

PLC programming

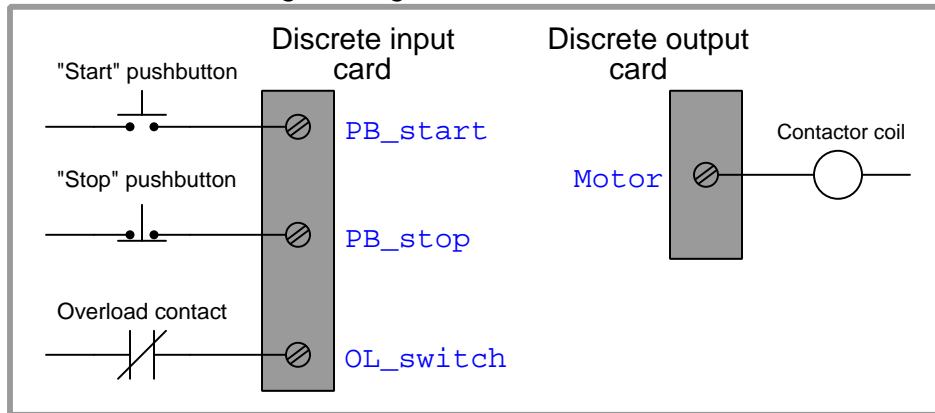
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Questions

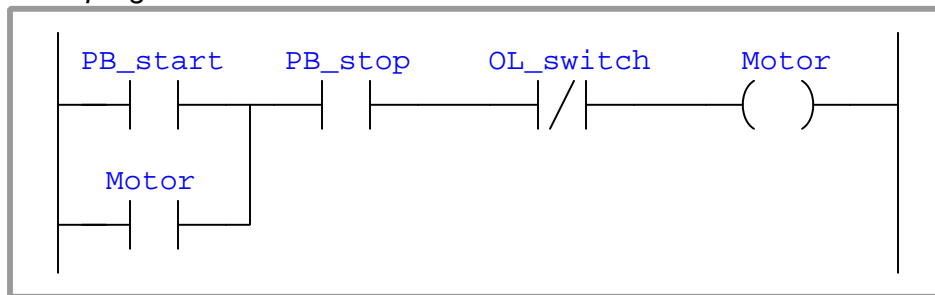
Question 1

A PLC has been programming to control the starting and stopping of a three-phase electric motor. Shown here is a partial wiring diagram and offline PLC program display for the system:

Real-world I/O wiring and tagnames



PLC program



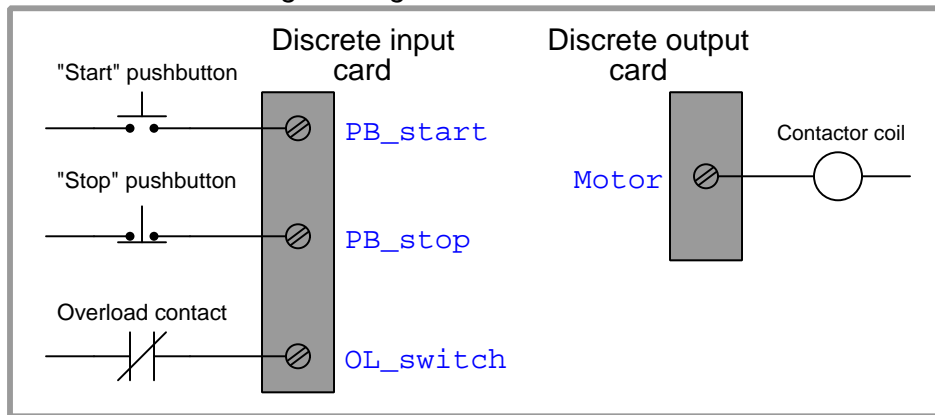
Identify the problem(s) in this PLC program, and modify it so that it will work as it should.

