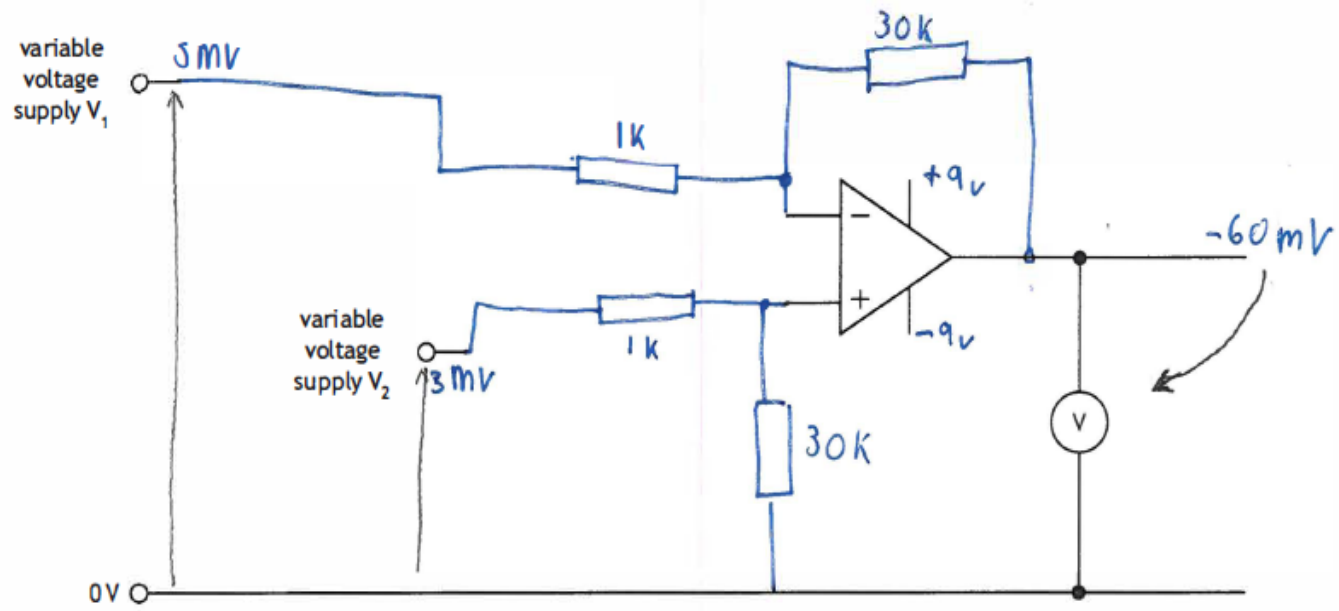
Candidate 1 evidence

Worksheet 1a

Specification 1	the wind direction sensor will send a signal to the error detection
Specification 2	if the wind direction and the turbine head position are different the error detection will send a signal to the control unit
Specification 3	the control unit tells the output driver how long to turn the motor for
Specification 4	the driver then turns the motor giving the actual turbine head position
Specification 5	the position sensor sends feedback to the error detection
Specification 6	the error detection compares the wind direction sensor and the turbine head position and makes adjustments if needed

(6 marks)

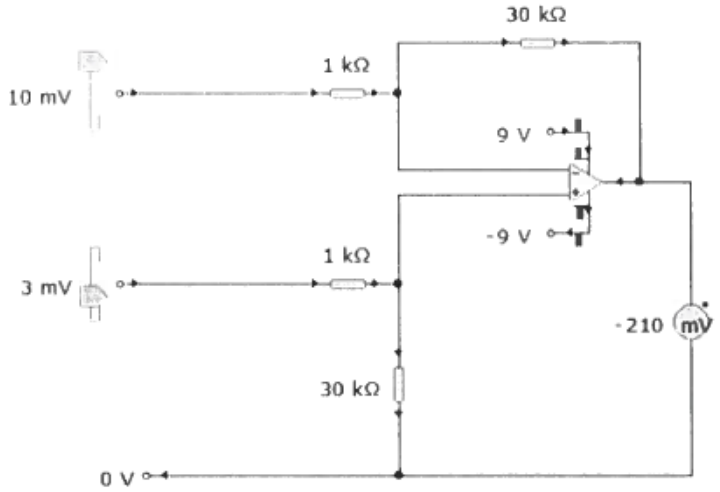
Worksheet 1b



(3 marks)

1 c)

Yenka - asignment task 1 - 1c



Worksheet 1d

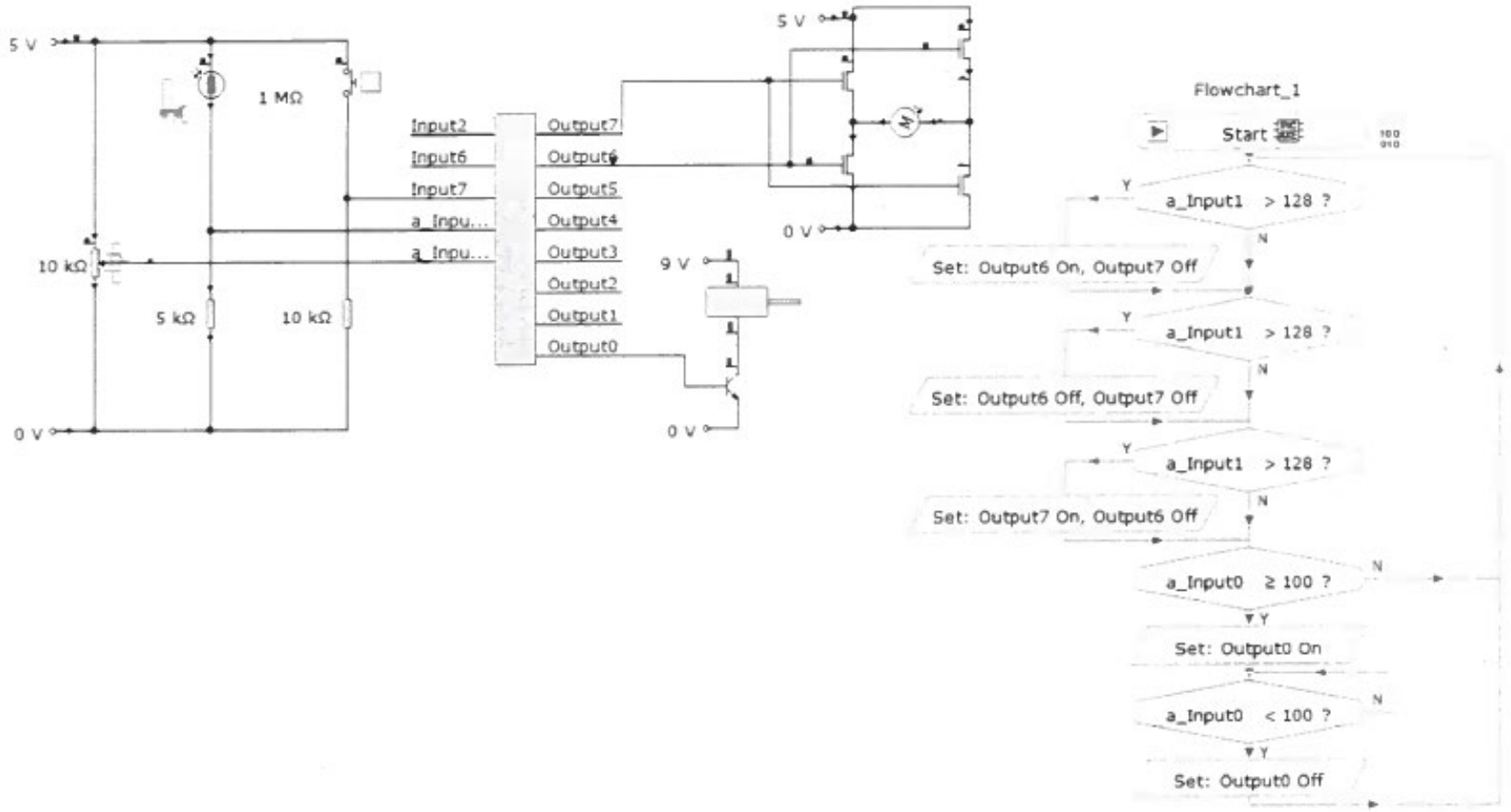
Planned test	Expected result	Actual result	Amendments made
Set both V_1 and V_2 to 5 mV.	The output voltage is 0 V.	the output voltage was 0v	no amendments made
Set V_1 to 10 mV and set V_2 to 0 mV.	The output voltage should be + 300 mV.	the output voltage is -300mV	add an inverting ompletier set up onto the end of the difference one, with a gain of -1
Set V_1 to 4 mV and set V_2 to 6 mV.	The output voltage should be - 60 mV.	the output voltage is -60mV	no amendments made

