

## Chapter 10 Review Questions Answer Key

1. What is the difference between changing a system using relay logic and changing a system using a PLC?

A: While it takes days in many cases to reprogram a relay logic system, PLCs allow for major changes of operation in minutes by simply changing the program.

2. What is the difference between a PLC and a standard computer?

A: PLC systems are designed, specifically, to withstand the harsh environment of industry that would rapidly deteriorate a standard computer or laptop. PLCs have one specific function, they filter the information coming in through the program created by the programmer and either create data or trigger output connections as directed. There are no screen savers, there is no update checker crawling the net, it does not run multiple programs at once that each require a portion of the processing power, all they do is run the PLC program and respond as directed and they do it very efficiently.

3. Do we still use relays? If so, why?

A: Yes. While the PLC can take the place of relay logic where we use relays to make decisions, it is not suited to high amperage needs.

4. What is the difference between a contactor and a motor starter and how does the part that makes the difference work?

A: Motor starters are contactors with an overload module added to start motors.

Overload modules, often just called overloads, are designed to allow the large inrush of current needed to start a motor, but change state if the flowing amperage exceeds their set value for more than a few seconds.

5. What are smart relays?

A: Smart relays have mini processors built in. These relays can often perform multiple timing functions and may offer the ability to control how outputs act, almost like limited PLC systems.

6. What is a PLC?

A: The PLC is a highly flexible, specialized, industrial control system hardened to survive the extremes of temperature, contaminants, and magnetic fields found in industry. The PLC was invented/designed to take the place of relay logic, but they have continued to expand to the point that many systems in use today offer many if not most of the programming options found in the computer realm.

7. What were some of the requirements that Dick Morley had to work to meet General Motors' specifications?

A:

- A solid-state system that was flexible like a computer but priced competitively when compared to the relay logic system it would replace
- Easily maintained and programmed in line with the accepted relay ladder logic way of doing things
- Able to work in an industrial environment, with all its dirt, moisture, electromagnetism, and vibration
- Modular in form to allow for easy exchange of components and expandability

(Automation Direct, 2017)

8. What was the first PLC sold on the market?

A: In 1969 the Modicon 084 was released. Modicon is short for Modular Digital CONtroller and the 084 designation came from it being the 84<sup>th</sup> project of Bedford Associates.

9. What is a PAC?

A: Programmable Automation Controllers (PAC) are a combination of PLC operation and PC-based control systems. In other words, a PAC is an industrial environment hardened PC that can interact with various components and run PLC software in a similar fashion to a dedicated PLC.

10. What is the difference between a relay logic schematic and a PLC program?

A: It is *crucial* to make the distinction that the relay logic ladder type schematic is an electrical path drawing and the PLC ladder logic structure is a *DATA PATH DRAWING*.

11. What is a DCS?

A: Distributed Control Systems (DCS) are systems where autonomous controllers are distributed throughout the equipment, but there is a central operator supervisory controller.

12. What are the four basic components of any PLC?

A: • Inputs that bring information in about the process  
• Outputs to send power in one form or another to devices in the field  
• Processor(s) to sort, store, and manipulate data  
• Backplane or something similar to allow all the various components to communicate

13. What is the difference between digital and analog inputs?

A: If the input is digital, where the only states are 1 or 0, on or off, then usually there is a threshold value for voltage that the incoming value must exceed in order to be considered at a 1 state. If the input is analog, where the incoming value varies and that variance has a meaning, then the value stored in the process will be a binary representation of the variable value coming in, usually taking a word or more of data.

14. What is a bit, a byte, a nibble, and a word?

A: Each 1 or 0 in the processors memory is called a bit. When you have a group of 4 bits, that is called a nibble. When you have 8 bits of data, we call that a byte. Words of data are made up of multiple bytes, with the number depending on the design of the system.

15. What is optical isolation?

A: Optical isolation is a process where the power coming in lights up an LED or similar light source that interacts with a photo resistor or other light sensitive device.

16. What is the difference between a diode and a triac?

A: Diodes are solid state devices that only allow current to flow in one direction. Triacs are solid state devices designed like two diodes in anti-parallel, with a trigger connection to start current flowing.

17. Which problem can we encounter when checking triac outputs? How do we eliminate this problem?

A: A triac output can show 120VAC when not triggered and there is no actual flow. To fix this you can use a resistive load adaptor for your meter, which puts a bit of load on the circuit and shows that power is not really flowing. The other concern

with triacs is that leakage current can build up high enough to give you a decent shock.

