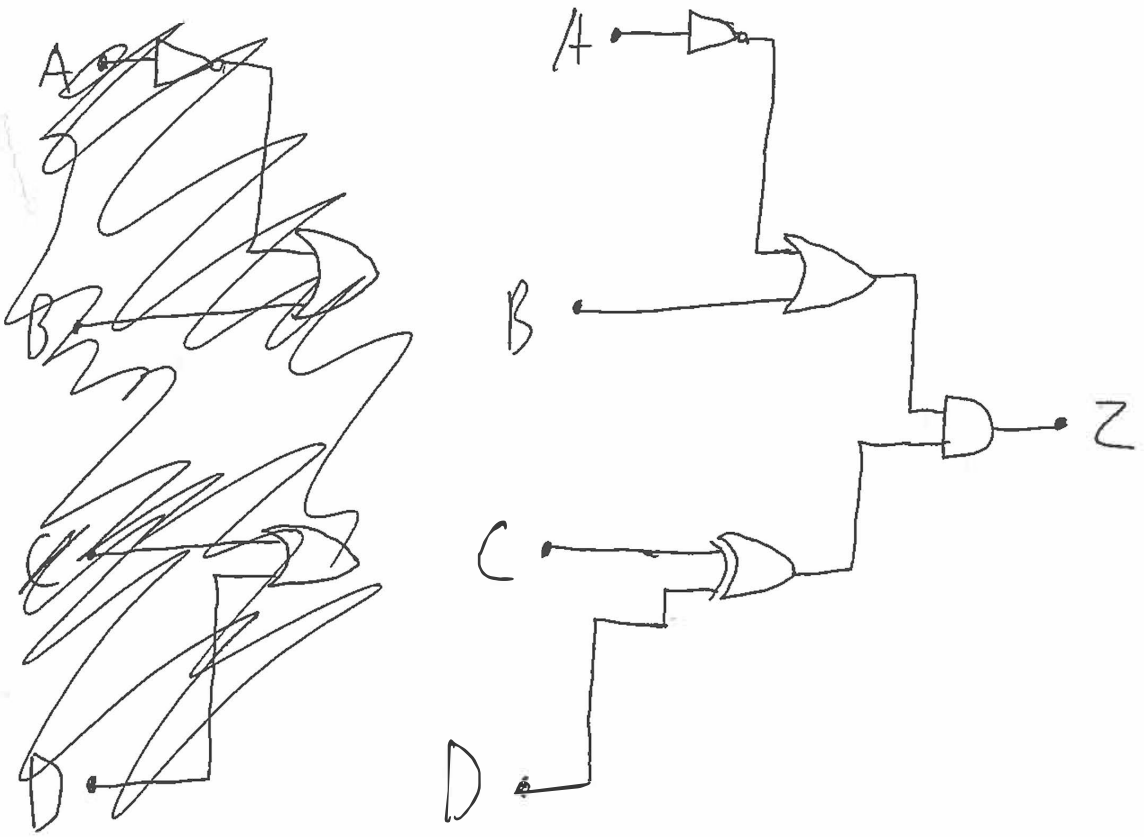
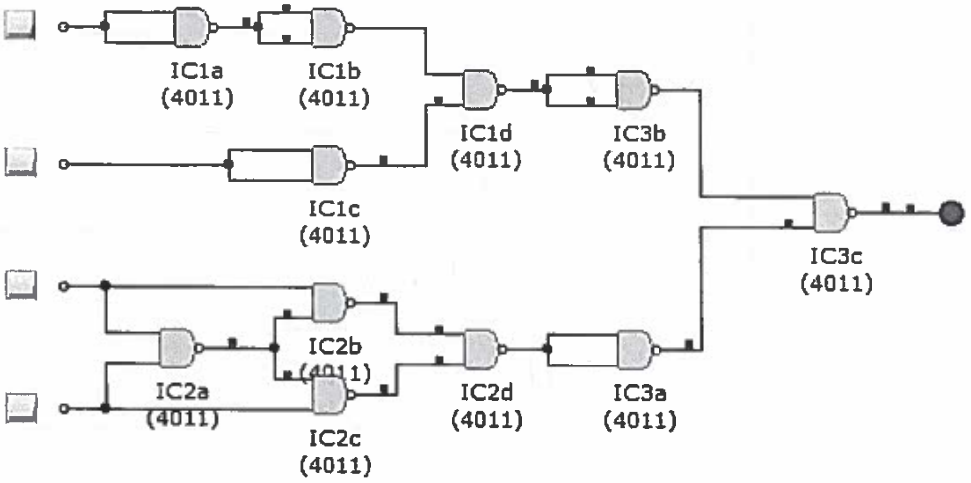
Candidate 3 evidence