(4 marks)

1) e)

my amendments meets point v as the output voltage is able to change magnitude as it changes from 0v to -60mV and it can change from a positive to a negitive as well showing it can change polarity my amendments also meet point IV as the gain can be calculated to be 30 by using the equation $A_V = \frac{R_f}{R_i}$ the amended solution is efficient as it doesnt have components that dont need to be there and it can quickly supply voltage to the motor using the input voltages given to improve the current that V_1 and V_2 around E_0 that E_0 it meets specification ii as it is not currently connected to the inverting input

task 2a


5 V
1 MΩ
10 kΩ
5 kΩ
10 kΩ
0 V
Input2
Input6
Input7
a_Inpu...
a_Inpu...
Output7
Output6
Output5
Output4
Output3
Output2
Output1
Output0
9 V
0 V
5 V
0 V
Flowchart_1
Start
a_Input1 > 128 ?
Set: Output6 On, Output7 Off
a_Input1 > 128 ?
Set: Output6 Off, Output7 Off
a_Input1 > 128 ?
Set: Output7 On, Output6 Off
a_Input0 ≥ 100 ?
Set: Output0 On
a_Input0 < 100 ?
Set: Output0 Off
Y
N

Worksheet 2b

Planned test	Expected result	Actual result	Amendments made
Activate the flowchart. Press the 'master' switch.	The robot program will run.	the robot program will run	none needed
Alter analogue input 1 maximum value, then activate the flowchart. Press the 'master' switch.	Output 7 switches on and the motor turns.	output 7 and 6 turn on backward forth output 6 turns on and the motor turns	turn the second G- input to 0 and G- input = 128 and the third G- input decision box to 0 G- input < 128 switch the signs on the first and third decision boxes around
Alter analogue input 0 LDR to the maximum light level, then activate the flowchart. Press the 'master' switch. Repeat this test.	The solenoid will energise and actuate each time.	the transistor explodes	add a 10K resistor between the solenoid and the collector of the transistor

(7 marks)

2c)

the robot doesnt meet the first specification as the motor already moves even if the motor switch isnt pressed. to fix this I moved the motor switch to just before the motor. it does not meet the second specification as the wrong inputs come on when it is above or below 128. to fix this I swaped the signs on the first diversion box and the third one. the robot does meet the third specification as the solenoid will turn on when the light level increases and will turn off when it decreases again.

