PLC Question Bank

1. What is a programmable logic controller (PLC)?

2. Identify four tasks in addition to relay switching operations that PLCs are capable of performing.

3. List six distinct advantages that PLCs offer over conventional relay-based control systems.

4. Explain the differences between open and proprietary PLC architecture.

5. State two ways in which I/O is incorporated into the PLC.

6. Describe how the I/O modules connect to the processor in a modular-type PLC configuration.

7. Explain the main function of each of the following major components of a PLC: a. Processor module (CPU) b. I/O modules c. Programming device d. Power supply module

8. What are the two most common types of PLC programming devices?

9. Explain the terms program and programming language as they apply to a PLC.

10. What is the standard programming language used with PLCs?

11. Answer the following with reference to the process control relay ladder diagram of Figure 1-18 of this chapter:

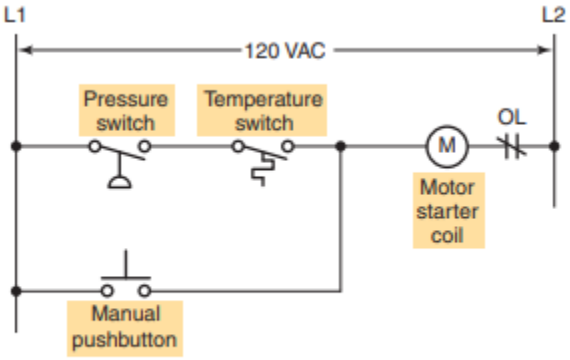


Figure 1-18 Process control relay ladder diagram.

a. When do the pressure switch contacts close?

b. When do the temperature switch contacts close?

c. How are the pressure and temperature switches connected with respect to each other?

d. Describe the two conditions under which the motor starter coil will become energized.

e. What is the approximate value of the voltage drop across each of the following when their contacts are open?

(1) Pressure switch

(2) Temperature switch

(3) Manual pushbutton

12. The programmable controller operates in real time. What does this mean?

13. Answer the following with reference to the process control PLC ladder logic diagram of Figure 1-21:

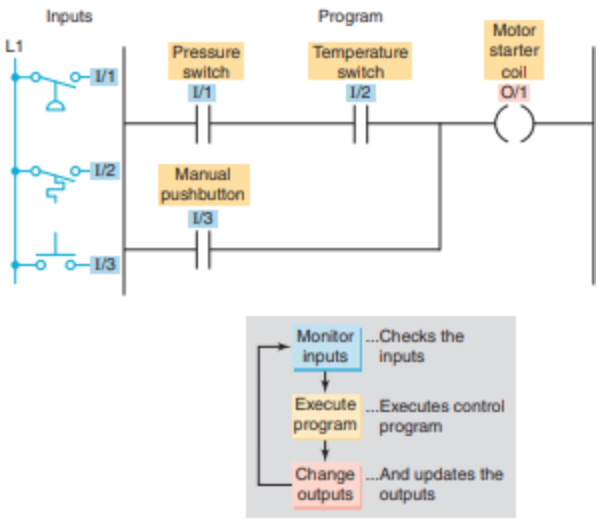


Figure 1-21 Process control PLC ladder logic program with typical a

a. What do the individual symbols represent?

b. What do the numbers represent?

c. What fi eld device is the number I/2 identified with?

d. What field device is the number O/1 identified with?

e. What two conditions will provide a continuous path from left to right across the rung?

f. Describe the sequence of operation of the controller for one scan of the program.

14. Compare the method by which the process control operation is changed in a relay-based system to the method used for a PLC-based system. 15. Compare the PLC and PC with regard to:

a. Physical hardware differences

b. Operating environment

c. Method of programming

d. Execution of program

16. What two categories of software written and run on PCs are used in conjunction with PLCs?

17. What is a programmable automation controller (PAC)?

18. List four criteria by which PLCs are categorized.

19. Compare the single-ended, multitask, and control management types of PLC applications.

20. What is the memory capacity, expressed in bits, for a PLC that uses 16-bit words and has an 8 K word capacity?

21. List five factors affecting the memory size needed for a particular PLC installation.

22. What does the instruction set for a particular PLC refer to?

23. answer the following questions

1. Given two single-pole switches, write a program that will turn on an output when both switch A and switch B are closed.

2. Given two single-pole switches, write a program that will turn on an output when either switch A or switch B is closed.

3. Given four NO (Normally Open) pushbuttons (A.B-C-D), write a program that will turn a lamp on if pushbuttons A and B or C and D are closed.

4. Write a program for the relay ladder diagram shown in Figure 1-31 .

5. Write a program for the relay ladder diagram shown in Figure 1-32 .

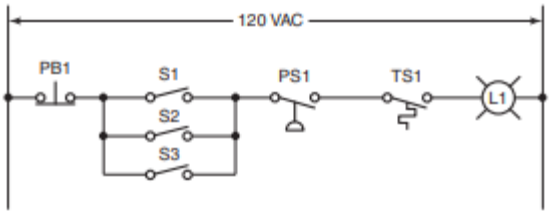


Figure 1-32 Circuit for Problem 5.

