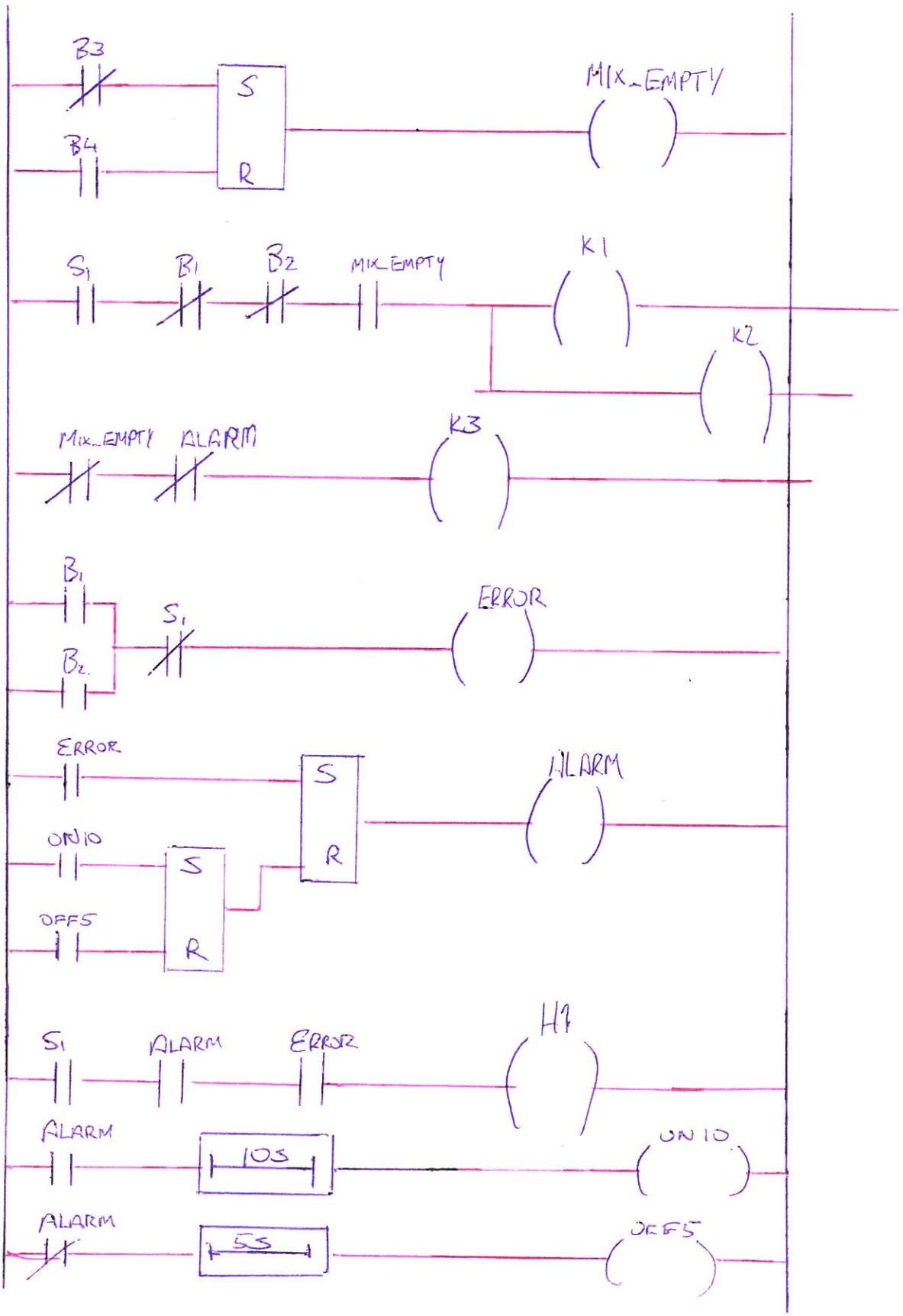
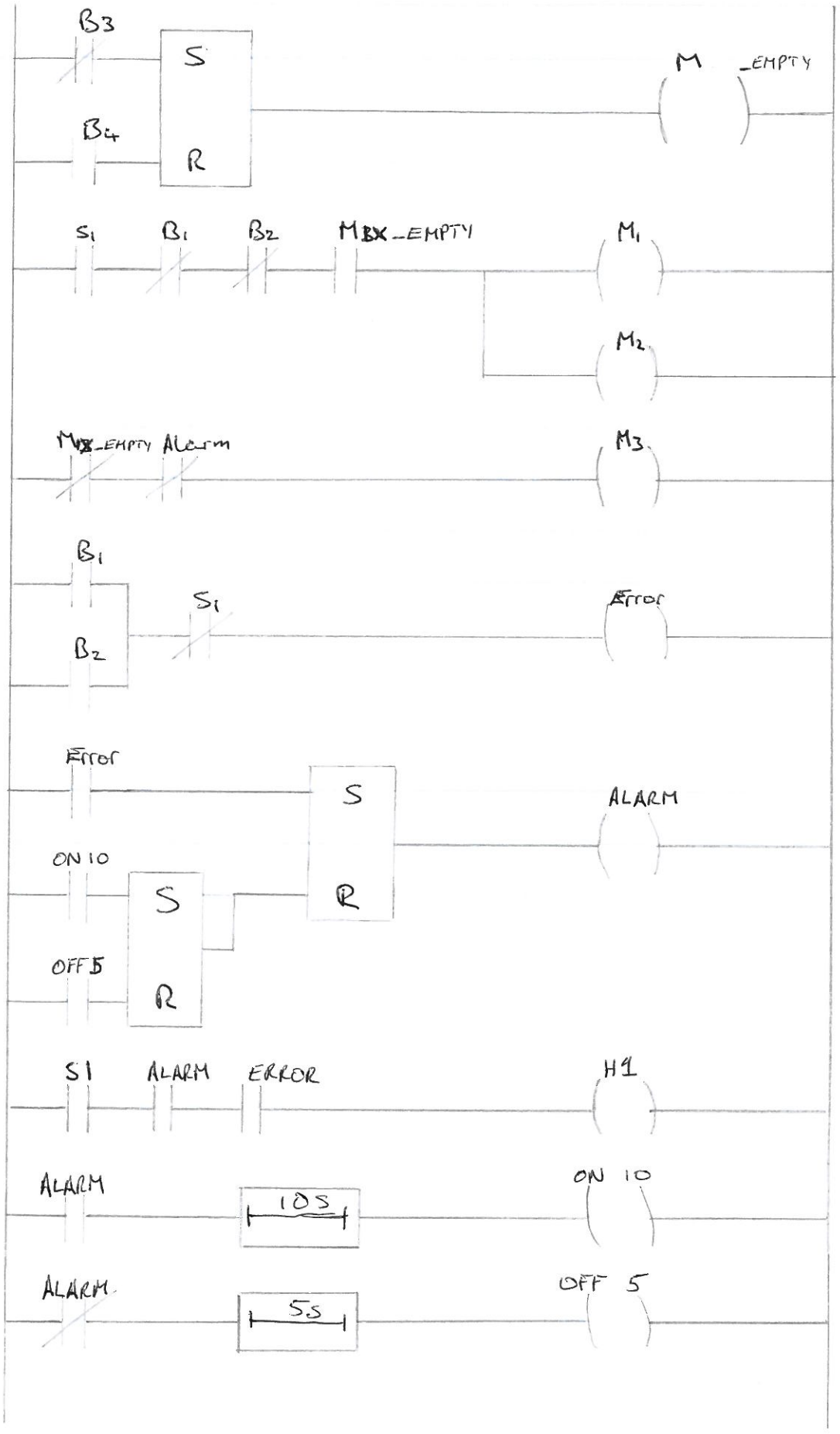
EE4009 Summer '05