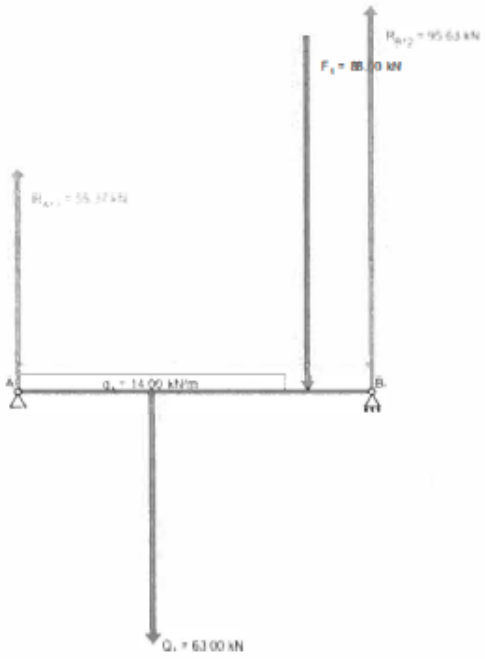
04/03/2024, 09:25 3a) image1.PNG

Report Done

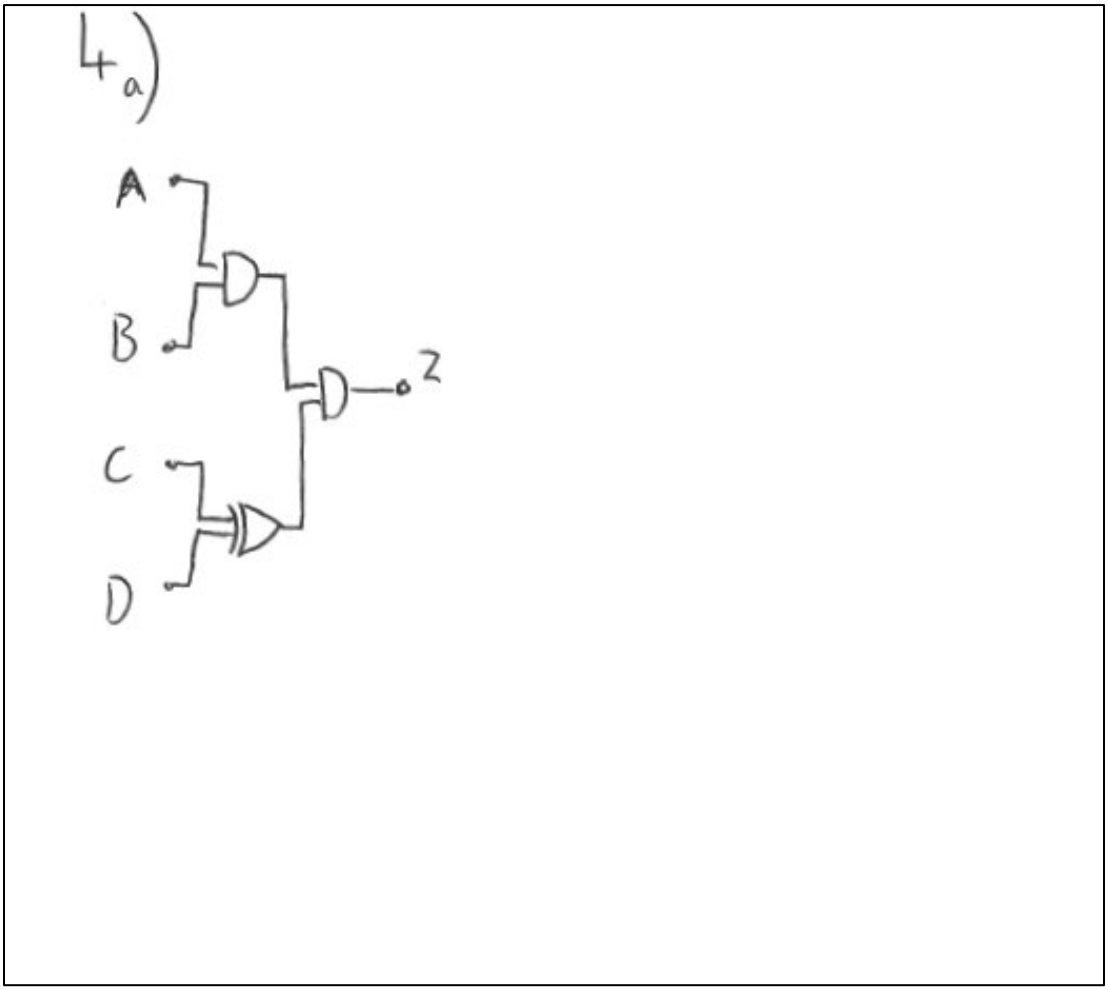
Reaction Forces

Force	Direction	Size	Angle
R_A	↑	55.37 kN	90.0°
R_B	↑	95.63 kN	90.0°

Element A-B



Equations	Results
$\Sigma M = 0 \Rightarrow 6.00 \times R_{B12[Y]} = -Q_{1[Y]} \times 2.26 - F_{1[Y]} \times 4.90$	$R_{A12[X]} = -0.00$ kN
$\Sigma F_{[X]} = 0 \Rightarrow R_{A12[X]} + R_{B12[X]} = -Q_{1[X]} - F_{1[X]}$	$R_{A12[Y]} = 55.37$ kN
$\Sigma F_{[Y]} = 0 \Rightarrow R_{A12[Y]} + R_{B12[Y]} = -Q_{1[Y]} - F_{1[Y]}$	$R_{B12[X]} = 0.00$ kN
$\Sigma F_{[X]} = 0 \Rightarrow R_{A[X]} - R_{A12[X]} = 0$	$R_{B12[Y]} = 95.63$ kN
$\Sigma F_{[Y]} = 0 \Rightarrow R_{A[Y]} - R_{A12[Y]} = 0$	
$\Sigma F_{[X]} = 0 \Rightarrow R_B \times \cos(270.0) - R_{B12[X]} = 0$	
$\Sigma F_{[Y]} = 0 \Rightarrow R_B \times \sin(270.0) - R_{B12[Y]} = 0$	


4 a)
A
B
C
D
Z

Worksheet 4c

Planned test	Expected result
activate pin 6 and push the button on V_2	Cylinder C_A outstrokes slowly and smoothly
activate pin 7	C_B should ~~[illegible]~~ outstrocke and instock
activate pin 4	Cylinder C_A will instock quickly

(3 marks)

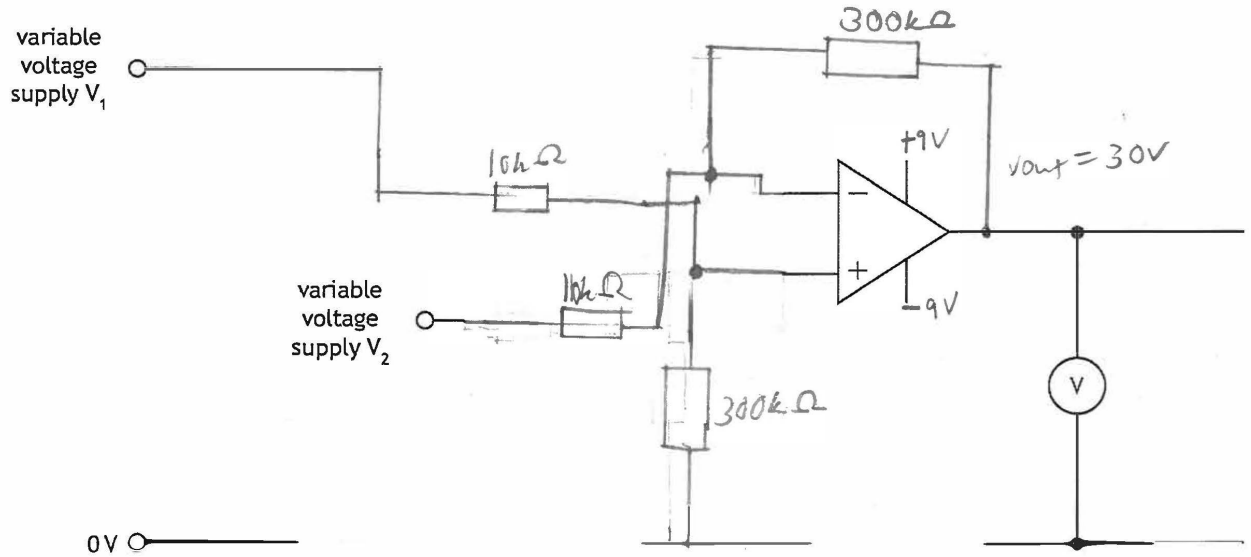
Candidate 2 evidence

Worksheet 1a

Specification 1	The wind direction sensor is used to detect where the wind is coming from.
Specification 2	The error detector will detect the actual output to the desired output.
Specification 3	The control unit will sense if a change needs to be made.
Specification 4	The driver will recieve power from the control unit to turn on the motor.
Specification 5	The motor will then turn the wind turbine at a desired speed of output.
Specification 6	The position sensor will then detect is the turbine head is in the correct position and will give feedback to the error detector.

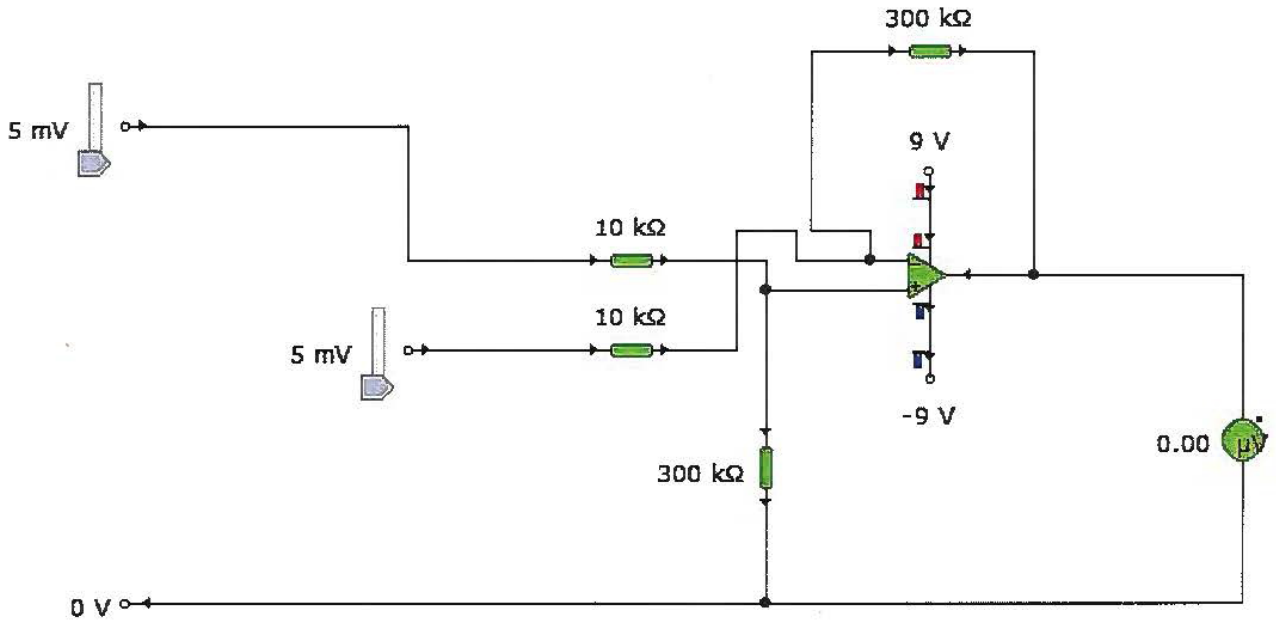
(6 marks)

Worksheet 1b



(3 marks)

Task 1C



Worksheet 1d

Planned test	Expected result	Actual result	Amendments made
Set both V_1 and V_2 to 5 mV.	The output voltage is 0 V.	The output voltage is 0V.	made both R1 resistors 10kΩ and Rf 300kΩ.
Set V_1 to 10 mV and set V_2 to 0 mV.	The output voltage should be + 300 mV.	+300V	changed the variable voltage supply and changed the wire inputs for the op amp for the it positive output.
Set V_1 to 4 mV and set V_2 to 6 mV.	The output voltage should be - 60 mV.	-60V	changed V1 and V2 voltage and kept the same wires so that it would be a negative voltage.