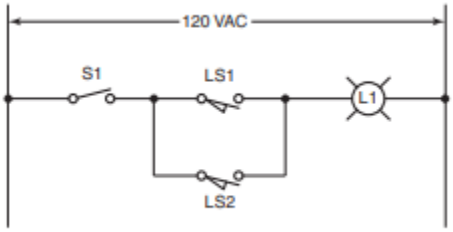


Figure 1-31 Circuit for Problem 4.

24. What is the function of a PLC input interface module?

25. What is the function of a PLC output interface module?

26. Defi ne the term logical rack.

27. With reference to a PLC rack: a. What is a remote rack? b. Why are remote racks used?

28. How does the processor identify the location of a specific input or output device?

29. List the three basic elements of rack/slot-based addressing.

30. Compare bit level and word level addressing.

31. In what way does tag-based addressing differ from rack/slot-based addressing?

32. What do PC-based control systems use to interface with fi eld devices? 10. What type of I/O modules have both inputs and outputs connected to them?

33. In addition to fi eld devices what other connections are made to a PLC module?

34. Most PLC modules use plug-in wiring terminal strips. Why?

35. What are the advantage and the disadvantage of using high-density modules?

36. With reference to PLC discrete input modules: a. What types of fi eld input devices are suitable for use with them? b. List three examples of discrete input devices.

37. With reference to PLC discrete output modules:

a. What types of field output devices are suitable for use with them?

b. List three examples of discrete output devices.

38. Explain the function of the backplane of a PLC rack.

39. What is the function of the optical isolator circuit used in discrete I/O module circuits? 18. Name the two distinct sections of an I/O module.

40. List four tasks performed by a discrete input module.

41. What electronic element can be used as the switching device for a 120 VAC discrete output interface module?

42. With reference to discrete output module current ratings:

a. What is the maximum current rating for a typical 120 VAC output module?

b. Explain one method of handling outputs with larger current requirements.

43. What electronic element can be used as the switching device for DC discrete output modules?

44. A discrete relay type output module can be used to switch either AC or DC load devices. Why?

45. With reference to sourcing and sinking I/O modules: a. What current relationship are the terms sourcing and sinking used to describe?

b. If an I/O module is specified as a current-sinking type, then which type of fi eld device (sinking or sourcing) it is electrically compatible with?

46. Compare discrete and analog I/O modules with respect to the type of input or output devices with which they can be used.

47. Explain the function of the analog-to-digital (A/D) converter circuit used in
analog input modules.

48. Explain the function of the digital-to-analog (D/A) converter circuit used in analog output modules. 49. Name the two general sensing classifications for analog input modules.

50. List five common physical quantities measured by a PLC analog input module.

50. What type of cable is used when connecting a thermocouple to a voltage sensing analog input module? Why?

51. Explain the difference between a unipolar and bi polar analog input module.

52. The resolution of an analog input channel is specified as 0.3 mV. What does this tell you?

53. In what two ways can the loop power for current sensing input modules be supplied?

54. List three fi eld devices that are commonly controlled by a PLC analog output module.

55. State one application for each of the following special I/O modules:

a. High-speed counter module b. Thumbwheel module c. TTL module

56. Convert each of the following binary numbers to decimal numbers: a. 10 b. 100 c. 111 d. 1011 e. 1100 f. 10010 g. 10101 h. 11111 i. 11001101 j. 11100011

57. Convert each of the following decimal numbers to binary numbers: a. 7 b. 19 c. 28 d. 46 e. 57 f. 86 g. 94 h. 112 i. 148 j. 230

58. Convert each of the following octal numbers to decimal numbers: a. 36 b. 104 c. 120 d. 216 e. 360 f. 1516

59. Convert each of the following octal numbers to binary numbers: a. 74 b. 130 c. 250 d. 1510 e. 2551 f. 2634

60. Convert each of the following hexadecimal numbers to decimal numbers: a. 5A b. C7 c. 9B5 d. 1A6

61. Convert each of the following hexadecimal numbers to binary numbers: a. 4C b. E8 c. 6D2 d. 31B

62. Convert each of the following decimal numbers to BCD: a. 146 b. 389 c. 1678 d. 2502

63. What is the most important characteristic of the Gray code?

64. What makes the binary system so applicable to computer circuits? 10. Defi ne the following as they apply to the binary memory locations or registers: a. Bit b. Byte c. Word d. LSB e. MSB

65. State the base used for each of the following num ber systems: a. Octal b. Decimal c. Binary d. Hexadecimal

66. Defi ne the term sign bit.

67. Explain the difference between the 1's complement of a number and the 2's complement.

68. What is ASCII code? 15. Why are parity bits used?

69. Add the following binary numbers: a. 110 1 111 b. 101 1 011 c. 1100 1 1011

70. Subtract the following binary numbers: a. 1101 2 101 b. 1001 2 110 c. 10111 2 10010

71. The following binary PLC coded information is to be programmed using the hexadecimal code. Convert each piece of binary information to the appropriate hexadecimal code for entry into the PLC from the keyboard. a. 0001 1111 b. 0010 0101 c. 0100 1110 d. 0011 1001

72. The encoder circuit shown in Figure 3-17 is used to convert the decimal digits on the keyboard to a binary code. State the output status (HIGH/LOW) of A-B-C-D when decimal number a. 2 is pressed. b. 5 is pressed. CHAPTER 3 PROBLEMS c. 7 is pressed. d. 8 is pressed.