[file i02690](#)

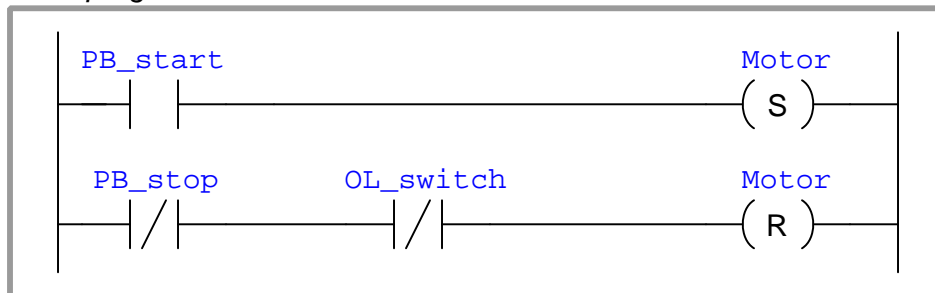
Question 2

A PLC has been programming to control the starting and stopping of a three-phase electric motor. Shown here is a partial wiring diagram and offline PLC program display for the system:

Real-world I/O wiring and tagnames



PLC program



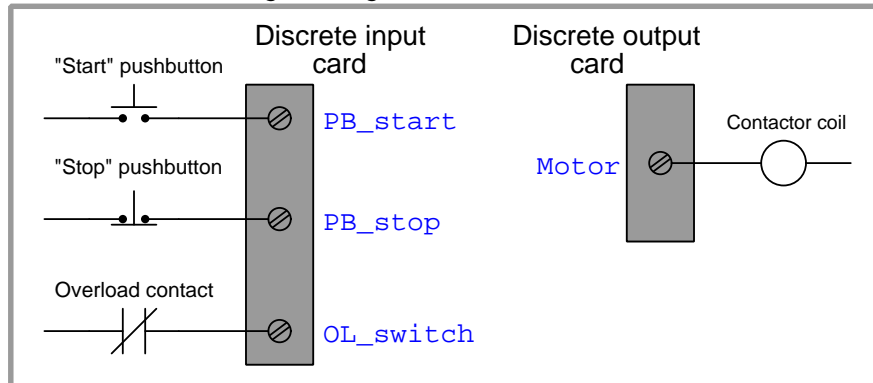
Identify the problem(s) in this PLC program, and modify it so that it will work as it should.

[file i02691](#)

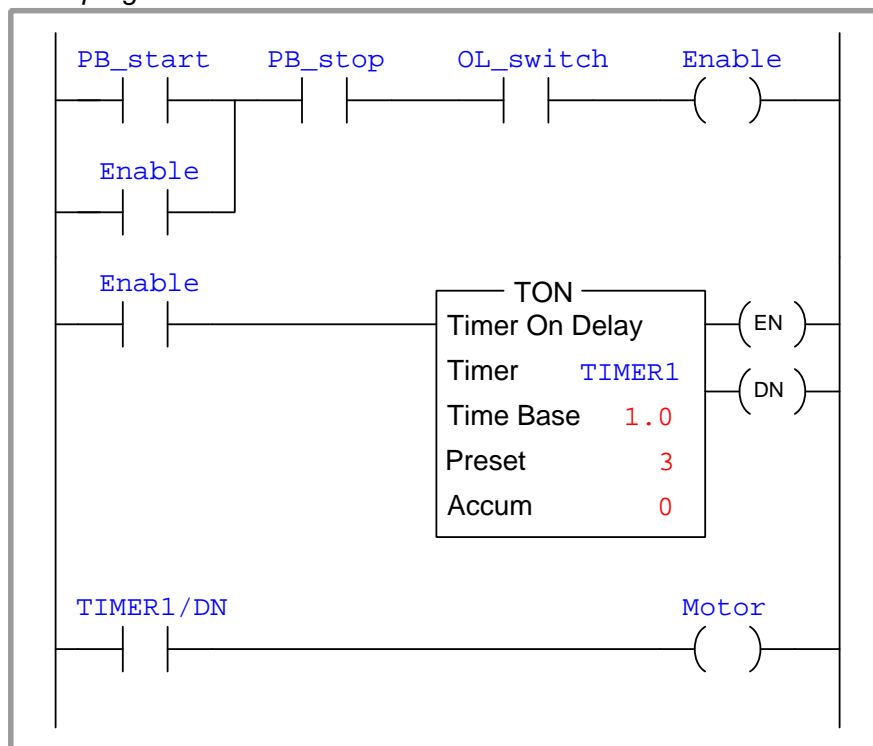
Question 3

A PLC has been programming to control the starting and stopping of a three-phase electric motor. The program is supposed to require that the operator press and hold the “Start” pushbutton for at least three seconds before the motor starts and runs. Shown here is a partial wiring diagram and offline PLC program display for the system:

Real-world I/O wiring and tagnames



PLC program



Identify the problem(s) in this PLC program, and modify it so that it will work as it should.