B3
S
M_EMPTY
B4
R
S1
B1
B2
MBX_EMPTY
M1
M2
MBX_EMPTY
Alarm
M3
B1
B2
S1
Error
Error
S
ALARM
ON 10
S
R
OFF 5
R
S1
ALARM
ERROR
H1
ALARM
10S
ON 10
ALARM
5S
OFF 5

MECHATRONICS

SUMMER 2005

QUESTION 7.

INPUTS: B1 : LIQUID 1 LEVEL → NO LIQUID (ON/CLOSED)

B2 : LIQUID 2 LEVEL → NO LIQUID (ON/CLOSED)

B3 : LOW LEVEL MIX → NO LIQUID (OFF/OPEN)

B4 : HIGH LEVEL MIX → NO LIQUID (OFF/OPEN)

S1 : ON/OFF SWITCH

OUTPUTS K1 : M1 DISCHARGE

K2 : M2 DISCHARGE

K3 : M3 DISCHARGE

H1 : HOOTER.

SPECS : ① ENABLED WHEN S1 ON (CLOSED)

② WHEN B3 OFF

→ K1 ON } PROVIDED B1 AND B2
K2 ON } ARE OFF
→ UNTIL B4 ON

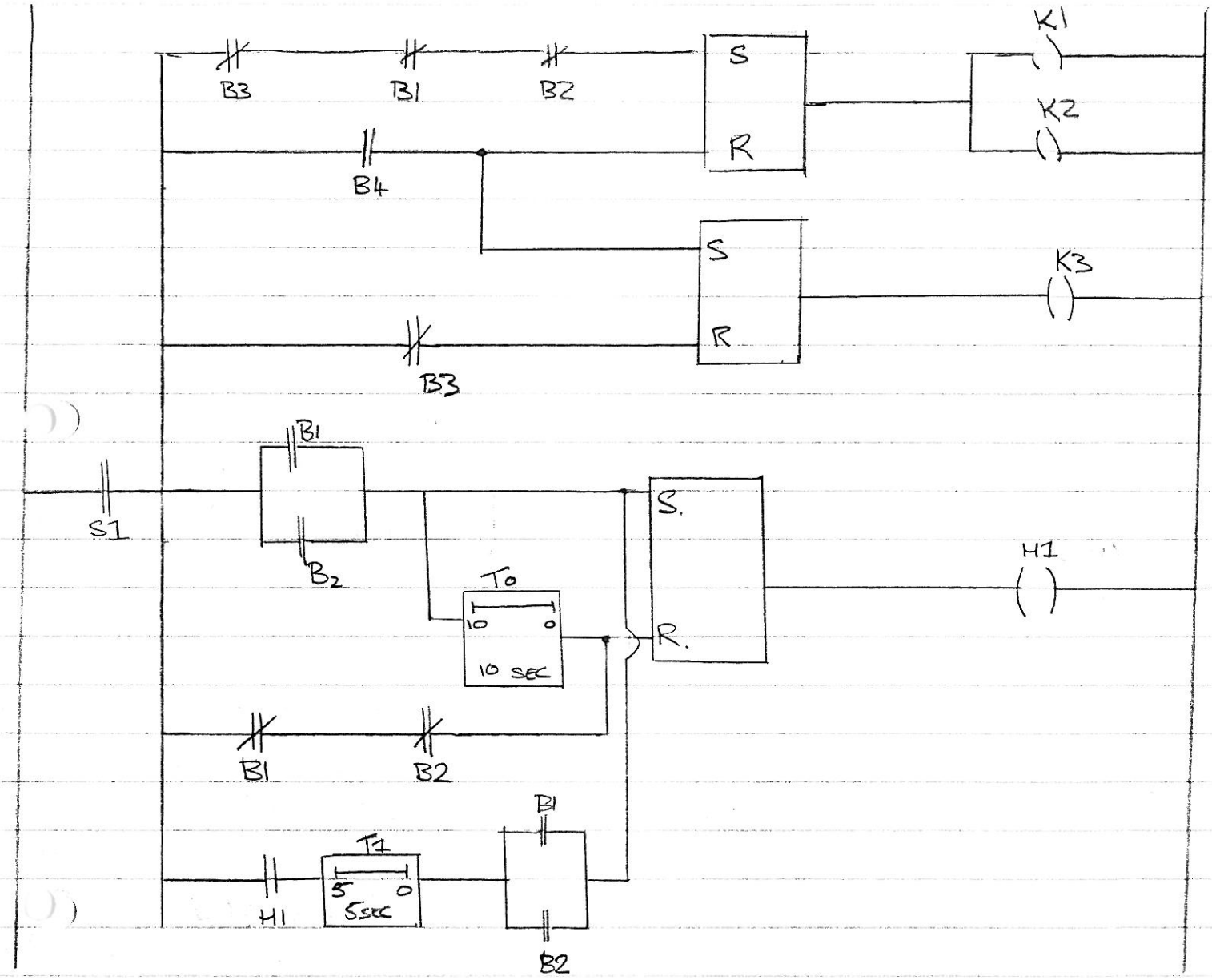
③ THEN K3 IS ON UNTIL B3 OFF

④ RESTART.

⑤ HOOTER SHOULD SOUND IF B1 OR B2 IS O

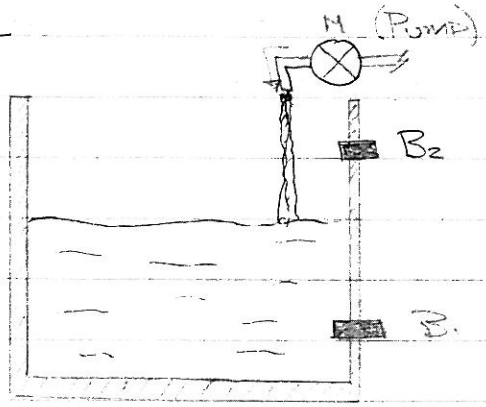
⑥ HOOTER ON FOR 10 SEC OFF FOR 5 SEC
- REPEAT UNTIL EITHER S1 IS OFF
OR B1 AND B2 OFF

SUMMER 2005 : Q7

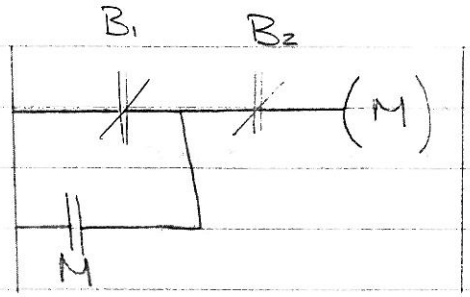


PROGRAMMABLE LOGIC CONTROLLER SOLUTIONS

SEC. 1

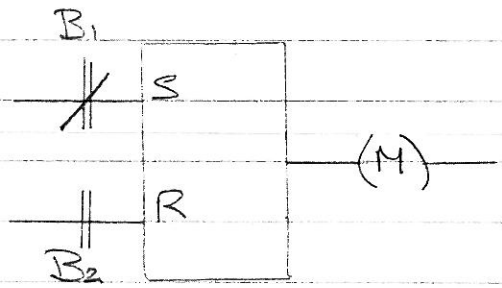


- CONTROL THE WATER LEVEL IN THE TANK.
- SWITCHES B_1 AND B_2 ARE ON (CLOSED) WHEN COVERED.



* THE SYSTEM USES FEEDBACK FROM THE MOTOR
=> WHEN B_1 AND B_2 ARE OPEN ('OFF') THEN THE MOTOR OPERATES TO PUMP WATER IN. SIGNAL M IS THEN SUPPLIED TO THE SYSTEM SO THAT WHEN B_1 BECOMES COVERED AGAIN (CLOSED - ON) THE MOTOR WILL KEEP PUMPING UNTIL B_2 IS COVERED.

ALTERNATIVELY USING AN SR LATCH.

