**ANSWER KEY**

**Distance Learning Exercise #3: Relay Circuits**

1. The voltages at each relay are:
   1. 12V
   2. 12V
   3. 0V
   4. 12V

Explanation: The relay pins are connected to source voltage when the ignition is ON. There is source voltage at pins 5 and 1. The relay switch contact is open so there is no voltage at pin 3 of the relay. Pin 2 has source voltage since the circuit is OFF. The current path for the relay coil is ground controlled through the combination switch. Voltage only drops across a load when current is present. Since the circuit is OFF, there is no current, and voltage is present at Pin 2.

1. 0V.

Explanation: The relay switch contacts are open when the circuit is OFF so no voltage is present at the fog lights.

1. The voltages at each relay are:
   1. 12V
   2. 12V
   3. 12V
   4. 0V

Explanation: Turning the fog light switch ON provides a path to ground for the relay coil. The coil energizes and the magnetic field closes the switch contacts. There is now source voltage at relay pin 3 as the relay contacts (switch) are in the ON position. The relay coil is the circuit load, and voltage drops to zero after the load. There should be almost 0 volts at pin 2 and through the switch, since current is now present in the circuit.

1. 12 V

Explanation: The relay switch contacts are now closed, so there is source voltage at each fog light and they can illuminate (turn on).

1. 12V

Explanation: When the combination switch fog light function is OFF, there is no path for current to ground through the switch. Source voltage will be present at pin 11 since there is no voltage drop across the circuit load, the relay coil.

1. 0V

Explanation: When the combination switch fog light function is ON, there is now a path for current through the relay coil. Voltage after the coil is very close to 0 volts from pin 2, through the switch, and to ground.

**Relay Diagnostic Practice.**

1. Open between combination switch pin 16 and junction connector pin A

Explanation: The relay tests OK. The voltage that is incorrect is source voltage at combination switch pins 11 and 16. This indicates that there is no path to ground for the relay coil circuit. The reading of zero volts at junction connector pin A isolates the fault to the white and black wire from pin 16 to the junction connector.

1. Open in relay coil, replace relay

Explanation: The relay does not test OK. The relay coil is OL, or infinite resistance, indicating it has failed open. The relay must be replaced.

1. Damaged relay switch contacts, replace relay

Explanation: The relay switch contacts failed their test with the relay ON. There should be very close to 0 ohms through the contacts, but this relay is OL, infinite resistance. This is why there is no voltage present at relay pin 3 and the fog lights do not operate. The relay must be replaced.

1. Open between relay pin 2 and combination switch pin 11

Explanation: The relay tests OK. The voltage that is incorrect is source voltage at relay pin 2 (it should be 0V). This indicates that there is no path to ground for the relay coil circuit. The reading of zero volts in combination at switch pin 11 isolates the fault to the red with yellow wire from the junction connector 2R pin 4 to combination switch pin 11. The technician checked the resistance of this wire and the DMM showed OL, infinite resistance indicating an open in the wire. The wire must be replaced or repaired to correct this fault.