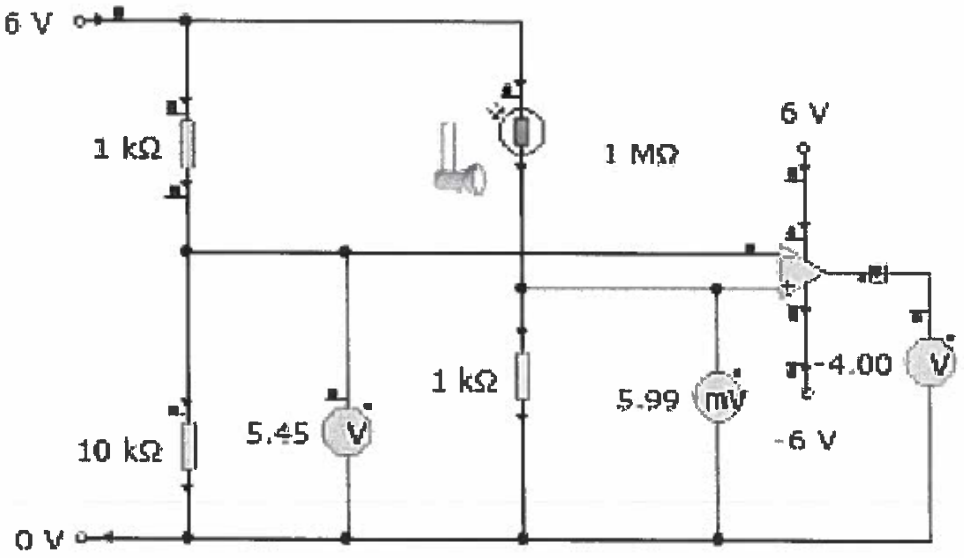
Task 1A



TASK 1B



TASK 2A



Worksheet 1c

Complete the actual results column on the truth table below.

A	B	C	D	Expected results	Actual results
0	0	0	0	0	1
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	0	1
0	1	0	0	0	1
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	1
1	0	0	0	0	0
1	0	0	1	0	1
1	0	1	0	0	1
1	0	1	1	0	0
1	1	0	0	0	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	0	1

(1 mark)

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Task 1d

The results differ because the NAND equivalent circuit is wrong as there is an OR gate at the end where there should be an and gate.

Task 2E

When the ticket is scanned and dark is sensed the motor turns on on my circuit just like is should. However at first it didn't and I had to change the direction of the diode and change which part of the relay the motor is connected to. After removing the ticket when ~~darkness~~ darkness is ~~sensed~~ no longer sensed the motor will turn ~~off~~ slowly as its meant to. Before I amended the circuit the motor would turn on when the ticket was removed and light was sensed, this was fixed by switching the connection to the relay from the motor. The sensitivity can be changed by changing the resistance of the 61kΩ resistor.

Worksheet 2d

Complete the testing table shown below.

Planned test	Expected result	Actual result	Amendments made
Reduce the light level to minimum.	Motor turns.	Relay doesn't switch and motor doesn't turn	Switch the direction of the diode. Connect the motor to the other side of the relay. Return 6V rail connected to relay/diode and connect it to the rest of the circuit.
Alter the value of both the LDR and the fixed resistor to 6kΩ.	The motor turns on under different lighting conditions.	Motor switches on at any light level producing a resistance of more than 6kΩ	No amendment made.