73. If the bits of a 16-bit word or register are numbered according to the octal numbering system, beginning with 00, what consecutive numbers would be used to represent each of the bits?

74. Express the decimal number 18 in each of the fol lowing number codes: a. Binary b. Octal c. Hexadecimal d. BCD

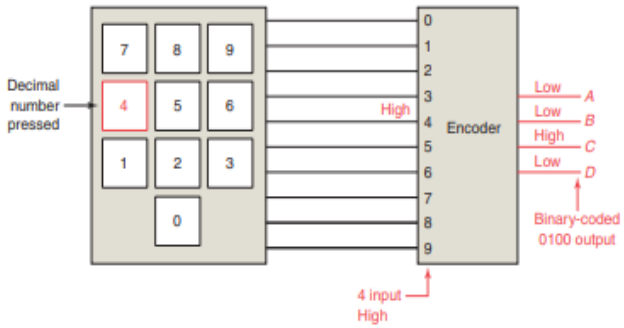


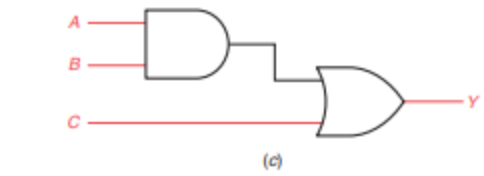
Figure 3-17 Diagram for Problem 2.

75. It is required to have a pilot light come on when all of the following circuit requirements are met:

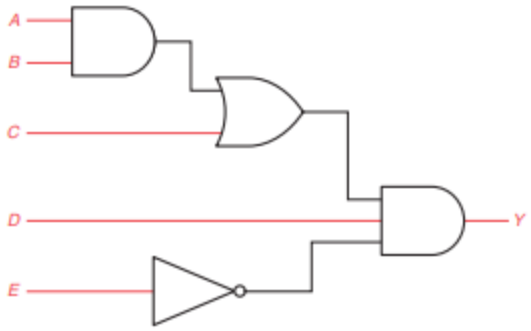
- All four circuit pressure switches must be closed.
- At least two out of three circuit limit switches must be closed.
- The reset switch must not be closed. Using AND, OR, and NOT gates, design a logic circuit that will solve this hypothetical problem.

76. Write the Boolean equation for each of the logic gate circuits in Figure 4-29a–f .

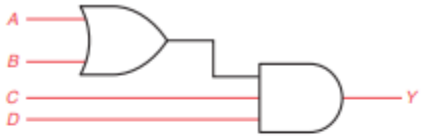
77. The logic circuit of Figure 4-30 is used to activate an alarm when its output Y is logic HIGH or 1. Draw a truth table for the circuit showing the resulting output for all 16 of the possible input conditions.



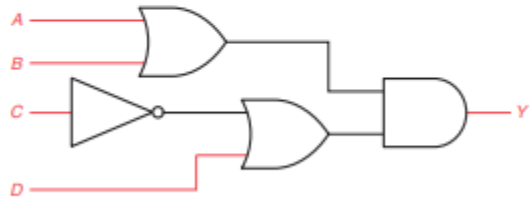
(c)



(d)

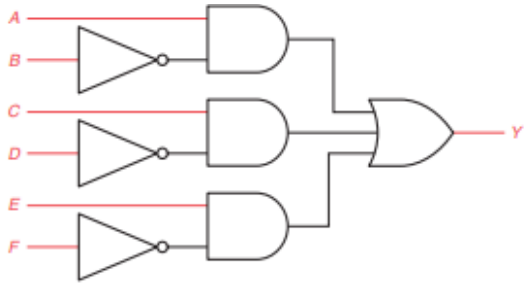


(a)



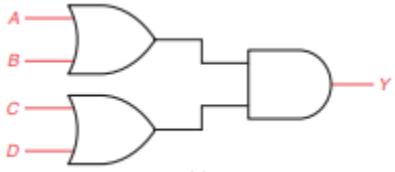
(b)

Figure 4-29 Logic gate circuits for Problem 2.



(f)

Figure 4-29 (*Continued*)



(e)

78. What will be the data stored in the destination ad dress of Figure 4-31 for each of the following logical operations? a. AND operation b. OR operation c. XOR operation

79. Write the Boolean expression and draw the gate logic diagram and typical PLC ladder logic diagram for a control system wherein a fan is to run only when all of the following conditions are met: • Input A is OFF • Input B is ON or input C is ON, or both B and C are ON • Inputs D and E are both ON • One or more of inputs F, G, or H are ON

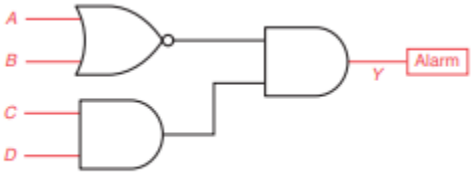


Figure 4-30 Logic circuit for Problem 3.