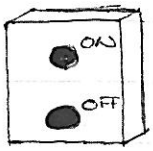


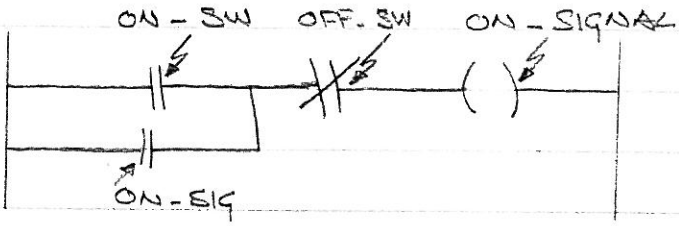
* WHEN B_1 IS UNCOVERED ('OFF') SET LATCH => OUTPUT M SIGNAL

WHEN B_2 IS COVERED ('ON') RESET LATCH
=> STOP O/P M SIGNAL

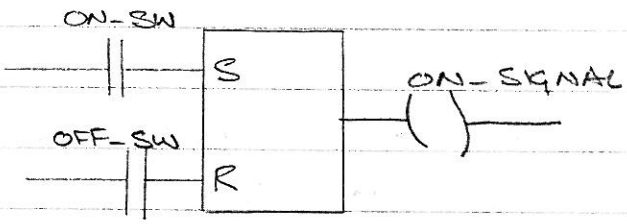
(2)

Sol 2. USING TOUCH SENSITIVE BUTTONS, START AND STOP A PROCESS AS APPROPRIATE BUTTONS ARE PUSHED.





* OR USING SR LATCH.



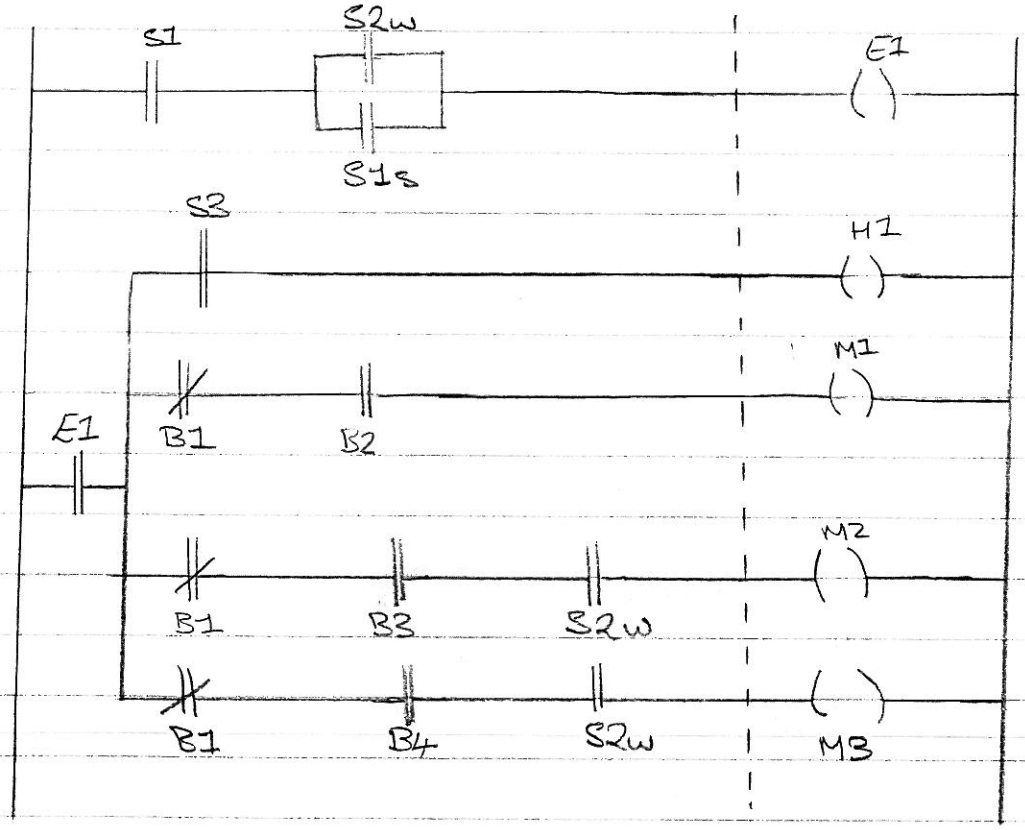
(5)

SOL 3: SEE EXAMPLE 6.6 IN THE HANDOUT.
CONTROL OF A FACTORY HEATING SYSTEM.

SIGNALS: E1 : BURNER ON/OFF } O/P
H1 → H3 : MOTOR CONTROLS }

I/P

SWITCHES: S1 : ON (CLOSED) BY CLOCK DURING WORKING HO
S2 : S2w : WINTER OPERATION
S2s : SUMMER OPERATION
OFF
S3 : ON (CLOSED) IF BURNER HAS A FAULT
B1 → B4 : TEMP SENSORS OFF (OPEN) ABOVE PRESE

