



Higher
Coursework
Assessment Task



Higher Engineering Science Assignment Marking instructions

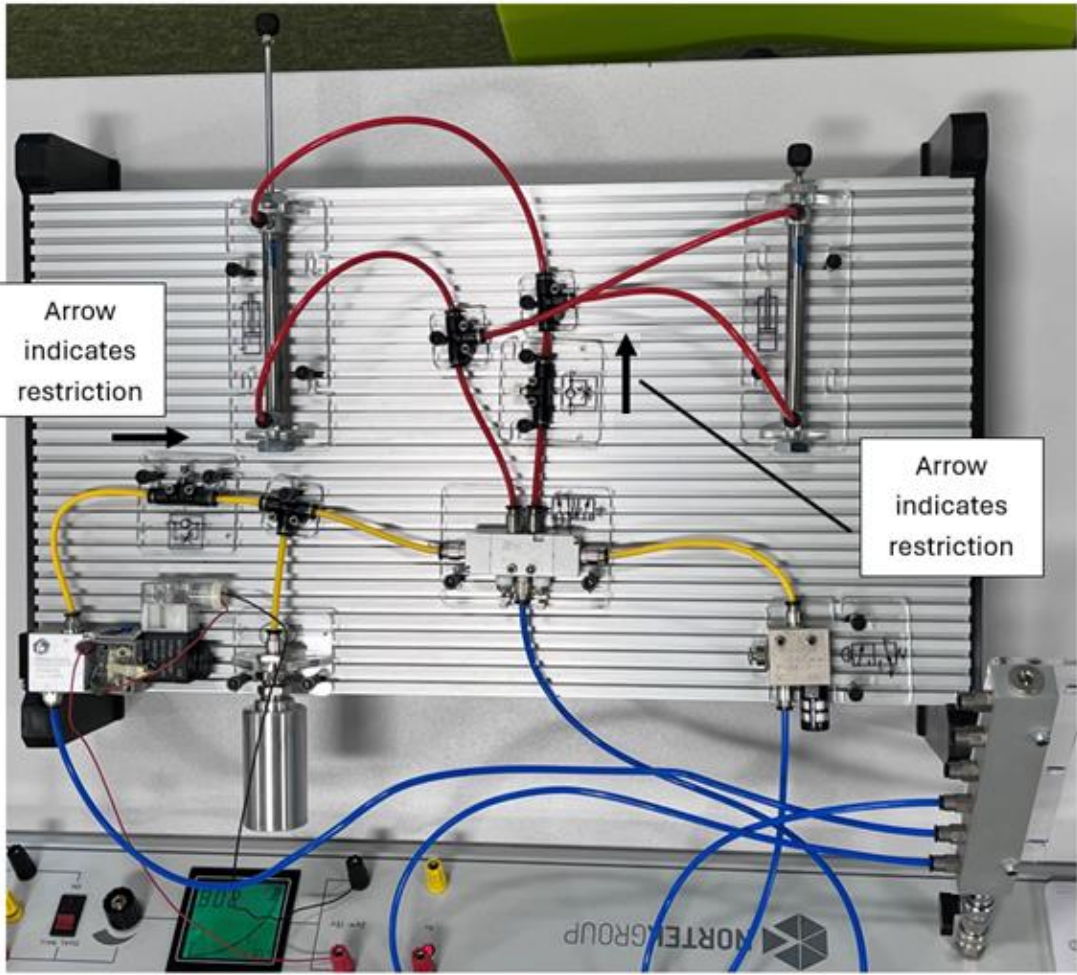
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General marking principles

This information is provided to help you understand the general principles that must be applied when marking candidate responses in this assignment. These principles must be read in conjunction with the detailed/specific marking instructions, which identify the key features required in candidate responses.

- a Marks for each candidate response must always be assigned in line with these general marking principles and the specific marking instructions for this assessment.
- b Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.
- c If a specific candidate response is not covered by either the general marking principles or detailed marking instructions, you must seek guidance from your team leader.