(4 marks)

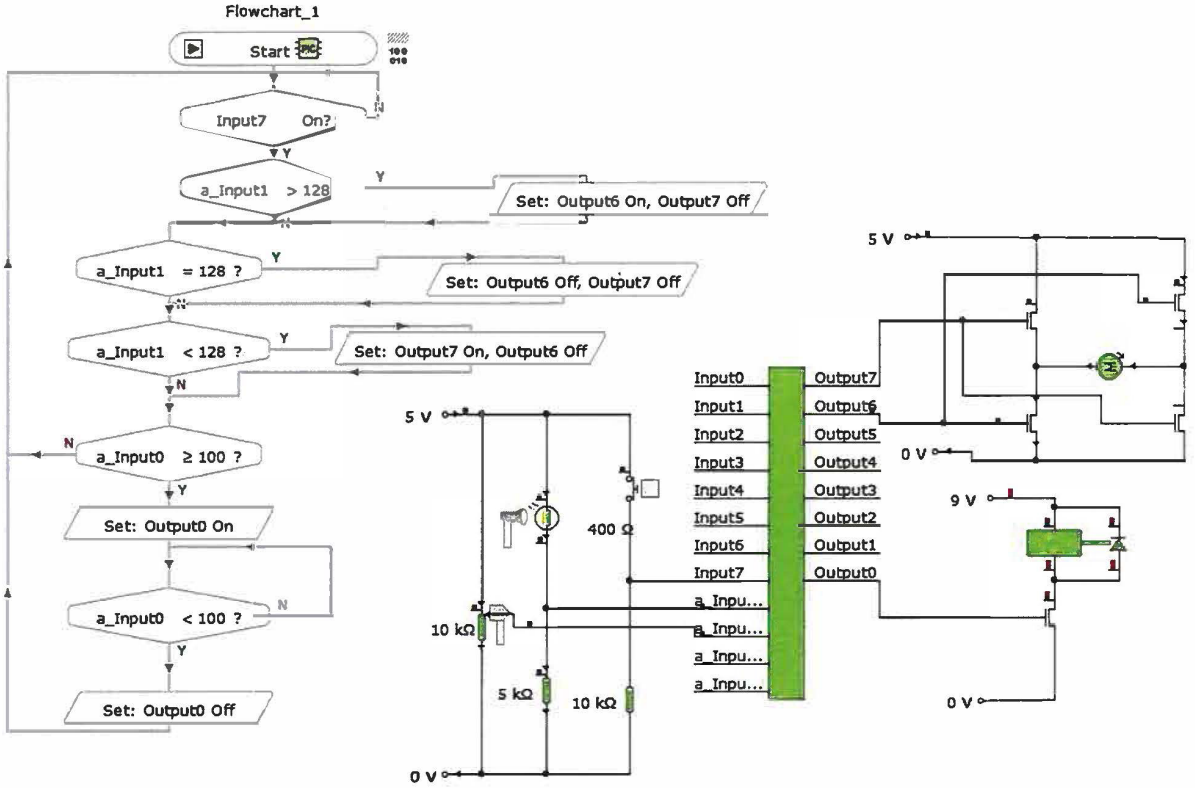
Task 1E

For my first amendment towards the turbine head position control system circuit I changed the voltage inputs towards the variable voltage supply making it both 5mv, this set the output to 0 as the resistance for the feedback resistors was 300k ohms and for the reference resistance i set them to 10k ohms, this was because the voltage gain was 30V. This made the output voltage to exactly 0V.

The second amendment i made towards the control system circuit was i changed the variable voltage supply again and this time it was 10 mv to 0 mv. This showed a drastic change in the voltage output making it -300mv. This was the wrong answer so I changed the wiring towards the input of the 741-op-amp and made it so the output would become positive, meaning that the output now is +300mv. This is so I could meet the expected result it was meant to be.

The third amendment i made to the control system circuit was i changed the variable voltage supply again to make V1 4 mV and then i set V2 to 6 mV, this changed the output voltage to -60 mV which was the correct answer, I kept the same wiring to my second amendment cause i knew it would make it a negative output voltage.

Task 2A


Flowchart_1
Start
Input7 On?
a_Input1 > 128
Set: Output6 On, Output7 Off
a_Input1 = 128 ?
Set: Output6 Off, Output7 Off
a_Input1 < 128 ?
Set: Output7 On, Output6 Off
a_Input0 ≥ 100 ?
Set: Output0 On
a_Input0 < 100 ?
Set: Output0 Off
5 V
400 Ω
10 kΩ
5 kΩ
10 kΩ
0 V
Input0
Input1
Input2
Input3
Input4
Input5
Input6
Input7
Output7
Output6
Output5
Output4
Output3
Output2
Output1
Output0
5 V
0 V
9 V
0 V

Worksheet 2b

Planned test	Expected result	Actual result	Amendments made
Activate the flowchart. Press the 'master' switch.	The robot program will run.	yes	Put a test input decision for input 7.
Alter analogue input 1 maximum value, then activate the flowchart. Press the 'master' switch.	Output 7 switches on and the motor turns.	yes	The light level has to be changed if you want to restart the circuit. Max light level will activate the circuit.
Alter analogue input 0 LDR to the maximum light level, then activate the flowchart. Press the 'master' switch. Repeat this test.	The solenoid will energise and actuate each time.	yes	changed the NPN transistor to an N-channel MOSFET. Also added a diode to the solenoid.

(7 marks)

Task 2C

First amendment I added was that I put in a test input decision at the start of my flowchart so that you have to press the "master switch" in order for the flowchart to operate. After pressing "start" on the flowchart then pressing the "master switch" the circuit will actuate as normal and will not continue on if the "master switch" isn't actuated. This was so the circuit would be efficient not blow up because of the constant signals coming one after another rapidly so the push to make the switch is there to help make the circuit operate on your behalf and when you want it to actuate.