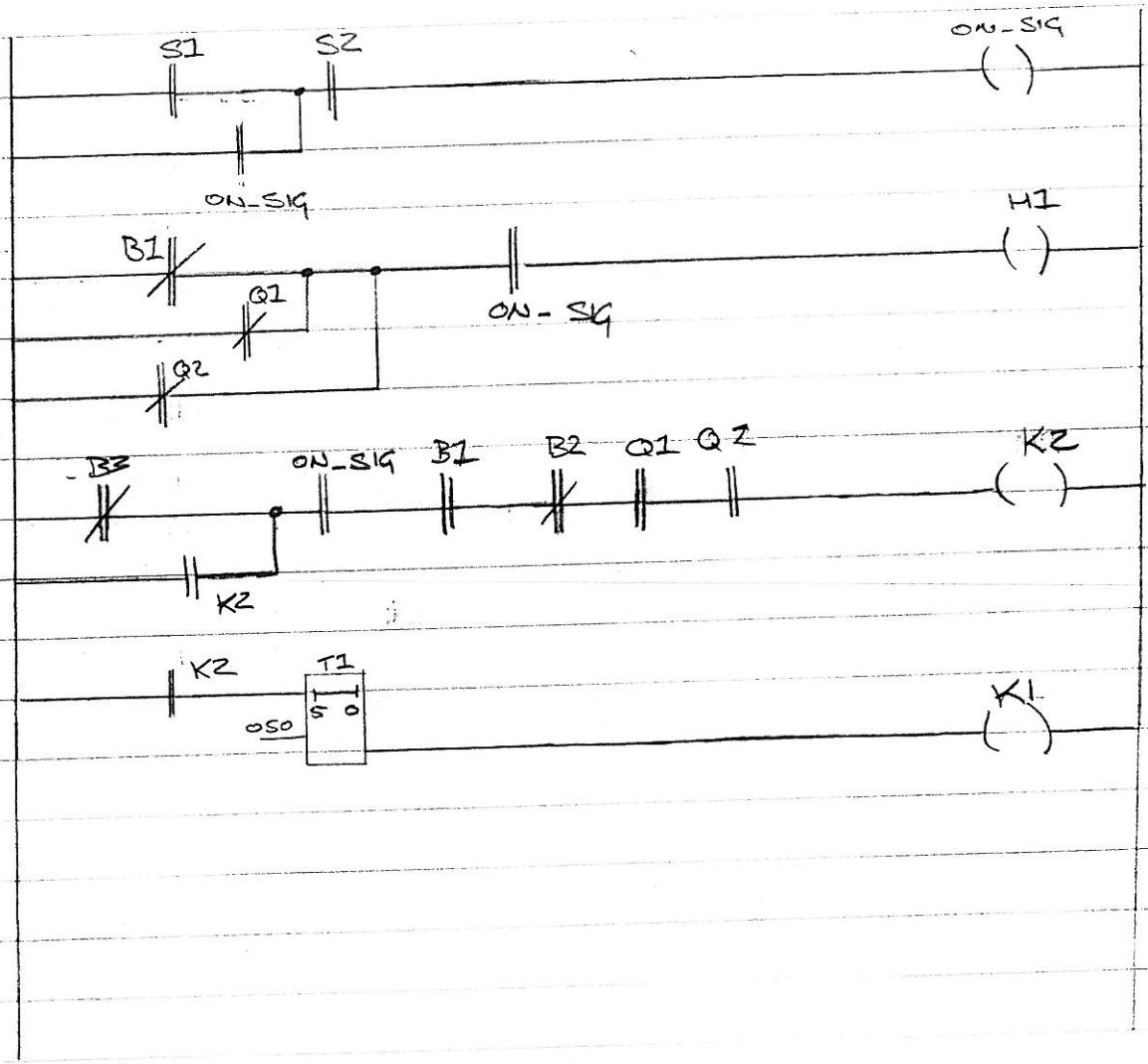


(2)

SOL 4: SEE EXAMPLE 6.7 IN THE HANDOUT
CONTROL OF POWDER DISTRIBUTION

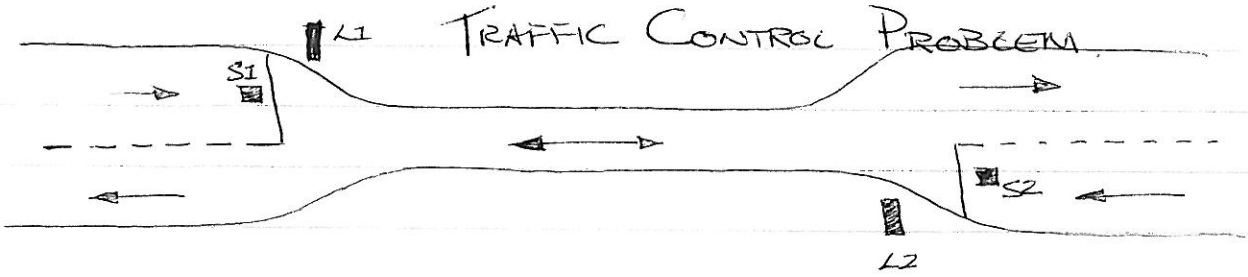
OUTPUT SIGNALS: M1 : DISCHARGE MOTOR
M2 : CONVEYOR MOTOR

INPUT SIGNALS : B1 : STORAGE LOW LEVEL SENSOR } OFF WHEN THERE IS NO POWDER
B2 : PRODUCTION HIGH " " }
B3 : " LOW " "
S1 : START : NORMALLY OFF (OPEN)
S2 : STOP : NORMALLY ON (CLOSED)
H1 : WARNING HOOTER
K1 : SUPPLIES M1
K2 SUPPLIES M2
Q1 : CIRCUIT BREAKER FOR M1 } ON (CLOSED) TO RUN
Q2 : " " " M2 }