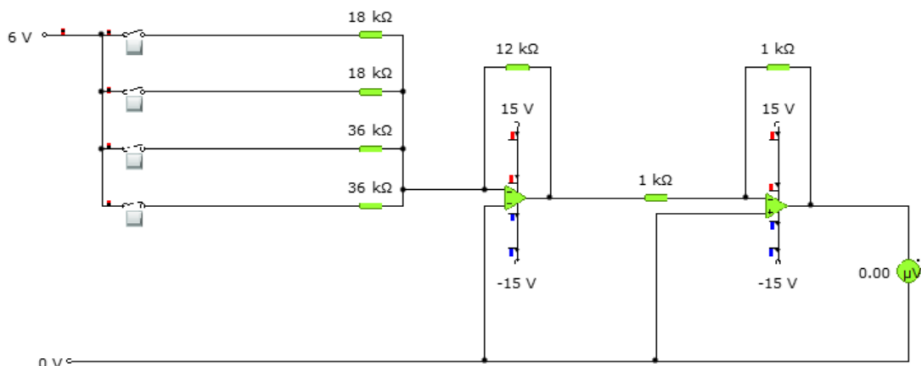
Detailed marking instructions

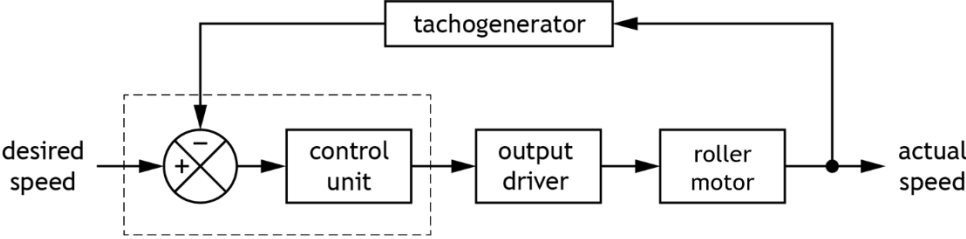
Task	Expected answer(s)	Max mark	Additional guidance
1 a		4	Two 3/2 valves with correct actuators, correctly connected. Substituted actuators must be labelled. (1 mark) 5/2 valve with unidirectional restrictor B correctly orientated. (1 mark) Maximum one mark for the above if any of the main air or exhaust connections are missing. Unidirectional restrictor A correctly orientated, in correct order with reservoir, connected correctly to 5/2 valve. (1 mark) Two double-acting cylinders connected correctly. (1 mark)

[illegible]

