed by oil). Without the baseline dry reading, the wet result has nothing to compare against.

27. D — A wideband oxygen sensor reports the actual air-fuel ratio across a wide range, typically from about 10:1 to 20:1. A narrowband zirconia sensor only switches around stoichiometric (14.7:1), reporting "rich" or "lean" without quantifying. Wideband data is essential for modern direct-injection and lean-burn engines and is used during catalyst diagnostics.

28. B — Swapping the coil-and-plug to another cylinder transfers the failed component (if it is one) to a different cylinder. If the misfire follows the swap to the new cylinder, the coil or plug is at fault; if it stays at cylinder #3, the cause is inside the cylinder (injector, valve, or compression). This is the fastest diagnostic step after confirming compression is good.

29. A — Cetane number measures how quickly diesel fuel ignites under compression, with higher numbers indicating shorter ignition delay. Adequate cetane is necessary for proper combustion timing, cold starting, and quiet operation. Diesel cetane (combustion willingness) is the inverse of gasoline octane (combustion resistance), reflecting the opposite combustion strategies of the two fuels.

30. D — NO₂ produced by the upstream diesel oxidation catalyst is a stronger oxidizer than O₂ and burns soot at the relatively low exhaust temperatures of normal highway driving (around 250 to 450°C). This continuous "passive" regeneration keeps DPF backpressure stable without driver involvement. Vehicles used mostly in low-load city driving don't reach passive regen temperatures and rely on active regen instead.

31. C — Approximately 125 psi minimum at cranking speed is a common rule of thumb for naturally aspirated gasoline engines, though specific values vary by engine design and compression ratio. The exam expects recognition of this general range; the variation between cylinders (less than 10 percent difference) often matters more than the absolute reading. Always consult manufacturer specifications for the engine being tested.

32. B — In the recessive state both CAN-H and CAN-L sit at approximately 2.5V with no differential, representing logic 1. In the dominant state (logic 0), CAN-H rises to about 3.5V and CAN-L drops to about 1.5V, creating a 2V differential. Measuring these voltages confirms whether the bus is functional or stuck in one state.

33. A — UDS (ISO 14229) is a standardized diagnostic protocol that runs on top of CAN (and other physical layers), providing a unified set of diagnostic services across manufacturers. It defines how scan tools request data, run tests, program modules, and access security functions. UDS is gradually replacing manufacturer-specific protocols and is the foundation of modern OBD-II diagnostics.

34. D — Pins 6 (CAN-H) and 14 (CAN-L) are the standardized DLC pins for ISO 15765 (CAN-based diagnostics), the protocol used on all OBD-II vehicles since 2008. The scan tool first attempts CAN; if no response, it falls back to older protocols using their assigned pins. Knowing the pin layout enables direct probing of the DLC during communication faults.

35. B — Mode 03 returns confirmed (stored) emissions-related DTCs that have been validated through enough drive cycles to illuminate the MIL. These are the codes the technician most commonly works from during diagnosis. Mode 03 codes are the standardized OBD-II emissions codes; manufacturer-specific codes are accessed through enhanced modes.

36. C — Mode 07 returns pending (one-cycle-failure) DTCs — faults that have failed monitor criteria once but not enough times to confirm and illuminate the MIL. Pending codes are useful for diagnosing intermittent faults or verifying a repair (a pending code that re-appears means the fault is recurring). Mode 07 is one of the most useful diagnostic modes during follow-up testing.

37. A — The third character indicates the subsystem affected within the system class. For powertrain (P) generic (0) codes, "3" indicates ignition/misfire, "1" indicates fuel and air metering, "2" indicates the fuel injector circuit specifically, and so on. Memorizing the subsystem codes lets the technician identify the affected area immediately on reading a DTC.

38. D — A new BCM ships without vehicle-specific configuration data (VIN, equipped options, regional settings, anti-theft data) and must be configured to the specific vehicle through scan tool programming. Without configuration, many functions either don't work or behave incorrectly. The configuration step is the most common omission when technicians replace control modules.

39. B — Module reflashing is most commonly performed to apply a manufacturer TSB (Technical Service Bulletin) or recall fix that updates the module's calibration to address a known issue. These updates can fix driveability problems, emissions failures, or specific complaints without replacing hardware. The procedure requires a manufacturer scan tool or a J2534-compatible programming setup.