SEX 5. SEE EXAMPLE 3 IN HANDOUT

TRAFFIC CONTROL PROBLEM

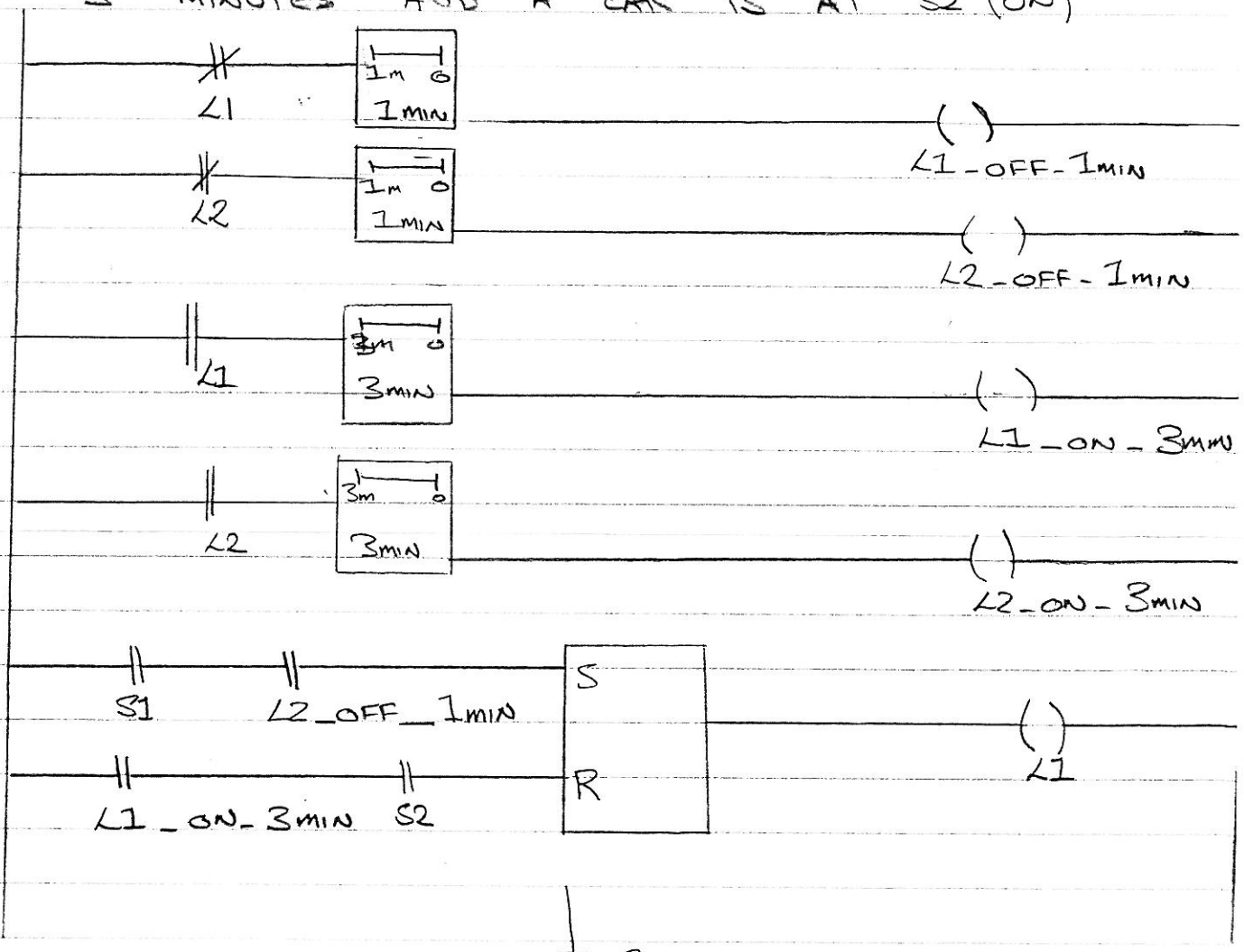


S1 : CLOSED (ON) WHEN A CAR IS WAITING
S2 : " " " " " "
L1 : } OPEN (OFF) : RED
L2 : } CLOSED (ON) : GREEN

OPERATION :

① CAR @ S1 (ON) AND L2 RED (OFF) FOR 1 MINUTE
⇒ L1 GOES TO GREEN (ON)

② L1 STAYS GREEN (ON) UNLESS IT HAS BEEN ON FOR 3 MINUTES AND A CAR IS AT S2 (ON)