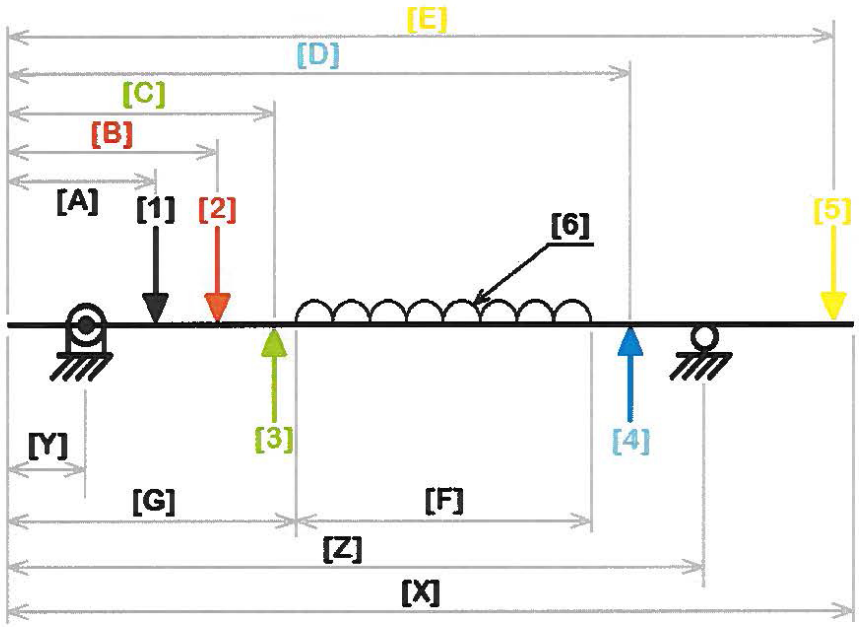
The second amendment I made was the light level to the LDR and that it has to be changed for the flowchart to turn off pin 0 for the solenoid and then it will go back to the beginning of the flowchart to then circle through the circuit and you will have to change the light level everytime in order for it to operate. This will then actuate the rest of the circuit enabling the motor in its clockwise/anticlockwise way.

The third amendment I made was that I switched the NPN transistor at the solenoid in place for a N-Channel MOSFET this was so the MOSFET would help actuate the solenoid at its correct state and I also added a diode at the solenoid to make it safer and so it wouldn't blow up. This helped the circuit function the way it is meant to be and not have any faults when it continues on for more than one time.

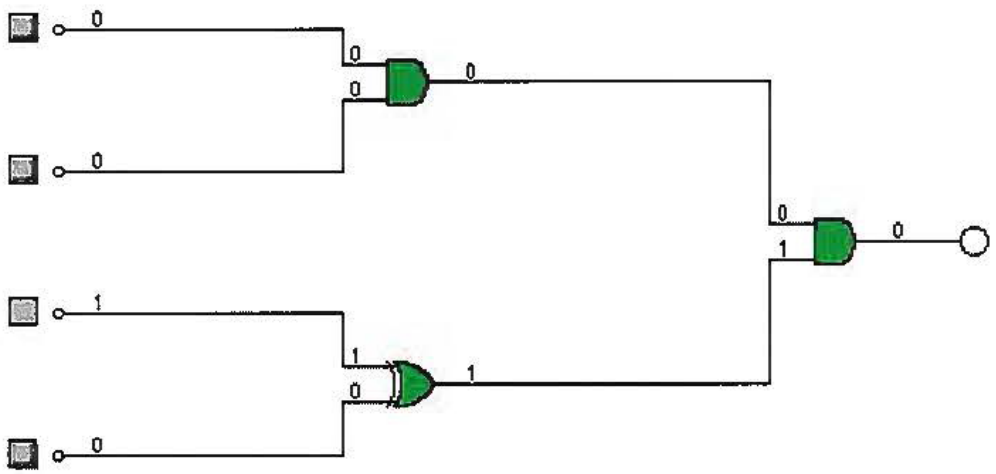
[X]	Enter Length of Beam [X]:	6	m
[Y]	Enter position of Hinge support (0 if the support is at the extreme left hand end) [Y]:	0	m
[Z]	Enter Position of Roller support (distance is along the beam from left not between Hinge and Roller) [Z]:	6	m
[1]	Enter Force 1 Magnitude in kN	88	kN
	~~Enter Force 1 Angle to the Beam~~ (90 is down, 270 is up, 0 is left, 180 is right)	90	Degrees
[A]	Enter Force 1 Position (from left hand end of beam)	4.9	m
[2]	Enter Force 2 Magnitude in kN		kN
	Enter Force 2 Angle to the Beam (90 is down, 270 is up, 0 is left, 180 is right)		Degrees
[B]	Enter Force 2 Position (from left hand end of beam)		m
[3]	Enter Force 3 Magnitude in kN		kN
	~~Enter Force 3 Angle to the Beam~~ (90 is down, 270 is up, 0 is left, 180 is right)		Degrees
[C]	Enter Force 3 Position (from left hand end of beam)		m
[4]	Enter Force 4 Magnitude in kN		kN
	~~Enter Force 4 Angle to the~~ Beam (90 is down, 270 is up, 0 is left, 180 is right)		Degrees
[D]	Enter Force 4 Position (from left hand end of beam)		m
[5]	Enter Force 5 Magnitude in kN		kN
	~~Enter Force 5 Angle to the Beam~~ (90 is down, 270 is up, 0 is left, 180 is right)		Degrees
[E]	Enter Force 5 Position (from left hand end of beam)		m
[6]	Enter the Magnitude of UDL:	14	kN/m
[F]	Enter the Length of UDL:	4.5	m
[G]	Enter distance from beam left end to UDL start:	0	m

Vertical Reaction at Hinge:	**55.51** kN	Up
Horizontal Reaction at Hinge:	**0.00** kN	Right
Magnitude of Reaction at Hinge:	**55.51** kN	
~~Angle of Reaction at Hinge~~ (to the Horizontal Axis):	**90.00** Degrees	
Reaction at Roller:	**95.49** kN	Up

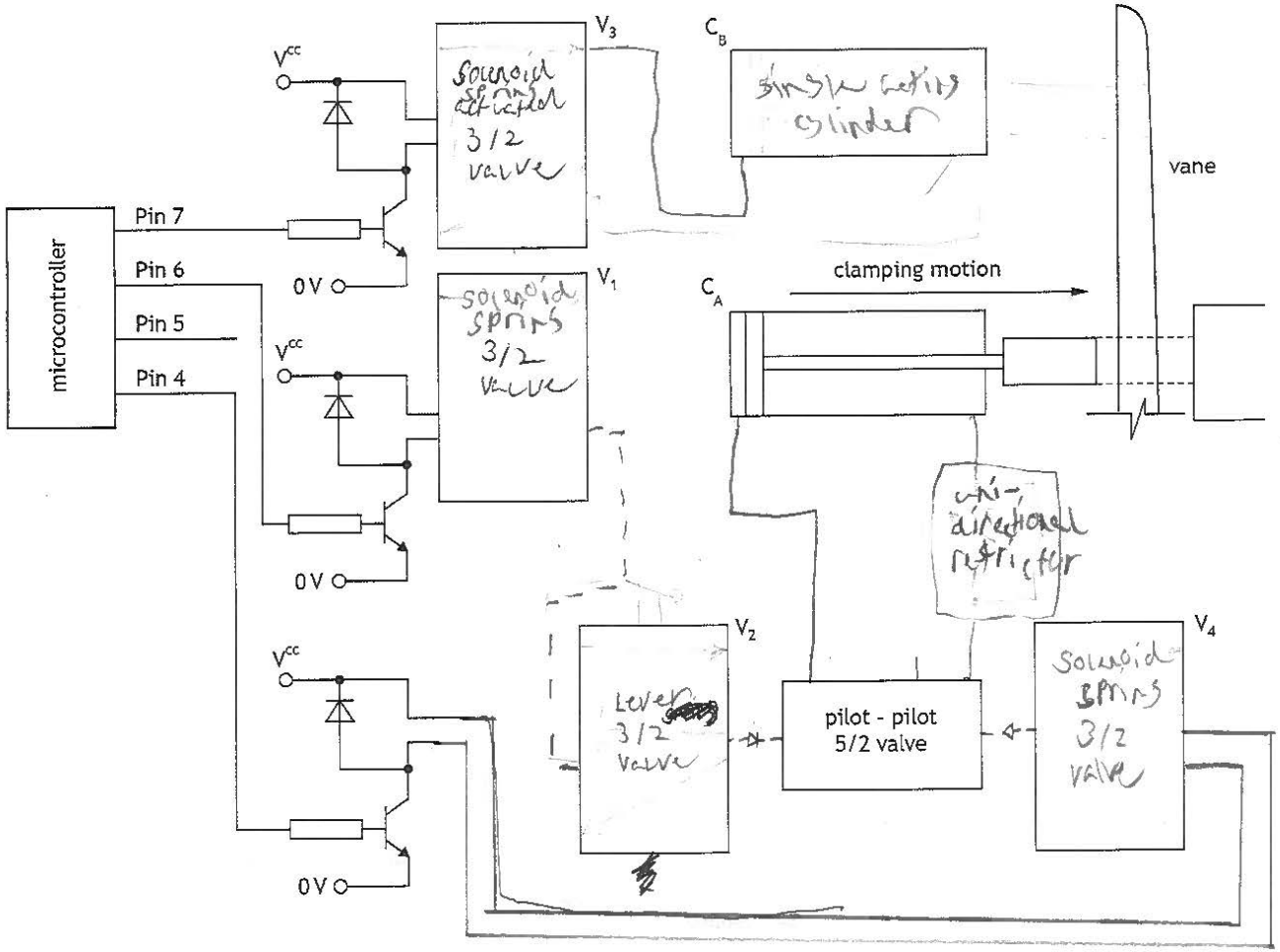
You can add up to 5 point loads at any angle. Angles are measured from the horizontal as in the concurrent systems simulator.