Task			Expected answer(s)	Max mark	Additional guidance								
1	b			6	Response should be descriptive.								
					Actual results and amendments from circuit given in 1a.								
					First actual result - must refer to both cylinders. (1 mark) First amendment - can be supported by amended circuit (1 mark)								
					Second actual result. (1 mark)								
					Third actual result. (1 mark)								
					Fourth actual result. (1 mark)								
					Fourth amendment - to meet specification point 3 'slowly and smoothly'. (1 mark)								
		<table><tr><th>Actual result</th><th>Amendments made</th></tr><tr><td>Cylinder X is in the instroke position. Cylinder Y is in the outstroke position.</td><td>Swap pipe connections for cylinder Y.</td></tr><tr><td>Both cylinders start from instroke position and outstroke when actuated.</td><td>No amendment required.</td></tr><tr><td>The time delay for the cylinder outstroke changes each time.</td><td>No amendments required.</td></tr><tr><td>When outstroked, both double-acting cylinders instroke more slowly each time.</td><td>Re-connect UDR B to restrict exhaust air when instroking.</td></tr></table>	Actual result	Amendments made	Cylinder X is in the instroke position. Cylinder Y is in the outstroke position.	Swap pipe connections for cylinder Y.	Both cylinders start from instroke position and outstroke when actuated.	No amendment required.	The time delay for the cylinder outstroke changes each time.	No amendments required.	When outstroked, both double-acting cylinders instroke more slowly each time.	Re-connect UDR B to restrict exhaust air when instroking.	
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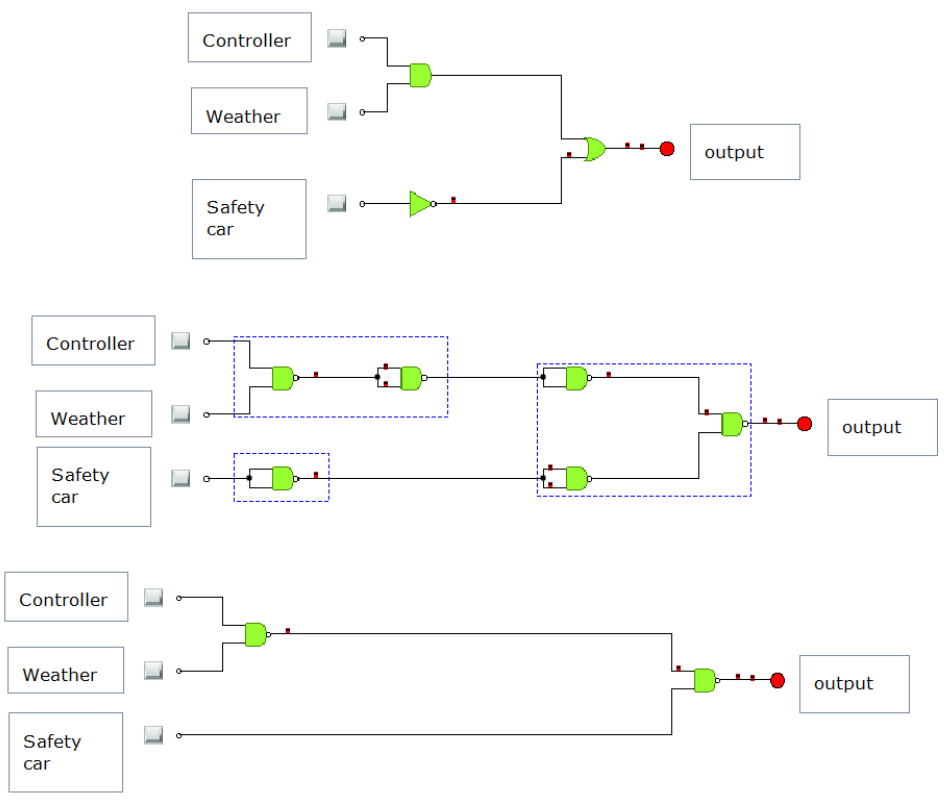
Task			Expected answer(s)	Max mark	Additional guidance
1	c		Specification point i: On initial connection to main air, one of the cylinders outstroked without the solenoid being energised. The piping was swapped on cylinder Y to allow both to outstroke simultaneously. Specification point ii: This operated as intended as during testing the time-delayed pilot signal was controllable therefore no amendments were required. Specification iii: Both cylinders instroked slowly but not smoothly. This was corrected by re-connecting unidirectional restrictor B in the exhaust line for both cylinders when instroking and in the correct orientation. On further testing, it was possible to instroke the two cylinders slowly and smoothly.	3	1 mark for each evaluative description for each specification point, referring to testing and any amendments made.