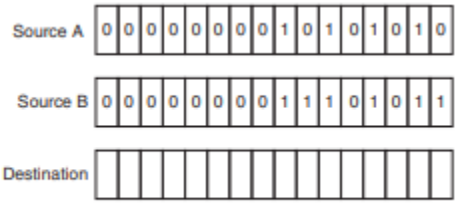


Figure 4-31 Data for Problem 4.

80. Assign each of the following discrete input and output addresses based on the SLC 500 format. a. Limit switch connected to terminal screw 4 of the module in slot 1 of the chassis. b. Pressure switch connected to terminal screw 2 of the module in slot 3 of the chassis. c. Pushbutton connected to terminal screw 0 of the module in slot 6 of the chassis. d. Pilot light connected to terminal screw 13 of the module in slot 2 of the chassis. e. Motor starter coil connected to terminal screw 6 of the module in slot 4 of the

chassis. f. Solenoid connected to terminal screw 8 of the module in slot 5 of the chassis.

81. Redraw the program shown in Figure 5-50 corrected to solve the problem of a nested contact.

82. Redraw the program shown in Figure 5-51 corrected to solve the problem of a nested vertical programmed contact.

83. Redraw the program shown in Figure 5-52 corrected to solve the problem of some logic ignored.

84. Redraw the program shown in Figure 5-53 corrected to solve the problem of too many series contacts (only four allowed).

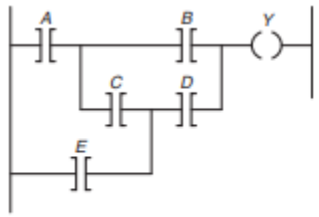


Figure 5-52 Program for Problem 4.

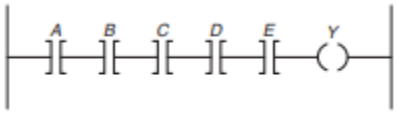


Figure 5-53 Program for Problem 5.

85. Draw the equivalent ladder logic program used to implement the hardwired circuit drawn in Figure 5-54 , wired using: a. A limit switch with a single NO contact connected to the PLC discrete input module b. A limit switch with a single NC contact connected to the PLC discrete input module

86. Assuming the hardwired circuit drawn in Figure 5-55 is to be implemented using a PLC program, identify a. All input fi eld devices b. All output fi eld devices c. All devices that could be programmed using internal relay instructions

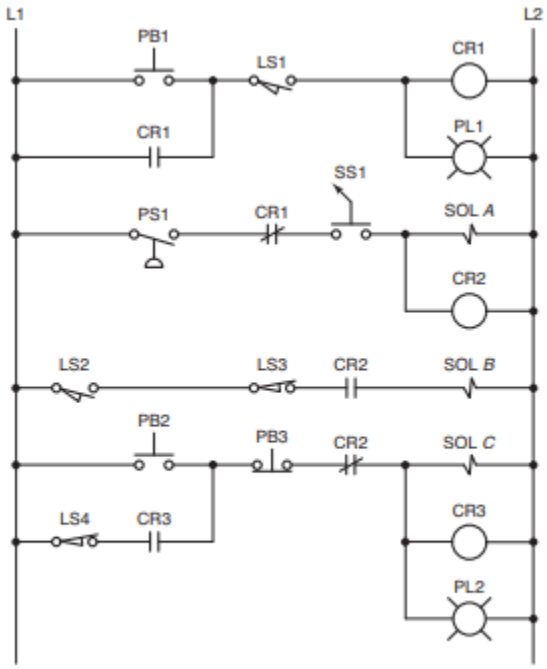


Figure 5-55 Hardwired circuit for Problem 7.

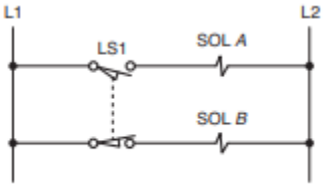


Figure 5-54 Hardwired circuit for Problem 6.

87. What instruction would you select for each of the following discrete input field devices to accomplish the desired task? (State the reason for your answer.) a. Turn on a light when a conveyor motor is running in reverse. The input field device is a set of contacts on the conveyor start relay that close when the motor is running forward and open when it is running in reverse. b. When a pushbutton is pressed, it operates a solenoid. The input fi eld device is a normally open pushbutton. c. Stop a motor from running when a pushbutton is pressed. The input fi eld

device is a normally closed pushbutton. d. When a limit switch is closed, it triggers an instruction ON. The input fi eld device is a limit switch that stores a 1 in a data table bit when closed.

88. Write the ladder logic program needed to implement each of the following (assume inputs A, B, and C are all normally open toggle switches): a. When input A is closed, turn ON and hold ON outputs X and Y until A opens. b. When input A is closed and either input B or C is open, turn ON output Y ; otherwise, it should be OFF. c. When input A is closed or open, turn ON output Y. d. When input A is closed, turn ON output X and turn OFF output Y.