18. What is a PID module?

A: PID stands for proportional integral derivative and is a mathematical process used to vary an output to maintain a specific set point.

19. What are the different modes of the PLC processor?

A: In the run mode, which is one of the extreme switch or key positions, the processor scans the program and manipulates data. In the run mode, we can pull the program from the PLC to our interface device, generally a laptop, which we call an upload, but we cannot send a program from the laptop to the PLC in a download. The middle position of the key or switch is the remote mode, abbreviated REM, and it is in this mode that we can use the laptop to upload or download data. The third position, the other extreme of travel, is the program mode and in this mode, we can upload or download data, but the processor does not scan the program and the I/O does not update with changes. The difference between remote mode and program mode is that we can change the mode of operation with the laptop or other communication device when the switch is in the remote position.

20. What are forces in the PLC context and what is the concern when using them?

A: Force is a condition where we set the state of data for an input or output, ignoring the actual field condition for inputs and the data result of the program for outputs. Forces are a great tool for troubleshooting purposes, but they are dangerous as you can make a motor come on with no regard for machine position or operator safety. If used incorrectly you could kill someone.

21. What does the backplane do?

A: The backplane provides a path for power and communication between all the other modules or parts of the PLC.

22. What are the three steps of a sequential scan cycle for a PLC?

A: The first step is to check all the inputs. For the binary inputs, if the proper amount of voltage is present it will put a one in the box in the memory that correlates to that terminal's address. If the input is analog it will put a group of ones and zeros into a word's worth of boxes with the corresponding address, based on the amount of voltage or current present at the terminal. The next step in the sequential scan sequence is to read the program from top to bottom, left to right. The third part of the scan cycle is to connect or disconnect output connections. If the output is digital in nature or the on/off type, a one in the data box for that address instructs the output module to make a connection between the designated terminal screw and the common connection. If the output is analog in nature, a specific voltage or amperage is sent to the terminal screw that matches the data in the word of data for that address.

23. How does an XIC instruction work?

A: The I:0/0 is the address for the box tied to a specific terminal. If the instruction looks in that box and finds a one, then it will be true. If it looks in box I:0/0 and finds a zero, then it will be false.

24. How does an XIO instruction work?

A: The O:0/4 is the address for the box tied to a specific terminal. If the instruction looks in the designated box and finds a one, the instruction will be false. If the instruction looks in the designated box and finds a zero, the instruction will be true.

25. How does an OTE instruction work?

A: The address O:0/0 is the address for a bit box tied to an output terminal screw. The OTE will write a one in the bit box if true logic comes in and will write a zero in bit box O:0/0 if false logic comes in.

26. What are the components used by timers?

A: • Preset: this is how long the timer will time for before it is considered done.

Abbreviation Pre

- Accumulation: this is how long the timer has been timing. Abbreviation Acc
- Done Bit: this is a bit box that is one or zero depending on how the timer uses it.

Abbreviation DN

- Timer Timing Bit: this is a bit box that is one when the accumulator is counting and zero all other times. Abbreviation TT
- Enable Bit: this is a bit box that has one in it anytime true logic is coming into the timer instruction and a zero anytime false is coming into the timer instruction.

Abbreviation EN

27. What is the danger of using a latch instruction?

A: The danger with the latching instructions comes from the fact that this is the only instruction that can put a one in the output bit box that will remain there when the PLC starts back up after power loss.

28. How do HMIs work?

A: With the HMI, the programmer uses software to create various graphical objects to show up on the screen such as buttons, switches, charts, graphs, animations, tables, or other needed items. Once the graphical piece is done, the next step is to tie it to data in some way. Sometimes the goal is to have the HMI pull data from the PLC or controller and display the information for the operator. Other times touching the area on the screen for the graphical object will send ones or zeros to bit boxes in the PLC.

29. What are the basic steps of using cell phones to control machine operation?

A: • The PLC or controller is linked to the plant's network and set up to work with remote signals

- The plant network is tied to the internet and secured with passwords and the usual virus protections
- An app is developed for the type of smart device intended for use, similar to what is done for an HMI
- The app on the smart phone is linked to the plant network via the internet and specific equipment via code
- Once the bugs are worked out, monitoring and control via smart device is possible

30. What is IIOT?

A: Industrial Internet of Things (IIOT), is the process of connecting everything in the plant to the network and then the network to internet to increase flexibility.