(3 marks)

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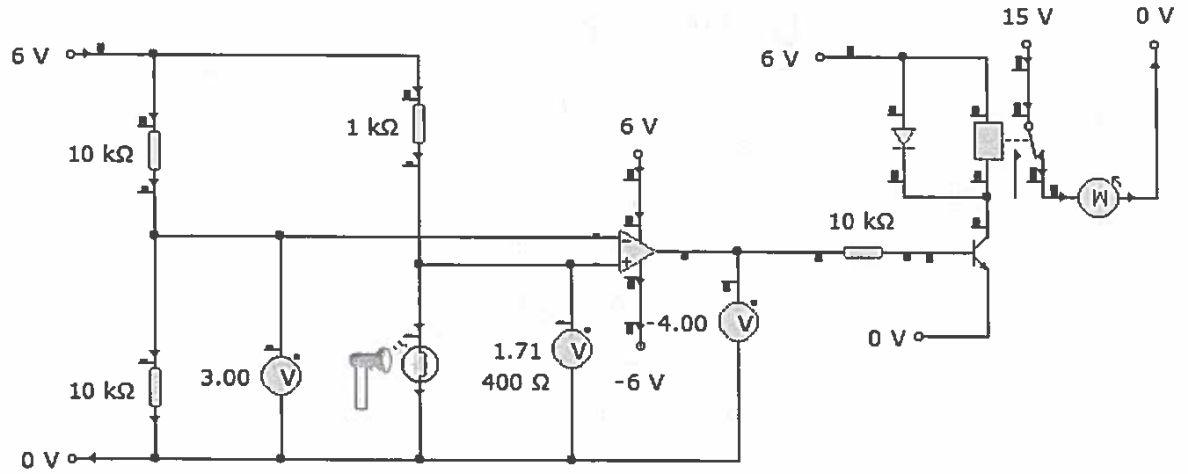
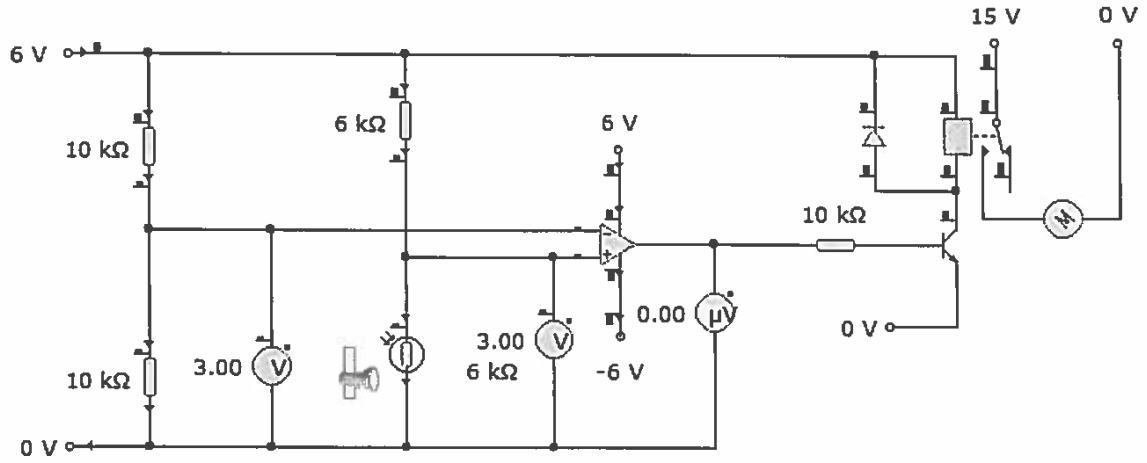
TASK 2C



TASK 2E/2D



Worksheet 2b

Complete the testing table shown below.

Planned test	Expected result	Actual result	Amendments made
Reduce the light level to the minimum setting.	Op amp output saturates positive.	op amp saturates negatively	Swap the position of the LDR and Resistor.
Alter the light level until op amp changes state.	Op amp output changes state at 3V.	op amp output changes state at 5.5V	Change the top 1kΩ resistor to 10kΩ.