Task 4A



Worksheet 4b



(8 marks)

Worksheet 4c

Planned test	Expected result

(3 marks)

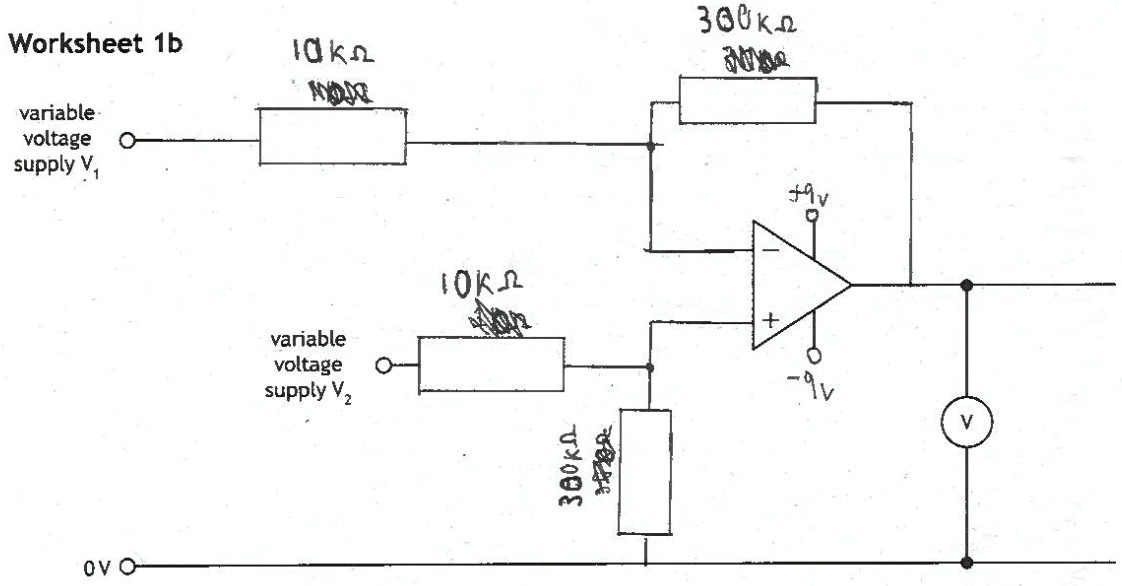
Candidate 3 evidence

Worksheet 1a

Specification 1	• Circuit must sense the position/direction of the turbine head
Specification 2	• Circuit must sense the wind direction and any changes in wind direction.
Specification 3	• Circuit must compare the sensed position of the turbine head with the sensed direction of wind continuously.
Specification 4	• If the sensed direction of the turbine head is different to the sensed direction of the wind the turbine head must swivel left or right to face into the direction of the wind.
Specification 5	• Turbine head must initially move quickly then slow to stop in the correct position facing the wind.
Specification 6	• If the sensed direction of the turbine head is the same as the sensed direction of the wind the turbine head should stay in the same position.

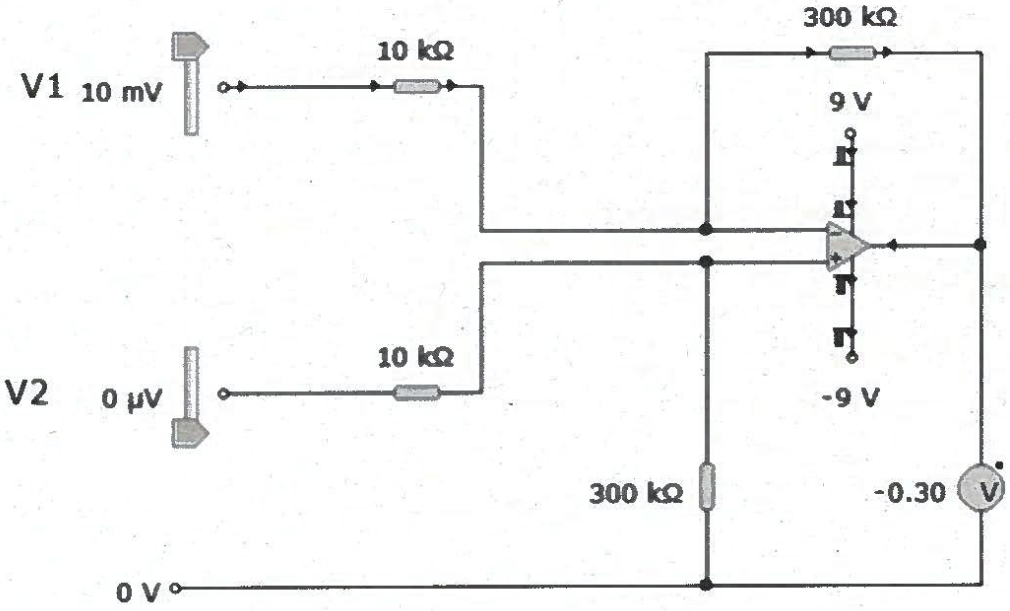
(6 marks)

Worksheet 1b



(3 marks)