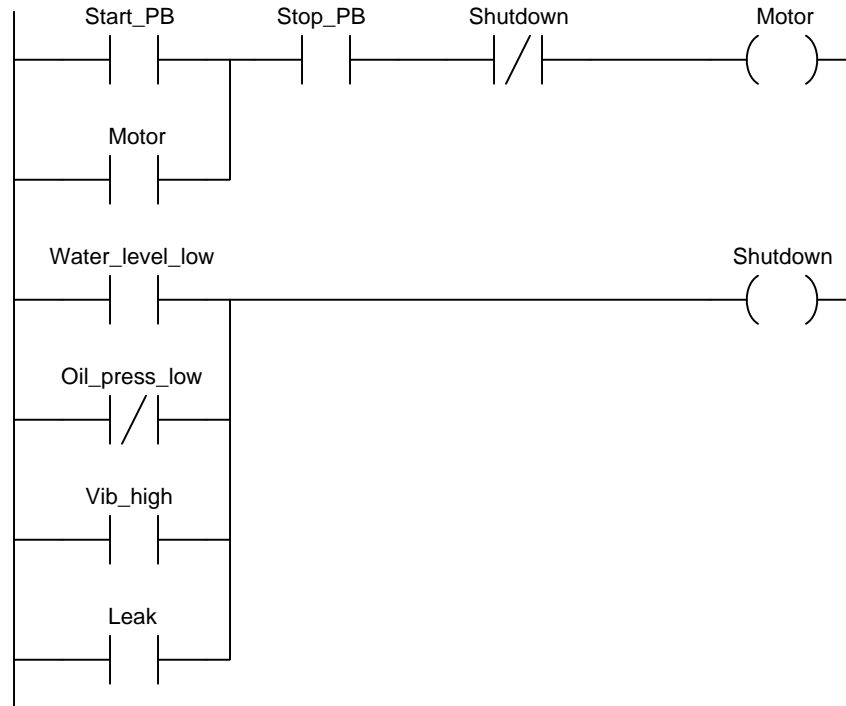
[file i02692](#)

Question 4

A technician needs to write a PLC program to control a water pump driven by an electric motor. This water pump will be manually started and stopped by pushbutton switches, and shut down automatically by any one of several “permissive” switches. The operating statuses of these switches are listed here:

- **Start pushbutton** (normally-open): open when unpressed, closed when pressed
- **Stop pushbutton** (normally-closed): closed when unpressed, open when pressed
- **Low water level** (normally-closed): closed when level is low, open when level is adequate
- **Low oil pressure** (normally-open): open when pressure is low, closed when pressure is adequate
- **High vibration** (normally-closed): closed when still, open when vibrating
- **Water leak detector** (normally-open): open when dry, closed when wet (leak detected)

The technician’s first attempt is shown here, but it contains a serious error. Identify and correct this error:



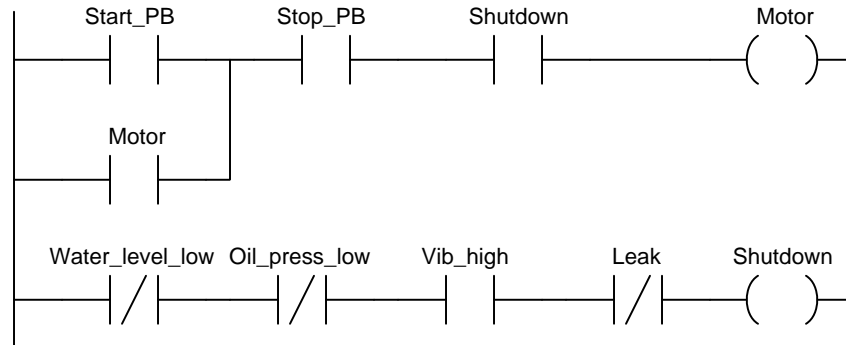
file i02656

Question 5

A technician needs to write a PLC program to control a water pump driven by an electric motor. This water pump will be manually started and stopped by pushbutton switches, and shut down automatically by any one of several “permissive” switches. The operating statuses of these switches are listed here:

- **Start pushbutton** (normally-open): open when unpressed, closed when pressed
- **Stop pushbutton** (normally-closed): closed when unpressed, open when pressed
- **Low water level** (normally-closed): closed when level is low, open when level is adequate
- **Low oil pressure** (normally-open): open when pressure is low, closed when pressure is adequate
- **High vibration** (normally-closed): closed when still, open when vibrating
- **Water leak detector** (normally-open): open when dry, closed when wet (leak detected)

The technician’s first attempt is shown here, but it contains a serious error. Identify and correct this error:



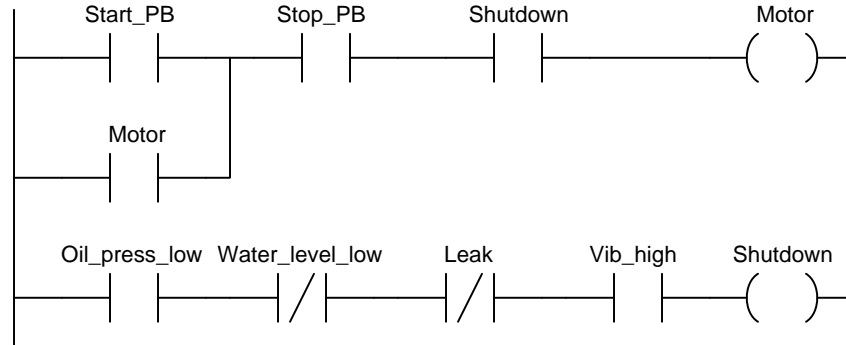
[file i02657](#)

Question 6

A technician needs to write a PLC program to control a water pump driven by an electric motor. This water pump will be manually started and stopped by pushbutton switches, and shut down automatically by any one of several “permissive” switches. The operating statuses of these switches are listed here:

- **Start pushbutton** (normally-open): open when unpressed, closed when pressed
- **Stop pushbutton** (normally-closed): open when unpressed, closed when pressed
- **Low water level** (normally-closed): closed when level is low, open when level is adequate
- **Low oil pressure** (normally-open): open when pressure is low, closed when pressure is adequate
- **High vibration** (normally-closed): closed when still, open when vibrating
- **Water leak detector** (normally-open): open when dry, closed when wet (leak detected)

The technician’s first attempt is shown here, but it contains a serious error. Identify and correct this error:



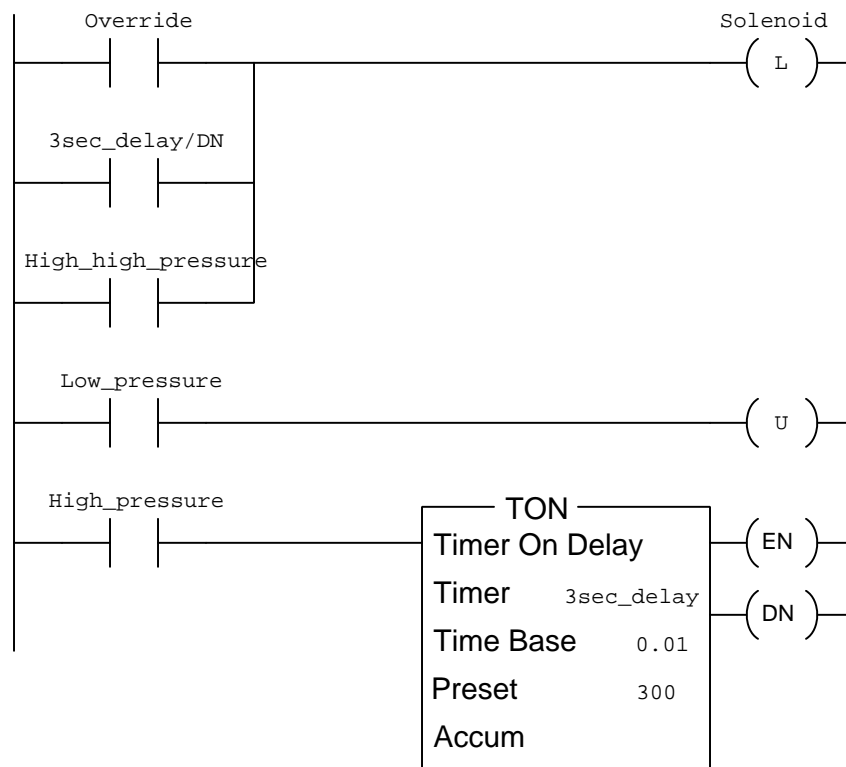
[file i02658](#)