(4 marks)

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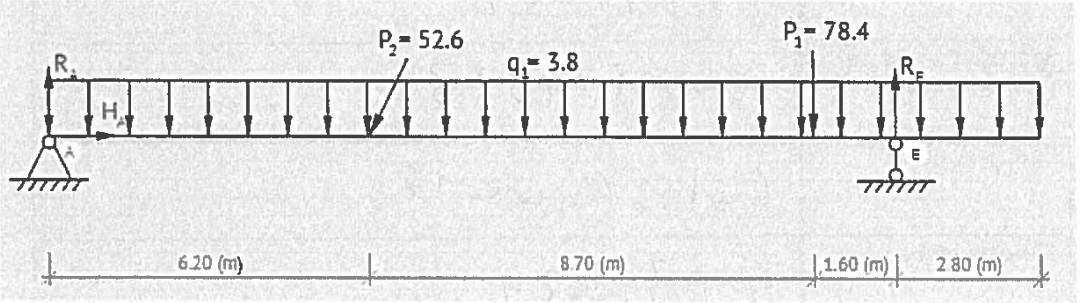
TASK 3b



Calculate the reactions at the supports of a beam

1. A beam is in equilibrium when it is stationary relative to an inertial reference frame. The following conditions are satisfied when a beam, acted upon by a system of forces and moments, is in equilibrium.

$\Sigma F_x = 0$: $H_A - P_2 \cdot \cos(63) = 0$

$\Sigma M_A = 0$: The sum of the moments about the pin support at the point A:

$-q_1 \cdot 19.3 \cdot (19.3/2) - P_2 \cdot \sin(63) \cdot 6.2 - P_1 \cdot 14.9 + R_B \cdot 16.5 = 0$

$\Sigma M_B = 0$: The sum of the moments about the roller support at the point B:

$-R_A \cdot 16.5 + q_1 \cdot 19.3 \cdot (16.5 - 19.3/2) + P_2 \cdot \sin(63) \cdot 10.3 + P_1 \cdot 1.6 = 0$

2. Calculate reaction of roller support at the point B:

$R_B = (q_1 \cdot 19.3 \cdot (19.3/2) + P_2 \cdot \sin(63) \cdot 6.2 + P_1 \cdot 14.9) / 16.5 = (3.8 \cdot 19.3 \cdot (19.3/2) - 52.6 \cdot 0.89106.2 + 78.4 \cdot 14.9) / 16.5 = 131.30$ (kN)

3. Calculate reaction of pin support at the point A:

$R_A = (q_1 \cdot 19.3 \cdot (16.5 - 19.3/2) + P_2 \cdot \sin(63) \cdot 10.3 - P_1 \cdot 1.6) / 16.5 = (3.8 \cdot 19.3 \cdot (16.5 - 19.3/2) + 52.6 \cdot \sin(63) \cdot 10.3 + 78.4 \cdot 1.6) / 16.5 = 67.31$ (kN)

4. Solve this system of equations:

$H_A = P_2 \cdot \cos(63) = 52.60 \cdot 0.4540 = 23.88$ (kN)