Task 1.c – Original Yenka Circuit

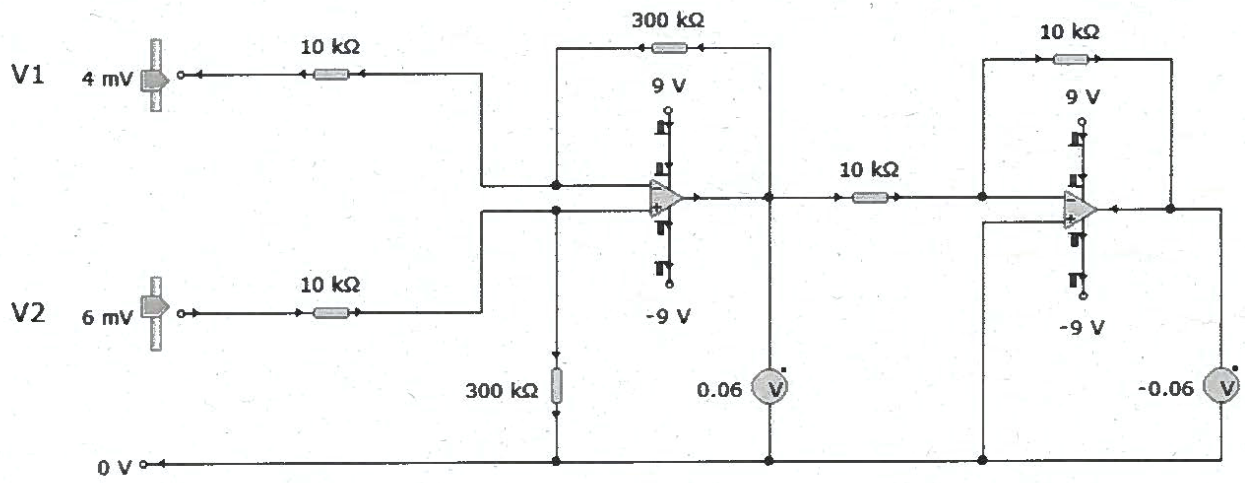


Worksheet 1d

Planned test	Expected result	Actual result	Amendments made
Set both V_1 and V_2 to 5 mV.	The output voltage is 0 V.	The output voltage is 0V.	No Ammendments needed.
Set V_1 to 10 mV and set V_2 to 0 mV.	The output voltage should be + 300 mV.	The output voltage is -0.30v/-300mv	Add an Inverting Amplifier after the difference amplifier with a gain of 1 to change output to + 0.30v/+300mV
Set V_1 to 4 mV and set V_2 to 6 mV.	The output voltage should be - 60 mV.	The output voltage is -0.06v/-60mV	No Ammendments needed.

(4 marks)

Task 1.d – Amended Yenka Circuit



Task 1.e

Higher Engineering Science – Assignment – Task 1.e

- The circuit meets specification 4 as using the equation to find circuit gain we get a value of 30:

Gain = Rf/Ri

Gain = 300 000/10 000

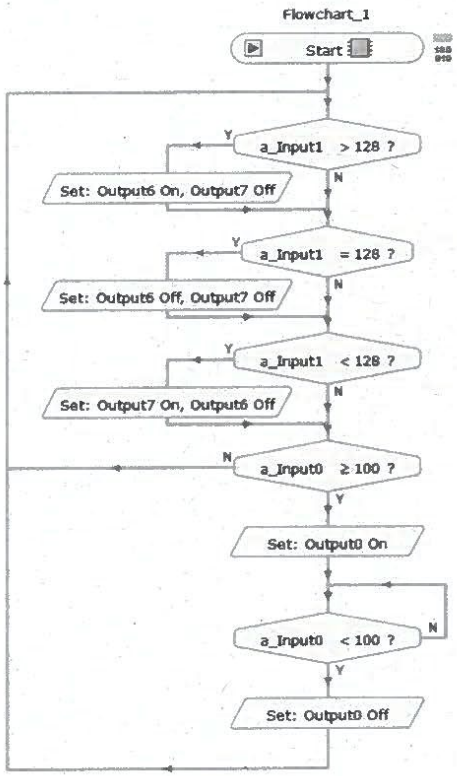
Gain = 30

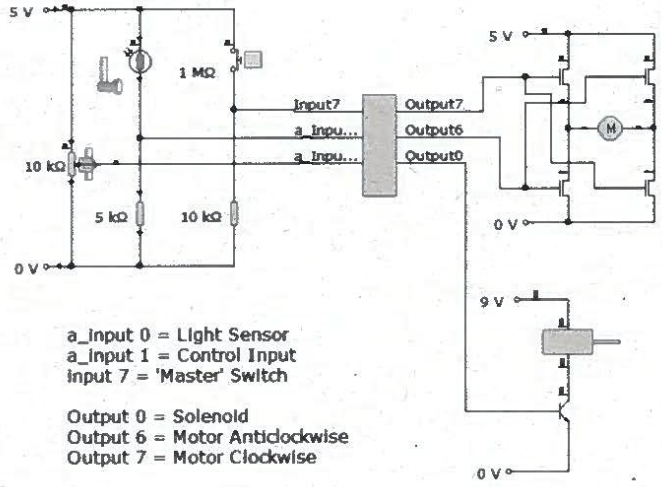
- The circuit meets specification 5 as the output does change magnitude and polarity, as seen in the testing when the output voltage changed from -60mV to 0V and finally to +300mV.

- I believe the circuit is effective at its job as it meets the circuit specification as well as delivering Positive and Negative voltage outputs which would be needed to turn the turbine left or right.

- I feel my design is as good as it can be and does not need any improvements as the circuit meets the specification exactly.

Task 2.a – Original Yenka Circuit





a_Input 0 = Light Sensor
a_Input 1 = Control Input
Input 7 = 'Master' Switch

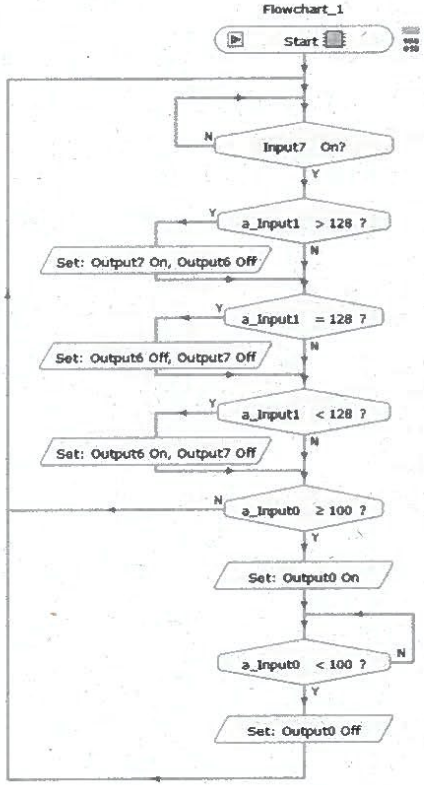
Output 0 = Solenoid
Output 6 = Motor Anticlockwise
Output 7 = Motor Clockwise

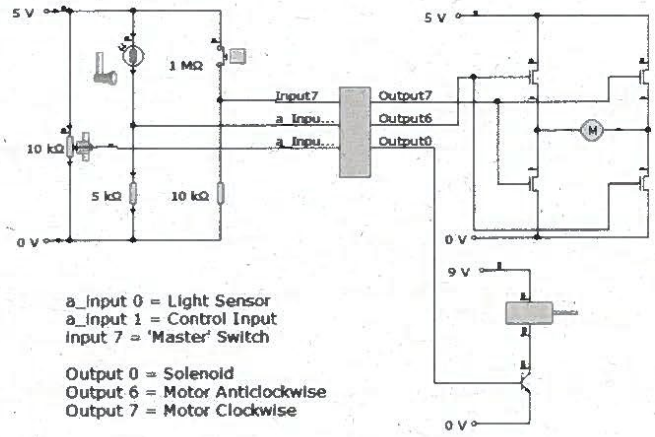
Worksheet 2b

Planned test	Expected result	Actual result	Amendments made
Activate the flowchart. Press the 'master' switch.	The robot program will run.	Flowchart runs without 'master' switch being pressed	Added a decision symbol to test whether or not input 7 is ON. (master switch)
Alter analogue input 1 maximum value, then activate the flowchart. Press the 'master' switch.	Output 7 switches on and the motor turns.	output 7 doesn't turn on but output 6 does, motor turns wrong way	changed flowchart so output 7 turns on when >128 and output 6 turns on when <128. • Altered circuit to make motor turn clockwise when output 7 is on and anticlockwise when output 6 is on.
Alter analogue input 0 LDR to the maximum light level, then activate the flowchart. Press the 'master' switch. Repeat this test.	The solenoid will energise and actuate each time.	The solenoid energises and activates each time.	No changes needed.