89. Design and draw the schematic for a conventional hardwired relay circuit that will perform each of the following circuit functions when a normally closed pushbutton is pressed: • Switch a pilot light on • De-energize a solenoid • Start a motor running • Sound a horn

90. Design and draw the schematic for a conventional hardwired circuit that will perform the following circuit functions using two break-make pushbuttons: • Turn on light L1 when pushbutton PB1 is pressed. • Turn on light L2 when pushbutton PB2 is pressed. • Electrically interlock the pushbuttons so that L1 and L2 cannot both be turned on at the same time.

91. Study the ladder logic program in Figure 6-69 , and answer the questions that follow: a. Under what condition will the latch rung 1 be true? b. Under what conditions will the unlatch rung 2 be true? c. Under what condition will rung 3 be true? d. When PL1 is on, the relay is in what state (latched or unlatched)? e. When PL2 is on, the relay is in what state (latched or unlatched)? f. If AC power is removed and then restored to the circuit, what pilot light will automatically come on when the power is restored? g. Assume the relay is in its latched state and all three inputs are false. What input change(s) must occur for the relay to switch into its unlatched state? h. If the examine if closed instructions at addresses I/1, I/2, and I/3 are all true, what state will the relay remain in (latched or unlatched)?

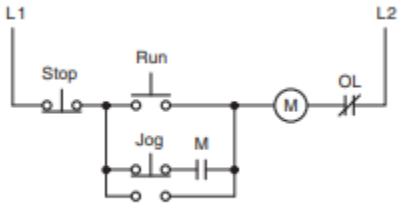


Figure 6-70 Hardwired control circuit for Problem 4

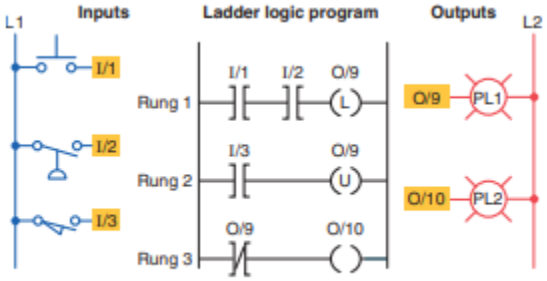


Figure 6-69 Ladder logic program for Problem 3.

92. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the hardwired control circuit in Figure 6-70 . Assume: Stop pushbutton used is an NO type. Run pushbutton used is an NO type. Jog pushbutton used has one set of NO contacts. OL contact is hardwired.

93. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the hardwired control circuit in Figure 6-71 . Assume: PB1 pushbutton used is an NO type. PB2 pushbutton used is an NC type. PS1 pressure switch used is an NO type. LS1 limit switch used has only one set of NC contacts. 6. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the hardwired control circuit in Figure 6-72 . Assume: PB1 pushbutton used is an NC type. PB2 and PB3 are each wired using one set of NO contacts. OL contact is hardwired.

94. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program for the following motor control specifications: • A motor must be started and stopped from any one of three start/stop pushbutton stations. • Each start/stop station contains one NO start pushbutton and one NC stop pushbutton. • Motor OL contacts are to be hardwired.

95. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program for the following motor control specifications: • Three starters are to be wired so that each starter is operated from its own start/stop pushbutton station. • A master stop station is to be included that will trip out all starters when pushed. • Overload relay contacts are to be programmed so that an overload on any one of the starters will automatically drop all of the starters. • All pushbuttons are to be wired using one set of NO contacts.

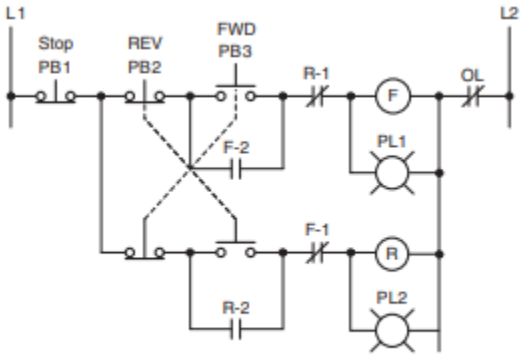


Figure 6-72 Hardwired control circuit for Problem 6.

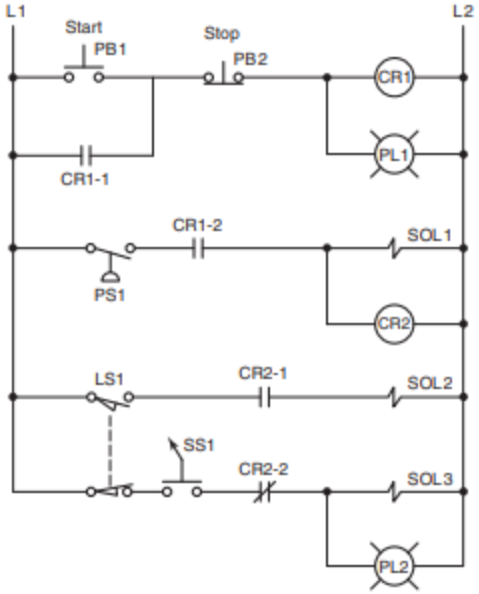


Figure 6-71 Hardwired control circuit for Problem 5.