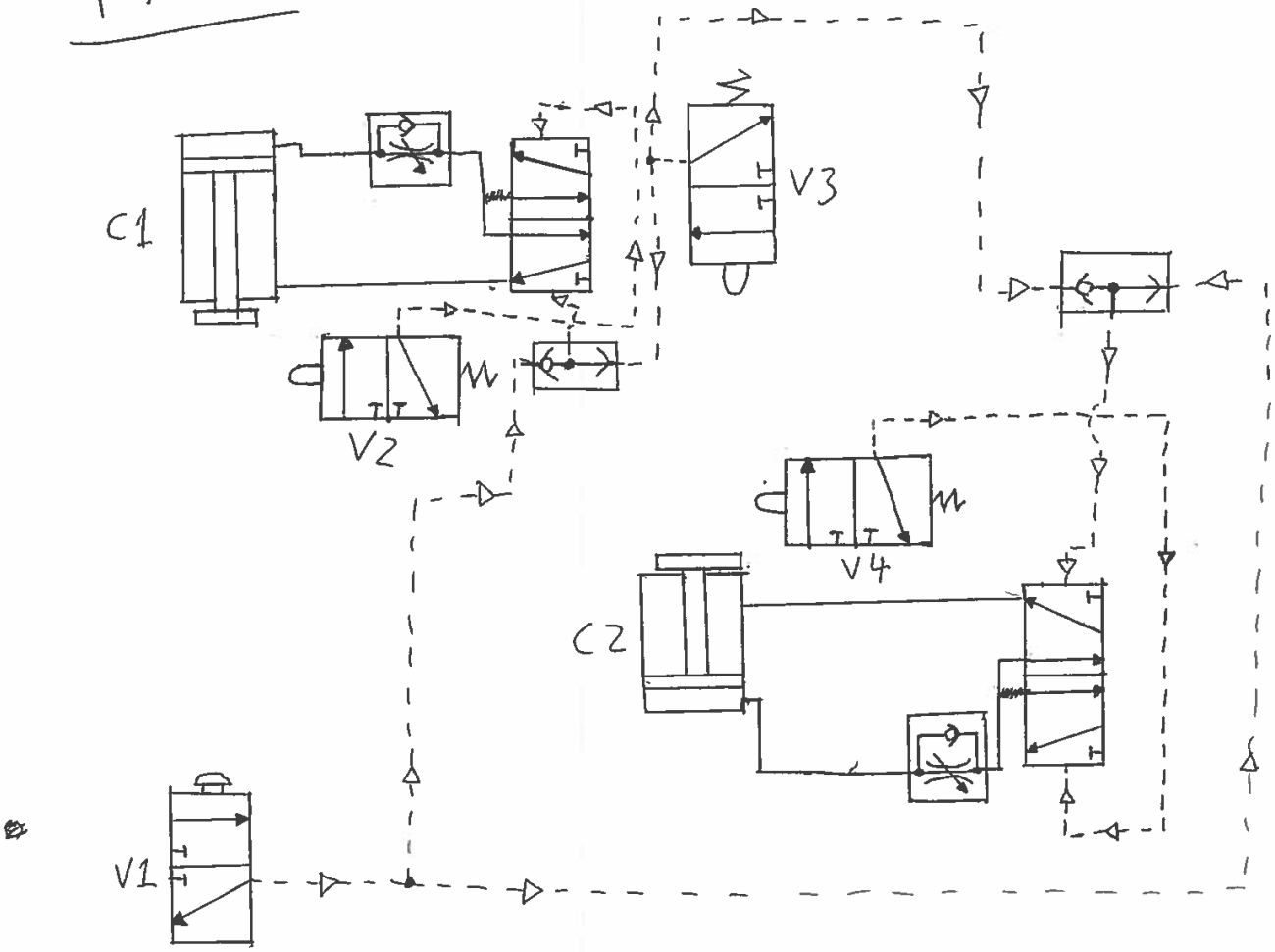
5. The sum of the forces about the Oy axis is zero:

$\Sigma F_y = 0$: $R_A - q_1 \cdot 19.3 - P_2 \cdot \sin(63) - P_1 + R_B = 67.31 \cdot 1 - 3.8 \cdot 19.3 - 52.6 \cdot 0.8910 - 78.4 + 131.30 \cdot 1 = 0$