Task			Expected answer(s)	Max mark	Additional guidance								
1	d			6	Four switches correctly connected. (1 mark) First op-amp in summing configuration.(1 mark) Summing op-amp input resistors and feedback resistor values to give two pairs of different ratios, with one input pair double the other pair. (1 mark) Second op-amp in inverting configuration. (1 mark) Correct input and feedback resistor ratio for inverting amp to give correct output voltages based on summing op-amp design, with voltmeter to allow for testing. (1 mark) Appropriate V_{cc} values for both op-amps to achieve 12 V output. (1 mark)								
	e		<table><tr><th>Planned test</th><th>Expected result</th></tr><tr><td>Close two switches to simulate sensing both front wheels only.</td><td>The output voltage will be + 4 V.</td></tr><tr><td>Close two switches to simulate sensing both rear wheels only.</td><td>The output voltage will be + 8 V.</td></tr><tr><td>Close four switches to simulate sensing all four wheels.</td><td>The output voltage will be + 12 V.</td></tr></table>	Planned test	Expected result	Close two switches to simulate sensing both front wheels only.	The output voltage will be + 4 V.	Close two switches to simulate sensing both rear wheels only.	The output voltage will be + 8 V.	Close four switches to simulate sensing all four wheels.	The output voltage will be + 12 V.	3	1 mark awarded for each planned test and expected result (max 2 marks if only wheels referenced).
Planned test	Expected result												
Close two switches to simulate sensing both front wheels only.	The output voltage will be + 4 V.												
Close two switches to simulate sensing both rear wheels only.	The output voltage will be + 8 V.												
Close four switches to simulate sensing all four wheels.	The output voltage will be + 12 V.												

Task	Expected answer(s)	Max mark	Additional guidance
2		6	Error detector in negative configuration. (1 mark) Control unit. Accept 'op-amp' or 'microcontroller'. (1 mark) Control boundary. (1 mark) Output driver. Accept 'driver'. (1 mark) Roller motor. Accept 'motor' or 'motorised roller'. (1 mark) Tachogenerator with correct interaction arrows. (1 mark)

Task			Expected answer(s)	Max mark	Additional guidance
3	a		Specification i - strength: Material A, B and C are strong enough to meet the specification while material D is not. Specification ii - elasticity: Materials B, C and D are elastic enough to meet the specification while material A is not. Specification iii - energy absorption: Materials A, B and C all have relatively high energy absorption while material D does not. Specification iv - weight: Materials A, C and D are lightweight and therefore meet the specification while material B is heavyweight and does not.	4	1 mark awarded for each evaluative comment comparing all four materials against the specification point. Accept comparison of numerical values.
	b		Material C is the most appropriate choice of material, as it meets all of the specification points. It is strong enough, elastic enough, has high energy absorption properties and is lightweight.	1	Stating material C with appropriate justification with reference to at least three specification points. (1 mark)

Task			Expected answer(s)	Max mark	Additional guidance
4			<i>PBASIC</i> <pre> symbol mark = b1 symbol space = b2 symbol brake = B.5 let mark = 10 let space = 40 label: if pin0 = 0 then label main: high brake pause mark low brake pause space goto label </pre>	3	Correct pin 5 set up for brake. (1 mark) Appropriate mark:space ratio of 1:4. (1 mark) Correct loop to retest pin 0. (1 mark) Maximum 2 marks if additional amendments would prevent code from operating. Note: due to the nature of programming, there may be other methods of coding that will provide the same functionality. Note: ignore syntax errors.
			<i>Arduino C++</i> <pre> int brake = 5 int pin0 = 0 void setup(){ pinMode(brake,OUTPUT); pinMode(pin0,INPUT); } void loop() { if(digitalRead(pin0)==LOW){ digitalWrite(brake,LOW;} else { digitalWrite(brake,HIGH); delay(10); digitalWrite(brake,LOW); delay(40); } } </pre>		

Task	Expected answer(s)	Max mark	Additional guidance
5 a	 The first diagram shows a logic circuit with three inputs: Controller, Weather, and Safety car. The Controller and Weather inputs are connected to an AND gate. The output of this AND gate is connected to an OR gate. The Safety car input is connected to a NOT gate, and its output is also connected to the same OR gate. The output of the OR gate is the final output. The second diagram shows a NAND equivalent circuit. The Controller and Weather inputs are connected to a NAND gate. The output of this NAND gate is connected to another NAND gate. The Safety car input is connected to a third NAND gate. The output of this third NAND gate is connected to the same NAND gate as the output of the first NAND gate. The output of this second NAND gate is the final output. The third diagram shows a simplified NAND equivalent circuit. The Controller and Weather inputs are connected to a NAND gate. The output of this NAND gate is connected to an OR gate. The Safety car input is connected to the same OR gate. The output of the OR gate is the final output.	3	1 mark total for initial logic circuit. 2 marks total awarded for NAND equivalent circuit. 3 marks total awarded for simplified NAND equivalent circuit (accept correctly scored through gates).