96. Draw the symbol and explain the operation of each of the following timed contacts of a mechanical timing relay: a. On-delay timer—NOTC contact b. On-delay timer—NCTO contact c. Off-delay timer—NOTO contact d. Off-delay timer—NCTC contact

97. Name five pieces of information usually associated with a PLC timer instruction.

98. When is the output of a programmed timer energized?

99. a. What are the two methods commonly used to represent a timer instruction within a PLC's ladder logic program? b. Which method is preferred? Why?

100. a. Explain the difference between the operation of a nonretentive timer and that of a retentive timer. b. Explain how the accumulated count of programmed retentive and nonretentive timers is reset to zero.

101. State three advantages of using programmed PLC timers over mechanical timing relays. 8. For a TON timer: a. When is the enable bit of a timer instruction true? b. When is the timer-timing bit of a timer instruction true? c. When does the done bit of a timer change state?

102. For a TOF timer: a. When is the enable bit of a timer instruction true? b. When is the timer-timing bit of a timer instruction true? c. When does the done bit of a timer change state?

103. Explain what each of the following quantities associated with a PLC timer instruction represents: a. Preset time b. Accumulated time c. Time base

104. State the method used to reset the accumulated time of each of the following: a. TON timer b. TOF timer c. RTO timer

105. a. With reference to the relay schematic diagram in Figure 7-37 , state the status of each light (on or off) after each of the following sequential events: i. Power is first applied and switch S1 is open. ii. Switch S1 has just closed. iii. Switch S1 has been closed for 5 s. iv. Switch S1 has just opened. v. Switch S1 has been opened for 5 s. b. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will execute this hardwired control circuit correctly.

106. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the hardwired relay control circuit shown in Figure 7-38 .

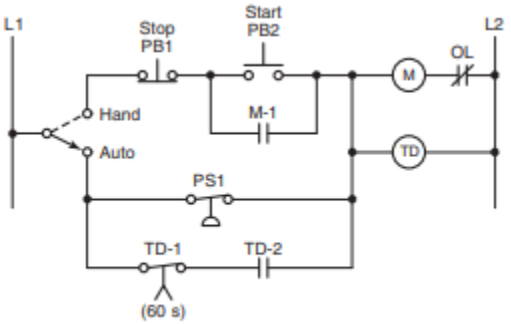


Figure 7-38 Hardwired relay control circuit for Problem 2.

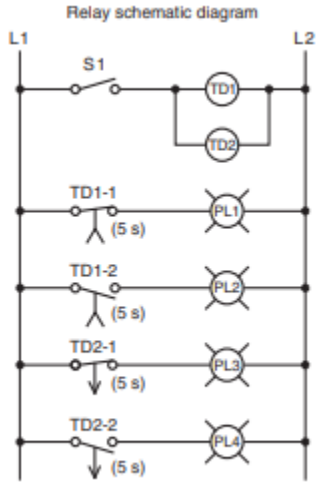


Figure 7-37 Relay schematic diagram for Problem 1.

107. Study the ladder logic program in Figure 7-39 and answer the questions that follow: a. What type of timer has been programmed? b. What is

the length of the time-delay period? c. What is the value of the accumulated time when power is first applied? d. When does the timer start timing? e. When does the timer stop timing and reset itself? f. When input LS1 is first closed, which rungs are true and which are false? g. When input LS1 is first closed, state the status (on or off) of each output. h. When the timer's accumulated value equals the preset value, which rungs are true and which are false? i. When the timer's accumulated value equals the preset value, state the status (on or off) of each output.

108. Study the ladder logic program in Figure 7-42 and answer the questions that follow: a. What is the purpose of interconnecting the two timers? b. How much time must elapse before output PL is energized? c. What two conditions must be satisfied for timer T4:2 to start timing? d. Assume that output PL is on and power to the system is lost. When power is restored, what will the status of this output be? e. When input PB2 is on, what will happen? f. When input PB1 is on, how much accumulated time must elapse before rung 3 will be true?

109. You have a machine that cycles on and off during its operation. You need to keep a record of its total run time for maintenance purposes. Which timer would accomplish this?

110. Write a ladder logic program that will turn on a light, PL, 15 s after switch S1 has been turned on.

111. Study the on-delay timer ladder logic program in Figure 7-43 , and from each of the conditions stated, determine whether the timer is reset, timing, or timed out or if the conditions stated are not possible. a. The input is true, and EN is 1, TT is 1, and DN is 0. b. The input is true, and EN is 1, TT is 1, and DN is 1. c. The input is false, and EN is 0, TT is 0, and DN is 0. d. The input is true, and EN is 1, TT is 0, and DN is 1.

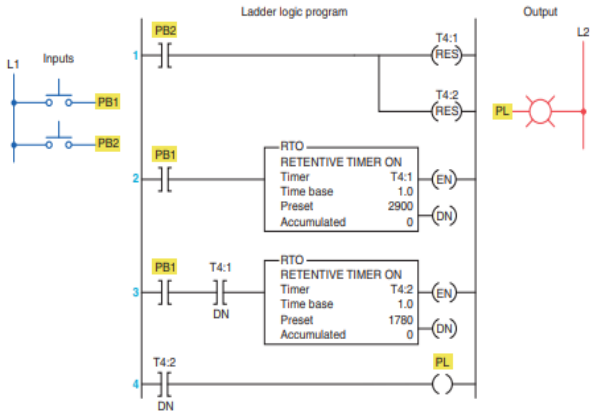


Figure 7-42 Ladder logic program for Problem 6.