40. C — CAN wire colors are not standardized across the industry; each manufacturer uses its own scheme. Common combinations include white-with-green and white-with-yellow, but always reference the specific vehicle's wiring diagram. The twisted-pair arrangement of the two conductors is the standardized feature, not the colors.

41. D — Telematics systems use an embedded cellular modem to maintain a connection to the manufacturer's servers wherever cellular coverage exists. The modem operates independently of the driver's phone and provides services such as emergency calling, remote start, vehicle location, and diagnostic uploads. Cellular service requires a subscription that the manufacturer maintains with carriers on the vehicle owner's behalf.

42. B — The gateway module routes diagnostic and operational messages between the vehicle's separate network protocols and segments (e.g., between HS-CAN, LS-CAN, FlexRay, and Ethernet). It enforces security boundaries, controls scan tool access, and centralizes diagnostic communication. The gateway is the single point through which an external scan tool reaches every module on the vehicle.

43. A — Seed-key security requires the scan tool to receive a random number ("seed") from the module, calculate the correct response ("key") using a proprietary algorithm, and send it back. Only an authorized tool with the algorithm can program the module, preventing unauthorized changes to safety- and emissions-critical software. The algorithm is licensed from the manufacturer to legitimate tool vendors.

44. D — Resurfacing or replacement per specification is required because a scored or heat-checked flywheel surface won't produce a smooth, full clutch engagement and will accelerate disc wear. Some flywheels have a minimum thickness specification and cannot be resurfaced; dual-mass flywheels typically cannot be resurfaced at all. Reinstalling a damaged flywheel ensures a comeback.

45. D — A clutch alignment tool simulates the transmission input shaft, centering the disc precisely on the pilot bearing so the transmission can slide back into place. Without alignment, the disc sits off-center, the input shaft cannot enter the splines, and forcing the install bends the disc or damages the pilot bearing. A proper alignment tool is mandatory for every clutch installation.

46. B — Pressure bleeding or gravity bleeding at the slave cylinder bleeder allows trapped air to escape from the hydraulic system. Most clutch hydraulic systems will not self-purge by pedal pumping alone because the slave cylinder is often mounted above the master cylinder or in a position where air collects. Following the manufacturer's specified bleed procedure is essential to restore proper pedal feel.

47. A — Modern automatic transmissions without dipsticks specify fluid level inspection at a precise fluid temperature, with the engine running and the gearshift cycled through the gears. A fill plug on the side of the case is removed and ATF is added until it just begins to overflow at the specified temperature. The temperature window is narrow because ATF expands significantly with heat.

48. D — A slip during 2–3 upshifts under heavy throttle, but not light throttle, indicates the 2–3 clutch pack can hold low-load torque but slips when full engine torque is applied. The clutch pack friction material is worn or the apply pressure is inadequate at heavy throttle. Pressure testing and scan tool data (commanded vs. actual gear ratio) confirm clutch pack wear before transmission service.

49. B — A worn one-way stator clutch slips inside the torque converter, allowing the stator to rotate instead of redirecting fluid. With the stator slipping, torque multiplication is lost and engine RPM climbs higher than spec during the stall test because the converter cannot lock against the impeller's pumping force. Replacement of the torque converter is the repair.

50. C — On modern vehicles, the VSS at the transmission output (or on some vehicles the wheel speed sensors via the ABS module) provides the speedometer signal. The signal is processed by the PCM or instrument cluster and displayed through an electronic speedometer. Mechanical cables disappeared with the move to electronic instrument clusters in the 1990s.

51. A — Modern outer CV joints (Rzeppa or similar designs) accommodate approximately 45 to 50 degrees of operating angle at full steering lock, allowing tight turning radii without binding. Exceeding this angle damages the joint cage and balls; off-road modifications that increase wheel travel can push joints beyond design angles. Inner tripod joints accommodate plunge but less angle (about 18 to 25 degrees).

52. C — The slip yoke at the transmission end allows the driveshaft to change effective length as the suspension travels up and down. Without it, the rear axle's vertical movement would either pull the yoke out of the transmission or push it back, damaging the seal and bearings. The slip yoke uses an internal spline that slides freely on the transmission output shaft.

53. B — A viscous coupling differential uses concentric plates inside silicone fluid; speed differences between the plates shear the fluid and produce drag torque that resists slip. The system is fully sealed, automatic, and proportional to slip speed. Common in older Subaru AWD and similar systems, viscous couplings have been largely superseded by clutch-pack and electronic systems.