Task	Expected answer(s)	Max mark	Additional guidance
5 b	<pre> graph TD Start([Start]) --> SetX[Set x to 0] SetX --> Input0_70{Input0 < 70?} Input0_70 -- Y --> SetOutput6On[Set: Output6 On] Input0_70 -- N --> SetOutput6Off[Set: Output6 Off] SetOutput6Off --> Input0_200{Input0 > 200?} Input0_200 -- Y --> SetOutput7On[Set: Output7 On] SetOutput7On --> Wait75s[Wait 7.5 s] Wait75s --> SetOutput7Off[Set: Output7 Off] SetOutput7Off --> Input1On{Input1 On?} Input1On -- Y --> SetOutput6On Input1On -- N --> X0{x = 0?} X0 -- Y --> SetY0[Set y to 0] SetY0 --> SetOutput5On[Set: Output5 On] SetOutput5On --> Wait02s1[Wait 0.2 s] Wait02s1 --> SetOutput5Off[Set: Output5 Off] SetOutput5Off --> Wait02s2[Wait 0.2 s] Wait02s2 --> Add1toY[Add 1 to y] Add1toY --> Y5{y = 5?} Y5 -- Y --> SetOutput4On[Set: Output4 On] SetOutput4On --> Add1toX[Add 1 to x] Add1toX --> X20{x = 20?} X20 -- Y --> SetOutputsOff[Set: Output5 On, Output4 Off] SetOutputsOff --> Wait5s[Wait 5 s] Wait5s --> SetOutputsOff2[Set: Output5 Off, Output6 Off, Output7 Off] SetOutputsOff2 --> Stop([Stop]) X20 -- N --> SetOutput6On Y5 -- N --> SetY0 </pre>	5	Correct flowchart. (2 marks) Maximum two errors. (1 mark)

Task	Expected answer(s)	Max mark	Additional guidance
5	b	(continued)	
			Correct input components and connections to microcontroller. (1 mark) Correct output connections for motor and both LEDs. (1 mark) Correct output components and connections from output pin 6. (1 mark)

Task			Expected answer(s)	Max mark	Additional guidance
5	c		Specification	4	
			Amendments		
			Specification ii: If the reading from the light sensor is under 70 at the start of a new lap, track lighting turns on (and turns off again if the reading rises to 70 or more.		Note: amendment descriptions can be supported by amended circuit. 1 st amendment. (1 mark)
			Specification iv: When the race starts, a red LED flashes five times before turning off, and a green LED turns on.		2 nd amendment. (1 mark)
			Specification v: The race controller's start switch is checked once each lap, and if it is open the green LED turns off and the red LED turns on until this switch is closed again to resume racing.		3 rd amendment must include both parts. (1 mark)
			Specification vi: As the leading car completes a lap, a lap counter switch is pressed to count up to twenty laps.		4 th amendment. (1 mark)

Task			Expected answer(s)	Max mark	Additional guidance
5	d		The microcontroller system and flowchart program has only been tested against four of the seven specification points therefore the overall effectiveness of the amended solution cannot be determined. Examples of improvement include: The circuit and code do not provide a way to retract the blinds if the light level drops, meaning the blinds will remain in place. The circuit and code could be modified to allow the blinds to open and close. A sensor system could be used to count laps rather than a human race controller constantly closing switches. There is only one check for accidents or obstructions on the road each lap. Continual checks could be built in to improve safety. Only red and green LEDs are used to control the movement of cars. The use of additional coloured LED could be used to gradually slow down cars. The lap counter could be changed to a push to make switch and the race controller switch could be changed to a SPST to make it easier to manage the control of the race.	2	Evaluative comment. (1 mark) Detailed description of possible improvement. (1 mark) Any other valid description of an improvement can be awarded.

[END OF MARKING INSTRUCTIONS]