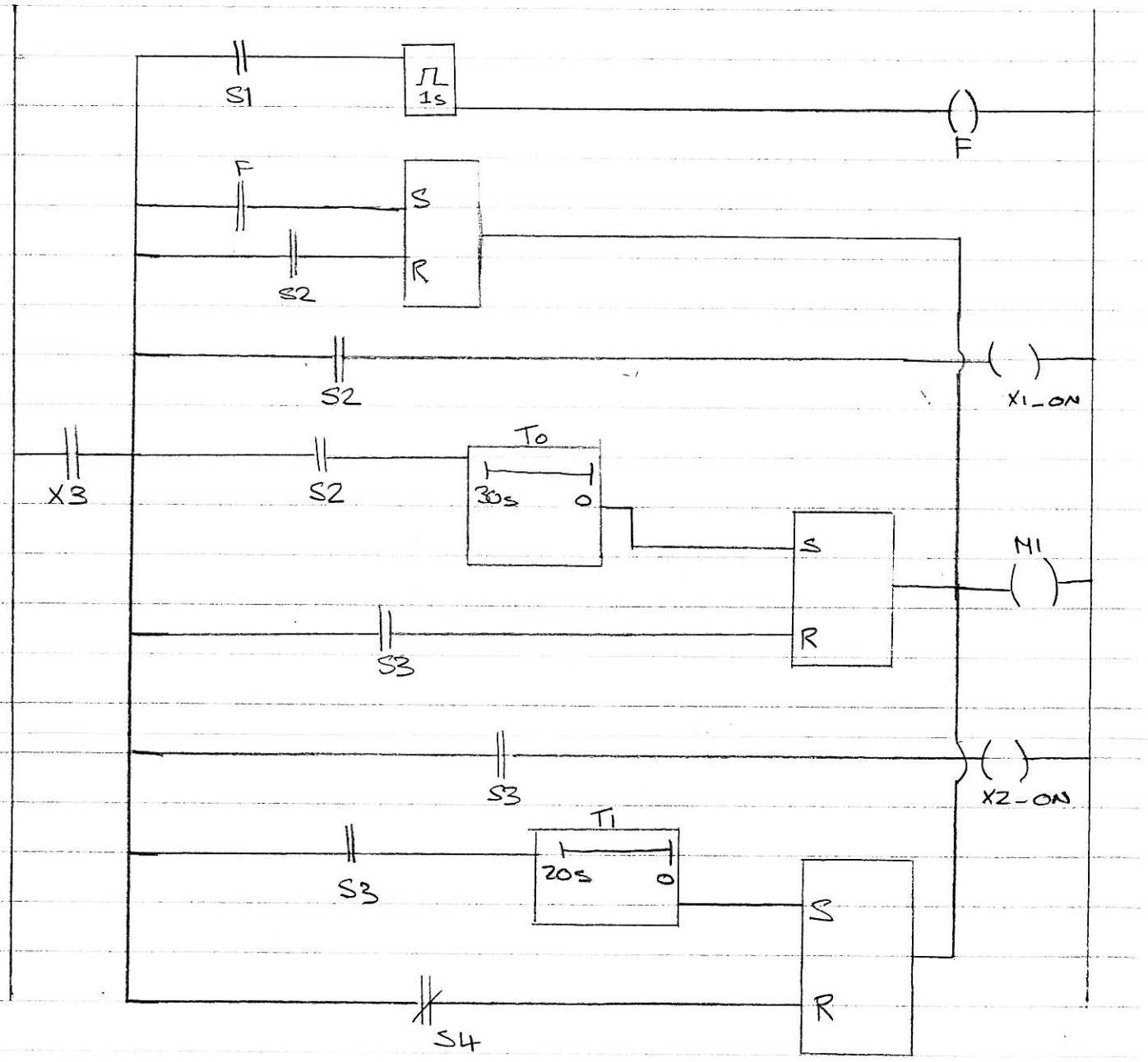


CONTINUED.

SOLUTION 6: SEE EXAMPLE 3 IN THE HANDOUT

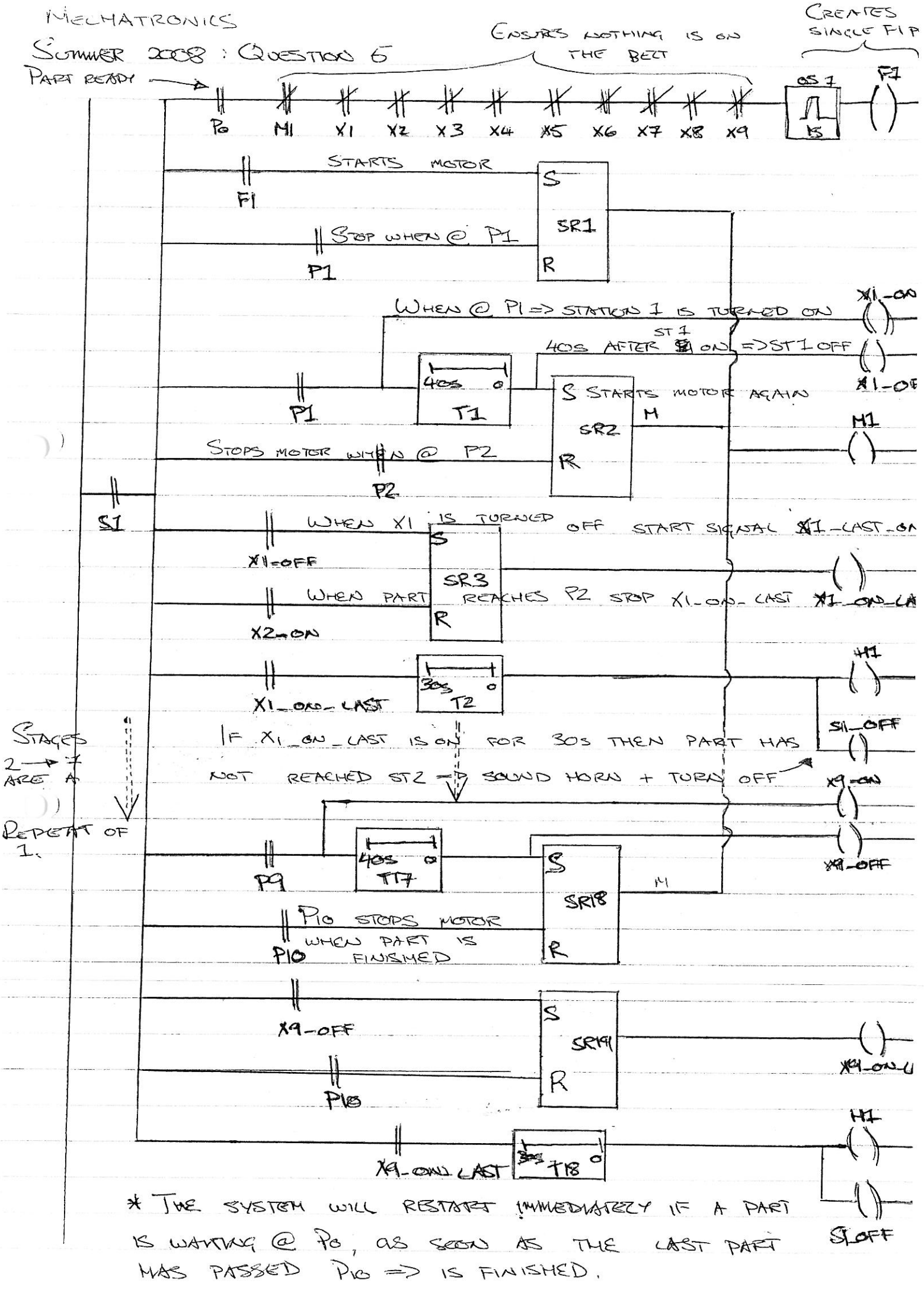
INPUTS:
- S1, S2, S3 } CLOSED WHEN PART IS PRESENT
- S4 OPEN WHEN PART PRESENT
- X3: OVERALL SYSTEM ON/OFF