54. C — Modern part-time 4WD systems use an electric shift motor on the transfer case, commanded by a dashboard switch or dial. The electronic system replaces the floor-mounted lever, reducing cabin intrusion and enabling programmable engagement features. Vacuum actuators were used briefly on some 1990s applications but are now largely obsolete.

55. A — Automatic locking front hubs engage when the transfer case sends torque to the front shafts, causing the hub mechanism to lock the wheels to the rotating shafts. They disengage when the shafts stop rotating in the same direction as the wheels. Auto-locking hubs are convenient but less reliable than manual hubs and may not engage if the front shafts aren't actually rotating.

56. D — The center support bearing is a sealed ball bearing in a rubber-isolated housing that supports the midpoint of a two-piece driveshaft and dampens vibration. The rubber isolator absorbs vibration that would otherwise transfer to the chassis. A worn center support bearing produces a noticeable whine or vibration at highway speed and requires replacement.

57. B — Haldex couplings use a wet multi-plate clutch pack engaged by hydraulic pressure from an electric pump, all under electronic control. The ECU can apply variable clutch pressure based on throttle, wheel speed, steering angle, and stability data, providing fully variable AWD torque distribution. Common on Volkswagen, Volvo, and other European AWD vehicles since the 2000s.

58. C — A digital inclinometer or magnetic angle gauge placed on the driveshaft and on machined surfaces of the transmission output yoke and pinion yoke measures the U-joint working angles. Excessive or unequal angles cause vibration. Pinion shims and ride-height correction restore the angles to the manufacturer's specifications.

59. D — On IRS rear suspension, the wheel hub moves up, down, and slightly fore-and-aft relative to the fixed differential housing through suspension travel. CV joints at both ends of the half-shaft accommodate this travel without binding. Solid rear axles need no CV joints because the housing and wheel move together.

60. A — Engine RPM at any given speed rises because the higher numerical ratio means the driveshaft turns more times per wheel revolution. A 3.42→3.73 change increases the driveline ratio by about 9 percent, so cruise RPM rises 9 percent at the same speed. Acceleration and tow capacity improve at the cost of fuel economy at highway speeds.

61. C — A capacitor stores electrical charge between two plates separated by a dielectric, releasing the stored energy when needed. In automotive circuits, capacitors filter voltage spikes, smooth power supplies, and provide rapid energy delivery for ignition systems and motor starting. The stored charge is proportional to the applied voltage multiplied by the capacitance.

62. B — Coolant temperature sensors are NTC thermistors: resistance decreases as temperature rises. The PCM applies a reference voltage through a fixed resistor in series with the sensor and reads the resulting voltage, which falls as the engine warms. NTC sensors are also used for IAT, transmission fluid temperature, and ambient temperature sensing.

63. D — Hall-effect sensors produce a clean digital on-off output as a magnet (or shutter wheel) passes the sensing element. The digital signal is robust against noise and works at any rotational speed, including stationary, which is why Hall sensors are common for crankshaft position, ABS wheel speed, and many other applications.

64. C — Variable reluctance sensors generate AC voltage proportional to the rate of magnetic flux change, so the signal amplitude increases with rotational speed. The signal is sinusoidal and may be too weak at very low speeds to read reliably. VR sensors are common on older ABS wheel speed sensors and crankshaft position applications; Hall-effect sensors have largely replaced them in new designs.

65. A — A specific gravity of 1.265 to 1.285 at 25°C indicates full state of charge on a healthy flooded lead-acid battery. The reading drops toward about 1.120 at fully discharged because sulphuric acid is consumed and replaced by water during discharge. A hydrometer reading is one of the most reliable indicators of battery state of charge.

66. B — An overrunning alternator decoupler (OAD) allows the alternator rotor to coast during engine deceleration and during high-frequency crank vibration. This reduces belt vibration, accessory drive noise, and stress on the belt system. OADs are common on modern engines with aggressive deceleration fuel cutoff calibrations.

67. D — The solenoid's shift fork pushes the pinion outward into mesh with the engine ring gear before motor torque is applied. The solenoid uses a two-stage action: first the fork pushes the pinion forward via a plunger, then the high-current contacts close, applying battery voltage to the motor. This sequence prevents grinding and reduces mesh damage.