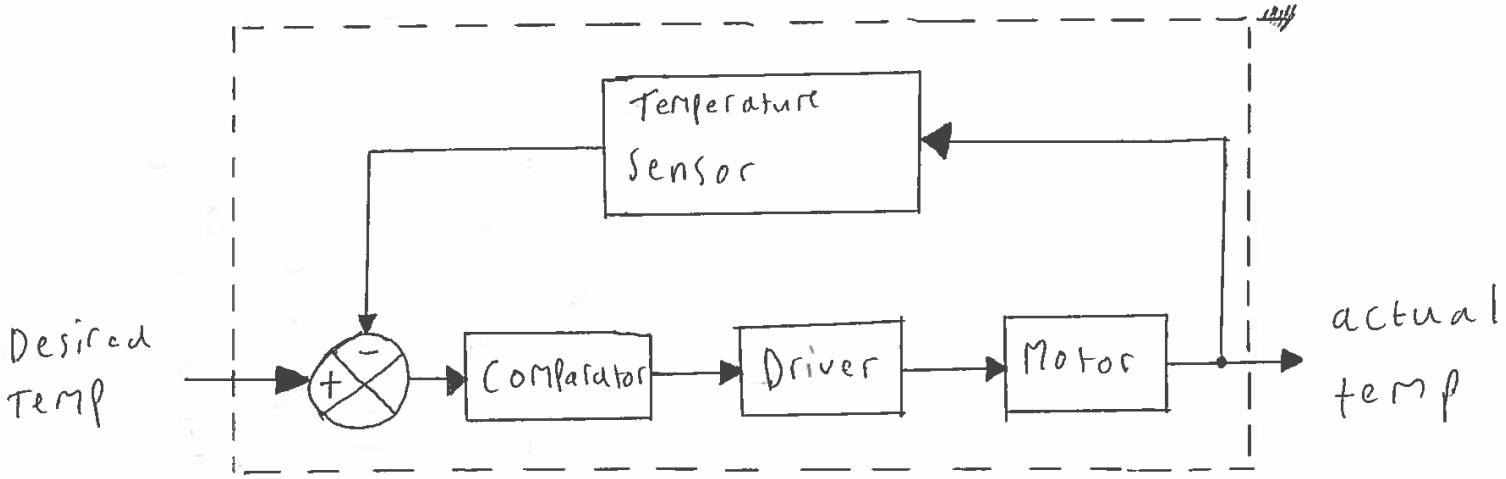
Vertical – $R_A = 67.31$ KN $R_B = 131.3$ KN