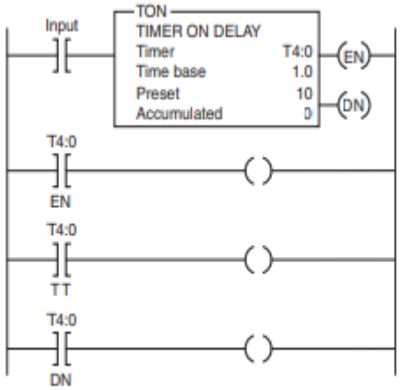


Figure 7-43 On-delay timer ladder logic program for Problem 9.

112. Name the three forms of PLC counter instructions, and explain the basic operation of each.

113. In a PLC counter instruction, what rule applies to the addressing of the counter and reset instructions?

114. When is the output of a PLC counter energized?

115. When does the PLC counter instruction increment or decrement its current count?

116. The counter instructions of PLCs are normally retentive. Explain what this means.

117. a. Compare the operation of a standard Examine on contact instruction with that of an off-to-on transitional contact. b. What is the normal function of a transitional contact used in conjunction with a counter?

118. Explain how an OSR (one-shot rising) instruction can be used to freeze rapidly changing data.

119. Identify the type of counter you would choose for each of the following situations: a. Count the total number of parts made during each shift. b. Keep track of the current number of parts in a stage of a process as they enter and exit. c. There are 10 parts in a full hopper. As parts leave, keep track of the number of parts remaining in the hopper

120. Describe the basic programming process involved in the cascading of two counters.

121. a. When is the overflow bit of an up-counter set? b. When is the underflow bit of a down-counter set?

122. Describe two common applications for counters.

123. What determines the maximum speed of transitions that a PLC counter can count? Why?

124. Study the ladder logic program in Figure 8-37 , and answer the questions that follow: a. What type of counter has been programmed? b. When would output O:2/0 be energized? c. When would output O:2/1 be energized? d. Suppose your accumulated value is 24 and you lose ac line power to the controller. When power is restored to your controller, what will your ac cumulated value be? e. Rung 4 goes true and while it is true, rung 1 goes through fi ve false-to-true transitions of rung conditions. What is the accumulated value of the counter after this sequence of events? f. When will the count be incremented? g. When will the count be reset?

125. Study the ladder logic program in Figure 8-38 , and answer the questions that follow: a. Suppose the input pushbutton is actuated from off to on and remains held on. How will the status of output B3:0/9 be affected? b. Suppose the input pushbutton is now released to the normally off position and remains off. How will the status of output B3:0/9 be affected?

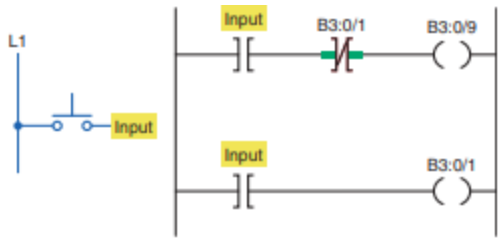


Figure 8-38 Program for Problem 2.

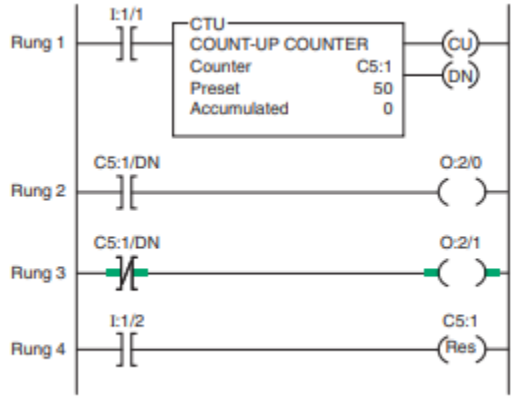


Figure 8-37 Program for Problem 1.

126. Study the ladder logic program in Figure 8-39 , and answer the questions that follow: a. What type of counter has been programmed? b. What input address will cause the counter to increment? c. What input address will cause the counter to decrement? d. What input address will reset the counter to a count of zero? e. When would output O:6/2 be energized? f. Suppose the counter is first reset, and then input I:2/6 is actuated 15 times and input I:3/8 is actuated 5 times. What is the accumulated count value?

127. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program for the following counter specifications: • Counts the number of times a pushbutton is closed. • Decrements the accumulated value of the counter each time a second pushbutton is closed. • Turns on a light anytime the accumulated value of the counter is less than 20. • Turns on a second light when the accumulated value of the counter is equal to or greater than 20. • Resets the counter to 0 when a selector switch is closed.

128. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the industrial control process in Figure 8-40 . The sequence of operation is as follows: • Product in position (limit switch LS1 contacts close). • The start button is pressed and the conveyor motor starts to move the product forward toward position A (limit switch LS1 contacts open when the actuating arm returns to its normal position). • The conveyor moves the product forward to position A and stops (position detected by 8 off-to-on output pulses from the encoder, which are counted by an up-counter). • A time delay of 10 s occurs, after which the conveyor starts to move the product to limit switch LS2 and stops (LS2 contacts close when the actuating arm is hit by the product) • An emergency stop button is used to stop the process at any time. • If the sequence is interrupted by an emergency stop, counter and timer are reset automatically.

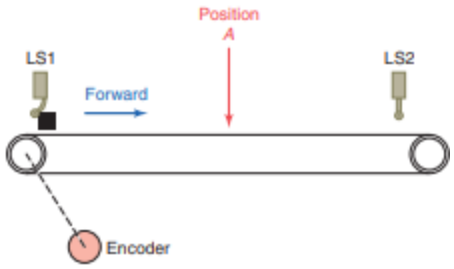


Figure 8-40 Control process for Problem 6.

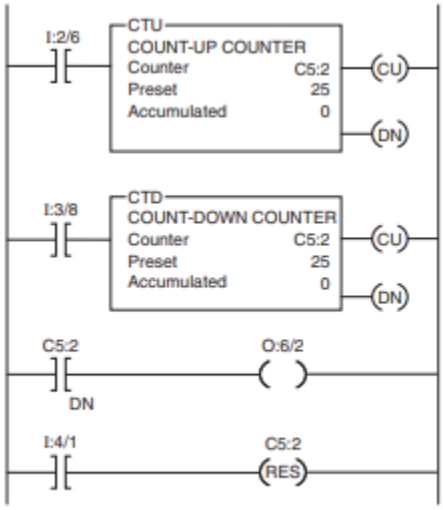


Figure 8-39 Program for Problem 3.

129. Answer the following questions with reference to the up/down-counter program shown in Figure 8-41 . Assume that the following sequence of events occurs: • Input C is momentarily closed. • 20 on/off transitions of input A occur. • 5 on/off transitions of input B occur. As a result: a. What is the accumulated count of counter CTU? b. What is the accumulated count of counter CTD? c. What is the state of output A ? d. What is the state of output B ? e. What is the state of output C ?

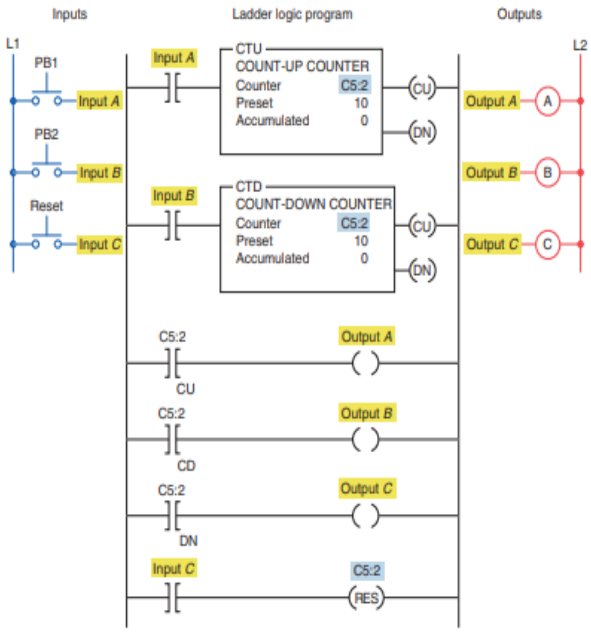


Figure 8-41 Program for Problem 7.

130. Write a program to implement the box-stacking process illustrated in Figure 8-44 . This application requires the control of a conveyor belt that feeds a mechanical stacker. The stacker can stack various numbers of cartons of ceiling tile onto each pallet (depending on the pallet size and the preset value of the counter). When the required number of cartons has been stacked, the conveyor is stopped until the loaded pallet is removed and an empty pallet is placed onto the loading area. A photoelectric sensor will be used to provide count pulses to the counter after each carton passes by. In addition to a conveyor motor start/stop station, a remote reset button is provided to allow the operator to reset the system from the forklift after an empty pallet is placed onto the loading area. The operation of this system can be summarized as follows: • The conveyor is started by pressing the start button.

• As each box passes the photoelectric sensor, a count is registered. • When the preset value is reached (in this case 12), the conveyor belt turns off. • The forklift operator removes the loaded pallet. • After the empty pallet is in position, the forklift operator presses the remote reset button, which then starts the whole cycle over again.

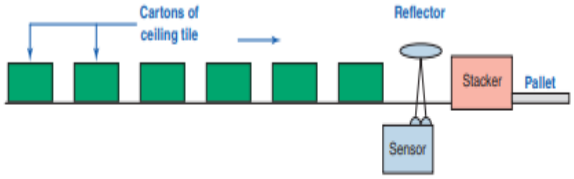


Figure 8-44 Control process for Problem 13.

131. Write a program to operate a light according to the following sequence: • A momentary pushbutton is pressed to start the sequence. • The light is switched on and remains on for 2 s. • The light is then switched off and remains off for 2 s. • A counter is incremented by 1 after this sequence. • The sequence then repeats for a total of 4 counts. • After the fourth count, the sequence will stop and the counter will be reset to zero.