68. C — Headlight aim is verified using either a dedicated aiming device (mounted to the headlight) or a wall pattern at a specified distance (typically 25 feet). The aim must place the beam cutoff at the correct height and lateral position for the headlight type (low beam, high beam, projector). Many provinces inspect headlight aim during safety inspections.

69. A — Electronic throttle control allows the PCM to command the throttle plate position directly via the throttle actuator motor, with no mechanical linkage to the driver's foot. Cruise control simply sends a target speed; the PCM commands the throttle to maintain it. This integration also enables traction control, stability control, and adaptive cruise.

70. B — Door pin switches and latch tamper sensors are the inputs the BCM uses to detect unauthorized entry. If a pin switch is failed or stuck, the BCM doesn't see the door as opened, so the alarm doesn't sound. Manual locking with the key doesn't always arm the alarm, which masks the failure until fob-locked entry is attempted.

71. D — Hall-effect sensors count motor armature rotations and the BCM tracks the count to know exact liftgate position. The system uses these pulses to control acceleration and deceleration ramps, detect obstructions (by pulse rate change), and stop at programmed open positions. Loss of pulse counting causes the system to malfunction or require relearning.

72. C — Low-side pressure rising above the cycling switch threshold indicates the evaporator is no longer absorbing enough heat to keep pressures low, so the switch closes and engages the compressor. The pressures cycle within a narrow range that keeps evaporator temperature just above freezing. Variable-displacement compressors largely eliminated cycling by varying output instead.

73. B — Refrigerant exits the condenser as high-pressure liquid (sub-cooled, ideally), having been compressed and then cooled by airflow through the condenser. The high-pressure liquid then passes through the metering device (TXV or orifice tube), which drops its pressure rapidly. The phase change back to vapour occurs in the evaporator, where heat is absorbed from cabin air.

74. A — Cabin air filters are pleated paper or synthetic media that capture particulate matter (dust, pollen, soot). Many include an activated carbon layer that absorbs odours and some gases. Replacement intervals are typically 20,000 to 30,000 km, and a restricted filter reduces airflow and HVAC efficiency.

75. C — The mode (mix/blend) door directs airflow between the defrost, vent (face), and floor outlets based on driver selection. Mixed modes (like floor + defrost) split the airflow between two outlets. The door is operated by a servo motor (electric) or a cable (manual) and is one of the most frequently used moving parts in the HVAC system.

76. A — Modern climate control activates the A/C compressor automatically when defrost mode is selected because A/C operation removes moisture from the air passing through the evaporator, preventing fog from re-forming on the glass. The A/C is also engaged in mixed defrost-plus-heat modes for the same reason. The compressor may not engage if ambient temperature is below approximately 0°C.

77. D — Heated outside mirrors typically share a circuit with the rear window defroster, activating whenever the defroster is on. This common control simplifies wiring and matches the use case: drivers turn on the rear defroster when ice or fog needs clearing, and the mirrors need the same treatment. Some vehicles have separate mirror controls or automatic operation based on ambient temperature.

78. B — A solder splice with adhesive-lined heat-shrink tubing creates a mechanically strong, electrically continuous, and moisture-sealed joint that withstands vibration and the road environment. The solder provides a low-resistance connection and the heat-shrink seals against moisture. Crimp butt connectors are acceptable when properly crimped and sealed; never twist-tape or wire-nut automotive wiring.

79. C — A loose or corroded terminal adds resistance to the circuit, causing voltage drop under load. Under light load the voltage drop is small and the circuit may seem to work normally, but at full load (motor running, lights on) the drop becomes significant and the load malfunctions. Voltage drop testing identifies this fault that resistance measurements often miss.

80. A — The charging system warning light illuminates when the PCM (or voltage regulator) detects charging voltage below a calibrated threshold (typically about 13 V). This means the battery is no longer being adequately recharged and will eventually discharge to the point the engine stops. Diagnose immediately — check belt, alternator, and connections — before the battery is exhausted.

81. D — Battery group size (such as 24, 35, 65) specifies the physical dimensions (length, width, height), terminal location, and terminal type. The group size ensures the battery fits the vehicle's battery tray and connects to the cables. CCA, reserve capacity, and AH ratings are separate specifications matched to the application.

82. B — The low-side service port has a smaller diameter and a different quick-connect style than the high-side port, to prevent connecting high-pressure equipment to the low side and vice versa. R-134a systems use this size distinction; R-1234yf uses different ports again for cross-system safety. Confirming you're connected to the correct side is critical for accurate diagnosis and safe service.