(7 marks)

Task 2.b – Amended Yenka Circuit





a_Input 0 = Light Sensor
a_Input 1 = Control Input
Input 7 = 'Master' Switch

Output 0 = Solenoid
Output 6 = Motor Anticlockwise
Output 7 = Motor Clockwise

Task 2.c

- The circuit meets specification point 'i' as the flowchart now checks to see if the 'master' switch has been pressed and will not go any further until it has. This has been achieved by adding a decision symbol to check whether or not the 'master switch had been pressed.

- The circuit meets specification point 'ii' as the flowchart now turns output 7 on when the 'control input' > 128 and output 6 on when 'control input' < 128, the motor now also turns clockwise when output 7 is ON and anti-clockwise when output 6 is ON.

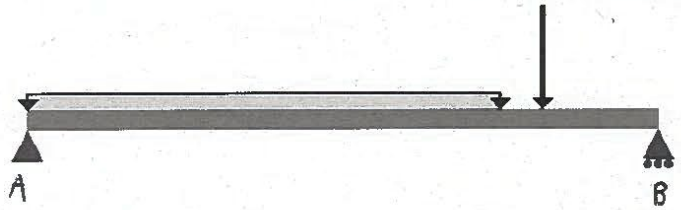
- The circuit meets specification point 'iii' as the flowchart now actuates a solenoid when the light level sensed is above a certain value, and actuates when below a certain value.

Task 3

Created with optimalbeam.com

OPTIMALBEAM

Model Name: Engineering Science - Assignment/CAT - Task		**Designer:** Finn Alexander
Units: Metric - (m), (kN)	**Date:** 2024/2/2	**Sheet No.:** Sheet 1 of 2



Type	Location (m)	Load (kN)|(kN-m)
Length .	0 | 6	
Support-pinned	0	
Support-roller	6	
Dt. Load	0 | 4.5	14 | 14
Point Load	4.9	88

Section Properties:

Reactions:

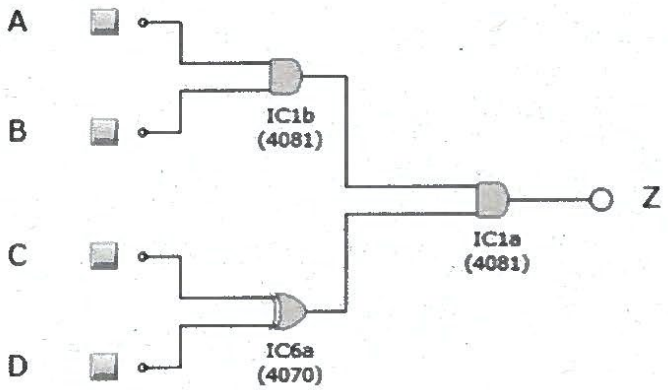
Reaction Force A: Location: 0 (m), Force Reaction = -55.5083 (kN)

Reaction Force B: Location: 6 (m), Force Reaction = -95.4917 (kN)

Reaction Force A = 55.5 kN vertically upwards ↑

Reaction Force B = 95.5 kN vertically upwards ↑

Task 4.a



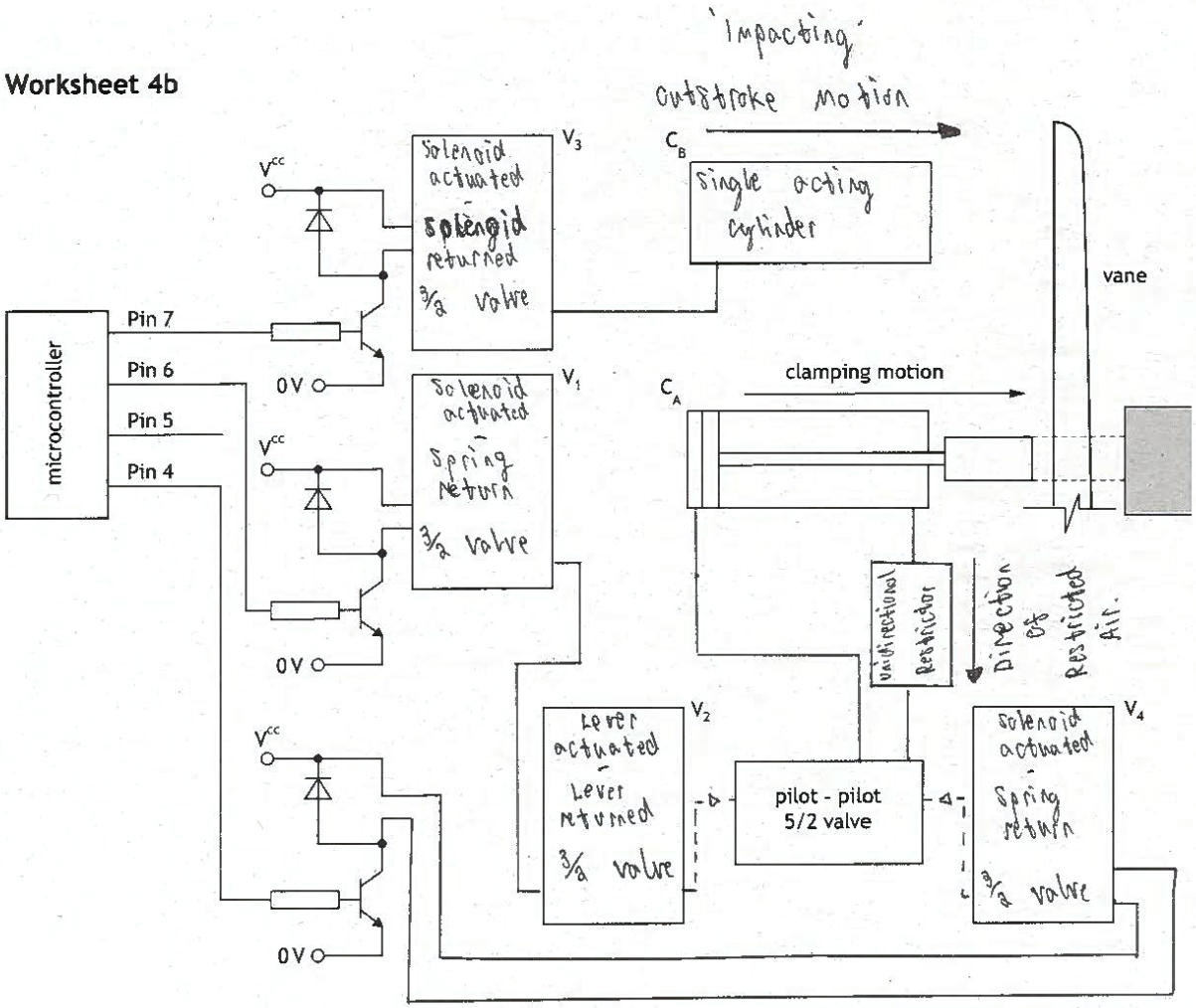
'Area check clear' switch = A

'Master switch' = B

'Operator switch 1' = C

'Operator switch 2' = D

Worksheet 4b



(8 marks)

Worksheet 4c

Planned test	Expected result
Actuate (V2) using the lever, operate microcontroller to turn Pin 6 High, actuating (V1).	• Cylinder (A) should outstroke slowly and smoothly to clamp the blade in place.
• Actuate (V3) by operating microcontroller to turn Pin 7 High/Low in an alternating fashion.	• Cylinder (B) should outstroke and instroke using pulse width modulation at a speed of; ON for 1 unit time then OFF for 3 units time, repeated.
• Actuate (V4) by operating flowchart/ microcontroller to turn Pin 4 High.	• Cylinder (A) should instroke to unclamp the blade.

(3 marks)