Horizontal – $H_A = 23.88$ KN vertical

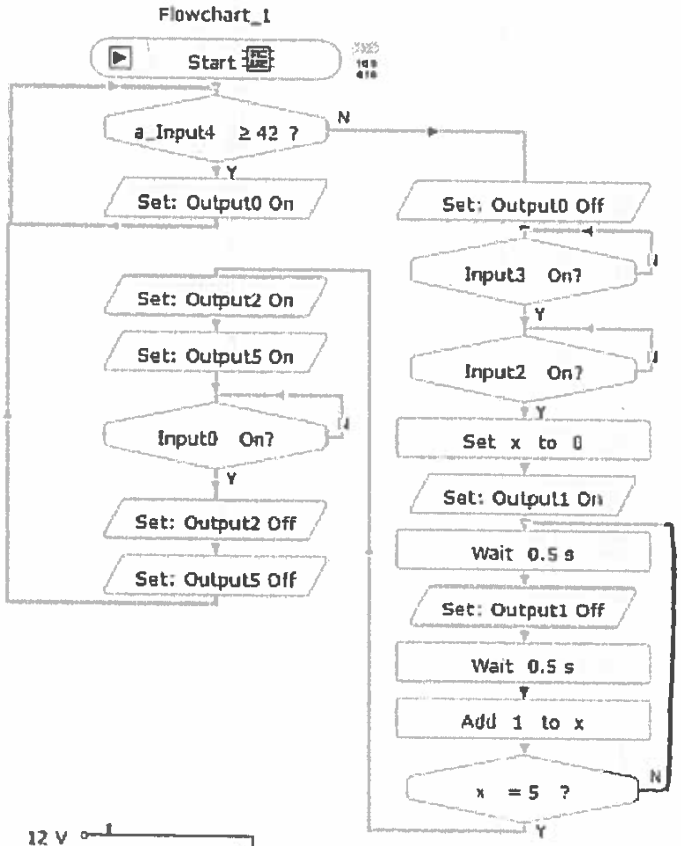
Task 17

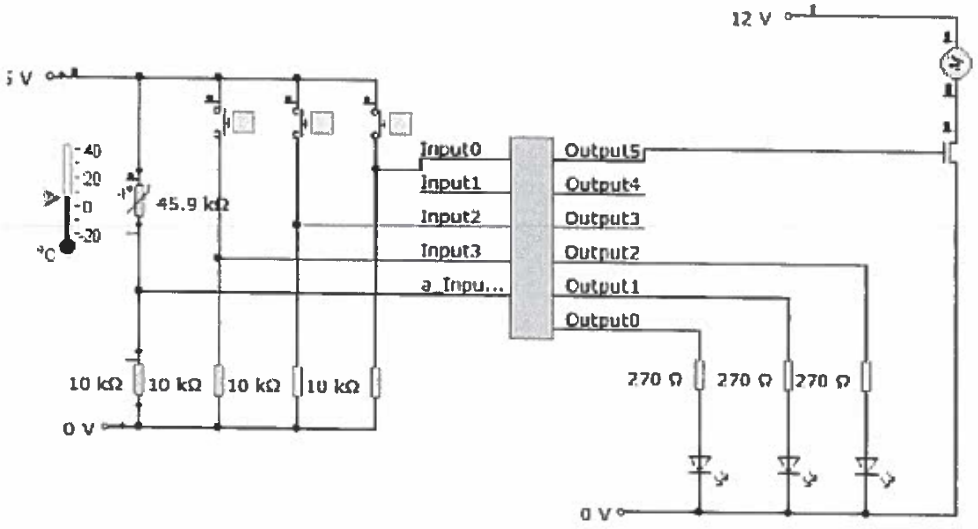


Task 4


Temperature
Sensor
Desired
Temp
+
−
Comparator
Driver
Motor
actual
temp

TASK 5a


Flowchart_1
Start
a_Input4 ≥ 42 ?
N
Y
Set: Output0 On
Set: Output0 Off
Input3 On?
Y
Input2 On?
Y
Set x to 0
Set: Output1 On
Wait 0.5 s
Set: Output1 Off
Wait 0.5 s
Add 1 to x
x = 5 ?
N
Y
Set: Output2 On
Set: Output5 On
Input0 On?
Y
Set: Output2 Off
Set: Output5 Off


12 V
5 V
-40
-20
-0
-20
°C
45.9 kΩ
Input0
Input1
Input2
Input3
a_Inpu...
Output5
Output4
Output3
Output2
Output1
Output0
10 kΩ
10 kΩ
10 kΩ
10 kΩ
270 Ω
270 Ω
270 Ω
0 V
0 V

Worksheet 5b

Complete the testing table shown below.

Planned test	Expected result	Actual result	Amendments made
Adjust the thermistor temperature to its lowest value.	The 'temperature warning' indicator should be on.	The 'temperature warning' switches off and the flowchart ~~[illegible]~~ moves onto next decision.	Changed sign in decision a_Input4 ≥ 42? to a_Input4 ≤ 42?
Adjust the thermistor temperature to its highest value.	The 'temperature warning' indicator should switch off – the flowchart should progress to the next decision.	The 'temperature warning' switches off and the flowchart moves onto next decision.	No amendment made.
Press the 'harness safety check complete' switch and the 'operator switch' in sequence.	The 'harness safety check complete' indicator should flash five times.	The 'harness safety check ~~[illegible]~~ Complete' indicator doesn't flash five times	Move the arrow from decision ~~[illegible]~~ x=5? from after Set:output1 on to before Set:output1 off

(5 marks)