83. C — The zigzag (sawtooth) symbol represents a resistor on automotive schematics in the North American convention. European and IEC schematics often use a rectangular box symbol instead. Recognizing schematic symbols is essential for reading wiring diagrams and tracing circuits during diagnosis.

84. D — Excessive pedal travel before pressure builds indicates either air in the hydraulic system or, on rear drum brakes, self-adjusters that have backed off allowing shoes to retract too far from the drum. The pedal travels until the shoes contact the drum, then pressure builds. Bleeding the system and verifying self-adjuster operation are the diagnostic steps.

85. A — Petroleum contamination causes immediate swelling and degradation of every rubber component in the brake system (master cylinder seals, caliper seals, wheel cylinder seals, hose linings, ABS valve seals). Even after flushing, contaminated rubber continues to swell and fail. Manufacturer procedures require complete replacement of all rubber components throughout the entire brake system.

86. C — The traditional bleeding sequence starts at the wheel furthest from the master cylinder (usually right rear), then left rear, right front, left front. This purges the longest line first and progressively moves air toward the bleed point. On vehicles with electronic brakes, follow the manufacturer's specific sequence, which may differ.

87. B — Vehicles without engine vacuum (full EVs, plug-in hybrids in EV mode, some stop-start systems) use an electric vacuum pump or an electrohydraulic brake booster (iBooster-style) to provide power assist. The iBooster applies brake fluid pressure via an electric motor instead of using vacuum. These systems also support automatic emergency braking integration.

88. D — The leading shoe "leads" in the direction of drum rotation and is wedged tighter against the drum by friction, producing self-energizing action that greatly amplifies braking force. The trailing shoe trails behind and is pushed away by friction, producing less braking effort. Most modern light-truck drum brakes use this asymmetric leading-trailing design.

89. A — A leaking wheel cylinder allows brake fluid to leak past the piston seal into the brake drum, contaminating the shoes and reducing or eliminating braking effort at that wheel. Visual inspection reveals fluid on the inside of the drum and on the shoe friction surfaces. Replacement of the wheel cylinder and contaminated shoes is required.

90. C — Worn rear brake shoes don't extend far enough to engage the parking brake mechanism, so the handle must pull the cable further before applying enough force on the shoes to lock the wheels. The parking brake adjustment depends on the service brake shoes being in good condition. New shoes typically restore proper parking brake travel.

91. B — An electric motor drives a hydraulic pump inside the ABS modulator, pressurizing fluid that the modulator valves use to apply or release brake pressure at individual wheels independently of the driver's pedal input. The motor runs briefly during the modulator's self-test, during ABS events, and during stability control interventions. A failed pump motor disables ABS and stability control.

92. D — ESC applies the brakes on individual wheels independently (to create a corrective yaw moment) and may also reduce engine torque to slow the vehicle. In oversteer, the outside front brake is applied to push the front out; in understeer, the inside rear brake is applied to pivot the vehicle. The intervention is invisible to the driver but is the most important active safety system after ABS.

93. A — Recirculating ball gears use a worm gear (the input shaft) meshed with a sector gear that rotates the pitman arm. Steel balls recirculate between the worm and the sector to reduce friction. The pitman arm moves linkage (drag link, center link) that operates the tie rods. This design is used on heavy trucks and older RWD vehicles.

94. C — Front toe is adjusted by rotating the tie rod adjuster sleeve, which changes the effective length of the tie rod and thus the position of the steering knuckle. Both tie rods must be adjusted equally to maintain steering wheel centering. Camber and caster on most modern struts are not adjustable; toe is the primary adjustment in most alignments.

95. B — A coil spring compressor compresses the spring before the upper mount nut is loosened, preventing the spring from releasing its stored energy explosively. A compressed strut spring contains enough energy to seriously injure or kill an unprotected technician. Never disassemble a strut without a properly engaged spring compressor rated for the spring force.

96. D — The steering damper is a hydraulic damper mounted between the steering linkage and the frame, damping out road shock and oscillation that would otherwise feel through the steering wheel. It is common on solid-front-axle trucks and four-wheel-drive vehicles where road shock is more pronounced. Wear or fluid leakage produces excessive steering "wobble" or "death wobble" on these vehicles.