Question 7

A technician needs to write a program for an Allen-Bradley CompactLogix PLC to control a pressure-relieving solenoid valve in a gas processing system. A pair of high-pressure control switches signals the PLC when to open the solenoid valve: one telling the PLC to open the valve after a 3-second time delay and the other (called the “high-high” switch, with a higher trip setting) telling the PLC to open the valve immediately. A pushbutton switch serves as a manual override to open the solenoid valve immediately when pressed. In all cases, the solenoid vent valve will remain open (energized) until pressure falls below the setting of a low-pressure gas switch. The operating statuses of these switches are listed here:

- **Override pushbutton** (normally-open): open when unpressed, closed when pressed
- **Low gas pressure** (normally-closed): closed when pressure is less than 10 PSI, open when pressure exceeds 10 PSI
- **High gas pressure** (normally-closed): closed when pressure is less than 30 PSI, open when pressure exceeds 30 PSI
- **High-high gas pressure** (normally-open): open when pressure is less than 40 PSI, closed when pressure exceeds 40 PSI

The technician’s first attempt is shown here, but it contains a serious error. Identify and correct this error:



[file i02853](#)

Answers

Answer 1

The `OL_switch` instruction in the PLC program needs to be changed to NO (Normally-Open). Since the real-world OL switch contact is supposed to be in the closed state when everything is okay, and this means the third input channel should be energized when all is well, a NO contact instruction is required so that the “1” bit state will maintain that instruction in the “colored” state and permit the coil instruction to receive color (virtual power) to run the motor.

Answer 2

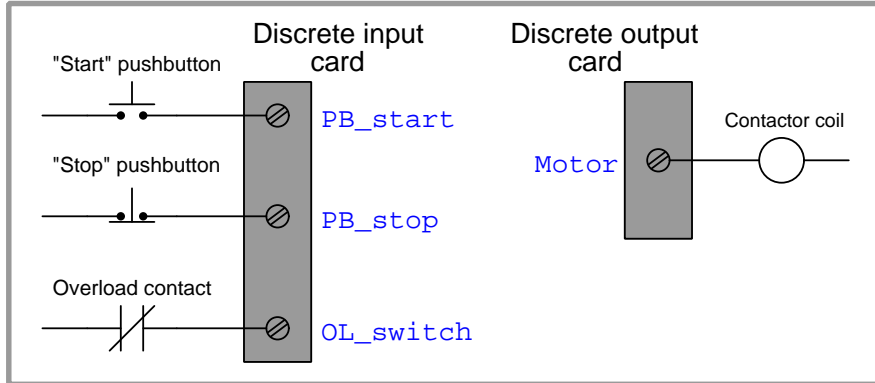
The `PB_stop` and `OL_switch` instructions in the second rung of the PLC program need to be connected in parallel with each other rather than in series. Being NC real-world switches and NC contact instructions, each one will “color” when the motor is supposed to stop (i.e. the `PB_stop` instruction colors when anyone presses the Stop pushbutton, and the `OL_switch` instruction colors when the motor overheats). Right now, programming in series with each other, *both* conditions would have to take place in order to stop the motor! To make the motor stop if *either* condition occurs, we need these two instructions to be programmed in a logical “OR” fashion, and that necessitates a parallel connection between the two contact instructions.