OUTPUTS:
- M1: CONVEYOR
- F1: FLAP
- X1: STATION 1 ON/OFF
- X2: STATION 2 ON/OFF



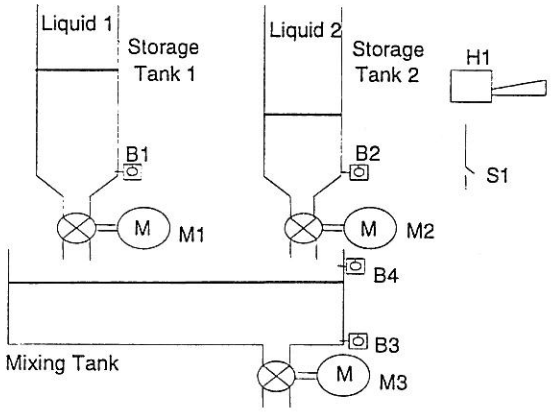
MECHATRONICS

SUMMER 2008 : QUESTION 6



* THE SYSTEM WILL RESTART IMMEDIATELY IF A PART IS WAITING @ P0, AS SOON AS THE LAST PART HAS PASSED P18 => IS FINISHED.

6. A process requires the mixing of two liquids as shown below. Use a ladder diagram to show how a PLC could be used to control this process.



Equipment description:

The Liquid 1 tank has a low-level sensor B1 (normally open when no liquid present) and a motorised discharge valve M1 that is controlled via a contactor K1.
The Liquid 2 tank has a similar low-level sensor B2 and a motorised discharge valve M2 that is controlled via a contactor K2.
The mixing tank has similar low-level (empty) and high-level sensors, B3 and B4. The mixing tank has a motorised discharge valve M3 under the control of a contactor K3.
A hooter, H1, is available to supply an audible warning.
A single on/off switch S1 is also provided.

Operational Specifications:

(a) The system is enabled when S1 is closed.

(b) When the mixing tank is empty, as indicated by B3, liquid is discharged from both liquid storage tanks, until the liquid in the mixing tank has reached the high level, as given by B4. The contents of the mixing tank are then discharged immediately until the mixing tank is empty. The process then repeats.

(c) The process should stop immediately if the level of either of the storage tanks goes low. A hooter warning should be sounded, the duty cycle of which should be: on for 10 seconds, off for 5 seconds, and then on continuously. (This should be programmed under the assumption that the PLC software is equipped with on-delay timers.) The warning continues until either (i) both storage tanks are no longer low, or (ii) S1 is opened.

(d) When S1 is closed, the system should first discharge any liquid in the mixing tank, and liquid should only be discharged from the storage tanks after the mixing tank is initially empty.

(20 marks)

MECHATRONICS

SUMMER 2008

QUESTION 5.

INPUTS P1 . . P9 : STATION SENSORS ON (CLOSED) PART PRES
P0 : PART @ FLAP => ON (CLOSED)
S1 : OVERAL SWITCH ON (CLOSED) TO GO
P10 : PRODUCT FINISHED => (CLOSED) ON
H1 : HOOTER

OUTPUTS : F1 : FLAP OPEN
M1 : CONVEYOR MOTOR
X1...X9 : STATION OPERATION (CLOSED TO ENABLE)

SPECS:
① TO OPERATE S1 CLOSED (ON)
② WHEN P0 CLOSED (ON) => ONE SHOT => (F1)
③ WITH F1 , M1 SHOULD OPERATE WHEN P1 (OFF
④ P1 (ON) => (X1)
⑤ P1 (ON) => + 40SEC => SET SR FOR (M1)
⑥ P2 (ON) => RESET SR (M1) + (X2)
⑦ REPEAT FOR ALL 9 STAGES.
⑧ WHEN P10 (CLOSED) RESET (M1)
⑨ IF M1 (OFF) AND X1 TO X9 (OFF)