97. A — Monotube shocks have a single chamber filled with both gas and oil, separated by a free-floating piston. The single-tube design exposes the working chamber directly to outside airflow, providing better heat dissipation and resistance to fluid aeration (foaming) under heavy use. Twin-tube designs are quieter and less expensive but less heat-resistant.

98. B — Active wheel speed sensors and their tone rings are most commonly integrated into the wheel bearing and hub assembly as one sealed unit. The integration improves accuracy, eliminates separate mounting hardware, and simplifies service (the entire bearing-hub-sensor is replaced as one unit). The sensor reads encoded patterns on a magnetic ring within the bearing.

99. C — All four lug studs on a modern North American vehicle use right-hand threads. Earlier vehicles (some 1960s-70s American cars) used left-hand threads on the driver side, but the industry standardized on right-hand threads decades ago. Always verify direction before applying force, but assume right-hand on modern vehicles.

100. C — Static balance corrects imbalance in one plane (the vertical), producing hop or up-and-down vibration if uncorrected. Dynamic balance corrects imbalance in two planes (the vertical and the lateral axes), preventing both hop and side-to-side wobble. Modern computer balancers perform dynamic balance using two correction weights (inner and outer rim positions) for full two-plane correction.

101. D — Compact spare tires are typically inflated to approximately 60 psi to support the vehicle's weight on the smaller, narrower tire structure. The high pressure compensates for the reduced contact patch and provides safe limited-distance use (usually less than 80 km at less than 80 km/h). The spare's pressure should be checked periodically because slow leaks reduce its effectiveness when needed.

102. A — The valve core, grommet seal, and washer at the sensor stem must be replaced during every tire service on direct TPMS-equipped vehicles. These components seal the air pressure inside the tire; reusing old seals leads to slow leaks and TPMS warnings. A complete service kit is inexpensive and is the manufacturer's required practice.

103. C — Lateral runout greater than approximately 0.5 mm produces noticeable vibration at highway speeds. Aluminum alloy wheels with their tighter manufacturing tolerances often meet this spec out of the box; bent or damaged wheels typically exceed it. Lateral runout is measured with a dial indicator on the rim flange during diagnosis of unexplained vibration.

104. D — A worn strut bearing or strut top mount allows the strut to bind or rotate roughly during steering. The clunk occurs as the strut breaks free near full lock when the suspension is loaded. Replacement of the strut bearing assembly resolves the noise. Confirm the diagnosis by feeling the strut top for roughness while turning the steering wheel by hand.

105. A — New copper sealing washers must be installed on both sides of the banjo fitting for every reassembly. Used copper washers have been compressed and may not seal again; the soft new copper crushes properly under the bolt torque to create a leak-free seal. Thread sealants and tape are never appropriate at hydraulic fittings of this type.

106. B — A calibrated torque wrench in a star (cross) pattern is the only accurate method for torquing wheel lug nuts. The star pattern evenly distributes clamping force, preventing rotor warping and ensuring even seating of the wheel on the hub. Impact guns apply variable, often excessive torque that distorts brake rotors and can damage studs; "by feel" is unreliable and unsafe.

107. C — A manufacturer-capable scan tool reads SRS module DTCs and identifies whether the system has actual faults or simply needs a reset after the battery disconnect. Generic OBD-II scan tools usually cannot access the SRS module. Never reset the SRS warning without first reading the codes — an actual fault must be repaired before clearing.

108. D — Side curtain airbags rely on roll-rate sensors and lateral accelerometers that detect rollover conditions. When the vehicle exceeds a calibrated tilt angle or rotation rate threshold (often combined with vertical acceleration), the airbag control module deploys the curtains to cushion occupants against the side glass and pillar. Rollover sensors are typically located in the SRS control module itself.

109. A — Frontal impact sensors are mounted at the front of the vehicle (behind the bumper, on sensor brackets, or in the radiator support) where they detect collision deceleration earliest. Their location maximizes deployment timing accuracy by sensing impact before the cabin deforms. Additional sensors may be located along the body for side and rear impact detection.

110. B — A failed LED bulb or door switch (the switch that activates when the visor cover is opened) are the most common causes of a non-functioning vanity mirror LED. LEDs occasionally fail like any bulb, and the small switch in the visor cover wears with repeated use. Both are typically replaced as part of the visor assembly.

111. C — Power sliding doors detect obstructions through motor current sensing — when an obstruction is contacted, motor current rises sharply as resistance increases, triggering the safety reverse. The system also uses Hall-effect motor pulses to track door position. Calibration after motor or controller replacement is typically required to ensure correct obstruction detection.