Answer 3

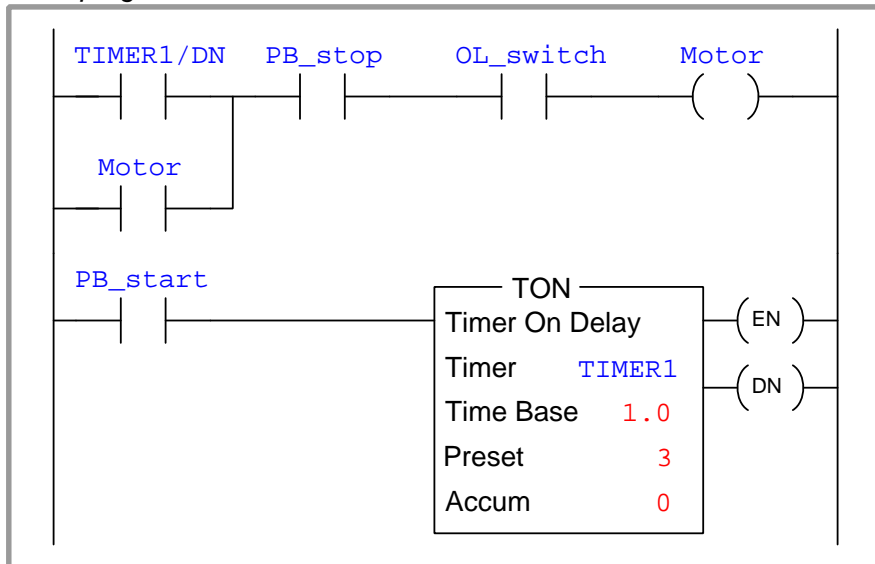
The way it's programmed right now, the "Start" pushbutton does not need to be held for three seconds – just pressing it momentarily is enough to start the motor. The motor, however, *does* delay for three seconds before starting. In other words, there is a three-second time delay in effect, but it's not requiring the "Start" switch be continuously pressed for that long. All the time delay is doing is delaying the start-up of the motor after the "Start" switch has been momentarily pressed.

Here is a functional solution:

Real-world I/O wiring and tagnames



PLC program



Answer 4

The `Vib_high` contact instruction should be drawn as normally-closed rather than normally-open as shown in the technician's first draft of the PLC program. The program is designed to shut down the motor if ever the `Shutdown` bit goes to a 1 state. This means the motor will shut down if any of the permissive contact instructions become colored (i.e. "conductive" to virtual power). We have been told that the real-world vibration switch is NC, which means its contact opens when vibration is excessive. This means high vibration causes that bit to be 0, which necessitates an NC contact instruction so that it will color under that condition.

Answer 5

The `Oil_press_low` contact instruction should be drawn as normally-open rather than normally-closed as shown in the technician's first draft of the PLC program. The program is designed to shut down the motor if ever the `Shutdown` bit goes to a 0 state. This means the motor will shut down if any of the permissive contact instructions become uncolored (i.e. fails to "conduct" virtual power). We have been told that the real-world oil pressure switch is NO, which means its contact opens when oil pressure becomes too low. This means a low oil pressure condition causes that bit to be 0, which necessitates an NO contact instruction so that it will un-color under that condition.

Answer 6

The `Stop_PB` contact instruction should be drawn as normally-closed rather than normally-open as shown in the technician's first draft of the PLC program. The program is designed to shut down the motor when that pushbutton is pressed (i.e. the `Stop_PB` contact instruction becomes uncolored (i.e. fails to "conduct" virtual power). We have been told that the real-world Stop pushbutton switch is NO, which means its contact closes when pressed. This means pressing the Stop pushbutton causes that bit to be 1, which necessitates an NC contact instruction so that it will un-color under that condition.

Answer 7

The `High_pressure` contact instruction should be drawn as normally-closed rather than normally-open as shown in the technician's first draft of the PLC program. This particular switch signals a high-pressure condition by opening its contacts, since the real-world switch is normally-closed (NC). We want the 3-second timer to begin timing when this switch senses a high pressure, and so we need the contact instruction to color when the real-world high-pressure switch trips (opens). A PLC contact instruction that colors when it senses a "0" bit condition is a normally-closed (NC) instruction.