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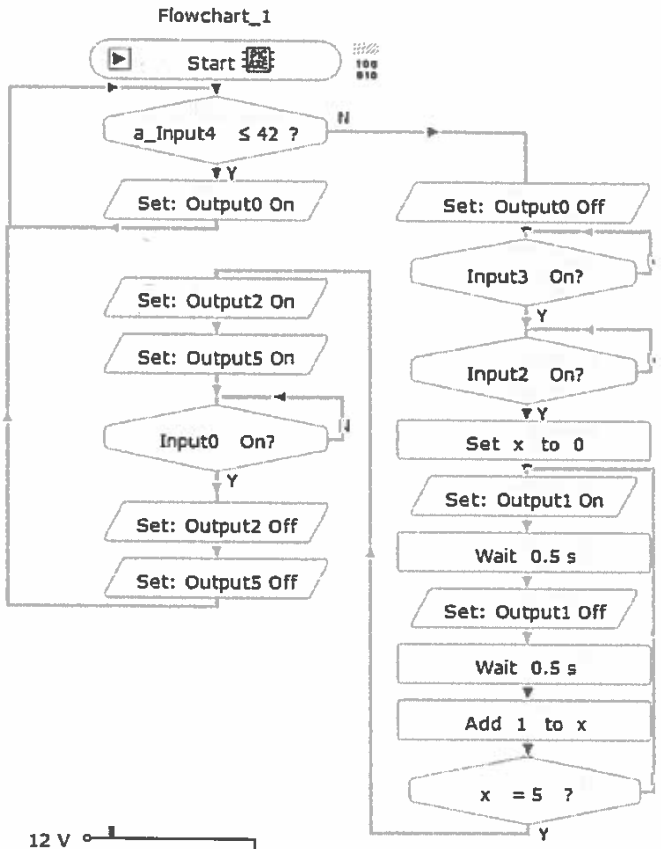
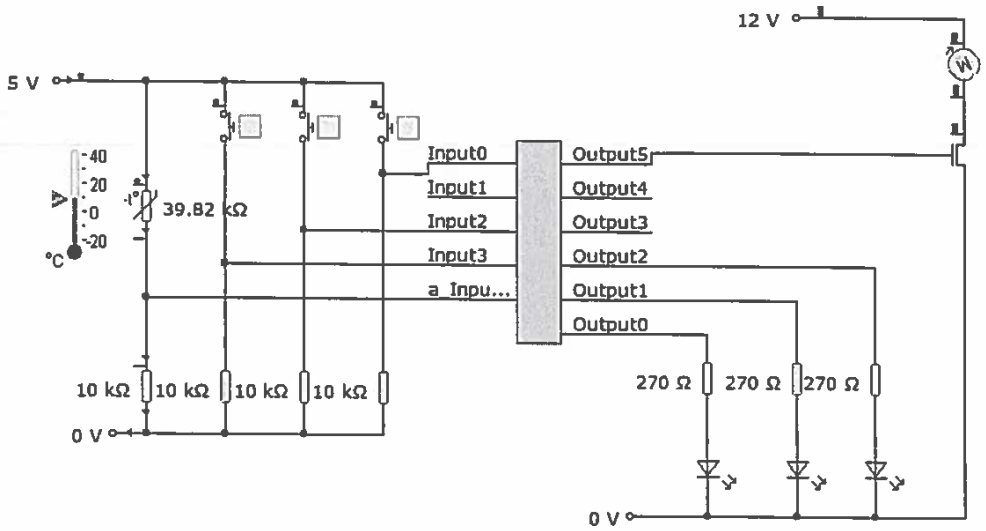
TASK 5c


Flowchart_1
Start
a_Input4 ≤ 42 ?
N
Y
Set: Output0 On
Set: Output0 Off
Input3 On?
Y
Input2 On?
Y
Set x to 0
Set: Output1 On
Wait 0.5 s
Set: Output1 Off
Wait 0.5 s
Add 1 to x
x = 5 ?
Y
Set: Output2 On
Set: Output5 On
Input0 On?
Y
Set: Output2 Off
Set: Output5 Off


12 V
5 V
40
20
0
-20
°C
39.82 kΩ
Input0
Input1
Input2
Input3
a_Inpu...
Output5
Output4
Output3
Output2
Output1
Output0
10 kΩ
10 kΩ
10 kΩ
10 kΩ
270 Ω
270 Ω
270 Ω
0 V
0 V

Task 5d

My solution meets specification point i a) when the temperature drops below a set value a warning indicator switches on. Specification point ii is also met as it requires a safe temperature and both switches to be pressed in order to work. The third specification point is also met as after pressing the 'harness safety check complete switch' the indicator will flash 5 times. Finally Specification point iv is also met as the motor and 'ride on' indicator stay on until the ride ends. Overall my solution is very effective in controlling the safety checks as it makes sure each one is done before continuing as well as using indicators to tell people what is happening.