112. D — Power running boards use an electric motor driving a worm gear or four-bar linkage to deploy and retract the board when a door opens or closes. The electric system is reliable, weather-resistant, and easy to integrate with the body control module. Pinch protection through motor current sensing prevents injury during operation.

113. A — Convertible top safety interlock switches (which confirm the manual latches at the windshield are released) must be closed before the convertible top motor will operate. A failed or misaligned switch makes the system think the top is still latched, preventing motor operation. Inspect and test these switches before condemning the motor or hydraulic pump.

114. C — Pinch protection on power tonneau covers automatically reverses the cover direction when an obstruction is detected during closing. Detection uses motor current sensing or pressure-sensitive strips, similar to power windows and slider doors. After reversing, manual intervention may be required to clear the obstruction before further operation.

115. B — Lidar sensors require an unobstructed view of the road ahead and are typically mounted at the roof, in the grille, or in similar high forward-facing positions. They scan the surroundings with pulsed laser light to build a 3D map of objects, including distance and motion. The position is critical for the sensor's effective range and field of view; even minor misalignment requires recalibration.

116. D — Driver attention monitoring uses an interior-facing camera with infrared illumination (so it works in darkness) tracking eye gaze, blink rate, and head position. The system warns the driver if signs of drowsiness or distraction are detected. Integration with the vehicle's ADAS may also influence lane-keeping or pre-collision interventions.

117. A — 48V mild hybrid systems use a belt-driven motor-generator (BSG) connected to the engine and a 48V battery to enable engine start-stop, capture regenerative braking energy, and provide brief torque assist during acceleration. The 48V architecture is more powerful than 12V systems while remaining below the 60V "high-voltage" threshold, so most service procedures are similar to conventional vehicles.

118. B — A lithium-ion cell operates between approximately 2.5V (fully discharged) and 4.2V (fully charged), with nominal voltage around 3.6 to 3.7V. Operating outside this range damages the cell — undervoltage causes copper shunting; overvoltage causes thermal runaway. The BMS monitors every cell to keep voltage within safe limits at all times.

119. D — EV battery packs use modules of cells in parallel (to increase capacity in amp-hours) connected in series (to increase pack voltage). A typical pack might have 96 series modules, with each module containing several cells in parallel. This series-parallel arrangement achieves both the high voltage needed for efficient motor drive and the high capacity needed for vehicle range.

120. C — EV traction motors are typically liquid-cooled via a dedicated cooling loop that often shares its radiator and pump with the inverter. The cooling system maintains motor temperature within design limits during sustained high-load operation; without it, the motor windings would overheat and fail. The loop uses a coolant similar to engine coolant but formulated to be compatible with motor electrical components.

121. A — PHEVs have a larger battery pack (typically 8 to 25 kWh) that can be charged from an external grid source through a charge port, providing meaningful all-electric driving range (often 30 to 100 km). Conventional hybrids have smaller batteries (1 to 2 kWh) charged only by regen and engine. PHEVs combine the convenience of long-range hybrid driving with daily electric-only commuting.

122. B — Hydrogen fuel cell vehicles generate electricity through an electrochemical reaction inside the fuel cell stack: hydrogen reacts with atmospheric oxygen to produce water and electrical energy. There is no combustion. The electricity drives an electric motor like in a BEV, but range is replenished by refilling hydrogen rather than charging a battery.

123. D — V2G capability allows the vehicle to discharge energy from its battery pack back into the electrical grid, helping balance supply and demand during peak periods. The vehicle becomes a distributed energy storage asset that the utility can call on. V2G requires a bidirectional charger and grid-compliant inverter; the technology is emerging in several markets.

124. C — The BMS typically communicates over a high-speed CAN bus segment, often a dedicated battery network isolated from other vehicle systems for security and reliability. The BMS reports cell voltages, temperatures, state of charge, and fault status to the vehicle's master controller and to the gateway module. Diagnostic access to the BMS requires manufacturer scan tool access through the gateway.

125. B — Measuring zero high-voltage at the inverter or battery terminals with a Category III/IV rated meter, after waiting the manufacturer's specified capacitor discharge time, is the only safe verification before working on de-energized HV components. The capacitors in the inverter store dangerous voltage for several minutes after shutdown. Skipping this verification is the most common cause of EV/hybrid technician electrocution.